Updated NI 43-101Technical Report on the NorthMet Deposit

Minnesota, USA

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APPENDICES

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GLOSSARY

Abbreviations, Symbols, and Acronyms

AGP Mining Consultants Inc..AGP
Anglesite PbSO4
Argentite Ag2S
Canadian Institute of Mining .... CIM
Cerargyrite .... AgCl
Cerussite..PbCO3
Chalcopyrite CuFeS2
Defiance Silver Corp. .... Defiance
Federal Official Gazette ....FOG
Foreign Investment Law... FIL
Freibergite.. (Ag, Cu, Fe) 12(Sb, As) 4S13
Galena ....PbS
Gold Equivalent .... Au
Ground Penetrating Radar ....GPR
Microsoft Excel spreadsheets ....XLS
Native Silver .... Ag
Proustite..Ag3AsS3
Quality Assurance/Quality Control .... QA/QC
Polymet Mining Corp. .... Polymet
Silver Equivalent.. AgEq
Specific Gravity... SG
Sphalerite ....(Zn, Fe) S
Standard Reference Material... SRM
Standard Reference Materials .... SRM
Standard Resources Inc... Silver Standard
Sterling Mining Company of Idaho .... Sterling
Two Dimensional.. 2D
Three Dimensional 3D

Transient Electromagnetic Method .... TEM

UNITS OF MEASURE

Above mean sea level	amsl
Acre	ac
Ampere	A
Annum (year)	a
Billion	B
Billion tonnes	Bt
Billion years ago	Ga
British thermal unit	BTU
Centimetre	cm
Cubic centimetre	cm3
Cubic feet per minute	cfm
Cubic feet per second	ft3/s
Cubic foot	ft3
Cubic inch	in3
Cubic metre	m3
Cubic yard	yd3
Coefficients of Variation	CVs
Day	d
Days per week	d/wk
Days per year (annum)	d/a
Dead weight tonnes	DWT
Decibel adjusted	dBa
Decibel	dB
Degree	°
Degrees Celsius	°C
Diameter	ø
Dollar (American)	US$
Dollar (Canadian)	C$
Dry metric ton	dmt
Foot	ft
Gallon	gal
Gallons per minute (US)	gpm
Gigajoule	GJ
Gigapascal	GPa
Gigawatt	GW

Gram	g
Grams per litre	g/L
Grams per tonne	g/t
Greater than	>
Hectare (10,000 m2)	ha
Hertz	Hz
Horsepower	hp
Hour	h
Hours per day	h/d
Hours per week	h/wk
Hours per year	h/a
Inch	"
Kilo (thousand)	k
Kilogram	kg
Kilograms per cubic metre	kg/m3
Kilograms per hour	kg/h
Kilograms per square metre	kg/m2
Kilometre	km
Kilometres per hour	km/h
Kilopascal	kPa
Kilotonne	kt
Kilovolt	kV
Kilovolt-ampere	kVA
Kilovolts	kV
Kilowatt	kW
Kilowatt hour	kWh
Kilowatt hours per tonne (metric ton)	kWh/t
Kilowatt hours per year	kWh/a
Less than	<
Litre	L
Litres per minute	L/min
Megabytes per second	Mb/sec
Megapascal	MPa
Megavolt-ampere	MVA
Megawatt	MW
Metre	m
Metres above sea level	masl
Metres Baltic sea level	mbsl

Metres per minute	m/min
Metres per second	m/s
Metric ton (tonne)	t
Microns	µm
Milligram	mg
Milligrams per litre	mg/L
Millilitre	mL
Millimetre	mm
Million	M
Million bank cubic metres	Mbm3
Million tonnes	Mt
Minute (plane angle)	'
Minute (time)	min
Month	mo
Ounce	oz
Pascal	Pa
Centipoise	mPa·s
Parts per million	ppm
Parts per billion	ppb
Percent	%
Pound(s)	lb
Pounds per square inch	psi
Revolutions per minute	rpm
Second (plane angle)	"
Second (time)	sec
Specific gravity	SG
Square centimetre	cm2
Square foot	ft2
Square inch	in2
Square kilometre	km2
Square metre	m2
Thousand tonnes	kt
Three Dimensional	3D
Tonne (1,000 kg)	t
Tonnes per day	t/d
Tonnes per hour	t/h
Tonnes per year	t/a
Tonnes seconds per hour metre cubed	ts/hm3

Total	T
Volt	V
Week	wk
Weight/weight	w/w
Wet metric ton	wmt

ABBREVIATIONS AND ACRONYMS

Absolute Relative Difference	ABRD
Acid Base Accounting	ABA
Acid Rock Drainage	ARD
Alpine Tundra	AT
Atomic Absorption Spectrophotometer	AAS
Atomic Absorption	AA
British Columbia Environmental Assessment Act	BCEAA
British Columbia Environmental Assessment Office	BCEAO
British Columbia Environmental Assessment	BCEA
British Columbia	BC
Canadian Dam Association	CDA
Canadian Environmental Assessment Act	CEA Act
Canadian Environmental Assessment Agency	CEA Agency
Canadian Institute of Mining, Metallurgy, and Petroleum	CIM
Canadian National Railway	CNR
Carbon-in-leach	CIL
Caterpillar's® Fleet Production and Cost Analysis software	FPC
Closed-circuit Television	CCTV
Coefficient of Variation	CV
Copper equivalent	CuEq
Counter-current decantation	CCD
Cyanide Soluble	CN
Digital Elevation Model	DEM
Direct leach	DL
Distributed Control System	DCS
Drilling and Blasting	D&B
Environmental Management System	EMS
Flocculant	floc
Free Carrier	FCA
Gemcom International Inc.	Gemcom
General and administration	G&A

Gold equivalent	AuEq
Heating, Ventilating, and Air Conditioning	HVAC
High Pressure Grinding Rolls	HPGR
Indicator Kriging	IK
Inductively Coupled Plasma Atomic Emission Spectroscopy	ICP-AES
Inductively Coupled Plasma	ICP
Inspectorate America Corp.	Inspectorate
Interior Cedar – Hemlock	ICH
Internal rate of return	IRR
International Congress on Large Dams	ICOLD
Inverse Distance Cubed	ID3
Land and Resource Management Plan	LRMP
Lerchs-Grossman	LG
Life-of-mine	LOM
Load-haul-dump	LHD
Locked cycle tests	LCTs
Loss on Ignition	LOI
Metal Mining Effluent Regulations	MMER
Methyl Isobutyl Carbinol	MIBC
Metres East	mE
Metres North	mN
Mineral Deposits Research Unit	MDRU
Mineral Titles Online	MTO
National Instrument 43-101	NI 43-101
Nearest Neighbour	NN
Net Invoice Value	NIV
Net Present Value	NPV
Net Smelter Prices	NSP
Net Smelter Return	NSR
Neutralization Potential	NP
Northwest Transmission Line	NTL
Official Community Plans	OCPs
Operator Interface Station	OIS
Ordinary Kriging	OK
Organic Carbon	org
Potassium Amyl Xanthate	PAX
Predictive Ecosystem Mapping	PEM
Preliminary Assessment	PA

Preliminary Economic Assessment	PEA
Qualified Persons	QPs
Quality assurance	QA
Quality control	QC
Rhenium	Re
Rock Mass Rating	RMR '76
Rock Quality Designation	RQD
SAG Mill/Ball Mill/Pebble Crushing	SABC
Semi-autogenous Grinding	SAG
Standards Council of Canada	SCC
Stanford University Geostatistical Software Library	GSLIB
Tailings storage facility	TSF
Terrestrial Ecosystem Mapping	TEM
Total dissolved solids	TDS
Total Suspended Solids	TSS
Tunnel boring machine	TBM
Underflow	U/F
Valued Ecosystem Components	VECs
Waste rock facility	WRF
Water balance model	WBM
Work Breakdown Structure	WBS
Workplace Hazardous Materials Information System	WHMIS
X-Ray Fluorescence Spectrometer	XRF

1 SUMMARY

This report describes the results of a mineral resource estimation update of the NorthMet Project, which includes the NorthMet polymetallic copper-nickel-cobalt-platinum group element (Cu-Ni-Co-PGE) Deposit (the "NorthMet Deposit") leased by PolyMet Mining, Inc., and the Erie Plant, both owned by a wholly-owned subsidiary of PolyMet Mining Corp. (together with PolyMet Mining, Inc. "PolyMet"), a Canadian corporation. This revision and update of the 2007 National Instrument 43-101 (NI 43-101) compliant Resource report (Wardrop, September 2007) and the 2006 NI 43-101 compliant Feasibility report (Hunter, 2006) is based on the inclusion of results from 31 additional diamond drill holes completed between March 2007 and July 2007.

This report is updated from earlier reports, namely Wardrop September 2007, Hellman 2005 and 2006, and Hunter, 2006, all of which made extensive reference to Hammond, 2005, and Patelke and Geerts, 2006. All references to resource evaluation are based on current PolyMet data; reference herein to historical information is updated from these earlier reports.

This report has been prepared in order to incorporate reserves previously reported by PolyMet, complete the resource estimation, and comply with revised form of NI 43-101. Once PolyMet has finalized detailed engineering that will be set out in the NorthMet Enviromental Impact Statement (EIS), the company plans to issue an updated Technical Report, which will incorporate capital and operating costs, as well as current metal markets.

This new resource estimate by AGP Mining Consultants Inc. (AGP) incorporates the 2007 drilling results that were available as of October 15, 2007, this includes all drilling done through the end of July 2007, specifically, through hole 07-570C. The block model matrix dimension and the interpolation parameters remained the same as the September 2007 report, which included an extension of the block model matrix down to the 0.00 ft elevation. A smaller block size was used than in the definitive feasibility study (DFS) based upon a selective mining unit determination.

Since the 2007 mineral resource and reserve calculations, PolyMet has made two changes to the operating plans.

First, in May 2008 PolyMet revised the plans to include:

- The sale of concentrate during the construction and commissioning of new metallurgical facilities resulting in a shorter pre-production construction period (under twelve months) and reduced capital costs prior to first revenues ($312 million versus $380 million).

- Mine plans reflect the increase in reserves and decrease in stripping ratio reported on September 26, 2007, the use of 240-ton trucks, and owner versus contract mine operations.
- On an equivalent basis, capital costs increase 36% to $517 million. In addition, the revised plan included an additional $85 million in measures to protect the environment, increasing the total capital to $602 million.
- Staged construction reduces pre-production capital costs to $312.3 million (including the additional environmental measures) with most of the additional $289.6 million for construction of the metallurgical facilities expected to be funded from operating cash flow.

In February 2011, PolyMet reported a further simplification whereby it would build the Project in two phases:

- Phase I: produce and market concentrates containing copper, nickel, cobalt, and precious metals.
- Phase II: process the nickel concentrate through a single autoclave, resulting in production and sale of high grade copper concentrate, value added nickel-cobalt hydroxide, and precious metals precipitate products.

The changes reflected continued metallurgical process and other project improvements as well as improved environmental controls that are being incorporated into the Supplemental Draft Environmental Impact Statement (SDEIS). The advantages, compared with the earlier plan, include a better return on capital investment, reduced financial risk, lower energy consumption, and reduced waste disposal and emissions at site.

Compared with the May 2008, of the total $602 million capital costs, approximately $127 million was attributed to the second autoclave and the copper circuit.

The SDEIS will also incorporate modifcations to the detailed operating plan including mine scheduling and waste handling that will reduce the environmental impact of the proposed project. These details are being finalized at the time of writing as part of the SDEIS preparation. The mine plan set out in this report reflects plans reported as part of the DFS Update in May 2008.

These changes are referenced in the appropriate sections covering process flowsheet, capital and operating costs.

PolyMet plans to complete a full project update, which will be summarized in a 43-101 Technical Report, once the details have been finalized in the environmental review process.

1.1 Location and Ownership

The NorthMet Deposit is situated on a mineral lease located in St Louis County in northeastern Minnesota, USA, at approximately Latitude 47° 36′ north, Longitude 91° 58′ west, about 70 miles north of the City of Duluth and 6.5 miles south of the town of Babbitt.

The NorthMet Project comprises two elements: the NorthMet Deposit and the nearby Erie Plant. PolyMet leases the mineral rights to the NorthMet Deposit under a perpetually renewable lease and owns the Erie Plant through a contract for deed with Cliffs Natural Resources (Cliffs), which will be satisfied when the State of Minnesota transfers existing operating permits to PolyMet.

1.2 Geology and Mineralization

The NorthMet Deposit is part of the Duluth Complex in northeastern Minnesota, which is a large, composite, grossly layered, tholeiitic mafic intrusion that was emplaced into comagmatic flood basalts along a portion of the Mesoproterozoic Mid-continent Rift System. NorthMet is one of eleven known copper-nickel deposits that occur along the western edge of the Duluth Complex and within the Partridge River (PRI) and South Kawishiwi (SKI) intrusions. The NorthMet Deposit is hosted within the PRI, which consists of varied troctolitic and (minor) gabbroic rock types that have been subdivided into seven igneous stratigraphic units based on drill core logging.

The metals of interest at NorthMet are copper, nickel, cobalt, platinum, palladium and gold. Minor amounts of rhodium and ruthenium are also present though these are considered to have no economic significance. In general, with the exception of cobalt, the metals have strong positive correlations with copper mineralization. Cobalt is well correlated with nickel and reasonably correlated with copper.

Mineralization occurs in four broadly defined zones throughout the NorthMet property. Three of these laterally continuous zones occur dominantly within basal Unit 1. The thickness of each of the three Unit 1 enriched zones varies from 5 ft to more than 200 ft. Unit 1 mineralization is found throughout the base of the Deposit. The definition of the Unit 1 mineralized domain (DOM1) includes a portion of localized mineralization in the overlying Unit 2, which is merged into the top of Unit 1 for estimation purposes. A less extensive mineralized zone (Magenta Zone), slightly enriched with platinum group elements, is found in Units 4, 5, and 6 in the western part of the Deposit. This is defined as a separate mineralized domain within units that are mainly barren.

1.3 Exploration and Sampling

Drill hole spacing averages between 190 and 200 ft in the area of the resource model. This excludes holes drilled for metallurgical or geotechnical purposes. Distance studies show that 50% of the drillhole intercepts within Unit 1 will be within a 197-ft distance from another hole. In the Magenta Zone, 50% of the drillhole intercepts will be within a 190-ft distance from another hole. Fourteen percent (14%) of the assayed footage is by Reverse Circulation (six inch) drilling, with the remainder by diamond coring (BQ, NQ2, NTW, PQ and four inch).

The assay and geological database was thoroughly checked, validated and updated by PolyMet in order to provide the basis for the resource estimates reported in July 2005 (Hellman, 2005). The 2005 estimate involved the re-evaluation of historical data and the addition of several thousand new assays since the 2001 estimate. Examination of check assay data from pre-2005 assay programs as well as from newly received data suggest that nickel and cobalt from previous drill programs (pre-2005) are likely to have been understated by between 5% and 15% due to the use of an analytical method that resulted in an incomplete digestion (aqua regia digestion). All assaying of samples since the 2005 drilling and sampling campaign is based on the more appropriate total digestion four acid method. The data added since the 2005 drilling and sampling campaign is well validated through both formal quality control methods and extensive review of all compiled data.

A comprehensive Quality Assurance/Quality Control (QA/QC) program involving the use of coarse blanks, standards and duplicates has been instigated under the direction of Hellman and Schofield (H&S) and Lynda Bloom of Analytical Solutions Ltd., Toronto (ASL). This process consisted of the production of three matrix-matched standards from the NorthMet Deposit, sample preparation and homogenization, homogeneity testing, formulation of recommended values based on a round robin and routine insertion of standards on an anonymous basis. The three standards have copper concentrations in the approximate range 0.15 to 0.60% and nickel from 0.1 to 0.2%. Homogeneity of pulps, as determined by coefficients of variation from 20 replicate assays, is excellent with, for example, values less than 2% for copper and nickel and less than 5% for palladium.

During February and March 2005, nearly 14,000 ft of four inch and PQ (3.3 inch) diameter core holes were drilled for metallurgical sample collection while, approximately, a further 16,000 ft of NTW and NQ2 drill core (21 holes) were completed for resource in-fill and geotechnical evaluation purposes. Sixty-one additional core holes (NQ2 and NTW diameter), totaling approximately 47,500 ft were drilled from September through December 2005, for resource definition, in-fill and geotechnical assessment purposes. Sampling and data compilation for this drilling as well as continued sampling of historic US Steel core continued into March 2006. In 2007, an additional 61 in-fill holes were drilled during the spring and summer months.

1.4 Mineral Resources & Reserves

In October 2006, PolyMet published a report titled “Technical Report on the NorthMet Project” authored by D.J. Hunter. The resource statement in the report was sourced from Dr. P.L. Hellman of Hellman & Schofield dated July 2006. The resource figures were based on a block model with dimensions of 100 ft on strike by 100 ft perpendicular to strike by 20 ft vertically and interpolated using ordinary kriging with data available as of July 2006. Hellman & Schofield elected to interpolate the resource model from surface to the 500 ft elevation based on a pit floor assumption at the 560 ft elevation. The pit floor elevation was obtained from a Whittle pit optimization conducted on an earlier model by mining engineering consultants Australian Mine Design & Development Pty Ltd (AMDAD). The resource was reported at a Net Metal Value (NMV) cut-off of US$7.42 per short ton.

AGP interpolated the June 2007 model using a new block size of 50 ft on strike by 50 ft perpendicular to strike by 20 ft vertically using ordinary kriging with inverse distance and nearest neighbour check models. The block size was reduced to 50 ft by 50 ft by 20 ft (from 100 ft by 100 ft by 20 ft) after an evaluation into the selective mining unit that is required to eventually mine the Deposit. The model was interpolated to the 0 ft elevation to allow further detailed mining engineering study to evaluate incorporating resources at depth.

AGP updated the resource model in December 2007 to include the assays that were pending from the spring 2007 drill campaign along with results from 14 new holes from the summer 2007 drilling campaign. Interpolation methodology remained essentially the same as the June 2007 model with updated parameters.

Based on the review of the QA/QC, data validation and statistical analysis of the data, AGP draws the following conclusions:

- AGP has reviewed the methods and procedures to collect and compile geological and assaying information for the NorthMet Deposit and found them meeting accepted industry standards and suitable for the style of mineralization found on the property.
- A mix of data type was used to generate the resource on the property. Fourteen percent (14%) of the assayed footage is by Reverse Circulation (six inch) drilling; with the remainder by diamond coring. The resource also includes historical drill results gathered while the property was under the ownership of US Steel.PolyMet validated the RC drill results against twin (or near twin) drill hole and found them to be satisfactory. AGP’s Principal Resource Geologist visited the site, reviewed some of the historical drill core and interviewed PolyMet staff. AGP believes that the information supplied for the resource estimate and used in this report is accurate.

- A QA/QC program comprising industry standard blank, standard and duplicate samples has been used on the Project since the 2005 drill program. QA/QC submission rates meet industry-accepted standards.
- Data verification was performed by AGP through site visits, collection of independent character samples and a database audit prior to mineral resource estimation. AGP found the database to be exceptionally well maintained and error free and usable in mineral resource estimation.
- The specific gravity determinations are representative of the in-situ bulk density of the rock types.
- Sampling and analysis programs using standard practices provided acceptable results. AGP believes that the resulting data can effectively be used in the estimation of resources.
- Core handling, core storage, and chain of custody are consistent with industry standards.
- In AGP's opinion the current drill hole database is adequate for interpolating grade models for use in resource estimation.
- Mineral resources were classified using logic consistent with the CIM definitions referred to in N 43-101.

Results including all data available as of October 15, 2007 indicate the NorthMet resources (above a US$7.42 NMV cut-off) contain 694.2 million short tons (629.8 million tonnes) in the Measured and Indicated categories grading at 0.265% copper, 0.077% nickel, 68 parts per billion (ppb) platinum, 239 ppb palladium, 35 ppb gold and 71 parts per million (ppm) cobalt. The Inferred category (above a US$7.42 NMV cut-off) totals 229.7 million short tons (208.4 million tonnes) grading at 0.273% copper, 0.079% nickel, 73 ppb platinum, 263 ppb palladium, 37 ppb gold and 56 ppm cobalt.

The NMV formula used and described in Section 17.2.12 of this report includes the gross metal price multiplied by the processing recovery minus refining, insurance and transportation charges and is the same formula used in the Hunter 2006 report.

Above the 0.2% copper cut-off the NorthMet Deposit contains 442.1 million short tons (401.0 million tonnes) in the Measured and Indicated categories grading at 0.325% copper, 0.089% nickel, 81 ppb platinum, 292 ppb palladium, 41 ppb gold and 73 ppm cobalt. The Inferred category totals 158.7 million short tons (144.0 million tonnes) grading at 0.329% copper, 0.088% nickel, 86 ppb platinum, 315 ppb palladium, 43 ppb gold and 55 ppm cobalt.

Comparing the AGP model with the previously published estimate, Table 17.23 of the Wardrop, September 2007 report, results show an increase of 15.5 million short tons (14.1 million tonnes) in the Measured category and 40.5 million short tons (36.7 million tonnes) in the Indicated category for a total of 56 million short tons (50.8 million tonnes) or

8.1% increase in the Measured plus Indicated category. The Inferred Resource tonnage dropped by 21.9 million short tons (26.4 million tonnes) or 9.5%. The comparison includes resources above a US$7.42 Net Metal Value cut-off from surface down to the 0 ft elevation level.

Compared with the Wardrop September 2006 estimate, grades in the Measured and Indicated categories dropped slightly for copper and nickel and increased slightly for platinum, palladium, gold, and cobalt grade elements. Copper changed by -0.3%, nickel by -0.5%, platinum by +2.1%, palladium by +1.8%, gold by +2.1% and cobalt by +0.1%. However, the contained metal value increased for all elements by about 10% in the Measured and Indicated categories. Copper increased by 8.5%, nickel by 8.2%, platinum by 11.1%, palladium by 10.8%, gold by 11.0% and cobalt by 8.9%.

The work carried out during the summer 2007 drill program met the primary objectives relating to the in-fill drilling.

Mineral Reserves are reported at commodity prices of:

- Copper = $1.25 /lb
- Nickel = $5.60 /lb
- Platinum = $800.00 /troy ounce
- Palladium = $210.00 /troy ounce
- Gold = $400.00 /troy ounce
- Cobalt = $15.25 /lb

These prices were used to generate the DFS pit shell, within which the reserves were contained. This pit shell is the same design as outlined in the DFS study published October 2006 and developed by Australian Mine Design & Development Pty Ltd. (AMDAD). This pit shell was applied to the updated resource model.

A mining cutoff was used by AGP that was determined on a block by block basis with the following formula:

Block Value ($) = Gross Metal Value – Mining Cost – Processing cost – G&A.

Where:

- Block Value = net value of the block in dollars
- Gross Metal Value = value of metals considering price, recovery and downstream costs
- Mining Cost = cost to mine ore and waste adjusted for haulage path
- Processing Cost = cost to process ore tonnes
- G&A = anticipated General and Administrative costs

The block value was stored in each block and a cutoff where the block value was greater than or equal to $0.01. This implies that the block would make $0.01 or greater of net revenue (not considering capital) to mine the block and process it for the contained metal. Blocks with a value of $0.00 or less were deemed to be waste material.

Table 1-1 Updated Reserve Estimate – September 2007

Class	Tonnage (Mst)	Grades (Diluted)					
		Copper (%)	Nickel (%)	Platinum (ppb)	Palladium (ppb)	Gold (ppb)	Cobalt (ppm)
Proven	118.1	0.30	0.09	75	275	38	75
Probable	156.5	0.27	0.08	75	248	37	72
Total	274.7	0.28	0.08	75	260	37	73

The following notes should be read in conjunction with Table 1-1:
Rounding as required by reporting guidelines may result in apparent summation differences between tons, grade and contained metal.
Tonnage and grade measurements are in Imperial units.
The reserves are bound within the DFS pit shell.

1.5 Mining and Processing

The NorthMet Deposit will be developed as an open pit mine, starting at the East Pit, then both the East Pit and the larger West Pit, and finally after the East Pit has been completed, some waste from the West Pit will be backfilled into the East Pit.

Run of mine (ROM) rock will be delivered to a loading system, loaded onto rail cars which will deliver the rock to Erie Plant by private railroad.

The Erie Plant operated from 1957 to 2001, processing taconite (low-grade iron ore), and was shut down in the bankruptcy of its owner, LTV Steel Mining Company (LTVSMC).

The exiting Erie Plant has a historic capacity of approximately 100,000 tons per day, comprising four-stage crushing and 34 mill lines, each comprising a rod mill and a ball mill. PolyMet's plans use one of the two primary crushers, and approximately one-third of the rest of the crushing and milling circuit.

The discharge from the ball mills will be processed through a flotation circuit to produce separate copper and nickel concentrates. In the initial phase of operation, PolyMet will sell both of these concentrates to Glencore International (Glencore) under a long-term marketing agreement.

PolyMet will then build a hydrometallurgical circuit to process the nickel concentrate, which will produce a nickel-cobalt hydroxide and a precious metals precipitate, which will be sold to Glencore.

Tailings from the flotation will be deposed of in the existing tailings basin, which is partially filled with taconite tailings, but has more than sufficient capacity for the planned operations.

1.6 Environmental

The NorthMet Project is located within the established mining corridor of existing and now disused iron ore mines, including the Peter Mitchell pit of the NorthShore operations of Cliffs immediately north of the NorthMet Deposit. The Erie Plant is an existing facility with all of the supporting infrastructure already in place.

Minnesota has very stringent environmental standards and environmental review process. The NorthMet environmental review process involves the Minnesota Department of Natural Resources (DNR) the United States Army Corp. of Engineers (USACE) and the United States Forest Service (USFS) as "Lead Agencies". The United States Enviromental Protection Agency (EPA) and tribal authorities are cooperating agencies and the Minnesota Pollution Agency (PCA) is taking part in the process as a permitting agency.

The biggest area of attention is water quality – NorthMet is in the headwaters of the St Louis River, which flows into Lake Superior and is therefore governed by Great Lakes standards. It is important to note that NorthMet is across the Laurentian Divide from the Boundary Waters Canoe Area wilderness and Voyagers National Park and therefore any water discharge will not affect those areas.

The Lead Agencies are currently preparing a detailed EIS that will consider the impact of the Project as it is planned to be built and operated. An earlier Draft EIS published in 2009 considered a range of alternative plans, did not include key mitigation plans that have been developed during the past three years, and did not recommend a preferred project plan. The Supplemental Draft EIS will address these concerns and demonstrate that the NorthMet project meets all state and federal standards.

1.7 Economics

The economic summary refects the 2008 DFS Update. Key economic metrics include earnings before interest, tax, depreciation, and amortization (EBITDA) which is projected to be $217.3 million on average over the first five years of operations. The net present value of future cash flow (after tax) discounted at 7.5% is estimated to be $649.4 million compared, and the after tax internal rate of return is estimated at 30.6%. Table 1-2 also sets out the affect on EBITDA of a 10% change in each metal price. The figures show a comparison with the NI 43-101 filed with the completion of the DFS in 2006.

Table 1-2: Key Economic Highlights

		Update May-08	DFS Sep-06
Operating plan			
Proven and probable reserves	million t	274.7	181.7
Ore mined - life of operation	million t	224.0	181.7
Overburden removed (capitalized under site preparation)	million t	18.5	-
Waste	million t	285.3	302.3
Operating costs per ton processed			
Mining and delivery to plant	$/t	4.31	3.80
Processing	$/t	8.07	6.75
G&A	$/t	0.94	0.46
Total	$/t	13.33	11.02
Metal price assumptions (SEC-standard)			
Copper	$/lb	2.90	2.25
Nickel	$/lb	12.20	7.80
Cobalt	$/lb	23.50	16.34
Palladium	$/oz	320	274
Platinum	$/oz	1,230	1,040
Gold	$/oz	635	540
Economic summary			
Annual earnings before interest, tax, depreciation and amortization (EBITDA) - average first five years	$ million	217.3	175.3
Net present value of future after tax cash flow discounted at 7.5%	$ million	649.4	595.4
Internal rate of return (after tax)		30.6%	26.7%
Sensitivity: 10% ± price = $Δ million in EBITDA			
Copper	$ million	18.6	15.7
Nickel	$ million	13.3	9.3
Cobalt	$ million	0.9	0.9
Palladium	$ million	1.7	2.0
Platinum	$ million	1.7	2.1
Gold	$ million	0.3	0.5
Copper costs			
cash - co-product method	$/lb	1.05	0.81
cash - by-product method	$/lb	(0.28)	0.06

Table 1-3: Metal Prices

		DFS Base Case	DFS Market Case	DFS Update	06/30/12 3-year trailing average
Metal Price					
Copper	$/lb	1.50	2.25	2.90	3.56
Nickel	$/lb	6.50	7.80	12.20	9.47
Cobalt	$/lb	15.25	16.34	23.50	17.69
Palladium	$/oz	225	274	320	684
Platinum	$/oz	900	1,040	1,230	1,689
Gold	$/oz	450	540	635	1,485
After tax:					
Internal rate of return	%	13.4%	26.7%	30.6%	
PV dicounted at 7.5%	$ millions	161.9	595.4	649.4	

PolyMet did not report detailed economic impact of the 2011 project changes but the impact will have been positive owing to reduced capital and operating costs. This analysis will be included in the full project update once all of the details of environmental mitigation measures have been finalized in the Supplemental Draft EIS.

1.8 Conclusions and Recommendations

AGP offers the following recommendations.

PolyMet should proceed with final design engineering and construction of the NorthMet Project as soon as permitting allows. Prior to construction, PolyMet should:

- Review and update the scope of the Project design to reflect any changes resulting from the environmental review process and other project enhancements.
- Update the capital and operating cost estimates based on the scope review and current prices.
    - Continue to review and reassess core drilled by US Steel with particular reference to skeletonised holes within or near the current 20-year pit shell.

Prior to detailed, pre-production planning a limited program of close-spaced drilling is recommended. This program will have two objectives;

- To determine the optimum blast-hole spacing for grade control and scheduling and,
- To increase confidence in grade affecting the initial open pit production.
    - Budget for 625 large diameter (5 ½") reverse circulation drill holes averaging 30 ft for a total of 19,050 ft is estimated at $40 /ft for an all in cost of $782,000 including a $20,000 mobilization charge. Cost is less if using a 3 ½" diameter.

The total for all of these items is in PolyMet's budgets for activities before the start of construction, for a total of approximately $3.0 million.

Various recommendations for further work resulted from the Updated DFS. Some of this work has been completed as of October 2012.

1) **Development of a low-grade recovery relationship for copper and nickel and the other metals**
   Development of a low-grade recovery relationship for copper, nickel and the other metals needs to be completed on low grade samples using a consistent metallurgical protocol. As the cutoff grade is dropped, the impact of lower grades becomes greater and also its impact on overall project economics. This work has been completed.

2) **Updating of metal payment pricing and terms**
Metal prices and terms for mining planning purposes have not been updated since the DFS. With the introduction of concentrate sales, long-term marketing with Glencore, and changes to metal markets, the current cut-off is likely to exclude mineralization that would be economic to mine and process.

3) **Stockpiling options possible to increase initial mill feed grade**
Current low grade ore stockpile limit is for 5 million tons of material. If the limit is increased to a higher value, the initial years mill feed grade can be increased improving overall project economics.

4) **Potential for daily mine ore production increase**
The NorthMet resource base and the geometry of the deposits could allow an increase in ore tonnage.

2 INTRODUCTION

This report describes the results of a mineral resource estimation update of the NorthMet Deposit, which is controlled by PolyMet. The original report was prepared at the request of Mr. Don Hunter, who at the time was the Area Manager-Mining, NorthMet Project, following a drilling program that commenced in February 2007 and completed in July 2007. This updated report was prepared at the request of Mr. Douglas Newby, Chief Financial Officer of PolyMet Mining, in response to a request from the British Columbia Securities Commission in June 2012 for inclusion of the reserves announced in 2007. The 2007 program was instigated primarily to provide additional grade and confidence information and importantly, to provide greater, more extensive definition to the Magenta Zone which had been recognized in earlier drilling. This report is concerned with the drilling results available to PolyMet as at October 15, 2007, including results from all previous drilling.

Information, conclusions, and recommendations contained herein are based on a field examination, including a study of relevant and available data and discussions with Polymet site geologists Richard Patelke and Steve Geerts. Pierre Desautels, Principal Resource Geologist for AGP Mining Consultants Inc. and senior author of this report visited the Project area for a total of five days in March 2007 and August 2007.

2.1 Terms of Reference

The NorthMet resource estimates described herein were completed by AGP at the request of PolyMet in order to provide input to ongoing pit optimization studies and are reported in compliance with the Canadian Securities Administrators NI 43-101 under the direct supervision of:

Pierre Desautels P.Geo. Principal Resource Geologist with AGP Mining Consultants Inc. He directed the review of the 2007 digital data as well as the estimation of the resource for the NorthMet Deposit and is the qualified person (QP) responsible for the report. Mr. Desautels visited the NorthMet site from March 21-23, 2007 and again from August 27-29, 2007 to gather the necessary data used in the resource estimate, review drill core logging and sampling procedures, collect representative check samples and verify drill hole collars locations.

Richard Patelke P.Geo. Former Project Geologist with Poly Met Mining, Inc., now deceased. He was responsible for historical and background information on the NorthMet Deposit. Mr. Patelke resided in Minnesota and was a Registered Professional Geologist of good standing with the State of Minnesota at the time of the estimate. Mr. Patelke was involved in fieldwork at NorthMet, several of the adjacent copper-nickel deposits, detailed outcrop mapping projects, and other mine development projects in the region in a period covering seventeen years. He worked on logging and sampling of drill core recovered from the NorthMet Deposit and others during previous drilling and sampling campaigns. Pierre Desautels will now assume responsibility as the QP for the sections that were authored by Mr. Richard Patelke.

Gordon Zurowski P.Eng. Principal Mine Engineer with AGP Mining Consultants Inc. He completed the mining plans as well as compiled mine capital and operating costs. Mr. Zurowski is the qualified person (QP) responsible for the reserve statement. Mr. Zurowski visited the site on October 9th to 11th, 2007 to review the overall site layout, infrastructure and proposed rail sidings.

All units used in this report are imperial unless otherwise stated; grid references are based on the Minnesota State Plane Grid (North Zone, NAD83, NAVD 88).

2.2 Effective Dates

The data cut-off date and resource effective dates is October 15th, 2007. No additional work has been conducted on the property by PolyMet and as such, the QP considers the resource estimate to be current.

Reference is made to subsequent revisions to the process flow sheet, reported by PolyMet in May 2008 and February 2011. . In addition, reference is made to changes to the mine plan that is bbeing incorporated into the current environmental review where the absense of such reference could be misleading.

2.3 Previous Technical Reports

Much of the text in this report was sourced from the following technical reports and edited as required:

- Report titled "Technical Report on the NorthMet Deposit, Minnesota, USA" by Wardrop Engineering Inc. this report is author by Desautels, P., Patelke, R. and dated September 2007. This report is available on SEDAR.
- Report titled "Mineral Resource Update, NorthMet Poly-Metallic Deposit, Minnesota, USA" by Hellman & Schofield Pty Ltd. author by Hellman, P.L., PhD, FAIG. and dated August 2006. This report is available on SEDAR.
- Report titled "Technical Report on the NorthMet Project" author by Hunter, D.J., C.Eng, CP (Mining) and dated October 2006. This report has a sub-titled " Technical Report on the Results of a Definitive Feasibility Study of the NorthMet Project"

- NI43-101 Report titled "Mineral resource update, NorthMet poly-metallic Deposit, Minnesota, USA." authored by Hellman & Schofield Pty Ltd., and dated 2005. This report is available on SEDAR.

3 RELIANCE ON OTHER EXPERTS

AGP has followed standard professional procedures in preparing the content of this resource estimation report. Data used in this report has been verified where possible and this report is based upon information believed to be accurate at the time of completion.

AGP has not verified the legal status or legal title to any claims and has not verified the legality of any underlying agreements for the subject properties and relied on the information provided by Richard Patelke and Mr. Don Hunter. More recently, Mr. Douglas J. Newby, Chief Financial Officer of Polymet Mining reviewed and approved the content of section 4 of the report on September 11, 2012.

The writers have also relied on several sources of information on the property, including technical reports by consultants to PolyMet, digital geological and assay data, and geological interpretations by PolyMet. Therefore, in writing this report the senior author relies on the truth and accuracy as presented in various sources listed in the References section of this report.

Other contributing authors and Qualified Persons responsible for producing this report include: Andrew Clark, David Dreisinger, William Murray, and Douglas Newby. Items of responsibility for each of the QP's and contribuiting authors are identified in Table 3-1 and Table 3-2 below.

Table 3-1: Qualified Persons Table of Responsiblity

Name	Site Visit	QP	Independent of the issuer	Responsibility
Pierre Desautels P. Geo. of AGP Mining Consultants	March 21-23, 2007 August 27-29, 2007	Yes	Yes	Geology and resource portion of section 1, complete section 2 and 3, a portion of section 4 particularly section 4.1, complete section 5 to 12, section 14, 23, 24 and a portion of section 25 and 26
Gordon Zurowski P. Eng. of AGP Mining Consultants	October 9-11, 2007	Yes	Yes	Portion 1.4, Portion 1.8, Sections 15 & 16, Portions of Section 26
David Dreisinger	Numerous	Yes	No	Sections 13 and 17
William Murray	Numerous	Yes	No	Portion of sections 1, 4, and complete sections 18, 19, 20, 21 and 22.

Table 3-2: Contributing Authors Table of Responsibility

Name	Independent of the issuer	Contribution
Douglas Newby CFO PolyMet Mining	No	Provided the project ownership and title opinion in section 4-2 to 4-8 and portion of sections 19, 20 and 22.
Andrew Clark, VP Construction, PolyMet Mining	No	Provided background for sections 18 and 21.

4 PROPERTY DESCRIPTION AND LOCATION

4.1 Project Location

The NorthMet Project comprises two key elements: the NorthMet Deposit and the Erie Plant. The NorthMet Deposit is situated on a mineral lease located in St Louis County in northeastern Minnesota at Latitude 47° 36’ north, Longitude 91° 58’ west, about 70 miles north of the City of Duluth and 6.5 miles south of the town of Babbitt (Figure 4-1). The Erie Plant is approximately six miles west of the NorthMet Deposit.

The NorthMet Deposit site totals approximately 4,300 acres and the Erie Plant site, including the existing tailings basin, covers approximately 12,300 acres.

The NorthMet project is located immediately south of the eastern end of the historic Mesabi Iron Range and is in proximity to a number of existing iron ore mines including the Peter Mitchell open pit mine located approximately two miles to the north of the NorthMet Deposit. NorthMet is one of several known mineral deposits that have been identified within the 30-mile length of the Duluth Complex, a well-known geological formation containing copper, nickel, cobalt, platinum group metals and gold.

The NorthMet Deposit is connected to the Erie Plant by a transportation and utilities corridor that will comprise an existing private railroad that will primarily be used to transport ore, a segment of the existing private Dunka Road that will be upgraded to provide vehicle access, and new water pipelines and electrical power network for the NorthMet mine site

Figure 4-1: Property Location Map

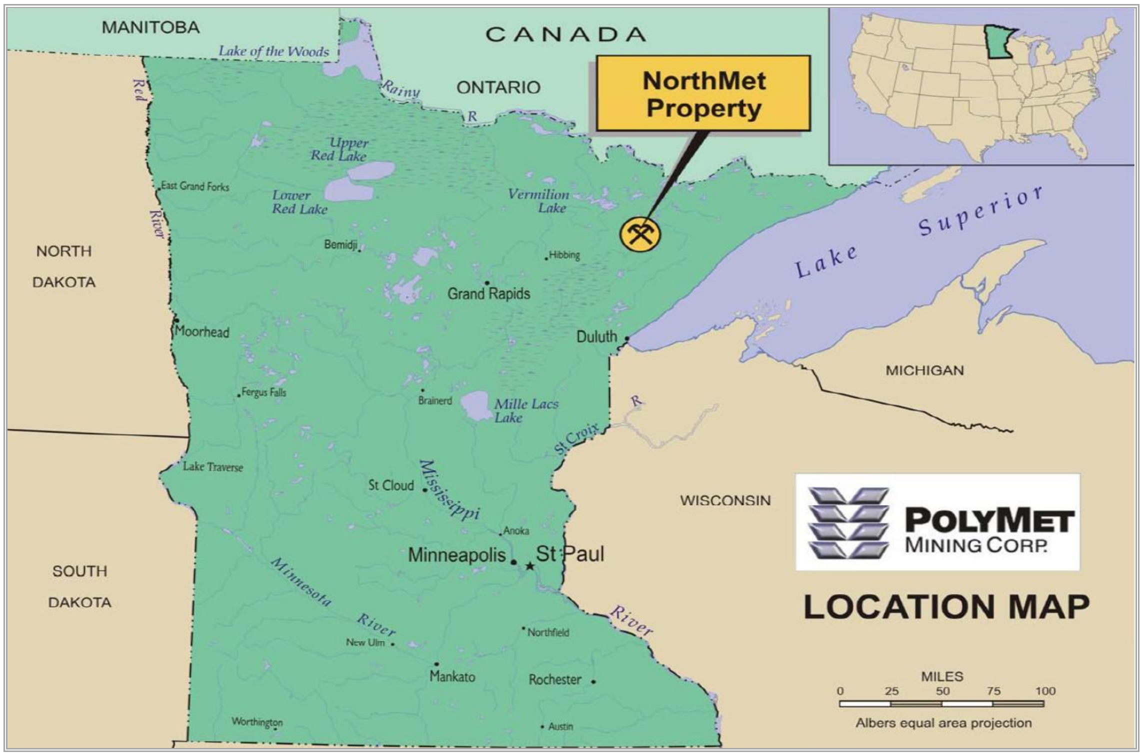
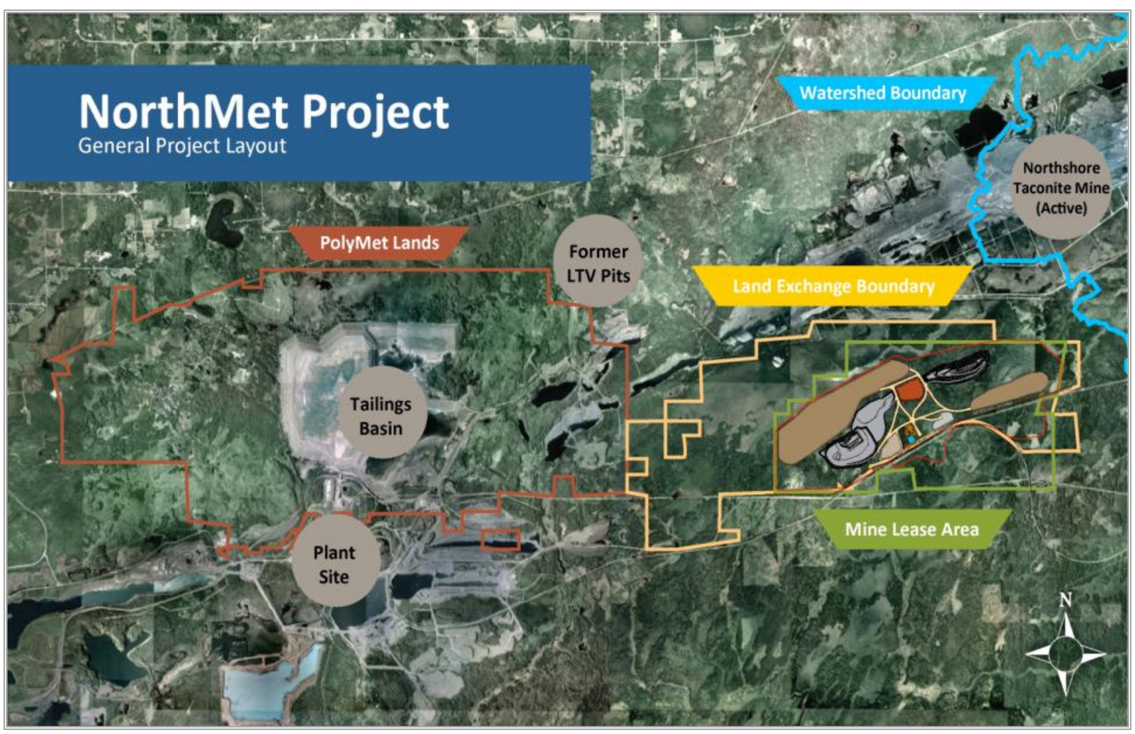


Figure 4-2: Property Layout Map



4.2 Project Ownership

PolyMet Mining Corp. owns 100% of Poly Met Mining, Inc. (PolyMet US), a Minnesota corporation.

PolyMet US controls 100% of the NorthMet Project. The mineral rights covering 4,282 acres or 6.5 square miles at the NorthMet orebody are held through two mineral leases:

- The US Steel Lease dated January 4, 1989, subsequently amended and assigned, covers 4,162 acres originally leased from US Steel Corporation (US Steel), which subsequently sold the underlying mineral rights to RGGS Land & Minerals Ltd., L.P (RGGS). PolyMet can and has extended the lease indefinitely by making $150,000 annual lease payments on each successive anniversary date. The lease payments are advance royalty payments and will be deducted from future production royalties payable to RGGS, which range from 3% to 5% based on the net smelter return, subject to minimum payments of $150,000 per annum.
- On December 1, 2008, PolyMet entered into an agreement with LMC Minerals ("LMC") whereby PolyMet leases 120 acres that are encircled by the RGGS property. The initial term of the renewable lease is 20 years with minimum annual lease payments of $3,000 on each successive anniversary date until the earlier of NorthMet commencing commercial production or for the first four years, after which the minimum annual lease payment increases to $30,000. The initial term may be extended for up to four additional five-year periods on the same terms. The lease payments are advance royalty payments and will be deducted from future production royalties payable to LMC, which range from 3% to 5% based on the net smelter return, subject to a minimum payment of $30,000 per annum.

The surface rights are held by the USFS - see Section 4.4.

PolyMet US owns 100% of the Erie Plant, which covers approximately 12,400 acres, or 19.4 square miles, through contracts for deed with Cliffs. Further details can be found in Section 4.6.

4.3 Mineral Tenure

The NorthMet Project lies within the lands ceded by the Chippewa of Lake Superior to the United States in 1854, known as the "1854 Ceded Territory."

In the 1940s, copper and nickel were discovered near Ely, Minnesota, following which, in the 1960s, US Steel drilled what is now the NorthMet Deposit. US Steel investigated the NorthMet Deposit as a high-grade, underground copper-nickel resource, but considered it to be uneconomic based on its inability to produce separate, clean nickel and copper concentrates with the metallurgical processes available at that time. In addition, prior to the development of the autocatalyst market in the 1970s, there was little market for platinum group metals (PGMs) and there was no economic and reliable method to assay for low grades of these metals.

In 1987, the Minnesota Natural Resources Research Institute ("NRRI") published data suggesting the possibility of a large resource of PGMs in the base of the Duluth Complex.

PolyMet, as Fleck Resources, acquired a 20-year renewable mineral rights lease to the NorthMet Deposit in 1989 from US Steel. The lease is subject to yearly lease payments before production and then to a sliding scale Net Smelter Return (NSR) royalty ranging from 3% to 5% with lease payments made before production considered as advance royalties and credited to the production royalty. PolyMet leases an additional 120 acres of mineral rights underlying 120 acres from LMC.

Mineral and surface rights have been severed, with the USFS owning the surface rights within most of the lease area. US Steel retained the mineral rights and certain rights to explore and mine on the site under the original documents that ceded surface title to the USFS.

4.4 Surface Rights

Surface rights at the NorthMet Deposit are held by the USFS. The United States acquired the surface rights from US Steel in 1938 under provisions of the Weeks Act of 1911. US Steel retained certain mining rights, which PolyMet secured under the US Steel Lease, along with the mineral rights.

PolyMet proposes to complete a land exchange with the USFS whereby the USFS will transfer its surface rights to PolyMet in exchange for two tracts of land totalling approximately 5,300 acres of forests, wetlands, and lakes with high recreational value that PolyMet has acquired. These lands are subject to a $4 million mortgage from the Iron Range Resources and Rehabiliation Board (IRRRB), an economic development agency with no regulatory oversight for mine permitting activities.

The proposed land exchange complies with the 2004 Superior National Forest Land and Resource Management Plan (Forest Plan) and will: provide and sustain benefits to the American people; conserve open space; sustain and enhance outdoor recreation opportunities; and maintain basic management capabilities of the Forest Service by reducing landlines and mineral conflicts.

The Superior National Forest will decide in a Record of Decision whether to proceed with the proposed land exchange, based on the Final EIS for the NorthMet Project.

4.5 Royalties and Encumbrances

The NorthMet Deposit mineral rights carry variable royalties of 3% to 5% based on the net metal value per ton of ore mined. For a net metal value of under $30 per ton, the royalty is 3%, for $30-35 per ton it is 4%, and above $35 per ton it is 5%. Both the US Steel Lease and the LMC Lease carry advance royalties which can be recouped from future royalty payments, subject to minimum payments in any year.

4.6 Environmental Liabilities

Federal, state and local laws and regulations concerning environmental protection affect PolyMet's operations. Under current regulations, PolyMet is contracted to indemnify Cliff's requirement to meet performance standards to minimize environmental impact from operations and to perform site restoration and other closure activities. PolyMet's provisions for future site closure and reclamation costs are based on known requirements. It is not currently possible to estimate the impact on operating results, if any, of future legislative or regulatory developments. PolyMet's estimate of the present value of the obligation to reclaim the NorthMet Project is based upon existing reclamation standards at July 31, 2012. Once PolyMet obtains permits to mine, the environmental and reclamation obligations will be transferred to PolyMet from Cliffs.

The Company's best estimate of the total environmental rehabilitation at July 31, 2012 was $25.8 million.

In April 2010, Cliffs entered into a consent decree with the Minnesota Pollution Control Agency (MPCA) relating to alleged violations on the Cliffs Erie Property. This consent decree required submission of Field Study Plan Outlines and Short Term Mitigation Plans, which have been approved by the MPCA. In April 2012, long-term mitigation plans were submitted to the MPCA for its review and approval, such approval remains outstanding to date. As part of its prior transactions with Cliffs, PolyMet has agreed to indemnify Cliffs for certain ongoing site environmental liabilities.

There is uncertainty related to the engineering scope and cost of mitigation required to meet applicable water standards, and responsibility for the financial liability. As such, the Company is unable to estimate its potential liability for the Long Term Mitigation Plan.

4.7 Permits

Cliffs holds certain permits that provide for the maintenance of the site, which is carried out by PolyMet at PolyMet's expense under the terms of the contracts for deed. PolyMet is not currenly carrying out any exploration at the NorthMet mine site but would require permits from the USFS for any additional work prior to the completion of the land exchange.

Prior to construction and operation of the NorthMet Project, PolyMet will require several permits from federal and state agencies – see section 20.4.

4.8 Social License

The environmental review process is described on Section 20. The federal, state and local government permits needed for PolyMet to construct and operate the NorthMet Project are described in Section 20.4.

PolyMet has maintained an active community outreach program for many years. The focus of the program has been to provide information about the Project, its likely impact in the environment, and the socio-economic benefits. The local communities are supportive of the Project. PolyMet has received letters of support from U.S. Senators Klobuchar and Franken and U.S. Representative Cravaack is publicly and actively seeking ways to help the Project move forward.

Bois Forte Band of Chippewa (Bois Forte), Grand Portage Band of Chippewa (Grand Portage), and the Fond du Lac Band of Lake Superior Chippewa (Fond du Lac) are cooperating agencies in preparation of the EIS. Fond du Lac has expressed the strongest opposition, primarily related to cultural heritage issues and seeking to ensure that water quality is protected.

The most active environmental groups in the area are focused on protecting the Boundary Waters Canoe Area Wilderness, which is located approximately 25 miles northeast of the NorthMet site, in a different watershed.

4.9 Significant Risk Factors

Permitting is the most significant risk factor for the Project. The NorthMet Project is the first copper-nickel project in Minnesota to seek permits for construction and operation and, as such, requires state regulators to interpret established regulations.

Permitting risk falls into two primary categories: permits may be denied or legally challenged, or operating requirements imposed by the permits could be financially so burdensome that the Project is unable to proceed.

These risks are mitigated by completing a thorough environmental review and, in the case of the NorthMet Project, the existance of the Erie Plant and associated infrastructure.

4.10 Comments on Section 4

Mineral and property tenure is secure. Completion of the environmental review and permitting is the biggest challenge, but the Lead and Co-operating Agencies are on track to finish this complex process.

5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

The Project site is situated immediately south of the eastern part of the historically important Mesabi Iron Range, a world class mining district that produces approximately 42 million tons per year of taconite pellets and iron ore concentrate. There are six producing iron ore mines on the Range, of which the nearby Northshore open pit mine owned and operated by Cliffs is one of the largest. The Northshore pit is located approximately two miles north of the NorthMet Deposit.

5.1 Accessibility

Access to the NorthMet project is by a combination of good quality asphalt and gravel roads via the Erie Plant site. The nearest center of population is the town of Hoyt Lakes, which has a population of about 2,500 people. There are a number of similarly sized communities in the vicinity, all of which are well serviced, provide ready accommodation, and have been, or still are, directly associated with the region's extensive taconite mining industry. The road network in the area is well developed, though not heavily trafficked, and there is an extensive railroad network, which serves the taconite mining industry across the entire Range. There is access by ocean shipping via the ports at Taconite Harbor and Duluth/Superior (on the western end of Lake Superior) and the St. Lawrence Seaway.

5.2 Climate

Climate is continental and characterized by wide temperature variations and significant precipitation. The temperature in the town of Babbitt, about 6.5 miles north of the NorthMet Deposit, averages four degrees Fahrenheit (°F) in January and 66°F in July. During short periods in summer, temperatures may reach as high as 90°F with high humidity. Average annual precipitation is about 28 inches with about 30% of this falling mostly as snow between November and April. Annual snowfall is typically about 60 inches with 24 to 36 inches on the ground at any one time. The local taconite mines operate year round and it is rare for snow or inclement weather to cause production disuption.

5.3 Local Resources and Infrastructure

The area has been economically dependent on the mining industry for many years and while there is an abundance of skilled labour and local mining expertise, the closure in 2001 of the LTVSMC open pit mines and taconite processing facility has had a significant negative impact on the local economy and population growth. There are, however, a number of other operating mines in other parts of the Iron Range. Hence the mining support industries and industrial infrastructure remains well developed and of a high standard.

The Erie Plant site is connected to the electrical power supply grid and a main HV electrical power line (138 kV) runs parallel to the road and railroad that traverse the southern part of the mining lease area. PolyMet has a long-term power contract with Minnesota Power.

There are plentiful local sources of fresh water. While electrical power and water is available nearby, the author is not qualified to comment as to the adequacy of these resources to support an open pit mining operation, but notes previous operations at 100,000 tons per day, or three times PolyMet's plans.

5.4 Physiography

The Iron Range forms an extensive and prominent regional topographic feature. The Project site is located on the southern flank of the eastern Range where the surrounding countryside is characterized as being gently undulating. Elevation at the Project site is about 1,600 ft above sea level (1,000 ft above Lake Superior). Much of the region is poorly drained and the predominant vegetation comprises wetlands and boreal forest. Forestry is a major local industry and the Project site and much of the surrounding area has been repeatedly logged. Relief across the site is approximately 100 ft.

5.5 Sufficiency of Surface Rights

Tenure of surface rights is described in some detail in Section 4.4. In summary, surface rights are held by the USFS. Exchange of these rights for other land owned by PolyMet is part of the Supplemental Draft EIS and PolyMet expects the exchange to occur following the Record of Decision related to the Final EIS.

6 HISTORY

There has been no prior mineral production from the NorthMet Deposit though it has been subject to several episodes of exploration and drilling since its discovery in 1969 by US Steel. Table 6-1 summarizes the exploration drilling activities since 1969 and the amount of assay data.

US Steel held mineral and surface rights over much of the region, including the NorthMet lease, until the 1930s when, for political and land management reasons, surface title was ceded to the US Forest Service. In negotiating the deeds that separated the titles, US Steel retained the mineral rights and the rights to explore and mine any mineral or group of minerals on the site, effectively removing the possibility of veto of such activities by the USFS, provided they are carried out in a responsible manner.

In 1989, Fleck Resources Ltd. (Fleck), a company registered in British Columbia, Canada, acquired a 20-year renewable mineral rights lease to the NorthMet Deposit from US Steel and undertook exploration of the NorthMet Deposit. Fleck developed joint ventures with NERCO Inc. in 1991 and Argosy Mining Corp. in 1995 in order to progress exploration.

In June 1998, Fleck Resources Ltd. changed its name to PolyMet Mining Corporation. In 2000, there was a short-lived joint venture with North Mining Inc. that was terminated by PolyMet when North Mining Inc. was bought by Rio Tinto plc. With the exception of a hiatus between 2001 and 2003, PolyMet has continued exploration and evaluation of the NorthMet Deposit until 2007, since when it has been focused on completing the environmental review and permitting process, and enhancing the process design.

In 2000, PolyMet commissioned Independent Mining Consultants, Inc. of Tucson, Arizona (IMC) to carry out a Pre-feasibility Study. The report was published in 2001 and filed on SEDAR (IMC, 2000). One of the conclusions of the IMC Pre-feasibility Study report was that proceeding to the preparation of a full Feasibility Study was warranted.

In 2004, US Steel sold much of its real estate and mineral rights in the region, including the NorthMet Deposit, to a private company, RGGS of Houston Texas. PolyMet's US Steel lease was transferred to RGGS at that time without any change in conditions.

US Steel took at least three bulk samples from NorthMet in 1970 and 1971 (Patelke and Severson, 2006). The three samples weighed approximately 9 tons, 300 tons and 20 tons respectively. The samples came from mineralization in Units 3 and 1 (see descriptions of these units in Section 7 of the report).

Table 6-1: Summary of NorthMet Exploration Activity Since 1969

Company	Date of Drilling	Date of Assaying	No. of Drill Holes	Total Footage for Group	Number of Assay Intervals used in "Accepted Values" Tables	Assayed Footage used in Final Database	Assay Labs
US Steel	1969-1974	1969-1974 1989-1991 1999-2001 2005-2006	112	113,716	9,475	56,525	US Steel, ACME, ALS-Chemex
US Steel	1971-1972	Three surface bulk samples for metallurgical testing taken from two locations					
NERCO	1991	1991	2 (4)	842	165	822	ACME
NERCO	1991	Bulk metallurgical sample from large size (PQ) core used for tests of CUPREX hydrometallurgical process (842 ft)					
PolyMet Reverse Circulation Drilling	1998-2000	1998-2000	52	24,650	4,765	23,767	ACME
PolyMet Core Drilling	1999-2000	2000-2001	32	22,156	4,058	20,727	ALS-Chemex
PolyMet RC Drilling Deepened with AQ Core Trail	2000	2000	3	2,696	524	2,610	ALS-Chemex
PolyMet	1998 & 2000	Two flotation pilot plant campaigns and variability testing used about 60 tons of sample derived from RC drilling programs					
PolyMet Core Drilling	2005	2005-2006	109	77,166	11,656	71,896	ALS-Chemex
PolyMet	2005	Samples from four inch and PQ core processed for pilot flotation and metal production, three composites of average 0.3%, and 0.4% Cu, 10, 20, and 10 tons respectively					
PolyMet Core	Winter, 2007	2007	47	19,102.5	2,801	18,174	ALS-Chemex

Company	Date of Drilling	Date of Assaying	No. of Drill Holes	Total Footage for Group	Number of Assay Intervals used in "Accepted Values" Tables	Assayed Footage used in Final Database	Assay Labs
Drilling							
PolyMet Core Drilling	Summer, 2007	2007	14	5,427.5	748	5,515.7	ALS-Chemex
Totals for Exploration Drilling			371	285,756	34,192	199,672.7	
US Steel Stratigraphic Holes*	1970s?	None used	6	9,647	None used	None used	
INCO*	1956	None used	3	2,015	None used	None used	
Humble Oil Exxon*	1968-1969	None used	3	9,912	None used	None used	
Bear Creek/AMAX*	1967-1977	None used	11	8,893	None used	None used	
PolyMet/Barr Engineering (Hydrologic Testing)	2005	None used	21	3,459	None used	None used	

Notes: The number of assays used in the PolyMet database reflects numerous generations of sampling duplication. See Section 14 for the assay history.

Stratigraphic holes in the area from other projects (not necessarily drilled for this project) used to help define edges of the geologic model and provided important stratigraphic information. Note that assays, especially those for the US Steel drilling, were not all completed at the time of the original drilling.

6.1 Historical Resource Estimates

Numerous historical resource estimates by US Steel, Fleck and NERCO were quoted by Peatfield (1999) who regarded these as preliminary in nature and lacking detailed documentation. Details on cut-off grades used in this early work are mostly absent though appear to be from 0.1 to 0.2% copper (Peatfield, 1999).

A 1970s US Steel report (in Patelke & Severson, 2006) provides a preliminary estimate of 109 million short tons of material containing 0.77% copper and 0.24% nickel which was considered to be potentially mineable by underground methods. Although not conforming to the definition of a Mineral Reserve, it was estimated at that time that the amount of this potentially mineable material could be doubled if the average combined cut-off grade was dropped by 0.2%. It is unclear how US Steel planned to process the ore.

During 2001, IMC completed mining studies and reported Measured, Indicated and Inferred categories within a pit design to 200 ft elevation (approximate final pit depth of 1,400 ft below surface) (IMC, 2001).

Resource estimate carried out by Hellman & Schofield Pty Ltd. in 2006 saw the introduction of a US$7.42 NMV cut-off, which was, according to Hellman and Schofield, roughly equivalent to a lower cut-off of 0.2% copper and 0.06% nickel.

The most recent resource estimate was carried out by Wardrop Engineering dated September 2007, which included an extension of the block model matrix down to the 0 ft elevation, a smaller block size based upon a selective mining unit determination, a new interpolation plan that honoured the geological features and statistical characteristics of the NorthMet Deposit and a new classification model.

Table 6-2 lists the historical resource estimates for the NorthMet Deposit.

PolyMet does not treat the historical estimates as current mineral resources or reserves. These estimates are historical in nature and, with the exception of Hellman & Schofield and Wardrop September 2007, pre-date and are non-compliant with NI 43-101. They are reproduced in Table 6-2 purely for a record. These estimates are no longer relevant as they are being replaced by the NI 43-101 resource estimated presented in this report.

Table 6-2: NorthMet Historical Resource Estimate

Origin	Cut-off	Tonage (M st)	Cu%	Ni*%	Ag* (ppm)	Au* (ppm)	Pt* (ppm)	Pd* (ppm)	Co (ppm)	Notes
US Steel	Unknown	272	0.5	0.16	-	-	-	-	-	Geological resources
US Steel	Unknown	99	0.77	0.24	-	-	-	-	-	to 200 ft elevation
Fleck? (1989)	Unknown	75	0.57	0.13	2.1	0.069	0.171	0.274	-	to 800 ft elevation
Fleck (1989)	Unknown	157	0.47	0.11	-	-	-	-	-	in pit, undiluted
Fleck (1989)	Unknown	173	0.43	0.1	-	-	-	-	-	"Diluted", to 800 ft
Fleck (1990)	Unknown	154	0.48	0.11	1.7	0.068	0.133	0.454	-	in pit, undiluted
Fleck (1990)	Unknown	179	0.42	0.09	1.5	0.06	0.117	0.399	-	"Diluted", to 800 ft
NERCO (1991)	0.1% Cu	1419	0.4	0.009	1.3	0.061	0.118	0.445	-	"Global"
NERCO (1991)		808	0.43	0.11	1.5	0.061	0.116	0.437	-	In Pit
IMC 2001 Resource	0.1% Cu	362	0.301	0.084	-	0.04	0.078	0.286	66	Measured
		303	0.328	0.085	-	0.047	0.09	0.324	62	Indicated
		340	0.336	0.085	-	0.048	0.093	0.341	59	Inferred
IMC 2001 Resource	0.2% Cu	290	0.336	0.091	-	0.045	0.087	0.323	67	Measured
		255	0.359	0.091	-	0.052	0.1	0.361	62	Indicated
		275	0.379	0.094	-	0.055	0.107	0.396	60	Inferred
IMC 2001 Mineable	0.1% Cu	489	0.3	0.08	-	0.042	0.083	0.285	66	Total "Ore"
		406								Measured + Indicated
IMC 2001 Mineable	0.2% Cu	340	0.336	0.085	-	0.048	0.093	0.341	59	Total "Ore"
		290								Measured + Indicated
H&S 2006 Resource	US$7.42 NMV	133.7	0.298	0.087		0.035	0.067	0.269	77	Measured (To 500 ft elev.)
		288.4	0.266	0.078		0.033	0.066	0.231	72	Indicated (To 500 ft elev.)
		120.6	0.247	0.074		0.033	0.065	0.217	70	Inferred (To 500 ft elev.)
Wardrop Sept 2007	US$7.42 NMV	187.0	0.287	0.084	-	0.035	0.068	0.256	73	Measured (To 0.00 ft elev.)
		451.1	0.256	0.075	-	0.034	0.065	0.226	70	Indicated (To 0.00 ft elev.)
		251.6	0.275	0.079	-	0.037	0.076	0.272	56	Inferred (To 0.00 ft elev.)

Note: Cu=copper Ni=nickel Ag = silver Pd = palladium Au = gold Pt = platinum Co =cobalt

7 GEOLOGICAL SETTING AND MINERALIZATION

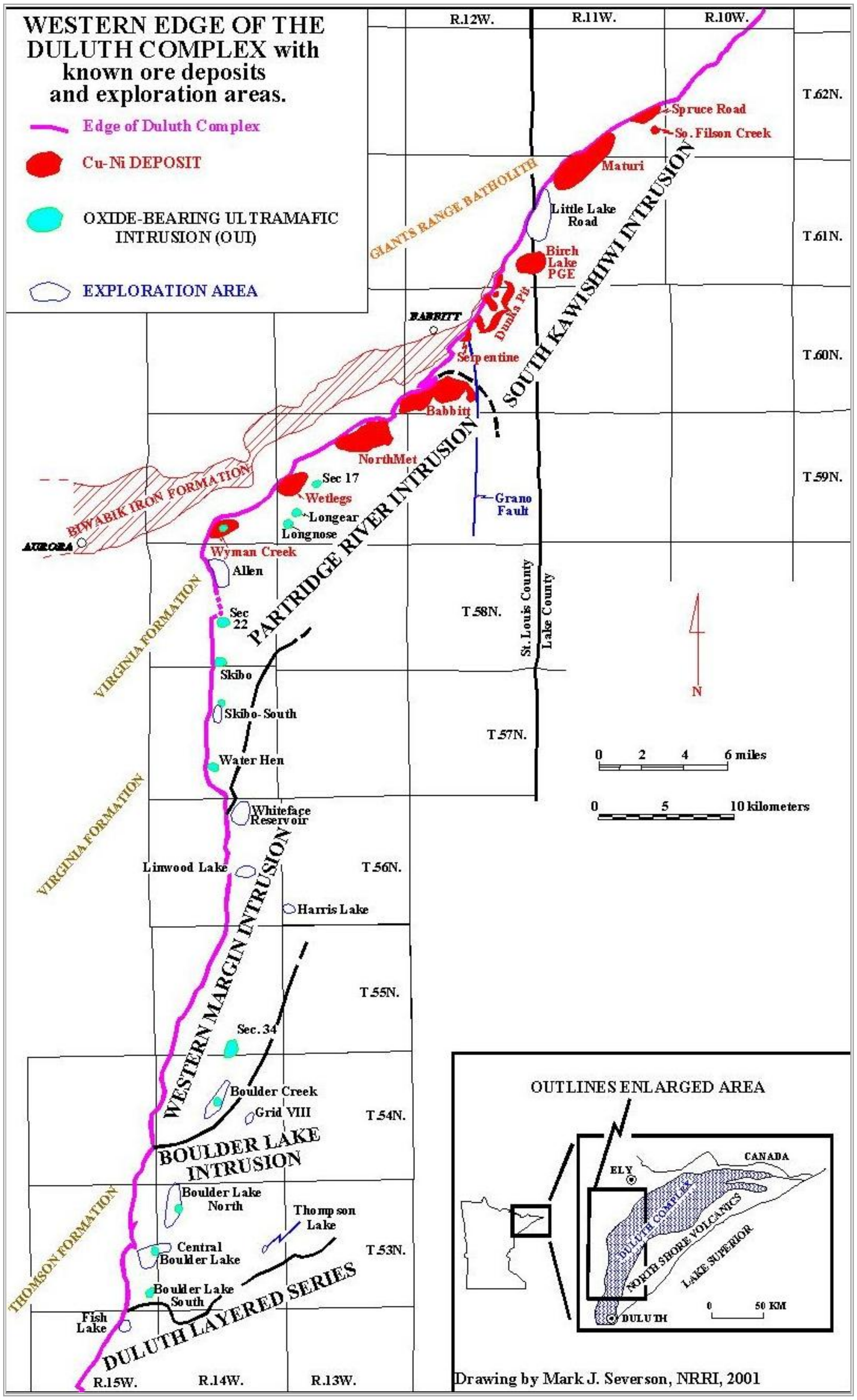
7.1 Regional Geology

The NorthMet Deposit is situated in the Duluth Complex of northeastern Minnesota. This is a large, composite, grossly layered, tholeiitic mafic intrusion that was emplaced into comagmatic flood basalts along a portion of the Mesoproterozoic (Geerts, 1994) Mid-continent Rift System. Along the western edge of the Duluth Complex, and within the Partridge River and South Kawishiwi intrusions, there are eleven known copper-nickel deposits, some of which contain platinum group elements (Figure 7-1). The NorthMet Deposit is situated within the Partridge River Intrusion, which consists of varied troctolitic and (minor) gabbroic rock types that have been subdivided into seven igneous stratigraphic units based on drill core logging. On the footwall is the Paleoproterozoic Virginia Formation, comprised of contact-metamorphosed graywackes and siltstones.

The regional and local geology are well known (Geerts et al., 1990; Geerts, 1991, 1994; Severson, 1988; Severson and Hauck, 1990, 1997; Severson and Zanko, 1996; Severson and Miller, 1999; Severson et al., 2000; Hauck et al., 1997; Miller et al., 2001, 2002). There are over 1,100 exploration drill holes on this part of the Complex, and nearly 1,000,000 ft of core have been logged or re-logged in the past fifteen years by a small group of company and university research geologists (see Patelke, 2003).

All of these igneous units, which are described in the sub section below from bottom to top, exhibit shallow dips (10°-25°) to the south-southeast. The NorthMet Deposit and the contact between the Duluth Complex and the Virginia Formation strike 56° approximately east-northeast.

Figure 7-1: Copper-Nickel Deposits in the Duluth Complex (after Severson)



7.1.1 Project Geology

Geology at NorthMet is well constrained by outcrop mapping (Severson and Zanko, 1996) and drill core logging on the US Steel holes, mostly by Geerts (Geerts et al., 1990, Geerts 1991, 1994), Severson (Severson et al., 2000) and Patelke (2001). This has been rather detailed logging which provided the framework for the more production oriented logging done by PolyMet during 1998-2000 (by various geologists trained by Severson) and the 2005 and 2007 (mostly by Severson and Geerts) drilling programs.

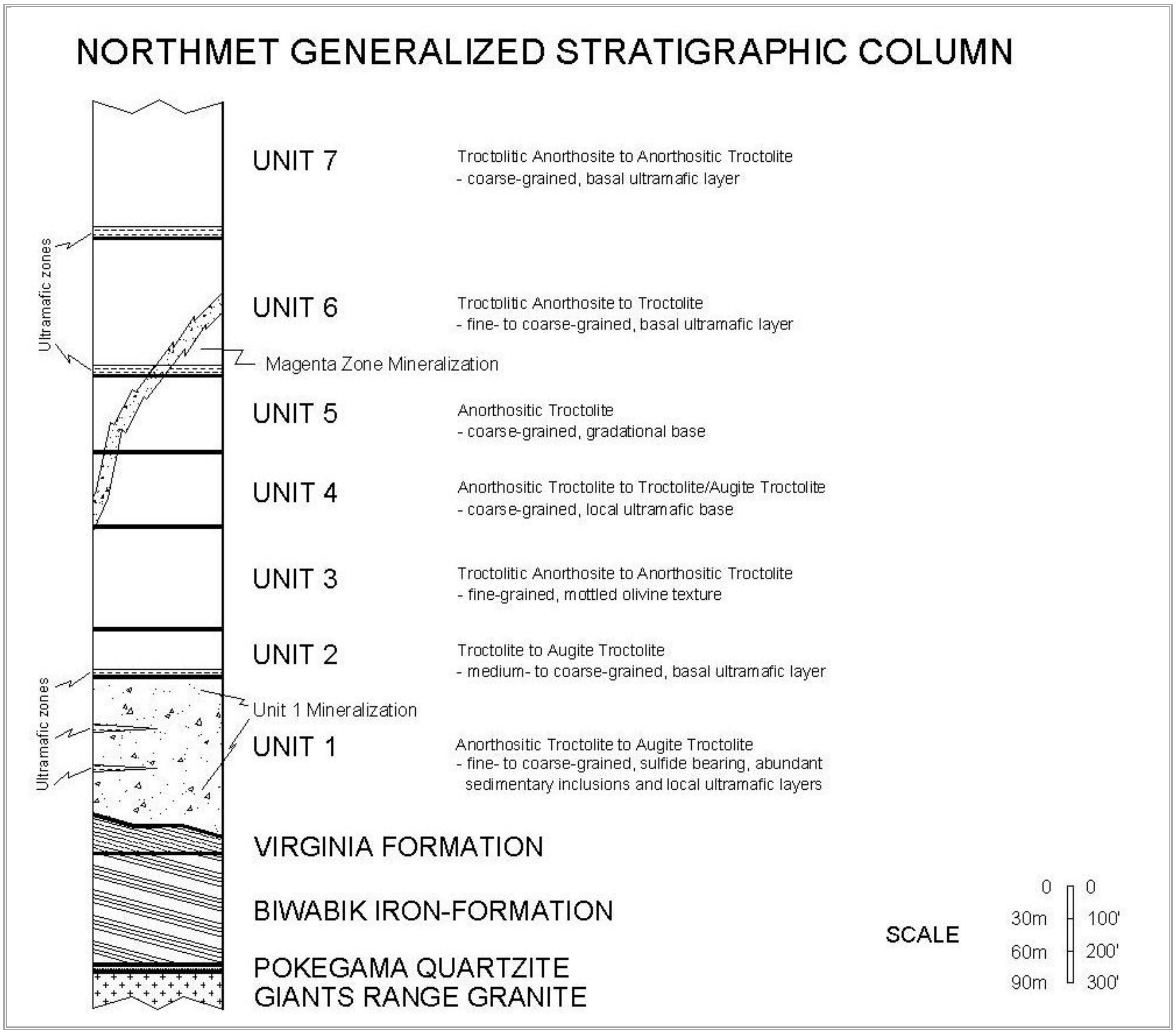
A summary of the general stratigraphy of the NorthMet Deposit shown in Figure 7-2 is outlined in the text below. Rock units and formations are listed in descending order, as would be observed from top to bottom in drill hole. NorthMet units are labeled as Units 1 through 7, bottom to top. Unit 3 is the oldest, the intrusion sequence of the other units is not clear.

The broad picture is of a regular stratigraphy of troctolitic to anorthositic rock units, dipping southeast at 20° to 25°, with basal ultramafic units commonly defining the boundaries of these units. The basal ultramafic zones tend to have diffuse tops, sharp bases, and are commonly serpentinized and foliated. Geologists have generally picked the unit boundaries at the base of these ultramafics though there are local exceptions. Economic sulfide mineralization is ubiquitous in the basal igneous unit (Unit 1) and is locally present, but restricted, in the upper units (i.e., Magenta Zone). There is no economic mineralization in the footwall rocks.

Geological domains for resource modelling are: Virginia Formation footwall rocks; a domain including the upper, higher grade parts of Unit 1, locally merged with the higher grade zones at the base of Unit 2; the remainder (lower part) of Unit 1; the Magenta Zone in Units 4, 5 and 6 in the western part of the Deposit; and the remaining, less mineralized, parts of Units 2 through 7.

Note that in the geologic solids model, Units 2 and 3 are combined as Unit 3, and Units 4 and 5 are combined as Unit 5. In both cases the combined units have more consistent thicknesses than the single units. Unit 2 and 3 may or may not be a single igneous package; there is evidence for both scenarios, while Units 4 and 5 are clearly one package with an arbitrary pick based on gradual changes in grain size and overall texture defining the unit boundaries.

Figure 7-2: NorthMet Stratigraphic Column (after Geerts, 1994)

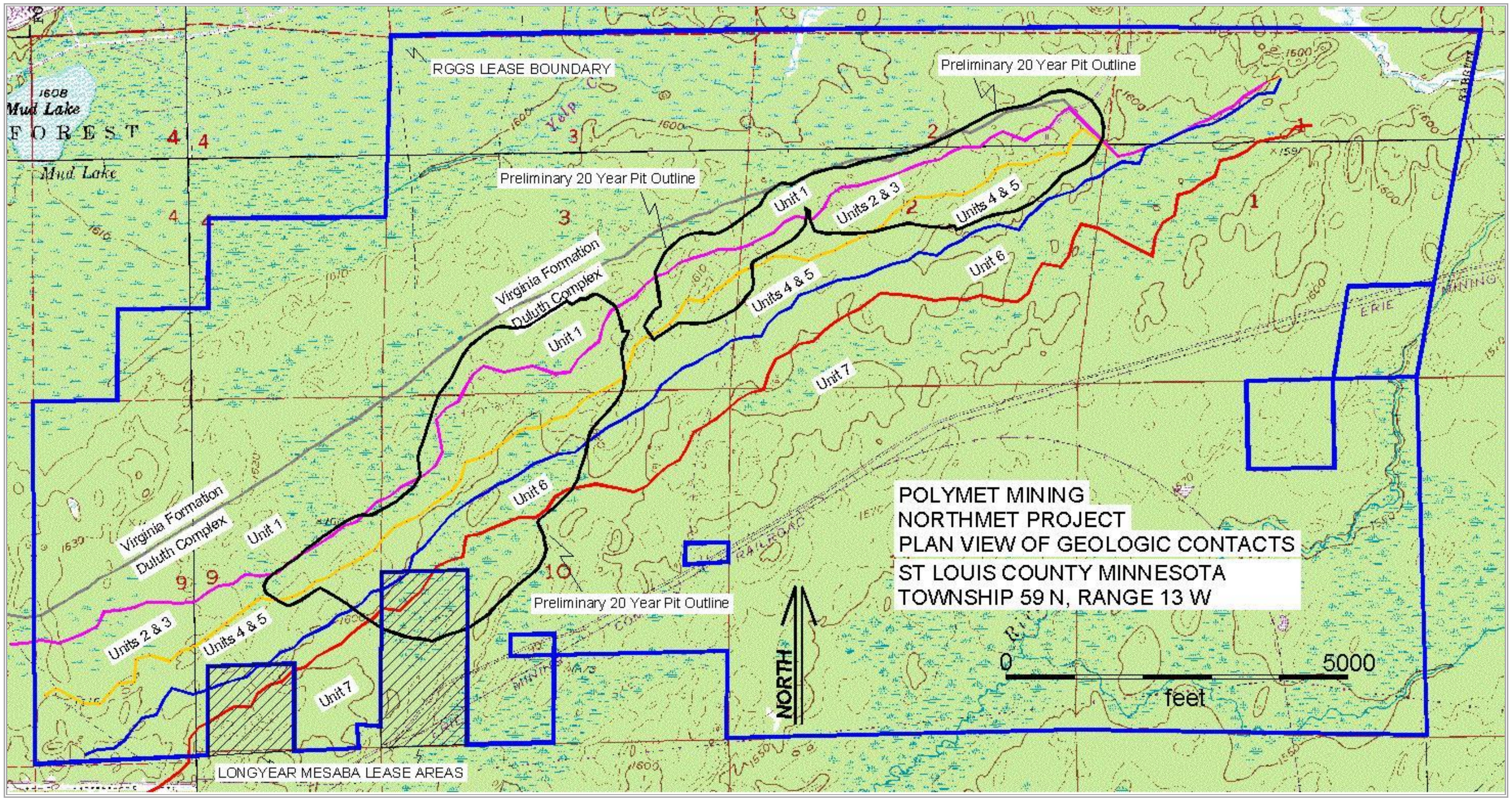


7.1.2 Rock Type and Unit Classification

Igneous rock types in the Complex are classified at NorthMet by visually estimating the modal percentages of plagioclase, olivine, and pyroxene. Due to subtle changes in the percentages of these minerals, a variation in the defined rock types within the rock units may be present from interval to interval or hole to hole. This is especially true for Unit 1.

Unit definitions are based on: overall texture of a rock type package; mineralogy; sulphide content; and context with respect to bounding surfaces (i.e., ultramafic horizons, oxide-rich horizons). Unit definitions are not always immediately clear in logging, but usually clarified when drill holes are plotted on cross-sections. In other words, to correctly identify a particular igneous stratigraphic unit, the context of the units directly above and below must also be considered. Figure 7-3 shows a plan view of the NorthMet geological contacts within the mining lease area.

Figure 7-3: NorthMet Geological Contacts



Based on drill hole logging, the generalized rock type distribution at NorthMet is about 83% troctolitic, 6% anorthositic, 4% ultramafic, 4% sedimentary inclusions, 2% noritic and gabbroic rocks, and the rest as pegmatites, breccia, basalt inclusions and others

7.1.3 Unit Definitions and Descriptions

Unit 7

Unit 7 is the uppermost unit intersected in drill holes at the NorthMet Deposit. It consists predominantly of homogeneous, coarse-grained, anorthositic troctolite and troctolitic anorthosite. The unit is characterized by a continuous basal ultramafic sub-unit that averages 20 ft thick. The ultramafic consists of fine- to medium-grained melatroctolite to peridotite and minor dunite. The average thickness of Unit 7 is unknown due to the truncation by erosion on the surface exposure.

Unit 6

Very similar to Unit 7, Unit 6 is composed of homogeneous, fine- to coarse-grained, troctolitic anorthosite to troctolite. It averages 400 ft thick and has a continuous basal ultramafic sub-unit that averages 15 ft thick. Overall, sulphide mineralization is generally minimal, although a number of drillholes in the south-western portion of the NorthMet Deposit contain significant copper sulphides and associated elevated PGEs (Geerts 1991, 1994). Sulphides within Unit 6 generally occur as disseminated chalcopyrite/cubanite with minimal pyrrhotite. This mineralized occurrence (the Magenta Zone) is discussed in greater detail in the following sections.

Unit 5

Unit 5 exhibits an average thickness of 250 ft and is composed primarily of homogeneous, equigranular-textured, coarse-grained anorthositic troctolite. Anorthositic troctolite is the predominant rock type, but can locally grade into troctolite and augite troctolite towards the base of the unit. The lower contact of Unit 5 is gradational and lacks any ultramafic sub-unit; therefore the transition into Unit 4 is a somewhat arbitrary pick. Due to the ambiguity of this contact, thicknesses of both units vary dramatically. However, when Units 5 and 4 are combined, the thickness is fairly consistent deposit-wide.

Unit 4

Being somewhat more mafic than Unit 5, Unit 4 is characterized by homogeneous, coarse-grained, ophitic augite troctolite with some anorthosite troctolitic. Unit 4 averages about 250 ft thick. At its base, Unit 4 may contain a discontinuous, local, thin (usually no more than six inches) ultramafic layer or oxide-rich zone. The lower contact with Unit 3 is generally sharp. Overall, outside of the Magenta Zone, sulphides only occur in trace amounts within Unit 4 as finely disseminated grains of chalcopyrite and pyrrhotite.

Unit 3

Unit 3 is used as the major "marker bed" in determining stratigraphic position in drill core. It is composed of fine- to medium-grained, poikilitic and/or ophitic, troctolitic anorthosite to anorthositic troctolite. Characteristic poikilitic olivine gives the rock an overall mottled appearance. On average, Unit 3 is 300 ft thick. The lower contact of Unit 3 can be disrupted, with multiple "false starts" into typical Unit 2 homogenous rocks, only to go back to mottled Unit 3 with depth. The alternating sequence is common in the south western portion of the NorthMet Deposit and can span for many tens of ft along core before finally settling into definitive Unit 2. This most likely indicates that Unit 3 is broken up in this area and intruded by Unit 2 near the base of Unit 3. As with Units 4 and 5, the thickness of Units 2 and 3 tend to be highly variable, whereas if combined into one unit, it is more consistent deposit-wide (though not as consistent as Units 4 and 5).

Unit 3 can contain both footwall meta-sedimentary (Virginia Formation) and hanging wall basalt inclusions, which seems to indicate earliest emplacement within the intrusive sequence of the NorthMet Deposit. This exemplified by the fact that few sedimentary inclusions are found above Unit 3 and few basalt inclusions are found below it, as if Unit 3 was initially intruded between these units and eventually formed a barrier between them.

Unit 2

Unit 2 is characterized by homogeneous, medium- to coarse-grained troctolite and pyroxene troctolite with a consistent basal ultramafic sub-unit. The continuity of the basal ultramafic sub-unit, in addition to the relatively uniform grain size and homogeneity of the troctolite, makes this unit distinguishable from Units 1 and 3. Unit 2 has an average thickness of 100 ft. The ultramafic sub-unit at the base of Unit 2 is the lowermost continuous basal ultramafic horizon at the NorthMet Deposit, averages 25 ft thick, and is composed of melatroctolite to peridotite and minor dunite.

In some ways the characteristics of Unit 2 and how it fits into the igneous stratigraphy and the sequence of intrusion are ambiguous; it can be interpreted as the lower part of Unit 3, the upper part of Unit 1, or a separate unit. Based on continuity of the ultramafic boundary it seems to be a lower, more mafic, counterpart to Unit 3. The general lack of footwall inclusions in Unit 2 would argue against Unit 2 being older than Unit 1 and would indicate an intrusion sequence of 3, 1 then 2. Though Unit 2 has been historically described as barren, in the western part of the NorthMet Deposit it has mineralization grossly continuous with that at the top of Unit 1.

Unit 1

Of the seven igneous rock units represented within the NorthMet Deposit, Unit 1 is the only unit that contains significant deposit-wide sulphide mineralization. Sulphides occur primarily as disseminated interstitial grains between a dominant silicate framework and are chalcopyrite > pyrrhotite > cubanite > pentlandite. Unit 1 is also the most complex unit, with internal ultramafic sub-units, increasing and decreasing quantities of mineralization, complex textural relations and varying grain sizes, and abundant metasedimentary inclusions. It averages 450 ft thick, but is locally 1,000 ft thick and is characterized lithologically by fine- to coarse-grained heterogeneous rock ranging from anorthositic troctolite (more abundant in the upper half of Unit 1) to augite troctolite with lesser amounts of gabbro-norite and norite (becoming increasingly more abundant towards the basal contact) and numerous metasedimentary inclusions. By far the dominant rock type in Unit 1 is medium-grained ophitic augite troctolite, but the textures can vary wildly. Two internal ultramafic sub-units occur in drill holes in the southwest, and have an average thickness of 10 ft.

Footwall: Animikie Group and Archean Rocks

The footwall rocks of the NorthMet Deposit consist of Paleoproterozoic (meta) sedimentary rocks of the Animikie Group. These rocks are represented by the following three formations, listed from youngest to oldest: the Virginia Formation; the Biwabik Iron Formation; and the Pokegama Quartzite. They are generally underlain by Archean granite of the Giants Range Batholith, but there are Archean basalts and metasediments mapped in outcrop near the Project area. The Duluth Complex is only in contact with the Virginia Formation at the NorthMet site.

Intrusion of the Complex metamorphosed the Virginia. Non-metamorphosed Virginia Formation (as found to the north of the site) consists of a thinly-bedded sequence of argillite and Greywacke, with lesser amounts of siltstone, carbonaceous-sulphidic argillite/mudstone, cherty-limey layers, and possibly some tuffaceous material. However, in proximity to the Duluth Complex, the grade of metamorphism (and associated local deformation) progressively increases, and several metamorphic varieties and textures are superimposed on the original sedimentary package at an angle to the original stratigraphy. At least four distinctive Virginia Formation varieties are present at NorthMet and informally referred to as Cordieritic Metasediments; Disrupted Unit; Recrystallized Unit; and Graphitic Argillite (often with pyrrhotite laminae). These sub-units are fully described in Severson et al., 2000.

Inclusions in the Duluth Complex

Two broad populations of inclusions occur at NorthMet: hanging wall basalts (Keweenawan) and footwall meta-sedimentary rocks. Basalts are fine-grained, generally gabbroic, with no apparent relation to any mineralization. Footwall inclusions may carry substantial sulphide (pyrrhotite) and often appear to contribute to the local sulphur content. Footwall inclusions are all Virginia Formation, no iron-formation, Pokegama Quartzite, or older granitic rock has been recognized as an inclusion at NorthMet.

Sedimentary inclusions make up about 4% of the logged rock types, and basalt inclusions sum to less than 1% of the drilling footage.

Generally, hanging wall inclusions are restricted to Unit 3 and the units above, while footwall inclusions are most abundant in Unit 1.

7.2 Mineralization

The metals of interest at NorthMet are copper, nickel, cobalt, platinum, palladium and gold. Minor amounts of rhodium and ruthenium are present though these are considered to have no economic significance. In general, with the exception of cobalt and gold, the metals are positively correlated with copper mineralization. Cobalt is well correlated with nickel.

Mineralization occurs in four broadly defined horizons or zones throughout the NorthMet property. Three of these horizons are within basal Unit 1, though they likely will not be discriminated in mining. The upper horizon locally extends upward into the base of Unit 2. The thickness of each of the three Unit 1 enriched horizons varies from 5 ft to more than 200 ft. Unit 1 mineralization is found throughout the base of the NorthMet Deposit. A less extensive (the copper-rich, sulphur-poor Magenta Zone) mineralized zone is found in Units 4, 5 and 6, in the western part of the NorthMet Deposit.

Mineralization occurs in two broad forms. Firstly, sulphides may be disseminated in heterogeneous troctolitic rocks (mainly Unit 1) in which the grain sizes of both silicates and sulphides widely vary. The occurrence and amount of this mineralization within drill holes can be unpredictable over the scale of 20 to 30 ft though mineralization is relatively constant in some horizons (i.e., top of Unit 1). Secondly, economic concentrations of sulphides in the upper units tend to be coarser grained and copper-rich (Units 2 to 7, particularly the Magenta Zone).

Sulphide mineralization consists of chalcopyrite and cubanite, pyrrhotite and pentlandite, with minor bornite, violarite, pyrite, sphalerite, galena, talnakhite, mackinawite and valerite. Sulphide minerals occur mainly as blebs interstitial to plagioclase, olivine and augite grains, but also may occur within plagioclase and augite grains, as intergrowths with silicates, or as fine veinlets. Small globular aggregates of sulphides (less than two centimetres) have been observed in core and in the small test pit on the site. The percentage of sulphide varies from trace to about 5%, but is rarely greater than 3%. Local massive sulphide is present, but rare. Platinum, palladium, and gold are associated with the sulphides as well as in tellurides and bismuthides.

8 DEPOSIT TYPES

The NorthMet Deposit is a large-tonnage, disseminated accumulation of sulphide in mafic rocks, with rare massive sulphides. Copper to nickel ratios generally range from 3:1 to 4:1. Primary mineralization is probably magmatic, though the possibility of structurally controlled re-mobilization of the mineralization (especially PGEs) has not been excluded. Sulphur source is both local and magmatic (Theriault et al., 2000). Extensive detailed logging has shown no definitive relation between specific rock type and the quantity or grade quality of sulphide mineralization in the Unit 1 mineralized zone or in other units, though the localized noritic to gabbronoritic rocks (related to footwall assimilation) tend to be of poorer PGE grade and higher in sulphur.

Footwall faults are inferred from bedding dips in the underlying sedimentary rocks, considering the possibility that Keweenawan syn-rift normal faults may affect these underlying units and show less movement, or indeed no effect on the igneous units. Nonetheless, without faults, the footwall or igneous unit dips do not reconcile perfectly with the overall slope of the footwall. There are some apparent offsets in the igneous units, but definitive and continuous fault zones have not been identified. So far, no apparent local relation between the inferred location of faults and mineralization has been delineated.

Outcrop mapping (Severson and Zanko, 1996) shows apparent unit relations that require faults for perfect reconciliation. However, as with information derived from drill core, neither igneous stratigraphic unit recognition, nor outcrop density, is sufficiently definitive to establish exact fault locations without other evidence.

There is a wealth of regional (and some local) geophysical data available, though the resolution of core logging and field mapping is probably better than that of the geophysics, hence while the geophysical data is interesting, it has not yet been useful at delineating the structural geology of the site nor proved to be a guide to mineralization.

9 EXPLORATION

Exploration history is outlined in Section 6. In general, the early drilling by US Steel is widely spaced but comparatively regularly distributed (approximately 600 ft by 600 ft), with some omissions that left substantial undrilled areas, especially down-dip. Subsequent programs by PolyMet were first focused on extracting metallurgical samples and on proving the up-dip and more readily accessible parts of the NorthMet Deposit. Besides extensive in-fill drilling since 2005, PolyMet has also expanded the definition of the mineralized zones to the west and southwest. In particular, it has become evident that the Magenta Zone, located in the upper units in the western part of the NorthMet Deposit, is much more robust than previously thought.

Those parts of the NorthMet Deposit at greater depth largely continue to have the original US Steel drill-hole spacing, which, in the eastern half of the NorthMet Deposit, is approximately 600 ft by 1,200 ft.

Drill spacing in the deepest known section of the NorthMet Deposit is approximately 1,200 ft by 1,200 ft. The Deposit is definitely open at depth and along strike. The deeper parts of the NorthMet Deposit (below about 1,600 ft from surface) may be of interest in the future, but they are considered to fall outside the scope of the current evaluation.

Drill hole spacing averages between 190 and 200 ft in the area of the resource model. This excludes holes drilled for metallurgical or geotechnical purposes. Distance studies show that 50% of the drillhole intercepts within Unit 1 will be within a 197 ft distance from another hole. In the Magenta Zone, 50% of the drillhole intercepts will be within a 190 ft distance from another hole. The best drilled area is in the vicinity of the preliminary optimum pit. This area also contains near-surface mineralization and is drilled at a spacing of about 150 ft (excluding geotechnical and metallurgical holes) from 171 holes.

10 DRILLING

There have been four major (and one minor) drilling campaigns on the property as shown in Figure 10-1. This discussion is largely taken from Patelke and Geerts (2006).

In all cases, drilling has shown a basal mineralized zone (Unit 1) in heterogeneous troctolitic rocks with the highest values at its top and with grades generally diminishing with vertical depth along drill holes. Grade appears to increase down dip, but as depth increases less information is available. The main ore zone is from 200 to 1,000 ft thick, averaging about 450 ft. Mineralization sub-crops at the north edge of the NorthMet Deposit and continues to depths of greater than 2,500 ft. Sampling on the longest holes is sparse, with little in-fill work done since the original US Steel sampling (PolyMet took about 700 samples from these longer holes in spring of 2006, these data are included in the drilling database)

While the concept of some structural control on mineralization is valid (i.e., proximity to a vent system or re-mobilization of some metals) no evidence collected to date fully supports this view. More likely, this is a magmatic sulphide system which was then contaminated by sulphur from locally assimilated footwall rocks and modified to some extent by (late magmatic?) hydrothermal action.

Core recovery (Table 10-1) is reported by PolyMet to be upwards of 99% with rare zones of poor recovery. Rock quality designation (RQD) is also very high, upward of 85% for all units except in the Iron formation. Experience in the Duluth Complex indicates that core drilling has no difficulty in producing samples that are representative of the rock mass. Rock is fresh and competent and the common types of alteration (sausserization, uralization, serpentinization and chloritization) in the NorthMet Deposit are not those that affect recovery. Core recovery was recorded by US Steel and PolyMet in its earlier work and for the smaller diameter (NQ2 and NTW) drilling in since 2005. There is no readily apparent relation of recovery to sulphur content or rock type. Values in excess of 100 may arise from errors associated with assembling broken core or from core runs that are slightly longer than the core barrel. AGP comment that the core recovery appears very good in the holes that were inspected during the site visits.

In short-range detail, the NorthMet Deposit geology is subtle and complex. However, mineralogical and textural variation occurs within narrow ranges and at the mining scale, the overriding lithology will be troctolite to augite-troctolite (plagioclase>olivine>>pyroxene with biotite and minor ilmenite). The known ultramafic horizons are thin enough, and metasedimentary inclusions small enough, that material handling will homogenize the plant feed, as accounted for in the bulk samples. In general, rocks are medium- to coarse-grained, fresh, and competent.

Figure 10-1: Drillhole Collar Location by Campaign

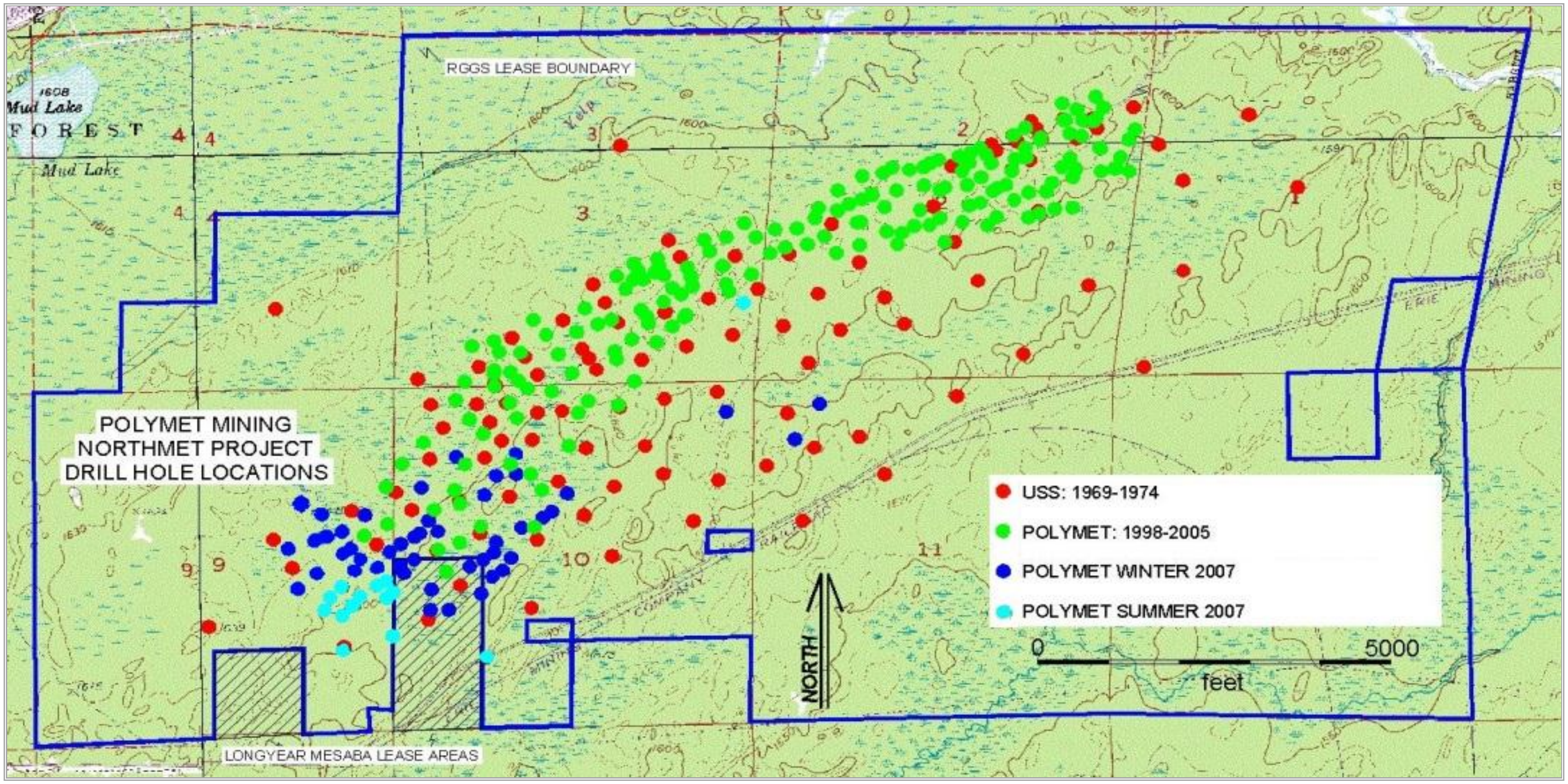


Table 10-1: Summary of Core Recoveries and RQD Measurements (includes all drilling through summer 2007)

Unit	Recovery Count	Recovery Percentage (%)	RQD Count	RQD Percent
1	8,906	99.9	4,194	91.8
2	1,879	99.5	968	90.3
3	4,374	100	2,632	93.5
4	2,160	100	1,063	96.4
5	1,901	100	838	94.3
6	2,262	100	1,041	94.7
7	951	99.3	396	87.4
Virginia Formation	2,095	99.7	1,069	87.6
Inclusions	62	98.1	57	86.6
Biwabik Iron Formation	381	100	60	79.8
Duluth Complex Average		99.96		92.82

10.1 Drilling Campaign

10.1.1 US Steel Drilling, 1969-1974

From 1969 to 1974, US Steel drilled 112 holes across the property. Drilling began in an attempt to intersect a geophysical conductor (virtually all of the deposits in the area were originally drilled on geophysical targets) and the first hole hit three ft of massive sulphide with 4.8% copper, 115 ft from the surface. Drilling continued, without discovery of any more such dramatic results and eventually defined a broad zone of low-grade copper-nickel sulphide mineralization. Further drilling indicated that the original geophysical target was graphitic argillite in the footwall, rather than any mineralization in the Duluth Complex.

US Steel assayed only about 22,000 ft of the 133,000 ft they drilled, generally on 10 ft intervals. Their focus was on developing an underground reserve and sampling was limited to zones of continuous “higher grade” mineralization. As in many exploration projects, sampling focused on the expected main ore body, not more scattered intervals or assumed waste rock. US Steel was aware of the PGE value from the assaying of concentrates derived from bench work and test pits, but did no assaying for these metals on drill core. Nearly all core was BQ size, and only 14 of the holes were angled (all to the northwest, grid north). Hole depths ranged from 162 ft to 2,647 ft, averaging 1,193 ft. Five holes were over 2,500 ft in length.

US Steel drilling was by Longyear. Virtually all of the core from this program exists, is properly stored, and is available for further sampling. Seventeen US Steel holes were “skeletonised” after assaying, with only a ft kept for each five or ten ft “un-mineralized” and unsampled run. Core was split by US Steel using a manual core splitter. Samples submitted for assay were half core. US Steel assays were done at their own laboratories; most of these have since been re-assayed by ACME Laboratories (ACME) or ALS Chemex (Chemex). Drilling by PolyMet near some of the locations of skeletonised holes has indicated the possibility that some mineralized intervals may have been missed and disposed of in the skeletonising process.

The US Steel geologists logged all their holes, but neither recognized nor documented any comprehensive igneous stratigraphy. Mark Severson of the Natural Resources Research Institute (NRRI), Duluth, Minnesota began re-logging these holes in the late 1980's as part of a Partridge River intrusion geochemistry project. He quickly recognized Unit 3 as a marker horizon, which led to reliable correlations among the other units.

Steve Geerts, working for the NRRI with Fleck Resources (PolyMet precursor), refined the geologic model for the NorthMet Deposit in light of this igneous stratigraphy. This basic model is still considered by PolyMet to be valid and currently guides the interpretation of the NorthMet Deposit (Severson 1988, Severson and Hauck 1990, Geerts et al. 1990, Geerts 1991, 1994).

10.1.2 NERCO Drilling, 1991

NERCO conducted a minor drilling campaign in 1991—four holes at two sites. At each site a BQ sized core hole (1.43 inches) was drilled and sampled from collar to bottom of hole. A PQ (3.3 inch) hole twinned each of these two holes and was sent in its entirety for metallurgical work on the assumption that the assays on the smaller diameter core would represent the larger diameter core. Both sets of holes twinned existing US Steel holes (Pancoast, 1991).

One-hundred and sixty-five assays were taken from the smaller diameter cores and processed at ACME.

10.1.3 PolyMet Drilling, 1998-2000, Reverse Circulation Holes

PolyMet drilled 52 vertical reverse circulation (RC) holes to supply material for a bulk sample in 1998 to 2000. These holes twinned some US Steel holes and others served as in-fill for parts of the NorthMet Deposit. The drilling was done by a contractor from Duluth with extensive RC experience and was carried out in both summer and winter. The type of bit and extraction system used (cross-over sub or face-sampling) is not known. Available recorded sample weights indicate a recovery of at least 85%. Metallurgical core drilling in February and March 2005 approximately twinned some of these RC holes.

The PolyMet drilling in 1998 to 2000 targeted the up-dip portions of the NorthMet Deposit and was essentially in-fill drilling. Reverse circulation holes averaged 474 ft in length with a minimum of 65 ft and a maximum depth of 745 ft. Core holes averaged 692 ft in length with a minimum of 229 ft and a maximum depth of 1,192 ft (this does not include the three RC holes completed with AQ core).

The RC holes were assayed on five ft intervals. Six inch reverse circulation drilling produced about 135 lb to 150 lb of sample for every five ft of drilling. This material was split using a riffle splitter into two samples and placed in plastic bags and stored underwater in five gallon plastic buckets. A 1/16th sample was taken by rotary splitter from each five ft of chip sample and assayed. The assay values were used to develop a composite pilot plant sample from bucket samples. Actual compositing was done after samples had been shipped to Lakefield (Patelke and Severson, 2006). A second 1/16th sample was sent to the Minnesota Department of Natural Resources for their archive.

Chip samples were collected and later logged at the PolyMet office. PolyMet retains these samples in their warehouse. Logging is obviously not as precise as that for core, but the major silicate and sulfide minerals can be recognized and location of marker horizons derived. The underlying metasedimentary rocks (Virginia Formation) are easily recognized and finding the bottom of the NorthMet Deposit is relatively straightforward. Where rock recognition is difficult, the higher zinc content of the footwall rocks can help define the contact.

10.1.4 PolyMet Drilling, 1999 to 2000, Diamond Core Holes

The first PolyMet core-drilling program was carried out during the later parts of the RC program, with three holes drilled late in 1999 and the remainder in early 2000. There were seventeen BTW (1.65 inch) and fifteen NTW (2.2 inch) holes all of which were vertical. Three RC holes were re-entered and deepened with AQ core.

These holes were assayed from top to bottom (with rare exception) on five ft lengths. Samples were half core. Cutting was done at the PolyMet field office in Aurora, Minnesota.

Core logging was done at the PolyMet office by a variety of geologists, all trained in recognition of the units and the subtleties of the mineralogy and textures by Mark Severson of the NRRI.

10.1.5 PolyMet Drilling, 2005, Diamond Core Holes

PolyMet's 2005 drilling program had four distinct goals: collection of metallurgical sample; continued in-fill drilling for resource estimation; drilling outward from the margins of the well drilled area to expand resource; and collection of geotechnical data through core logging and recovery of oriented cores. The program covered 109 holes for 77,165 ft. These included:

- 54 one inch diameter holes for metallurgical sample (6,974 ft) drilled by Boart-Longyear of Salt Lake City in February-March 2005.

- 12 PQ sized holes (core diameter 3.3 inches) for 6,897 ft, mostly used for bulk sample material, but with a few holes intended as in-fill. The PQ holes were also all drilled in February-March of 2005.
- 52 NTW sized holes (2.2 inches) totalling 41,403 ft for resource definition.
- 30 NQ2 sized holes (2.0 inches) totalling 21,892 ft for resource definition and geotechnical purposes. The NTW and NQ2 size core was drilled in February-March and September-December of 2005.

About 11,650 multi-element assays were collected from the 2005 drilling program. Another 1,790 assays were performed on previously drilled US Steel and PolyMet core during that time. All assaying was by ALS-Chemex.

Of the 109 holes drilled in 2005, 93 were angled, generally to grid north at dips of -60°to -75°. Sixteen NQ2 sized holes were drilled and marked as oriented core, ten to grid south and six to grid north, at varying dips, for geotechnical assessment across the NorthMet Deposit. These holes targeted expected positions of pit walls as defined by Whittle pit shells developed by mining consultants AMDAD and available in January 2005. These locations have proved to be reasonable for more recent iterations of pit design.

Besides extensive assaying for "pay" elements during this program, about 900 core intervals were analyzed for "whole rock" oxides, about 300 samples were analyzed for Rare Earth Elements (REE), and thousands of density measurements were taken. This data is used to support resource evaluation as well as waste characterization efforts for permitting.

Separately, about 100 samples from previously drilled and analyzed core were submitted for humidity cell testing. These samples represented a broad cross-section of Units, rock-types, metals content, and sulphur content. In addition, these humidity cell samples were all re-assayed, analyzed for whole rock and assessed in thin-section and by micro-probe.

10.1.6 PolyMet Drilling, 2007, Diamond Core Holes

In 2007, PolyMet conducted two drilling programs, a winter program for 47 holes over 19,102.5 ft and a summer program for 14 holes over 5,437.5 ft. The first 16 winter holes were NTW sized, the rest from both programs were NQ2 sized core. Most of these holes were angled to north-northeast (azimuth 326°).

For the 2007 holes the minimum length was 148 ft, the maximum length was 768.5 ft and the average length was 402 ft.

During the site visit, AGP noted that the drill core handling procedure carried out by Polymet met or exceed industry standard. Drill hole orientation and dip results in intersection with the lithological units that are more or less normal to the main structural trend and are appropriate for the style of mineralization present on the NorthMet Deposit.

11 SAMPLE PREPARATION, ANALYSES, AND SECURITY

Sections 11.1 and 11.2 were extracted from the Hellman 2005 report.

11.1 Sampling Methods

Original US Steel sampling, generally on 10 ft intervals, honoured some, but not all, of the geological boundaries that were encountered. The PolyMet RC sampling transgressed boundaries, though the five ft chip samples diminish the opportunity for this to be of any consequence in a bulk mining (15 to 20 ft bench or greater) scenario.

Sampling of US Steel core by Geerts, Severson, and Patelke of NRRI at various times usually was on five ft samples and seldom crossed any significant geologic boundaries. Core sampling by PolyMet in 1999 and 2000 was usually on five ft intervals and crossed unit boundaries, as with the RC samples, the short sample length negates any major effect from this sampling choice. Sampling by PolyMet on the US Steel core in 2005 was generally on 10 ft intervals, but did not cross any major geologic boundaries and included some shorter intervals. Sampling of in-fill (NTW and NQ2) core in 2005 and 2007 used five ft samples in the main mineralized zone and 10 ft in the upper zones. This was adjusted to use smaller intervals in the upper parts with visible mineralization and did not cross-geologic boundaries.

Large diameter core collected for metallurgical sample was sampled and assayed by the box with the goal of minimizing re-handling during the preparation and compositing of the bulk sample. Four-inch core was sampled on an average interval of 3.45 ft, and PQ core was sampled on an average interval of 4.47 ft.

Table 11-1 shows average length of samples in Unit 1 and all other units for holes used in the resource model. Approximately 90.5% of Unit 1 and about 55.5% of the other units have been sampled project-wide. About 70% of the total exploration drilling by US Steel and PolyMet has been sampled across the property. Over 97% of the drilling intercepting the anticipated 20-year pit has been sampled.

Table 11-1: Sample Lengths (includes all drilling through summer 2007)

	Average Sample Length in Unit 1 (ft)	Average Sample Length in Other Units (ft)
US Steel Original Core	6.3	7.1
PolyMet RC Drilling	5.0	5.0
PolyMet Core Drilling	4.8	7.2
All Drilling	5.3	7.0

Sampling in Unit 1 (the main mineralized zone) is mostly continuous through the zone for all generations of drilling. The older PolyMet RC and core holes have continuous sample through the upper waste zones (which do have some intercepts of economic mineralization). Work in 2005 and 2006 essentially completed the sampling of historic US Steel core within the area likely to be mined. This broad sampling limits the possibility of bias in the sample set. The 2005 and 2007 sampling has been continuous along the drill hole. There is some US Steel core below the current block model to be sampled in the future. The overall effect on the resource should be minimal and is expected to be positive.

11.2 Preparation and Analysis

11.2.1 Sample Preparation Pre-2000

Bright (2000), an employee of ALS Chemex, summarized the sample preparation history of the Project up to that point, the following is an extract from his summary.

- Pre-1996, Lerch Brothers, and State of Minnesota crushed in a jaw crusher to about 1/4 inch and pulverized about 250g in a Bico type plate pulverizer to about -100 mesh (149 µm). Bondar Clegg also did some work on the Project, crushing about the same, but pulverizing in a ring mill to -106 µm.
- In 1997, samples were sent directly to Acme Laboratories, where they crushed to finer than 1/4 inch and pulverized to about 149 to 106 µm range.
- In 1998, Lerch Bros. crushed and pulverized about 250 g in an older ring mill to finer than 149 µm and sent to Acme.
- In 1999, Lerch Bros. prepped as in 1998, but sent to Chemex for analysis. Early on in the Project, I requested a finer grind out of Lerch Bros, and they accomplished it. (-106 mic). Also in 1999, some drill cuttings and core were directly picked up by ALS Chemex. This is what we did in Thunder Bay:
- 3.5-4 kg of RC or percussion samples were dried and split to obtain two splits of each sample. Core samples of 2.5 to 3 kg were crushed to pass >70% -2 mm, 200 to 300 g were split out. Both r.c. cuttings and crushed core were shipped to Toronto for pulverizing in a ring mill to >95% -106 µm (-150 Tyler mesh).
- We also took selected core samples and crushed to -1/2 inch and put in a poly bottle, purged with nitrogen, and capped and sealed for special met / enviro work.

11.2.2 Sample Preparation Pre-2005

In summary (Gatehouse 2000a), pre-2005 drilling has been prepared in either of two ways depending on drill type or on the work load of Lerch Bros in Hibbing.

- 5’ of 6” RC chips

- 1/16 split using an Eklund rotary Splitter (3 to 4 kg)
- Jaw crush >> Gyratory Crusher >> Rolls crusher
- 1/16 split to 200 to 250 g for pulverizing to 109 µm (some data poorly pulped to 150 µm)
- 5' of 1/2 core (1.65" and 2.2"diameter, BTW, NTW) at Chemex
- Rhino (Jaw) Crush to 2 mm
- Split 200 to 250 g for pulverizing to 109 µm
- 5' of 1/2 core (1.65" & 2.2"diameter, BTW, NTW) at Lerch Bros.
- Jaw Crush >> Gyratory Crusher
- Split 200 to 250 g for pulverizing to 149 µm.

11.2.3 Sample Preparation 2005 through 2007

The 2005 and 2007 sample preparation varied at the cutting and sampling stage with ½ core samples used for all NQ2 and NTW drilling and 1/8 core samples used for all four inch and PQ drilling. For smaller diameter core, the field duplicates were ¼ core, for the larger cores the field duplicates were 1/8 core.

All sample preparation after cutting was done at ALS Chemex in Thunder Bay, Ontario, and all analyses at ALS-Chemex in Vancouver, B.C. Transport from Hoyt Lakes to Thunder Bay was by truck driven by ALS-Chemex employees and under ALS-Chemex custody.

Sample preparation methods were as follows:

- A 10 lb to 15 lb sample was crushed in a single stage crusher to 90% -2 mm
- A 500 to 700 g sample was split off and pulverized to -150 mesh in one pass
- 1 in 20 samples also duplicated at the crusher
- Approximately 200 g for each sample were sent to Vancouver
- All samples were analyzed for multi-element ICP package (four acid digestion) and PGE
- Depending on batch size and other factors 1 in 10 to 1 in 20 samples were submitted as pulps for analysis for whole rock major elements, aqua regia digestion, REE and iron oxide (FeO)
- A standard, coarse blank (iron formation) or core (field) duplicate was submitted at a rate of one in every 12 samples
- LECO Corporation (LECO) furnace sulphur was run on 1 in 10 samples.

11.3 Analytical History

The following discussion is derived largely from Patelke and Geerts (2006), an internal company report on the compilation and history of the newly revised PolyMet drilling database.

There are eight generations of sample preparation and analyses that contribute to the overall project assay database:

- Original US Steel core sampling, by US Steel, 1969-1974
- Re-assaying of US Steel pulps and rejects, selection by Fleck and NRRI, 1989-1991
- Sampling of previously unsampled US Steel core, sample selection by Fleck and NRRI in 1989-1991
- Sampling of two NERCO drill holes in 1991
- Sampling of RC cuttings by PolyMet in 1998-2000
- Sampling of PolyMet core in 2000
- Sampling of previously unsampled US Steel core (sample selection work done by NRRI, done in two phases) in 1999-2001

1. Sampling of PolyMet core from 2005 drilling, continued sampling of previously unsampled US Steel core in 2005-2006, and sampling from 2007 drilling, with continued protocols in place since 2005.

2. Employees of PolyMet (or Fleck Resources) have been either directly or indirectly involved in all sample selection since the original US Steel sampling. Sample cutting and preparation of core for shipping has been done by PolyMet employees or contract employees. Reverse circulation sampling at the rig was done by, or in cooperation with, PolyMet employees and drilling contractor employees.

3. US Steel took about 2,200 samples, mostly ten ft in length, and assayed for copper, nickel, sulphur, and iron. Assays were done at two US Steel laboratories in Minnesota, the Applied Research Laboratory (ARL) in Coleraine (now the NRRI mineral processing laboratory), and the Minnesota Ore Operations Laboratory (MOO) at the MinnTac Mine in Mountain Iron. Most of the original US Steel samples have been superseded by ACME and Chemex re-assays which included many more elements.

4. Analytical method at these US Steel laboratories is uncertain (AAS?). While standards were developed and used (as evidenced by documents in PolyMet files), it is not thought the standards were inserted into the sample stream in a blind manner. It is likely that these were used for calibration or spot checks.

5. There are less than 200 sets of US Steel copper-nickel values that remain in the database.

6. PolyMet used 63 coarse reject US Steel samples, weighing from five to seven pounds each, to create three standards in 2004. The 2004 assay results are consistent with estimates based on original US Steel assays of drill core. The ALS-Chemex results are shown in Table 11-2.

Table 11-2: ALS-Chemex Assays compared with US Steel Assays

	Cu %	Ni %	S %
Standard 1 expected value based on 1969 to 1974 US Steel assays	0.18	0.08	1.04
Standard 1 assayed value-2004 – Chemex	0.20	0.11	1.08
Standard 2 expected value based on 1969 to 1974 US Steel assays	0.36	0.14	0.88
Standard 2 assayed value-2004 – Chemex	0.37	0.15	0.82
Standard 3 expected value based on 1969 to 1974 US Steel assays	0.55	0.18	1.17
Standard 3 assayed value-2004 – Chemex	0.57	0.21	1.04

Averages are based on twenty samples of each standard with 4-acid assays completed in 2004. In all cases, the US Steel results are slightly understated relative to the Chemex values. These standards have been used throughout the 2005 and 2007 programs.

The re-assaying of US Steel pulps and sampling of previously unsampled core completed in 1989-1991 was sponsored by Fleck Resources and partially involved cooperative work with the NRRI in Duluth. A large number of pulps and coarse reject from the original US Steel drilling were re-assayed for copper, nickel, PGE, and a full suite of other elements. The NRRI's contribution was the selection and sampling (and re-logging) of previously unsampled core. This was the first large scale testing for PGE done on the Project.

About 2,600 of these analyses are in the current PolyMet database. All of this analytical work was done at ACME Laboratories by aqua regia with ICP-ES for copper and nickel. Gold, platinum, palladium were by lead-oxide (PbO) collection fire assay/AAS finish. There is uncertainty about the level of standards used at ACME, though it is certain that they used some duplicates. There is agreement between the ACME assays done on pulps and rejects and the original US Steel work. PolyMet is using the US Steel sulphur value for most of these intervals. Sample preparation for all this work is thought to have been done by ACME.

The two NERCO BQ core holes (1991, 162 samples) were analyzed at ACME by the same methods.

There are 5,216 analyses from the RC drilling in the current PolyMet database. The 1998 RC drilling program started with all analyses being sent to ACME and check assays going to

Chemex. RC sample collection involved a 1/16 sample representing each five ft run. These were sent to Lerch Brothers of Hibbing Minnesota (Lerch), for preparation, and then sent to ACME for analysis. It is not certain that all samples were prepared at Lerch.

Part of the way through the RC program, PolyMet switched laboratories and sent the samples to Chemex, with ACME undertaking check assays. Analytical methods for the RC samples were aqua regia digestion, fire assay for PGE, and ICP-AES for other elements. LECO furnace sulphur was run on nearly every sample.

Table 11-3 details the distribution and source of the assays for the RC drilling.

Table 11-3: Assaying of RC Samples

	Percent of Samples in Database
ACME	21
Chemex	41
Chemex Re-run (chosen over ACME or Chemex)	38

The PolyMet core drilling has all been assayed by ALS Chemex. A matrix problem was discovered on some copper and nickel assays in the earlier groups in 2000. The problem was rectified and affected samples were re-assayed (eventually including some RC samples). Sample preparation was done at Chemex, though some may have been done at the Lerch facility — various original Chemex laboratory certificates show both "received as pulp" and give grind directions. ACME ran the check assays on these samples.

Some samples on US Steel in 2000 core were done through ACME.

On pre-2005, post US Steel sampling, intervals were generally five ft, sometimes adjusted for geological breaks. Analyses were aqua regia digestion with fire assay for PGE and ICP-AES for other elements. LECO furnace sulphur was run on most intervals. During this program standards and blanks were inserted into the sample stream.

Table 11-4 details the distribution and source of assays for PolyMet core drilling.

Table 11-4: Assaying of Samples from all Core Drilling on Project

	Percent of Samples in Database
ACME	6%
Chemex	91%
Chemex Re-run	3%
USS	< 1%

Samples (collected by Severson et al., in 1999-2000 and Patelke, in 2000-2001) of previously unsampled US Steel core were assayed by ALS Chemex. These samples were sawn at the Coleraine laboratory by University of Minnesota employees. At various times samples were prepared at the Coleraine laboratory, Lerch, and probably by ALS Chemex.

Assays were by aqua regia digestion with fire assay for PGE and ICP-AES for other elements. LECO furnace sulphur was run on most intervals. During this program, standards and blanks were inserted into the sample stream.

Samples were generally five ft in length, with some adjustments to avoid crossing geologic boundaries. This work was intended to supplement and in-fill the database, primarily in the Unit 1 mineralized zone as well as to provide some geochemical data for waste characterization.

The 2005 drilling and 2005-2006 sampling used four acid digestions on all samples, with aqua regia also done on about 1 in 10 samples. Since 2005, all samples have honored geological contacts.

PolyMet continued in 2005 and 2006 the process of assaying previously un-sampled US Steel core, adding about 1,700 assays during 2005-2006. The majority of this is in the anticipated 20 year pit.

Table 11-5 shows previously un-sampled intervals of US Steel core that were sampled by Severson et al (1999-2000) and Patelke (2000-2001).

No sieve tests are available for pre 2005 work. These were performed for samples from the 2005 and 2007 drilling programs.

Table 11-5: Details of Sampling of US Steel Core by PolyMet

	Number of Samples in Database from each Laboratory	Minimum Number of Duplicates and/or Re-runs
Chemex (Post Re-run)	5,032	229

11.4 Quality Assurance and Quality Control

A comprehensive QA/QC program involving the use of coarse blanks, standards and duplicates has been instigated under the direction of Hellman and Schofield and Lynda Bloom of ASL, Toronto. This process consisted of the production of three matrix-matched standards from the Duluth complex, sample preparation and homogenization, homogeneity testing, formulation of recommended values based on a round robin and routine insertion of standards on an anonymous basis. The three standards have copper concentrations in the approximate range 0.15 to 0.60% and nickel from 0.1 to 0.2%. Homogeneity of pulps, as determined by coefficients of variation from 20 replicate assays, is excellent with, for example, values less than 2% for copper and nickel and less than 5% for palladium. Analytical method for the matrix match standard was ALS Chemex code ME-ICP61, 4 acid digestion ICP with AES finish for Co, Cu, Mo, Ni and Zn. For the platinum group metals and gold, ALS Chemex code PGM-ICP23, which is a 30 g fire assay with ICP-AES finish. Total sulphur was done by LECO furnaise Code S-IR08. Table 11-6 shows the expected value of the standards.

Table 11-6: Standard Reference Material

	Standard 4-1		Standard 4-2		Standard 4-3	
Element	Average	Std.Dev	Average	Std.Dev	Average	Std.Dev
Co (ppm)	90.1	10.44	95.10	10.64	110.73	11.11
Cu (%)	0.201	0.008	0.378	0.009	0.589	0.019
Mo (ppm)	13.87	1.78	9.61	1.36	12.25	1.40
Ni (%)	0.109	0.007	0.143	0.009	0.197	0.015
Zn (ppm)	174.15	14.62	116.77	12.18	124.76	12.65
Au (ppb)	57.85	12.70	33.32	6.48	54.18	7.36
Pt (ppb)	36.54	9.50	55.76	11.15	125.52	15.55
Pd (ppb)	117.52	10.66	238.95	14.64	518.05	22.18
S (%)	1.17	0.04	0.91	0.04	1.15	0.005

Reference materials (RMs) and Blanks were inserted at a rate of one blank with every 35 samples and 1 SRM with every 36 samples. Duplicate are submitted with every 36 samples. Typically, there are very few assay failures found in the drill programs with Chemex and they are investigated in batches by PolyMet. Depending on the nature of the failures, samples may be re-run or discarded from the data set.

11.4.1 Linda Bloom Assessment of the QA/QC Program to 2005

AGP observes that Lynda Bloom of Analytical Solutions Ltd is independent from the issuer and specialized in sampling and analytical procedures, QA/QC program design, QC review and laboratory audits. She is very well known in her field and review the PolyMet 2005 quality control program. AGP reviewed the report provided to PolyMet from Lynda Bloom and agree with its findings.

11.4.2 AGP Assessment of the QA/QC Program to 2007

AGP reviewed the data provided by PolyMet for the two main pay elements. Out of 526 RMs submitted between April 2005 through to June 2007, there was 54 copper failures (10.2%) most of which occur with RM 4-2 showing a 21.2 % failure rate. The other two RMs 4-1 and

4-3 indicated a failure rate of 2.9% and 5.0%, respectively. All copper standards showed increase deviation from the expected values for samples submitted after April 30, 2007.

For Nickel, out of 526 RMs submitted during April 2005 through to June 2007, there were six nickel failures (1.14%).

The exact number of batches resubmitted to the laboratory is unknown by the author.

11.5 Databases

It is AGP's opinion that PolyMet staff has made a strong commitment to the geological and assay database and have, as far as is possible, produced a database that is complete, well documented and traceable.

11.6 Core Storage and Sample Security

The US Steel core has been stored, either at the original US Steel warehouse in Virginia, Minnesota during drilling, or more recently at the Coleraine Minerals Research Laboratory (now a part of the University of Minnesota). Core has been secured in locked buildings within a fenced area that is locked at night where a key must be checked out. The NERCO BQ size core is also stored at this facility.

The PolyMet core and RC reference samples were stored in a PolyMet leased warehouse in Aurora, Minnesota during drilling and pre-feasibility. Core and samples were then moved in 2002 to a warehouse in Mountain Iron, Minnesota where they remained until 2004. They were then moved to a warehouse at the Erie Plant site in Hoyt Lakes. Access to this warehouse has been limited to PolyMet employees.

11.7 Comments on Section 11

AGP is of the opinion that PolyMet went to considerable effort to ensure that the laboratory procedures, QA/QC protocol, the use of a matrix match standards and the continuous sampling of most of the historical holes. There was a weak degradation of precision at the laboratory starting April 30, 2007 to the end of the drill program. This is noticeable in both copper and nickel assays. The degradation was not sufficient to create a material change that would affect the resource model grade.

The distribution of the core drilling versus RC in the database (Table 11-7) shows that 91% of the holes used in the resources are core holes. RC holes amount only to 9% of the database. The reproducibility of the grade between RC and Core holes was investigated and found to be within acceptable limit. A discussion on that subject has been inserted in Section 12 of this report.

Table 11-7: Distribution of Drillhole Types

CORE_RC	No. of Holes	Length of Hole	Percent of Total
CORE	299	227,665.50	80
CORE-SKEL (partial assays)	17	30,745.00	11
RC	52	24,650.00	9
RC-CORE	3	2,696.50	1
		285,757.00	

The QP regards the assay database and analytical procedure to be industry standard and of sufficient precision to be use in the resource estimation.

12 DATA VERIFICATION

12.1 PolyMet Data Compilation and Verification 2004

Data verification by PolyMet has involved the checking of digital data against that in the paper records and also establishing the quality and source of that data.

In 2004, all tables in the drillhole database (header, survey, lithology, and assay) were reconstructed from digital and paper records and checked by PolyMet staff against the completely re-organized original paper data. Known discrepancies were addressed and corrected. In the assay data file, erroneous or suspect data was not removed, but was flagged to prevent its inclusion in the "accepted values" file used for evaluation.

The 2004 recompilation included a generalized first-pass review list for finding any database errors or suspect assays as well as facilitating further sorting and analysis. This occurred during and after assembly of the current PolyMet drill database and prior to the finalization of an "accepted values" assay data file for project evaluation. Suspect values were either corrected or flagged for exclusion from the final "accepted values" file.

This review by PolyMet included the following quality assurance steps:

- The completeness of paper records was confirmed for each hole and assay certificates were checked to determine if they were the final versions.
- Drill hole numbers were checked for correct formats.
- Drill hole lengths were checked against data in PolyMet database header file. Any assay or lithology depths recorded as below the length of the hole were assessed.
- Depth to overburden were checked against lithological logging, many RC samples, in particular, were shown as having been collected in the overburden, these were then isolated and rejected.
- The master assay file as a whole was sorted by each element in every laboratory group. The data filter in Excel was used to inspect and check the lowest and highest value samples. The highest values were checked against the paper records. The lowest values were checked against detection limits for that period. Any discrepancies found were checked and corrected.
- All assays below detection limit were designated with "less than symbols (<)". All "<" were corrected to the detection limits listed by the laboratories for that time as shown in their "schedules of services". It was found that ACME did not show the "<" values in their older digital data reports, these had to be checked against paper records and entered manually.

- Where LECO Corporation furnace sulphur analyses had been run, these were compared with the ICP scan sulphur, if one or other seemed out of range, the possible reason was investigated and corrected if possible. If not reconcilable, the data was flagged as not to be used.
- Copper and nickel parts per million values were converted to percent for the final step before export of data for resource estimation.
- If the original copper value was above the upper detection limit of the method, the determination had always been re-run by a different method; this value was merged into the database as copper percent data.
- Duplicates were noted as field duplicates (two 1/4 core samples), or sample preparation duplicates (laboratory duplicates) where a crushed and/or ground sample was split at the laboratory. These duplicates were considered to have been assayed at about the same time. Copper and nickel values were compared; where these values did not reasonably match both samples were removed from the final data set.
- Where there are multiple "good" assays for copper, nickel, etc, i.e., US Steel and ACME, or ACME and Chemex, (the same intervals, but generally done at different times) the values were compared; for those that did not match, a preferred value was resolved through examination of the data or both samples were removed from consideration for the final data set.;
- Obvious laboratory typographical errors or inconsistent data were checked and either corrected or flagged to not be used. These included simple laboratory errors such as double decimal points or mistyped sample numbers;
- Copper, nickel, sulphur, platinum, palladium and gold were plotted as a function of time to highlight clusters of data well above or below the average for the group, none were found;
- Duplicate results were plotted for US Steel work in the 1970s, to determine any discrepancies;
- All "check assays" were checked as duplicate pairs; if the samples were not in reasonable agreement, then the samples were flagged for possible exclusion.

12.1.1 First Step

The first step was to sort the data into subsets by laboratory and time.

12.1.2 Second Step

The second step was to compare all the "intentional duplicate pairs", i.e., all pulp duplicates and quarter core duplicates done by the same laboratories at (more or less) the same time. PolyMet calculated a copper:copper ratio for these pairs, sorted from lowest to highest, graphed these, and generally discarded pairs where the copper:copper ratio values were beyond the inflection point of the sigmoidal graph. This somewhat depended on the geologist's view of the quality and size of the sample group, but usually this was any difference greater than about 10% to 15% of the pair. Experience in the data set, as well as some other ratio tests, were also used to see if numbers were reasonable. Only a single sample from each pair that PolyMet believed matched duplicate and original was used.

12.1.3 Third Step

The third step was to compare pairs or multiple samples on the same interval by different laboratories at different times (US Steel and ACME, ACME vs. Chemex vs. Chemex rerun etc.) The same approach was used, graphing copper:copper ratios and eliminated those pairs outside some range determined by inspection of the graph, which again was group by group dependent. This was more subjective. The goal here was to find mis-numberings or mis-orderings, not to quantify the quality of the data. Other ratio tests were also applied to identify if values were within expected ranges (copper:sulphur, copper:nickel).

As a result of this review, about 1,800 intervals were flagged as suspect and filtered out of the "accepted values" data used for resource evaluation.

An unexpected, but welcome, result of the 2004 data re-compilation was the discovery that about 5,000 samples taken by Severson et al. (2000) and Patelke (2001) on stored US Steel core had not been previously entered into any database. This addition greatly improved the data density within Unit 1, as well as improving the waste characterization data set for the upper units.

12.2 Hellman and Schofield Assessment

Dr. Hellman of Hellman and Shofield Pty Ltd. (H&S) undertook several assessments of the database and advised PolyMet of a number of minor issues which were addressed. Dr. Hellman conducted spot checks of the digital data by comparing it with assay certificates. In addition, Mr. S. Gatehouse, a former North Mining employee, now an employee of Hellman and Schofield Pty Ltd, did a detailed review of sampling and QA/QC aspects whilst in the previous employ of North. Although a number of concerns were identified, these did not relate to the possibility of overstatement of grade but, rather, highlighted the conservative nature of the assays.

A re-study by Hellman and Schofield of PolyMet's work of 205 coarse blanks with drill samples in 2000 shows only three samples exceeding 70 ppm nickel. These three samples appear to have resulted from transcription errors. However, PolyMet has identified some samples that were incorrectly labelled and has deleted these from the database. There is negligible cross contamination for copper, gold and platinum as evidenced by the rest of the data set. Approximately 2% of coarse blanks have palladium in excess of 20 ppb, which may suggest either some cross-contamination during sample preparation or variable background content in the blank. In another sampling program in 2000-2001, there were negligible values above lower detection limits for gold, palladium and platinum for 82 submitted blanks. The use of pulp blanks, as well as the coarse blanks, may help to resolve any future issues regarding higher than expected values.

12.2.1 Reverse Circulation Drilling Compared to Diamond Drilling

Hellman (2005, 2006) has analyzed duplicate assay sets from RC samples that are closely situated (within 20 ft of each other) to core samples.

Gatehouse (2000) summarizes the sampling and assaying of the RC samples: 6” hole RC drilling conducted by PolyMet in 1998 had assay samples over 5’ taken at the rig using a 1/16 split creating (10 to 15 lb) samples. These initially was were sent to Lerch Bros in Hibbing where preparation consisted of jaw and gyratory crushing of entire sample followed by riffle splitting (0.5 lb) for final pulping. Assaying was done by ACME using the same techniques as above. One in ten samples had pulps sent to Chemex in Vancouver for check assaying using the same Fire Assay technique and similar (notionally stronger) aqua regia ICP technique for Co, Ni, Cu and other elements.

In the 1999-2000 drilling and prior to February 2000, PolyMet sampling of 5’ intervals of ½ BTW core was prepared at Lerch Bros Hibbing as above and assayed using Acme. One in ten samples were sent to Chemex as the check laboratory. Subsequently, for no apparent technical reason, Chemex were made the primary laboratory and Acme was used as a check. Analytical techniques remained the same.

This analysis is summarized in Table 12-1 for Diamond Drilling-Reverse Circulation (DD-RC) sample pairs that are at a similar elevation. For comparison, Table 12-2 shows pairs of closely situated core samples.

Table 12-1: Summary of Closely Situated RC and DD Samples

Parameter	DD Samples	RC Samples
Cu%	0.25	0.25
Ni%	0.07	0.08
Co (ppm)	62	70
Au (ppb)	32	36
Pd (ppb)	231	223
Pt (ppb)	54	59
Separation distance/number of pairs	15.6 ft/200	

Table 12-2: Summary of Closely Situated DD and RC Samples

Parameter	DD Samples	RC Samples
Cu%	0.22	0.23
Ni%	0.07	0.07
Co (ppm)	60	71
Au (ppb)	97	98
Pd (ppb)	306	238
Pt (ppb)	62	56
Separation distance/number of pairs	31.3 ft/98	

These results show excellent agreement even for gold, palladium and platinum. The differences between the RC and DD samples are of a similar level to those between adjacent pairs of diamond core samples. These results strongly support the integrity of both the RC samples and their assays, especially considering the many generations of sampling at NorthMet.

AGP reviewed the information available and agrees with Hellman and Schofield's conclusion.

12.2.2 Wardrop Assessment (September 2007)

Wardrop carried out an internal validation of the 330 drill holes in the NorthMet database used in the September 2007 resource estimate. Data validation has been done throughout the years by various consultants to PolyMet prior to the 2007 drill campaign and therefore the hole selection for the validation was heavily weighted on the 2007 drilling with spot checks of the US Steel, 1999, 2000 and 2005 drill campaigns. A total of 40 holes were checked amounting to 3,121 individual samples or 9% of the total sample counts in the database.

The error rate was found to be exceptionally low with only one sample (or 0.03%) entered erroneously in the GEMS database. In addition, three samples were found to have a laboratory certificate value available but were entered in GEMS as not sampled because they failed to meet PolyMet's quality standard.

During the validation, the QP found that values from laboratory certificates prior to the 2005 drill campaign were rounded half-up at the 3rd decimal while certificate values from the 2005-2007 drill campaign were truncated to the 3rd decimal during the parts per million (ppm) to percent conversion, thereby slightly understating the actual laboratory value.

The core handling facility at NorthMet is located in the former LTVSMC light duty mechanical shop and warehouses. The facility is large, well lit and equipped with overhead cranes and front-end loaders assisting staff moving palletized core bundles and crates containing sample bags ready for shipment to the ALS Chemex laboratory in Thunder Bay, Canada. The core logging room is very large and well lit and contains three large tables allowing Geologists to lay out in excess of 1,000 ft of core at any one time. Three diamond core cutting saws plus a spare are located in the core cutting room.

Table 12-3 shows a summary of the holes validated by Wardrop.

Table 12-3: Holes Validated by Wardrop

Hole-ID	Source	Elements Checked	Total No. of Samples	Errors	Missing in Gems
26025	Lab cert paper copy	Cu, Ni	176	1	
26093	Lab cert paper copy	Cu	163	0	
99-309B	Lab cert paper copy	Cu	142	0	
00-337C	Lab cert paper copy	Cu, Ni, Pd	121	0	1
00-352C	Lab cert paper copy	Cu, Ni	156	0	2
00-352C	Lab cert PDF	Cu, Ni	156	0	
05-406C	Lab cert PDF	Cu	107	0	
05-451C	Lab cert PDF	Cu, Ni, Pd, Pt, Au, Co	150	0	
05-501C	Lab cert PDF	Cu, Ni, Pd, Pt, Au, Co	151	0	
05-502C	Lab cert PDF	Cu, Ni, Pd, Pt, Au, Co	182	0	
07-510C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	44	0	
07-511C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	32	0	
07-512C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	28	0	
07-513C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	42	0	
07-514C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	46	0	
07-515C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	45	0	
07-516C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	70	0	
07-517C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	58	0	
07-518C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	71	0	
07-519C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	60	0	
07-520C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	73	0	
07-521C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	55	0	
07-522C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	49	0	
07-523C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	43	0	
07-524C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	62	0	
07-525C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	41	0	
07-526C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	55	0	
07-527C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	59	0	
07-528C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	24	0	

Hole-ID	Source	Elements Checked	Total No. of Samples	Errors	Missing in Gems
07-529C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	19	0	
07-530C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	24	0	
07-531C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	27	0	
07-532C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	96	0	
07-533C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	116	0	
07-534C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	35	0	
07-535C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	64	0	
07-536C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	26	0	
07-538C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	44	0	
07-539C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	98	0	
07-540C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	111	0	
		Total checked	3121	1	3
		Total Samples in Database	34641		
		Percent checked	9.0%		
		Percent errors		0.03%	
		Percent missing			0.10%

During the site inspection, 12-drill hole collars were located using a hand held Garmin GPSMap 60CSx global positioning instrument. The average difference between the GPS collar against the database value was 22 ft, which is very good considering that the instrument reported an accuracy of ±17 to 18 ft at most field locations surveyed which is typically influenced by vegetation cover and number of satellites seen by the instrument on the day the survey was taken.

On location, the QP also inspected the core facility, core cutting room and shipping crates, geological logging and collected a limited number of check samples. Figure 12-1 shows a few images taken during the site inspection.

12.2.3 AGP Assessment (October 2007)

AGP data validation for the October 2007 database consisted of comparing an archived copy of the database used in the September 2007 resource estimate for discrepancies. Comparison focused on drill hole collar location and length, down-hole survey data from-to pairs, azimuth and dip differences, assay data from-to pairs, Cu%, Ni%, Pd ppb, Pt ppb, Au ppb and Co ppm differences.

Results indicated that for holes used in the resource model that were common to both databases the collar and survey information was identical. In the assay table, one recorded missing assay results in the September database was now complete and one copper assay had a difference of 0.15%.

An additional 16 holes belonging to the summer 2007 drill program were checked against the electronic copy of the lab certificate. Only one error was found (hole 547C) accounting to less than a 0.1% error rate as shown in Table 12-4.

Table 12-4: Additional Holes Validated by AGP

HOLE-ID	Source	Elements Checked	Total No. of Samples	Errors
07-541C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	71	0
07-542C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	57	0
07-543C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	135	0
07-544C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	72	0
07-545C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	94	0
07-546C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	19	0
07-547C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	80	1
07-548C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	67	0
07-549C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	27	0
07-550C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	37	0
07-551C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	67	0
07-552C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	140	0
07-553C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	102	0
07-554C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	63	0
07-555C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	42	0
07-556C	Electronic XLS Lab cert	Cu, Ni, Pd, Pt, Au	38	0
		Total Checked	**111**	**1**

12.2.4 Site Visits by AGP

The March 21-23, 2007 and August 27-29, 2007 site visit entailed a review of the following:

- Overview of the geology and exploration history of the geology of the Duluth complex presented by Mr. Patelke
- Current exploration program design (drill hole orientation, depth, number of holes, etc.)
- Surveying (topography and drill collar)
- Field visit to the to review drill procedures
- Visit of the core logging facility
- Discussion of the sample transportation and sample chain of custody and security

- Core recovery
- QA/QC program (insertion of standards, blanks, duplicates, etc.)
- Review of the diamond drill core, core-logging sheets and core logging procedures. This review included commentary on typical lithologies, alteration and mineralization styles, and contact relationships at the various lithological boundaries.
- During the 2007 visit, AGP collected quarter core character samples. AGP retained full custody of the sample from the NorthMet project site to Barrie Ontario where the samples were shipped to Activation Laboratories Ltd., at 1428 Sandhill Drive, Ancaster, Ontario, via Canada Post. This sample analysis allowed an independent laboratory, not previously used by PolyMet, to confirm the presence of the metal of interest. The samples were analysed for platinum group elements by Fire assay with a ICP/MS finish. Copper, Nickel and Cobalt were analyse with a 4 acid digestion ICP method (Code 8 – 4 acid ICP-OES).
- Table 12-5 shows the grade comparison between the AGP quarter core character sample and the PolyMet laboratory result for the same sample. From the assay results shown in Table 12-5, AGP confirmed that the general range of values reported by PolyMet correspond well with those reported by character samples collected by AGP.

Table 12-5: Character Sample Results

	AGP	PolyMet	AGP	PolyMet	AGP	PolyMet	AGP	AGP	PolyMet
Elements	11213	261033	11214	114084	11215	114118	11216	11216-split	00-347C-455-460
Cu%	0.438	0.542	0.811	0.926	0.335	0.355	0.280	0.272	0.209
Ni%	0.100	0.123	0.226	0.218	0.097	0.090	0.130	0.124	0.089
Co%	0.010	0.010	0.012	0.010	0.009	0.010	0.010	0.010	0.010
Au (ppb)	64.0	71.0	68.0	80.0	21.0	36.0	46.0	31.0	20.0
Pt (ppb)	151.0	149.0	149.0	172.0	47.4	53.0	90.9	109.0	75.0
Pd (ppb)	381.0	394.0	738.0	753.0	156.0	162.0	430.0	496.0	306.0

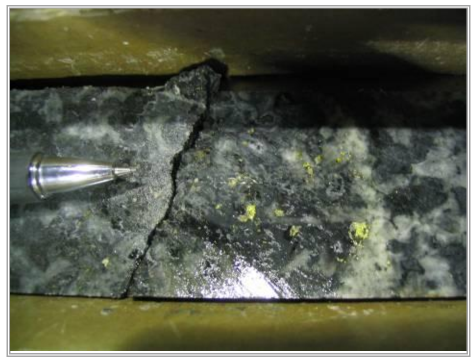
Following the site visit by AGP, the QP regards the sampling, sample preparation, security and assay procedures as adequate to form the basis of resource estimation.

Figure 12-1: Sample Preparation, Security and Assay Procedures

Crate almost ready for shipment to ALS Chemex

Core cutting in progress

Core storage facility



Typical Copper mineralization

US Steel core re-sampled by PolyMet

Collar coordinate hole 98-108B

13 MINERAL PROCESSING AND METALLURGICAL TESTING

The Pre-feasibility Study of the NorthMet Project, which was completed in 2001 and filed on SEDAR contained a description of metallurgical test work and hydrometallurgical process design work undertaken as an integral part of that Pre-feasibility Study. Further mineral processing developments were described in a report entitled “Technical Update of the NorthMet Project Incorporating the established Cliffs-Erie crushing / milling / concentration facilities with the Hydrometallurgical processes described in the May 2001 Pre-feasibility study” by P. Downey and Associates, dated July 2004 and filed on SEDAR.

Since that time additional mine engineering work has been undertaken along with metallurgical test work by SGS Lakefield Laboratories and extensive process design and engineering work by Bateman Engineering Pty Ltd. as part of the DFS. The results of this DFS were filed on SEDAR September 20, 2006 (Hunter, 2006).

There have been no substantive changes to the processing flowsheet since 2006, however PolyMet has made two relatively minor changes in order to improve the economics, take advantage of its marketing relationship with Glencore, and reduce the environmental impact of the Project. In May 2008, PolyMet modified the process to include an initial stage when it would sell concentrate during completion of construction and commissioning of the hydrometallurgical plant contemplated in the DFS. This approach had the advantage of staging capital costs so that the hydrometallurgical plant could be funded in part from cash flow from sales of concentrate, and reduced reliance on delivery of long lead-time equipment before the start commercial production.

In February 2011, PolyMet made further modifications to its plans, replacing the full hydromet facility with a smaller plant resulting in production and sale of high-grade copper concentrate, value added nickel-cobalt hydroxide, and precious metals precipitate products.

Both of these changes have a positive impact in project economics and, as such, neither is material in terms of the viability of the NorthMet Project.

14 MINERAL RESOURCE ESTIMATES

14.1 Data

Mineral resource estimates have been completed by AGP for PolyMet's NorthMet polymetallic Deposit. The NorthMet Deposit is located in the St Louis County in north-eastern Minnesota, USA at Latitude 47°36' north, Longitude 91°58' west, approximately 70 miles north of the City of Duluth and 6.5 miles south of the town of Babbitt. PolyMet Mining Corp. (as Fleck Resources), acquired a 20-year renewable mineral lease to the NorthMet Deposit in 1989 from US Steel, which disposed of much of its non-core assets to RGGS Ltd. in 2003 consequently transferring the underlying mineral rights to RGGS Ltd.

Gemcom software GEMS 6.04™ was used for the resource estimate in combination with Sage 2001 for the variography. The metals of interest at NorthMet are copper, nickel, cobalt, platinum, palladium and gold. Minor amounts of rhodium and ruthenium are also present although these elements are not significant. Sulphur was also estimated for process and environmental purposes.

PolyMet provided the digital data files in a GEMS database dated October 13, 2007. The GEMS database consisted of the digital drill hole database containing a complete data set from 673 holes, a triangulation workspace with the upper surfaces of the different units on the NorthMet Deposit, two geological domains for the Virginia Formation inclusions, two grade shell domains and a topographic and ledge surface. Appendix A lists the data that was available for the December 2007 resource evaluation.

As shown in Table 14-1, out of a total of 673 holes, 371 were used for the resource evaluation grade models. None of the holes in the database had pending assays. A total of 47 stratigraphic control drill holes without assays were left out of the resource model along with the 241 vertical electrical soundings (entered into the database as "pseudo" drill holes for ease of use) holes and 15 other holes drilled to assess the bedrock depth.

The PolyMet NorthMet project geology is divided into seven main lithological units and two grade shell domains. A typical cross section Figure 14-1 shows the stratigraphic position of the units in relation to the grade shells DOM1 and Magenta Zone.

The bulk of the mineralization is located within the two grade shells with minor amounts in the remainder of Units 1 through 7. The Virginia Formation typically carries very low copper, nickel, palladium, platinum, gold and cobalt values but has elevated sulphur values and has been modelled for waste characterization purposes. No grades were interpolated in the Iron Formation (Unit 30).

Table 14-1: Total Number of Holes Used for the December 2007 Resource Estimate

	No. of Holes	Total Length (ft)	Total Number of Assays
Holes with assay results 2007	61	24,530	3,612
Holes with assay results pre-2007	309	261,227	31,790
Holes outside the pit area/hydro holes	47	29,827	0
Vertical electrical bedrock sounding holes	241	3,900	0
Depth to bedrock holes	15	155	0
Total	**673**	**319,639**	**35,402**

14.2 Geological Models

The NorthMet Deposit digital data set consists of seven surfaces provided by PolyMet describing the geological boundaries observed during core logging. The stratigraphy (bottom to top) covers the Iron Formation, the Virginia Formation, Unit 1, Unit 2 and 3 combined into Unit 3, Unit 4 and 5 combined into Unit 5, Unit 6, Unit 7 and the overburden (glacial drift). Topography is a two ft contour derived from air photo work in 1999.

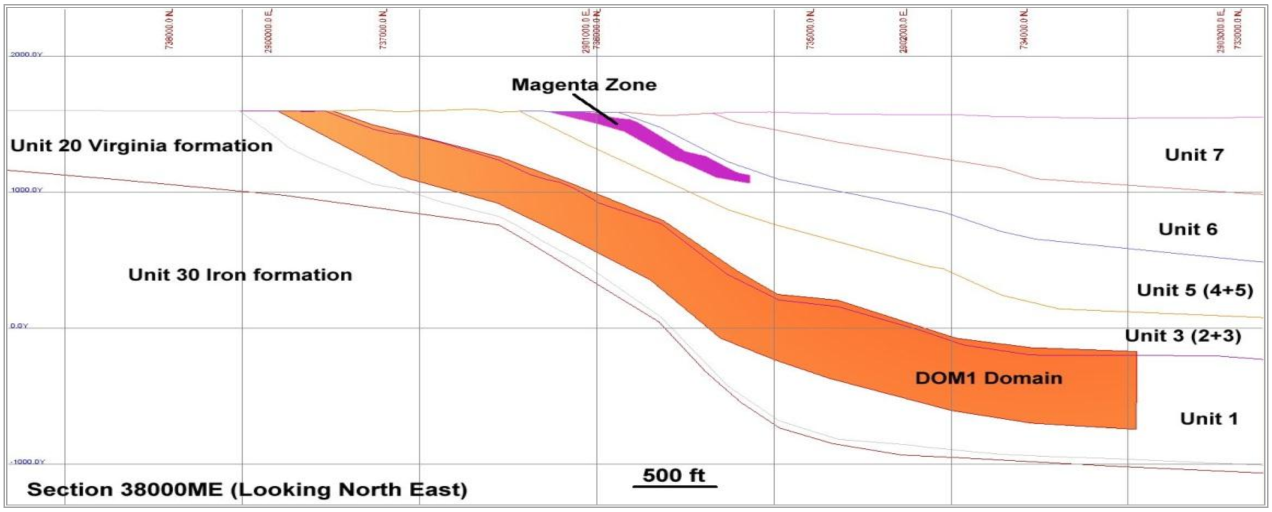
This geological model is overlain by two grade shell models, the DOM1 Zone and the Magenta Zone where the boundaries were drawn based on a US$6.00 per short ton NMV calculated with the formula in Section 17.2.11 of this report. The US$6.00 NMV is currently below the cut-off and is designed to include all areas of mineralization that have the potential to be economically viable. The grade shell model also limits the potential smearing of high grade value into adjoining low grade areas or vice versa.

The DOM1 domain is located near the top of Unit 1 and breaks through the contact to include some of the higher grade material near the bottom of Unit 2 (Unit 2 is merged with Unit 3 in this study). The DOM1 domain spans 14,300 ft east-west and 4,700 ft in the north-south direction between 2895955 E and 2910402 E and 730073 N to 741199 N and is largely unchanged since the September 2007 resource estimate.

The Magenta Zone domain is smaller in size and is mostly contained within Units 5 and 6 but occasionally is seen in Units 3 and 7. The domain is located in the western part of the NorthMet Deposit between 2897383 E and 2902320 E and 732708 N and 737038 N. The Magenta zone was re-interpolated based on the summer drilling program. The domain was extended predominantly in a westerly direction and is now 147,097,310 ft3 larger.

Based on the contact profile, the geological model was re-coded into six distinct grade domains for the purpose of grade interpolation as illustrated in Figure 14-1 which also illustrates the location of the various units and grade shell domains.

Figure 14-1: Domains and Unit Code



14.3 Exploratory Data Analysis

Exploratory data analysis is the application of various statistical tools to characterize the statistical behaviour or grade distributions of the data set. In this case, the objective is to understand the population distribution of the grade elements in the various units using such tools as histograms, descriptive statistics, probability plots and contact plots.

Statistical analysis of the data was performed on each of the unit codes and also on the grade shell domains.

14.3.1 Assays

Table 14-2 shows the assay mean values for the different unit codes. Units 1, 5, and 6 show elevated metal values, with minor amounts distributed in Unit 7. The complete set of descriptive statistics for the NorthMet Deposit is included in Appendix B.

Table 14-2: NorthMet Raw Assay File by Unit – Mean Grade

Units	30	20	1	2+3 (3)	4+5 (5)	6	7
Number of Samples	76	1370	19819	8164	3351	1596	462
Cu (%)	0.001	0.017	0.211	0.067	0.118	0.142	0.033
Ni (%)	0.001	0.012	0.066	0.034	0.040	0.051	0.038
Co (ppm)	0.22	23.18	66.86	52.83	53.51	63.62	64.55
Pt (ppb)	1	2	45	24	43	59	20
Pd (ppb)	1	7	172	76	113	147	39
Au (ppb)	1	3	24	13	21	25	8
S (%)	0.24	1.74	0.63	0.18	0.26	0.23	0.07

14.3.2 Contact Profiles

As part of the September 2007 resource model, AGP examined in detail the contact relationship between the individual units and between the units adjacent to the grade shell models. Only copper was used for this study assuming that nickel, cobalt and platinum, palladium and gold would behave similarly since the correlation coefficients (Hellman) are known to be high. No other elements were evaluated and the study was not updated with the October 2007 dataset.

The software calculates the average grade of an element over distance from a boundary between two lithologies, two units/domains or two indicator values. Contact relationships can be used to determine the inclusion or exclusion of sample data points used in the interpolation of one particular grade domain and also to assist in confirming geological interpretations. A gradational contact (or soft boundary) generally allows the interpolation parameters to include a limited number of samples from the adjoining domain while a sharp contact (or hard boundary) will restrict the sample points used in the interpolation to its own domain.

Results from the analysis are as follows with accompanying plots in Figure 14-2 thru to Figure 14-6.

- The expected hard boundary between the Virginia Formation (Unit 20) and Unit 1 is clearly visible in the contact plots with no grade enrichment at the contact and a slight depletion in Cu% grade up to 20 ft from the boundary inside Unit 1.
- Units 1 and 3 (2 + 3) also show a hard boundary with a large variance in grade and no apparent enrichment or depletion at or near the boundary.
- Units 3 (2 + 3) and 5 (4 +5) show a gradational contact with copper enrichment near the boundary.
- Units 5 (4 + 5) and 6 show a gradational contact near the boundary and a slight depletion internal to Unit 6, followed by an enrichment. Note that the data point count for Unit 5 (4 + 5) is 2609 points with 393 points inside the higher grade Magenta Zone. It is therefore normal to expect a higher grade in Unit 6 than Unit 5 (4+ 5).
- Units 6 and 7 both show gradational contacts and even grade distribution. The point count for Unit 7 is low at 358 points.

Figure 14-2: Contact Profiles Unit 20 and Unit 1 (distance in ft)

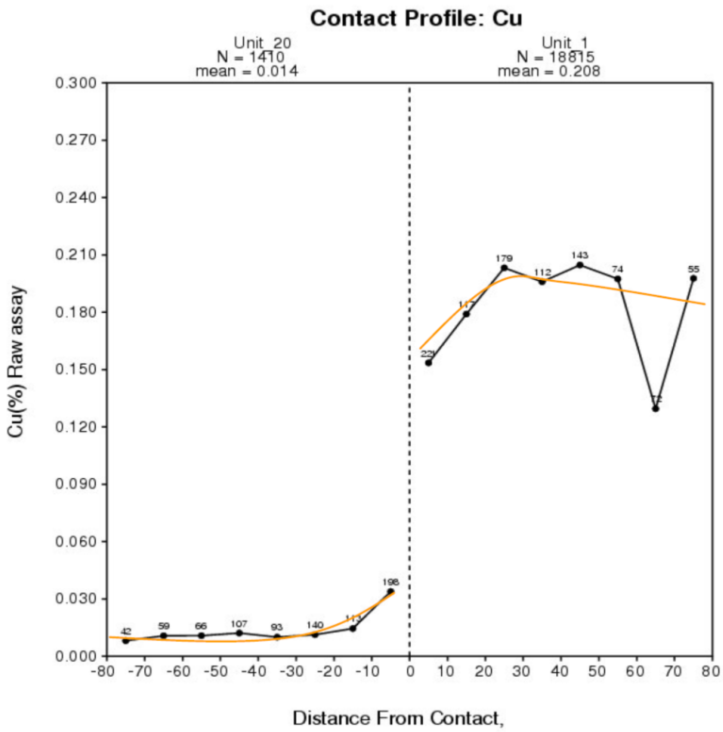


Figure 14-3: Contact Profile Unit 1 and Unit 3 (Distance in ft)

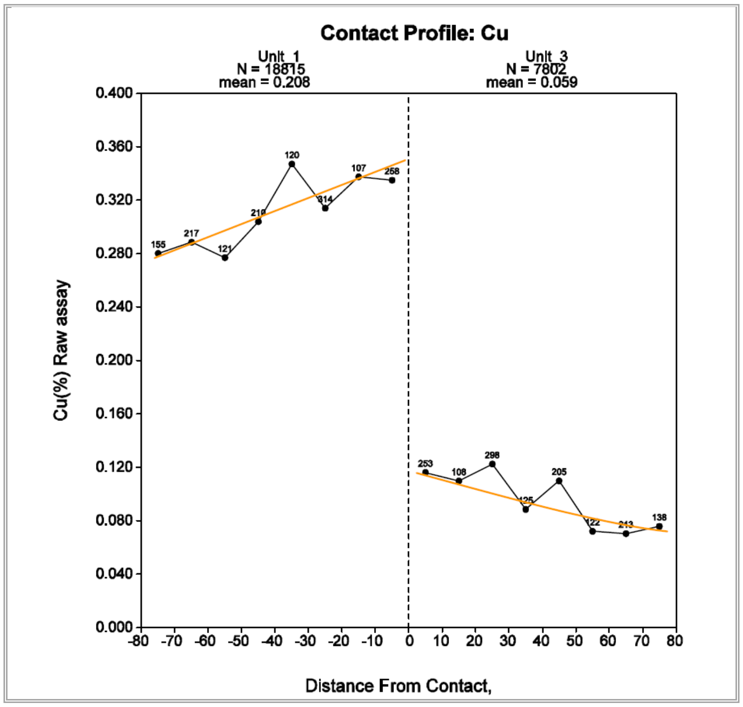


Figure 14-4: Unit Contact Profile Unit 3 and Unit 5 (Distance in ft)

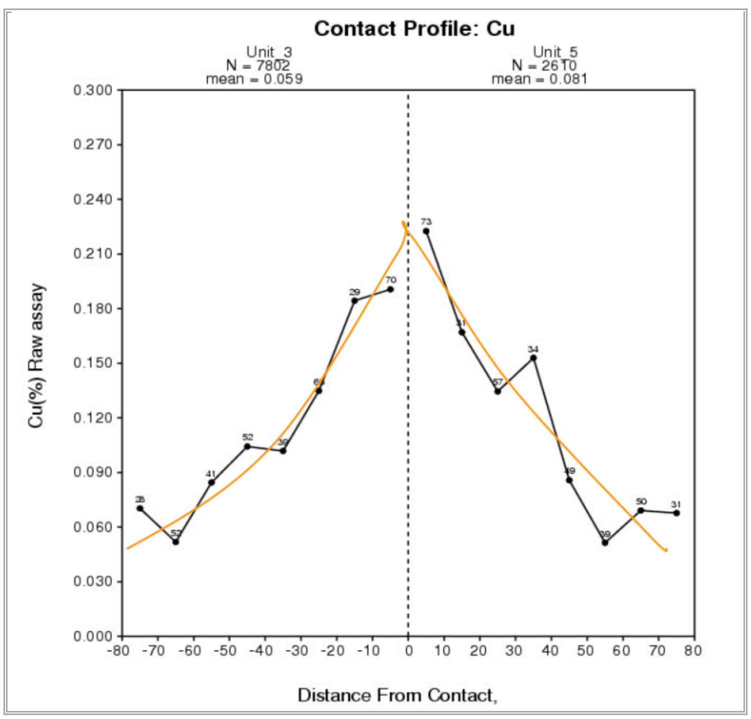


Figure 14-5: Contact Profile Unit 5 and Unit 6 (Distance ft)

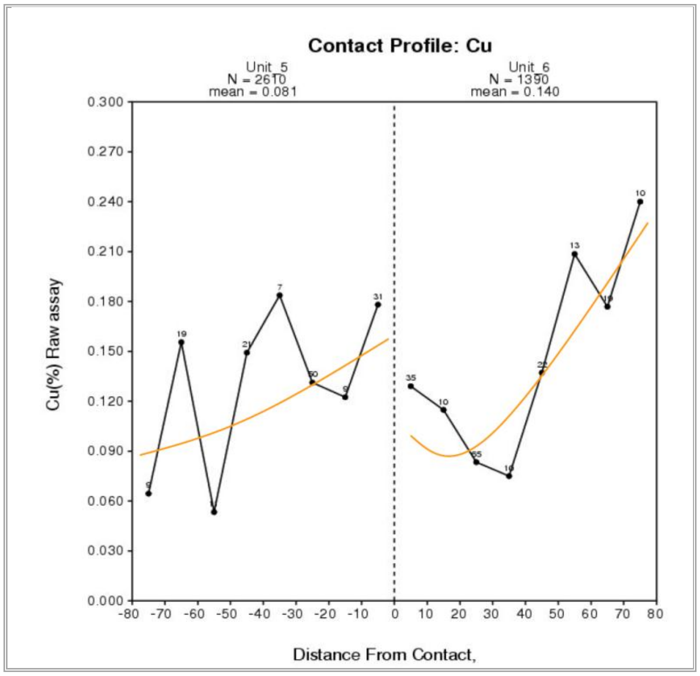
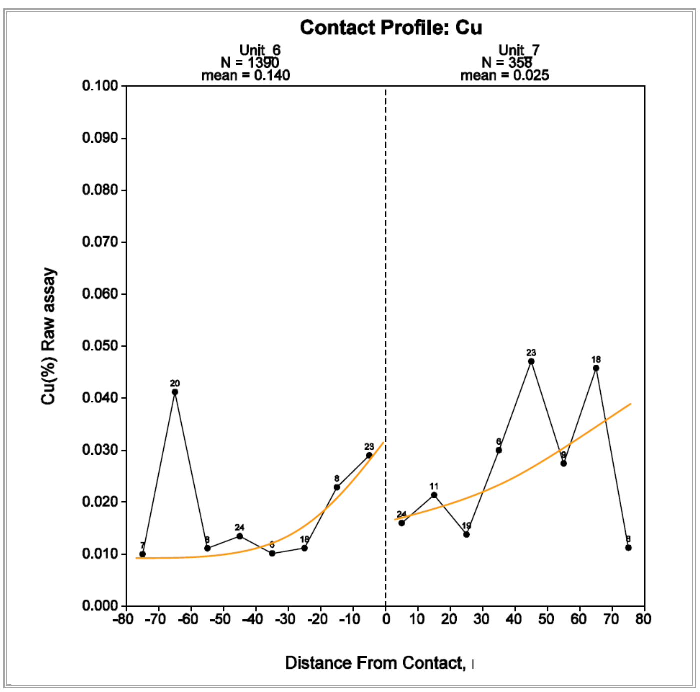
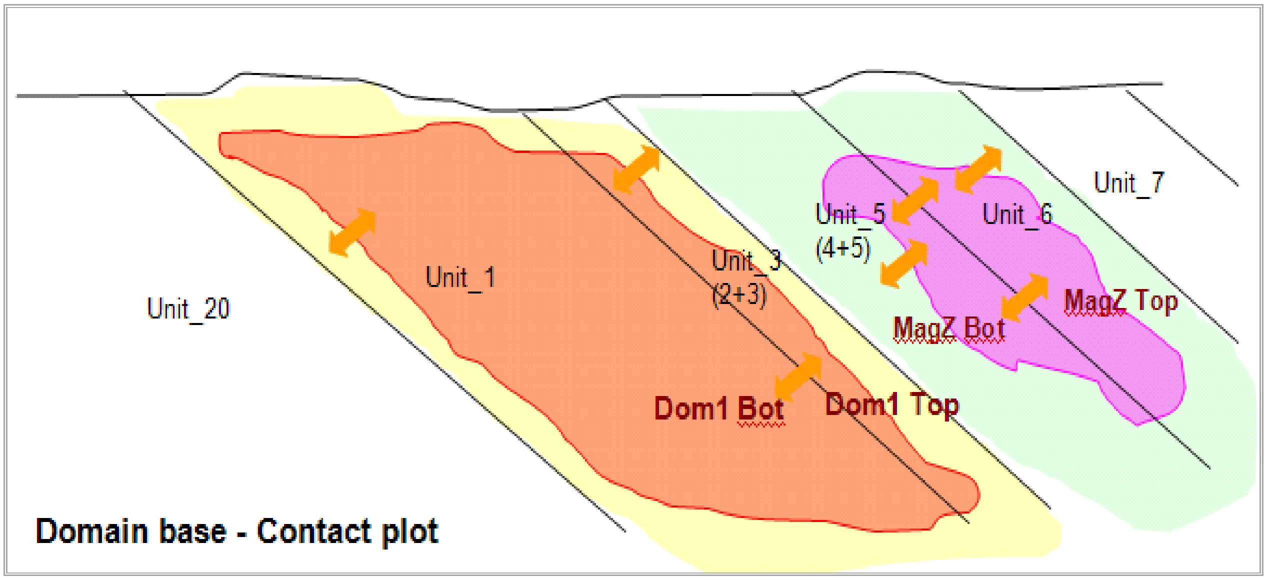


Figure 14-6: Unit Contact Profile Unit 6 and Unit 7(Distance in ft)



On the basis of the unit contact profile results, the assay points located in the DOM1 and Magenta Zone grade shell models were grouped by unit code and additional contact profiles were evaluated between the following boundaries as shown in Figure 14-7.

Figure 14-7: Schematic Cross-Section Illustrating Unit and Domain Nomenclature and Contact Profiles



The Magenta Zone overlays Units 3 (2 + 3), 5 (4 + 5), 6 and 7, however, since the Magenta Zone is primarily in contact with Unit 5 (4 + 5) and 6, only the points from these Units were considered for the contact study relating to the Magenta Zone:

- Unit 1 and DOM1 points located in Unit 1
- DOM1 points located in Unit 1 and DOM1 points located in Unit 3 (2 + 3)
- Unit 3 (2 + 3) and DOM1 points located in Unit 3 (2 + 3)
- Unit 5 (4 + 5) and Magenta Zone points located in Unit 5 (4 + 5)
- Magenta Zone points located in Unit 5 (4 + 5) and Magenta Zone points located in Unit 6
- Unit 6 and Magenta Zone points located in Unit 6.

Results for DOM1 grade shell indicate the following with accompanying plots in Figure 14-8:

- Gradational contact across Unit 1 and the DOM1 bottom boundary
- Sharp contact with no enrichment between DOM1 bottom and DOM1 top mimicking the Unit 1 and Unit 3 (2 + 3) contact profiles
- Gradational contact across DOM1 top and Unit 3 (2 + 3)

Contact plots for across the Magenta Zone indicate the following with accompanying plots in Figure 14-9

- Semi-soft contact between Unit 5 (4 + 5) and the bottom of the Magenta Zone. Grade increases gradually inside the Magenta Zone
- Relatively sharp contact exists between the Magenta top and Unit 6. Grade decreases gradually from the core of the Magenta Zone toward the contact. The copper grade in Unit 6 is consistently low.

Based on the contact profile, the geological model was re-coded into six distinct grade domains for the purpose of grade interpolation as illustrated in Figure 14-10.

Figure 14-8: Grade Shell DOM1 Contact Profiles (distance in ft)

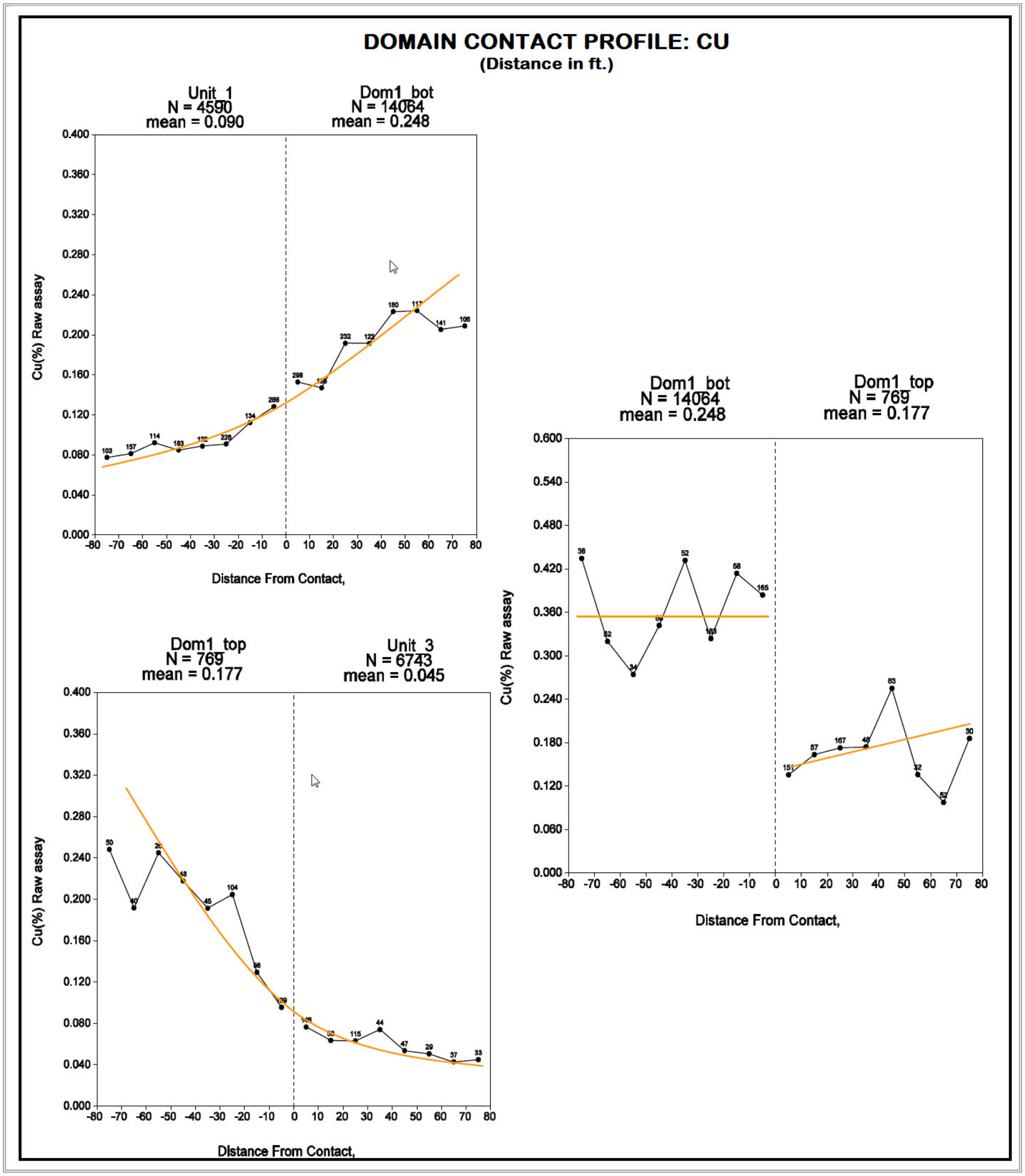


Figure 14-9: Contact Profile for Magenta Zone Grade Shell (distance in ft)

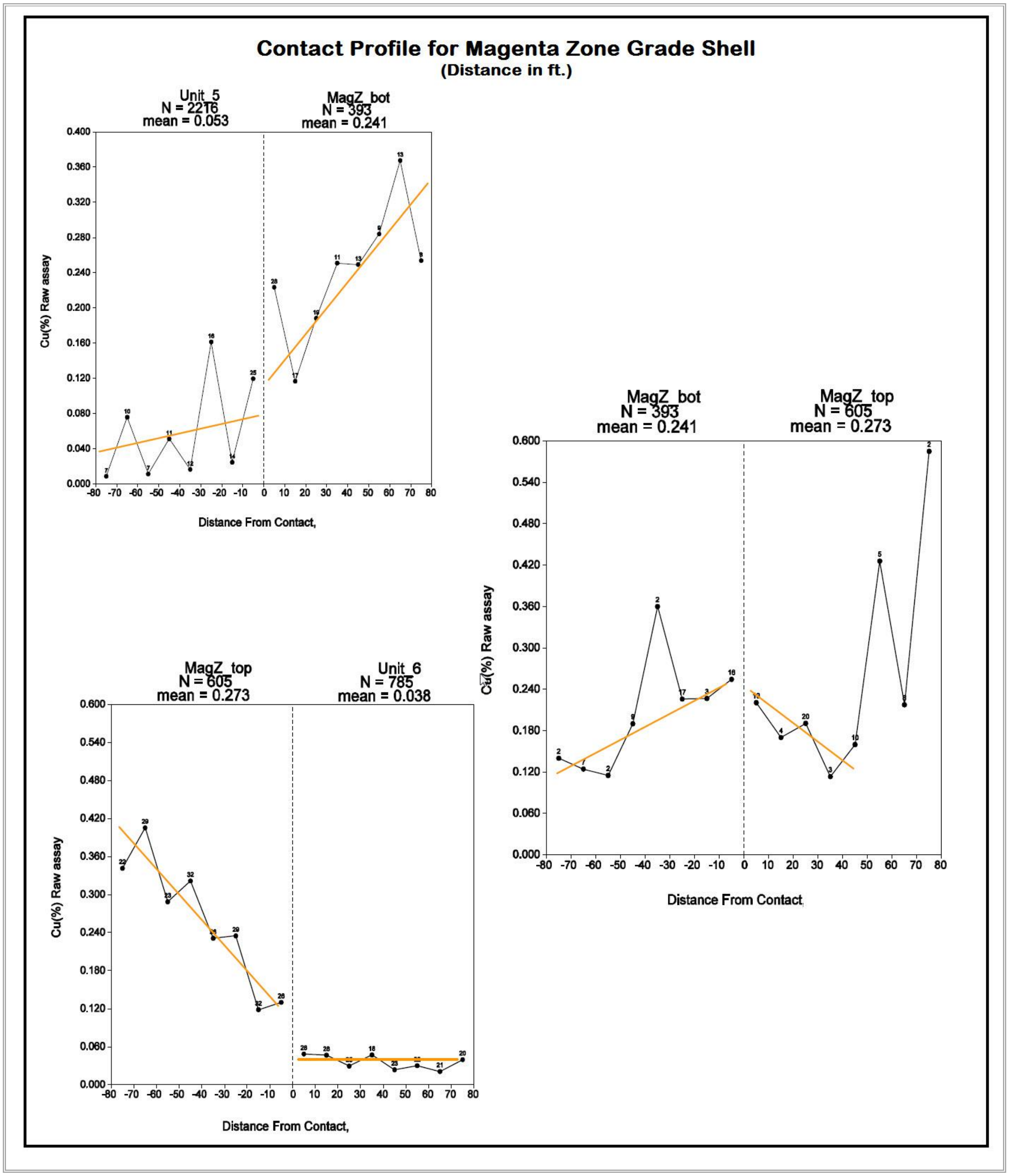
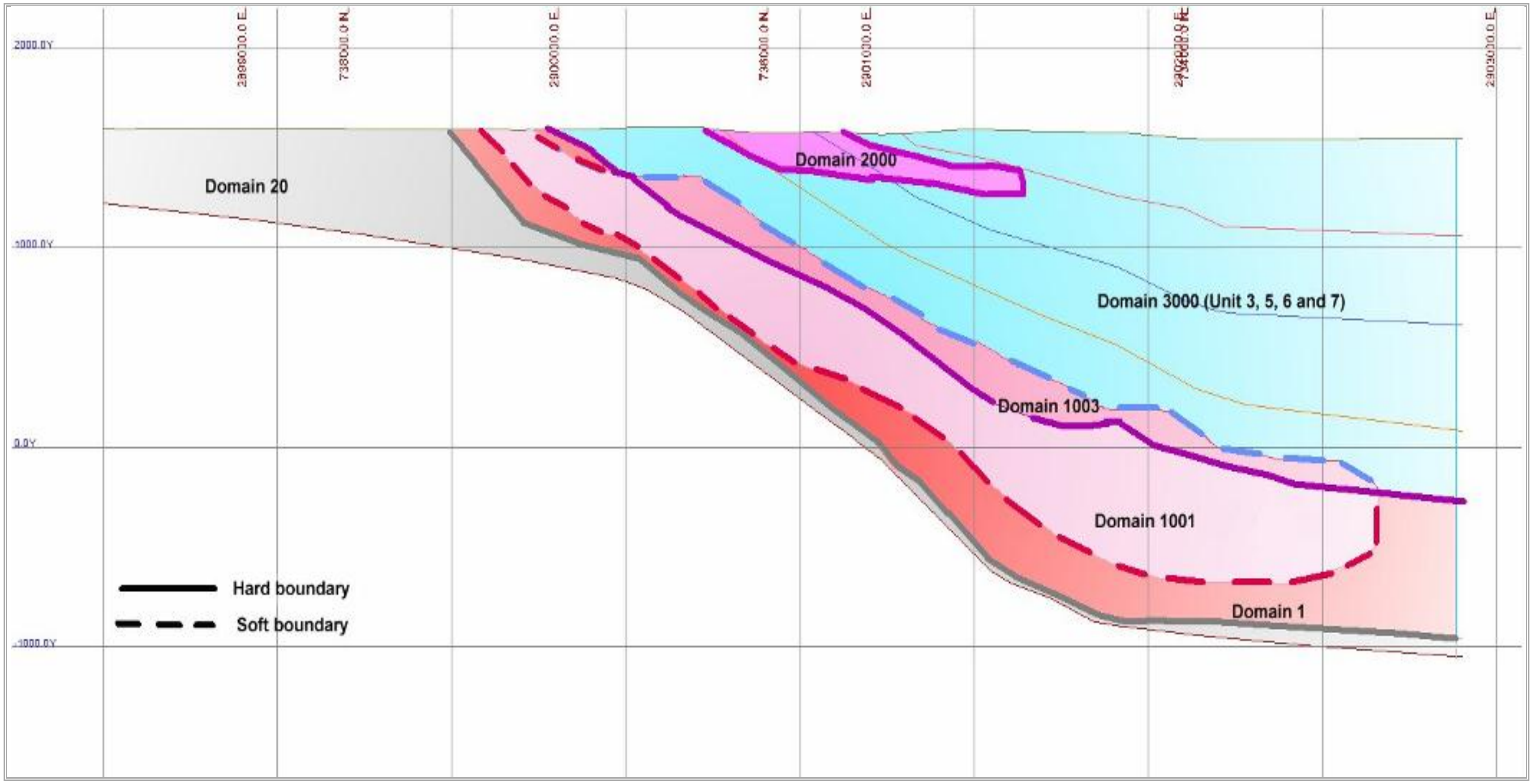


Figure 14-10: Grade Domains Schematic Section Looking North-East



14.4 Grade Capping/Outlier Restrictions

A combination of decile analysis and review of probability plots were used to determine the potential risk of grade distortion from higher-grade assays. A decile is any of the nine values that divide the sorted data into ten equal parts so that each part represents one tenth of the sample or population. In a mining project, high-grade outliers can contribute excessively to the total metal content of the NorthMet Deposit.

Typically in a decile analysis, capping is warranted if:

- the last decile has more than 40% of metal, or
- the last decile contains more than 2.3 times the metal quantity contained in the one before last, or
- the last centile contains more than 10% of metal, or
- the last centile contains more than 1.75 times the metal quantity contained in the one before last.

The decile analysis performed by the QP for the September 2007 resource model was not updated with the October 2007 dataset as very few additional data points were added. Results shown in Appendix C indicate that no grade capping is warranted for the DOM1 and Magenta Zone grade shell domains. Unit 1, Unit 20 and Units 3, 4, 5, 6 and 7 outside the Magenta Zone show significant high-grade outliers and a high-grade search restriction was considered by the QP as appropriate for the NorthMet Deposit. Table 14-3 compares the analyses and tabulates the implemented level.

Table 14-3: Threshold Value Used for High Grade Search Restriction (May 25, 2007 dataset)

	Cu (%)	Ni (%)	Co (ppm)	Pt (ppb)	Pd (ppb)	Au (ppb)	S (%)
Unit 20	0.7	0.18	n/a	200	1000	80	7.5
Unit 1 outside DOM1 Grade shell	1.8	0.6	n/a	450	1600	500	7.5
DOM1 (in Unit 1)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
DOM1 (in Unit 3)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Units 2/3, 4/5, 6, and 7 excluding Magenta Zone	2.1	0.4	n/a	700	4000	500	8
Magenta Zone	n/a	n/a	n/a	n/a	n/a	n/a	n/a

The search restriction size was based on a next block, diamond shape pattern with a 75 ft radius from the block center. Essentially, a sample search selection ellipsoid is applied to a block during the interpolation process. Points that are above the threshold value and outside the smaller restricted search ellipsoid are eliminated from the set during the interpolation. Grade for the block is calculated and the process is repeated for the next block. The end result is that all high grade samples are used at face value but their range of influence is limited to an area that is more or less 75 ft in diameter

14.5 Composites

Core length statistics on the October 13 dataset indicate the sampling intervals in the two grade shell domains for the NorthMet Deposit average 5.3 ft in the DOM1 domain and 5.8 ft in the Magenta Zone. The upper third quartile shows 10 ft or less for Units 1, 3, 5, 6, 7, and 20. Based on that information a 10 ft composite length was selected. This length allowed for a few samples of greater length to be broken without affecting the variance and shorter samples to be combined to produce a sample of proper support. Summary statistics are shown in Table 14-4.

Assays were composited in 10 ft intervals starting at the toe of the hole and honouring the geological hard boundaries. Composite remnants, which are composites less than 10 ft in length, are unavoidable if the hard geological boundaries are to be honoured. The compositing methodology used by AGP locates the composite remnant (<10 ft) in Unit 20 and on the wider side of the Unit 1-Unit 3 boundary while minimizing the composite remnants in the remaining units.

Table 14-4: Core Length Summary Statistics (October 15 Dataset)

Unit Code	30	20	1	3	5	6	7	DOM1	Magenta Zone
Number of values	2	982	4698	6857	2189	845	427	15495	1894
Minimum (ft)	0.3	1.5	1.0	0.3	1.0	2.0	2.0	0.3	1.0
Maximum (ft)	17.0	12.5	14.0	12.0	26.0	12.5	12.0	17.0	15.0
Mean (ft)	10.0	5.2	5.2	6.7	8.3	8.6	8.9	5.3	5.8
Median (ft)	10.0	5.0	5.0	5.0	10.0	10.0	10.0	5.0	5.0
First quartile (ft)	-	5.0	5.0	5.0	5.0	7.0	8.0	5.0	5.0
Third quartile (ft)	-	5.0	5.0	10.0	10.0	10.0	10.0	5.0	5.0

Un-sampled intervals, gaps and assays below detection limits were composited at zero grades for copper, nickel, platinum, palladium, gold and cobalt.

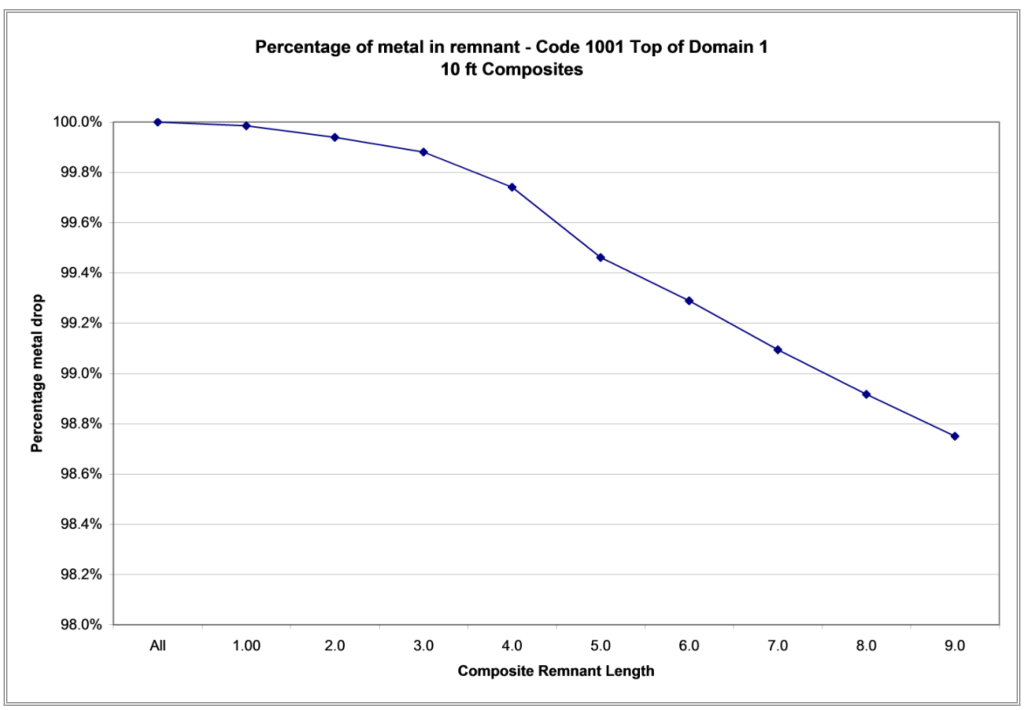
For sulphur, the un-sampled intervals were initialized to the domain average value prior to compositing. A total of 1,571 sulphur intervals out of 35,402 (or 4.4% of the assay database) needed initialization. Table 14-5 shows the background value used for this resource estimate.

Table 14-5: Sulphur Background Values for Unsampled Intervals

Domain	Sulphur Background Value
Unit 1 outside Domain 1	0.454
Domain 1	0.668
Unit 3,5,6 or 7 outside Domain 1 or Magenta zone	0.146
Magenta zone	0.420
Virginia formation	1.230
Iron formation	0.240

Statistical analysis of the composite remnants indicates that intervals less than 4 ft could be safely deleted from the dataset without introducing a bias in the remaining composites. This ensured that smaller, less representative samples would not be included in the interpolation. Figure 14-11 shows an example graph for the upper DOM1 Zone where deleting composites less than four ft would only affect the metal content by 0.2%. Box plots showing statistical analysis of sample interval lengths are included in Appendix D along with the complete remnant statistical study.

Figure 14-11: DOM1 Composite Remnants



Composite statistics by unit codes are shown in Table 14-6. Complete composite statistics are located in Appendix E. Composite statistics sorted by grade domain code shown in Table 14-6 and Table 14-7.

Table 14-6: Final Composite Statistics by Unit Code (October 2007 Dataset) Mean Grade Compilation

Units	1	2/3	4/5	6	7	20	30
Counts	11,481	6,813	4,054	2,184	847	2,241	374
Cu (%)	0.201	0.047	0.057	0.064	0.015	0.007	0.001
Ni (%)	0.062	0.026	0.022	0.026	0.019	0.006	0.001
Co (ppm)	60.5	40.9	31.6	34.6	31.3	10.1	0.2
Pt (ppb)	44	17	21	28	9	1	0.5
Pd (ppb)	167	53	54	68	18	3	0.5
Au (ppb)	23	10	11	12	4	2	0.5
S (%)	0.64	0.17	0.18	0.17	0.11	1.40	0.30

Table 14-7: Final Composites by Domain (October 15 Dataset) – Mean Grade Compilation

Grade Domain	Unit 1 outside DOM1 Zone	Unit 20 Virginia Formation	Code 22 Ramp Area	Code 23	DOM1 Bot (in Unit 1)	DOM1 Top (In Unit 3)	Magenta Zone	Unit 3,4,5,6 and 7 outside Magenta Zone
Domain Code	1	20	22	23	1001	1003	2000	3000
Count	3,192	2,018	498	102	8,158	423	1,132	12,155
Cu%	0.081	0.007	0.028	0.015	0.250	0.176	0.241	0.029
Ni%	0.029	0.005	0.014	0.012	0.075	0.071	0.066	0.019
Cobalt ppm	40.6	9.2	31.4	23.6	68.5	71.9	64.7	32.8
Platinum ppb	14	1	6	3	56	60	95	11
Palladium ppb	50	3	16	3	215	219	252	30
Gold ppb	9	2	5	4	29	33	43	6
S%	0.47	1.41	0.67	2.29	0.70	0.37	0.40	0.14

14.6 Variography

Geostatisticians use a variety of tools to describe the pattern of spatial continuity, or strength of the spatial similarity of a variable with separation distance and direction. The correlogram measures the correlation between data values as a function of their separation distance and direction. If we compare samples that are close together, it is common to observe that their values are quite similar and the correlation coefficient for closely spaced samples is near 1.0. As the separation between samples increases, there is likely to be less similarity in the values and the correlogram tends to decrease toward 0.0. The distance at which the correlogram reaches zero is called the "range of correlation" or simply the range. The range of the correlogram corresponds roughly to the more qualitative notion of the "range of influence" of a sample; it is the distance over which sample values show some persistence or correlation. The shape of the correlogram describes the pattern of spatial continuity. A very rapid decrease near the origin is indicative of short scale variability. A more gradual decrease moving away from the origin suggests longer scale continuity.

Using Sage 2001 software, directional sample correlograms were calculated for all elements, copper, nickel, platinum, palladium, gold, cobalt and sulphur in each of the six grade domains along horizontal azimuths of 0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300 and 330 degrees. For each azimuth, sample correlograms were also calculated at dips of 30 and 60 degrees in addition to horizontally. Lastly, a correlogram was calculated in the vertical direction. Using the thirty-seven correlograms an algorithm determined the best-fit model. This model is described by the nugget (C0) which was derived using down hole variograms; two nested structure variance contribution (C1, C2), ranges for the variance contributions and the model type (spherical or exponential). After fitting the variance parameters, the algorithm then fits an ellipsoid to the thirty-seven ranges from the directional models for each structure. The final models of anisotropy are given by the lengths and orientations of the axes of the ellipsoids. Tables 14-8 to 14-10 summarize the results of the variography.

Table 14-8: Variography DOM1 Top and Bottom (October 15 Dataset)

Domain	Component	Increment	Cumulative	Rotation	Angle1	Angle2	Angle3	Range1	Range2	Range3
DOM1 Bottom – Au Code 1001	Nugget C0	0.036	0.036							
	Exponential C1	0.748	0.784	ZYZ	-82.94	-72	45	14.3	60.8	3.4
	Exponential C2	0.216	1	ZYZ	-101.9	-53	11	108.7	466.1	560.8
DOM1 Bottom – Co Code 1001	Nugget C0	0.044	0.044							
	Exponential C1	0.697	0.741	ZYZ	-99.94	58	4	105.9	221.1	24
	Exponential C2	0.259	1	ZYZ	-135.9	23	93	18	630.2	773.2
DOM1 Bottom – Cu Code 1001	Nugget C0	0.005	0.005							
	Exponential C1	0.605	0.61	ZYZ	-85.94	-75	-4	26.1	74.9	7.9
	Exponential C2	0.39	1	ZYZ	-202.9	72	36	76.1	611.7	473.7
DOM1 Bottom – Ni Code 1001	Nugget C0	0.006	0.006							
	Exponential C1	0.6	0.606	ZYZ	-41.94	21	42	58.3	11	33.3
	Exponential C2	0.394	1	ZYZ	-84.94	-46	-5	67.4	488.4	369.3
DOM1 Bottom – Pd Code 1001	Nugget C0	0.008	0.008							
	Exponential C1	0.671	0.679	ZYZ	-52.94	15	-16	8.2	44.6	22.3
	Exponential C2	0.321	1	ZYZ	-110.9	-51	12	103.9	699.9	441.8
DOM1 Bottom – Pt Code 1001	Nugget C0	0.014	0.014							
	Exponential C1	0.745	0.759	ZYZ	-108.9	21	21	6.5	33.4	24.1
	Exponential C2	0.241	1	ZYZ	-150.9	-71	31	108.3	494.6	895
DOM1 Bottom – S Code 1001	Nugget C0	0.015	0.015							
	Exponential C1	0.558	0.573	ZYZ	-92.94	-56	9	19.4	157.1	8.8
	Exponential C2	0.427	1	ZYZ	-100.9	52	51	162.3	357.3	56.2
DOM1 Top – Au Code 1001	Nugget C0	0.013	0.013							
	Exponential C1	0.817	0.83	ZYZ	-147.9	-33	-39	38.6	20.3	9.5
	Exponential C2	0.17	1	ZYZ	-83.94	-55	11	85.3	201.4	873.1
DOM1 Top – Co Code 1003	Nugget C0	0.006	0.006							
	Exponential C1	0.626	0.632	ZYZ	-4.94	-83	-95	10.7	165.5	19.9
	Exponential C2	0.368	1	ZYZ	-66.94	31	67	12.1	2965.2	491.9
DOM1 Top – Cu Code 1003	Nugget C0	0.028	0.028							
	Exponential C1	0.833	0.861	ZYZ	-90.94	-79	61	17.9	84.7	5.8
	Exponential C2	0.139	1	ZYZ	-58.94	-37	-31	156.8	1250.9	648.6
DOM1 Top – Ni Code 1003	Nugget C0	0.016	0.016							
	Exponential C1	0.559	0.575	ZYZ	-102.9	-9	-4	79.8	104.6	14.2
	Exponential C2	0.425	1	ZYZ	-47.94	-1	-32	40.3	477.2	253.8
DOM1 Top – Pd Code 1003	Nugget C0	0.004	0.004							
	Exponential C1	0.79	0.794	ZYZ	-68.94	-32	6	23.1	89.6	9.7
	Exponential C2	0.206	1	ZYZ	-53.94	-54	-21	81.6	277.2	1041.1
DOM1 Top – Pt Code 1003	Nugget C0	0.416	0.416							
	Exponential C1	0.391	0.807	ZYZ	-88.94	-55	14	49.9	207.8	3.7
	Exponential C2	0.193	1	ZYZ	-73.94	-46	-12	98.1	446.7	640.1
DOM1 Top – S Code 1003	Nugget C0	0.061	0.061							
	Exponential C1	0.819	0.88	ZYZ	-65.94	-69	0	37.3	100.5	9.4
	Exponential C2	0.12	1	ZYZ	-81.94	-9	-11	77.5	1,568.4	352.5

Table 14-9: Variography Unit 1 and Unit 20 (October 15 Dataset)

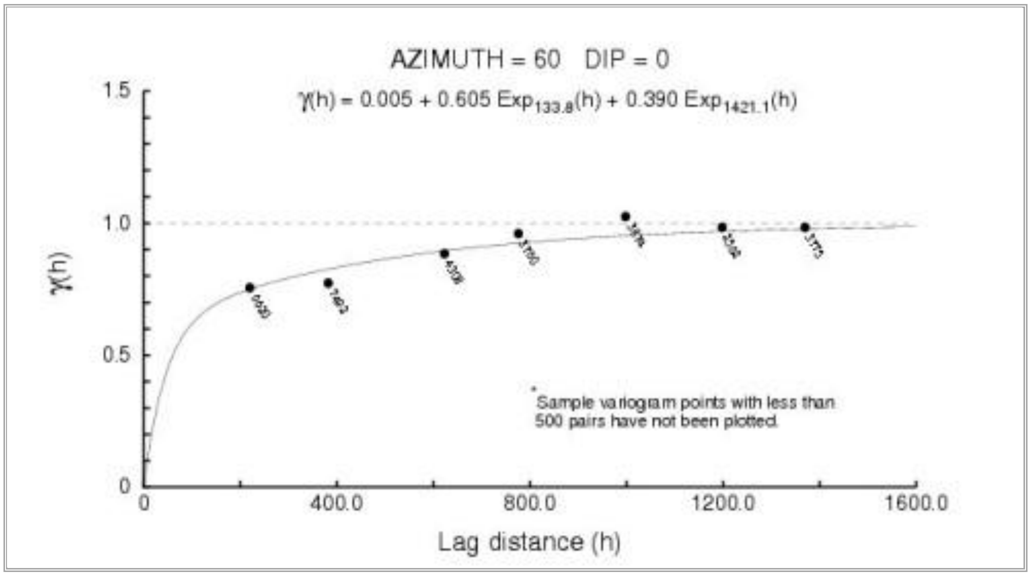
Domain	Component	Increment	Cumulative	Rotation	Angle1	Angle2	Angle3	Range1	Range2	Range3
Unit 1 – Au Code 1	Nugget C0	0.784	0.784							
	Spherical C1	0.137	0.921	ZYZ	-57.94	80	-36	143.4	102.9	3
	Spherical C2	0.079	1	ZYZ	-151.9	-3	91	542.1	12688	16,954
Unit 1 – Co Code 1	Nugget C0	0.495	0.495							
	Spherical C1	0.186	0.681	ZYZ	-115.9	64	-50	213.8	80.9	26.7
	Spherical C2	0.319	1	ZYZ	-89.94	-48	97	3002.4	244.7	789.9
Unit 1 – Cu Code 1	Nugget C0	0.48	0.48							
	Spherical C1	0.265	0.745	ZYZ	-100.9	-11	-30	15.6	95.6	118.3
	Spherical C2	0.255	1	ZYZ	-62.94	4	16	52.4	104.2	960.3
Unit 1 – Ni Code 1	Nugget C0	0.647	0.647							
	Spherical C1	0.205	0.852	ZYZ	-128.9	85	48	155.9	181.5	10.1
	Spherical C2	0.148	1	ZYZ	-118.9	3	46	283.3	3019.2	1,094.7
Unit 1 – Pd Code 1	Nugget C0	0.508	0.508							
	Spherical C1	0.296	0.804	ZYZ	-121.9	90	3	306	171.8	7.9
	Spherical C2	0.196	1	ZYZ	-66.94	7	89	5569.9	902.3	599.5
Unit 1 – Pt Code 1	Nugget C0	0.672	0.672							
	Spherical C1	0.234	0.906	ZYZ	-122.9	89	-35	313.8	213.9	8.1
	Spherical C2	0.094	1	ZYZ	29.06	-74	47	1183.8	765.1	2,754.6
Unit 1 – S Code 1	Nugget C0	0.533	0.533							
	Spherical C1	0.3	0.833	ZYZ	119.06	70	-16	316.1	93.5	40.9
	Spherical C2	0.167	1	ZYZ	-101.9	39	8	218.4	2008.7	214.2
Unit 20 – Au Code 20	Nugget C0	0.368	0.368							
	Spherical C1	0.435	0.803	ZYZ	-74.94	90	26	66.6	85.5	6.2
	Spherical C2	0.197	1	ZYZ	-55.94	-12	62	143.8	79.1	546.8
Unit 20 – Co Code 20	Nugget C0	0.398	0.398							
	Spherical C1	0.279	0.677	ZYZ	-124.9	-62	81	48.3	215.9	11.4
	Spherical C2	0.323	1	ZYZ	-106.9	50	33	457	1,859.6	223.2
Unit 20 - Cu Code 20	Nugget C0	0.45	0.45							
	Spherical C1	0.381	0.831	ZYZ	-94.94	87	-49	163.5	152.2	9
	Spherical C2	0.169	1	ZYZ	-60.94	-5	-54	155.5	500	1,200
Unit 20 – Ni Code 20	Nugget C0	0.406	0.406							
	Spherical C1	0.34	0.746	ZYZ	-80.94	90	3	182.4	67.1	7.9
	Spherical C2	0.254	1	ZYZ	-83.94	11	9	78.3	117.5	1,190.4
Unit 20 – Pd Code 20	Nugget C0	0.571	0.571							
	Spherical C1	0.198	0.769	ZYZ	-68.94	61	-55	44.1	140.4	163.5
	Spherical C2	0.231	1	ZYZ	-14.94	0	-24	5.4	50.9	609
Unit 20 – Pt Code 20	Nugget C0	0.434	0.434							
	Spherical C1	0.402	0.836	ZYZ	-47.94	89	-47	81.3	52.1	4.9
	Spherical C2	0.164	1	ZYZ	-39.94	3	82	179.3	76.5	759.2
Unit 20 – S Code 20	Nugget C0	0.227	0.227							
	Spherical C1	0.389	0.616	ZYZ	-150.9	28	3	28.4	60.8	138.8
	Spherical C2	0.384	1	ZYZ	-48.94	0	13	47.9	105.4	1,410.5

Table 14-10: Variography Magenta Zone and Code 3000 (October 15 Dataset)

Domain	Component	Increment	Cumulative	Rotation	Angle1	Angle2	Angle3	Range1	Range2	Range3
Magenta Zone – Au Code 2000	Nugget C0	0.004	0.004							
	Exponential C1	0.796	0.8	ZYZ	-47.94	41	-57	34.7	77.2	13.1
	Exponential C2	0.2	1	ZYZ	-102.9	-69	3	48.5	1609.1	469.9
Magenta Zone – Co Code 2000	Nugget C0	0.003	0.003							
	Exponential C1	0.695	0.698	ZYZ	-68.94	83	-14	16.6	91.5	8.6
	Exponential C2	0.302	1	ZYZ	-91.94	35	48	1415.2	297.2	134.7
Magenta Zone – Cu Code 2000	Nugget C0	0.004	0.004							
	Exponential C1	0.81	0.814	ZYZ	-10.94	20	-54	170.1	67.4	19.9
	Exponential C2	0.186	1	ZYZ	-87.94	-53	-4	26.4	1004.3	911.1
Magenta Zone – Ni Code 2000	Nugget C0	0.006	0.006							
	Exponential C1	0.816	0.822	ZYZ	-12.96	27	-63	156.4	89	19
	Exponential C2	0.178	1	ZYZ	-88.9	-53	-3	28.7	1396.2	424.5
Magenta Zone – Pd Code 2000	Nugget C0	0.003	0.003							
	Exponential C1	0.744	0.747	ZYZ	-63.94	57	11	35.5	79.1	11.5
	Exponential C2	0.253	1	ZYZ	-5.94	-88	-25	60.2	272.8	1068.1
Magenta Zone - Pt Code 2000	Nugget C0	0.004	0.004							
	Exponential C1	0.727	0.731	ZYZ	-59.94	59	8	28.3	103.7	1.9
	Exponential C2	0.269	1	ZYZ	-105.9	-74	2	33.1	937.5	246.1
Magenta Zone – S Code 2000	Nugget C0	0.082	0.082							
	Exponential C1	0.723	0.805	ZYZ	-4.94	21	-97	149.2	87.1	19
	Exponential C2	0.195	1	ZYZ	-88.94	-68	-2	26.5	551.9	332.2
Unit 3, 4, 5, 6, 7 – Au Code 3000	Nugget C0	0.3	0.3							
	Exponential C1	0.7	1	ZYZ	5.06	-22	18	210.6	78.5	20.2
Unit 3, 4, 5, 6, 7 – Co Code 3000	Nugget C0	0.152	0.152							
	Exponential C1	0.848	1	ZYZ	-5.94	0	7	101.9	17.2	1321.8
Unit 3, 4, 5, 6, 7 – Cu Code 3000	Nugget C0	0.006	0.006							
	Exponential C1	0.994	1	ZYZ	69.06	20	-55	410	29.7	21
Unit 3, 4, 5, 6, 7 – Ni Code 3000	Nugget C0	0.142	0.142							
	Exponential C1	0.858	1	ZYZ	12.06	-13	-11	318.9	19.4	58.2
Unit 3, 4, 5, 6, 7 – Pd Code 3000	Nugget C0	0.4	0.4							
	Exponential C1	0.6	1	ZYZ	-47.94	25	31	216.2	66.1	27.7
Unit 3, 4, 5, 6, 7 – Pt Code 3000	Nugget C0	0.133	0.133							
	Exponential C1	0.867	1	ZYZ	-11.94	37	-14	133.4	87.8	9.8
Unit 3, 4, 5, 6, 7 – S Code 3000	Nugget C0	0.011	0.011							
	Exponential C1	0.989	1	ZYZ	79.06	18	-55	176.4	56.9	28.2

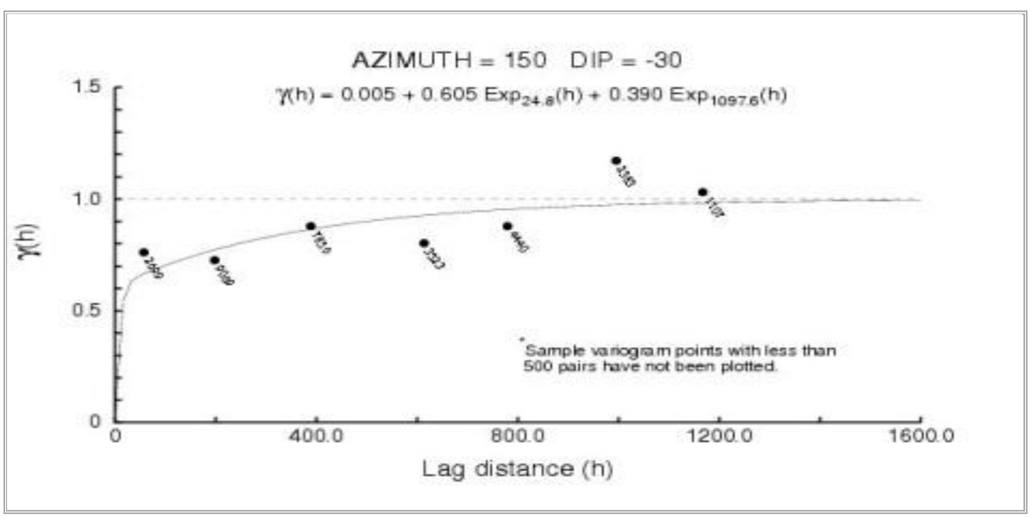
Generally, ranges for the copper correlogram in the main DOM1 grade shell reach 1,000 ft at approximately 96% of the 1.0 sill level in the main strike direction as shown in Figure 14-12.

Figure 14-12: Copper Correlogram for Domain 1001 – Main Strike Direction



In the down dip direction, the range is shorter reaching about 800 ft at about 96% of the sill value as shown in Figure 14-13. The variography indicate good continuity in the grade distribution, the contact profile show a good marker horizon exists between unit 1 and unit 3 which is consistent with PolyMet's NorthMet field geologists being able to predict the location of the high grade horizon with a relatively good degree of accuracy prior to drilling.

Figure 14-13: Copper Correlogram for Domain 1001 - Down Dip Direction



The Magenta Zone show shorter ranges with a maximum range of 800 ft at the sill in the main strike direction and 500 ft in the down dip direction.

Domain 1003 did not provide enough points to generate a reliable correlogram and AGP elected to use the lithological Unit 3 points for the spatial analysis in lieu of the domain 1003 points.

The complete spatial analysis is attached in Appendix F.

14.7 Density Assignment

PolyMet's October 15, 2007 database contains 6,997 specific gravity/density measurements.

Mark J. Severson et al., Natural Resources Research Institute of the University of Minnesota, Duluth compiled 1,037 comparative specific gravity (SG) determinations in 1999-2000 using Jolly balance determinations on smaller pieces and duplicate measurements of displacement and weight ("graduated cylinder method") on larger core pieces.

From this work, Severson reported the following:

> *When compared to the Jolly Balance method, the Graduated Cylinder method is not only faster (about 25 samples per hour, versus the Jolly Balance's 30-40 samples per day), but just as accurate.*

and subsequently concluded:

> *In most cases, sample variance is smaller for the Graduated Cylinder method than the Jolly Balance method, probably because the Graduated Cylinder method uses a much larger sample. This sheer difference in specimen size makes the Graduated Cylinder samples more robust to minor variations. Furthermore, the relatively simple nature of the Graduated Cylinder method reduces the chance for introducing measurement errors.*

PolyMet used primarily the Graduated Cylinder method for subsequent specific gravity determination. The distribution of the data including all determinations in the database is shown in Table 14-11.

Table 14-11: Percentage of Specific Gravity Determination by Method (October 15 Dataset)

Method	Percent of Total Determination	Average SG
PolyMet Graduated Cylinder	82	2.93
PolyMet Weight in Water	3	2.95
Severson/Zanko Data - Graduated Cylinder	14	2.92
Severson/Zanko Data - Jolly Balance	1	2.93
Chemex (average)	0.1	2.91

Density measurements to date have been made on core that has not been oven dried and has not been sealed. This is likely to have resulted in a small (~1%) overstatement due to the inclusion of moisture that would normally be driven off at 105 to 110°C. It is recommended that approximately 50 samples be selected and the weight loss be determined after drying for the same temperature and duration as used by the assay laboratory.

The QP considered the specific gravity determination using the graduated cylinder method to be accurate enough to use in the resource estimation.

Table 14-12 list the average specific gravity determination including all determination (October 2007 dataset) sorted by unit.

Table 14-12: Specific Gravity Average per Unit (October 15 Dataset)

Unit	Mean	Count
1	2.98	2,381
3 (2+3)	2.92	1,818
5 (4+5)	2.90	1,266
6	2.90	902
7	2.92	326
20	2.77	273
30	3.17	9
All Units	2.93	6,975

14.8 Resource Model Definition

One block model was constructed in Gemcom's GEMS version 6.04™ software. The block size was 50 ft by 50 ft by 20 ft to allow for detailed engineering of the resource model.

The block model matrix was defined using the following coordinates (block edge) based on the Minnesota State Plane Grid (North Zone, NAD83, NAVD 88):

- Easting: 2,896,240.59081
- Northing: 728,838.73616
- Top elevation: 1,620
- Number of blocks in the X direction: 399
- Number of blocks in the Y direction: 122
- Number of blocks in the Z direction: 81

The model is rotated 33.94 degrees counter-clockwise around the origin giving the model X direction an azimuth of 56.06 degree. The block model matrix covers the area bounded by the coordinates listed in Table 14-13.

Table 14-13: Maximum and Minimum Coverage for the Block Model Matrix (edge to edge)

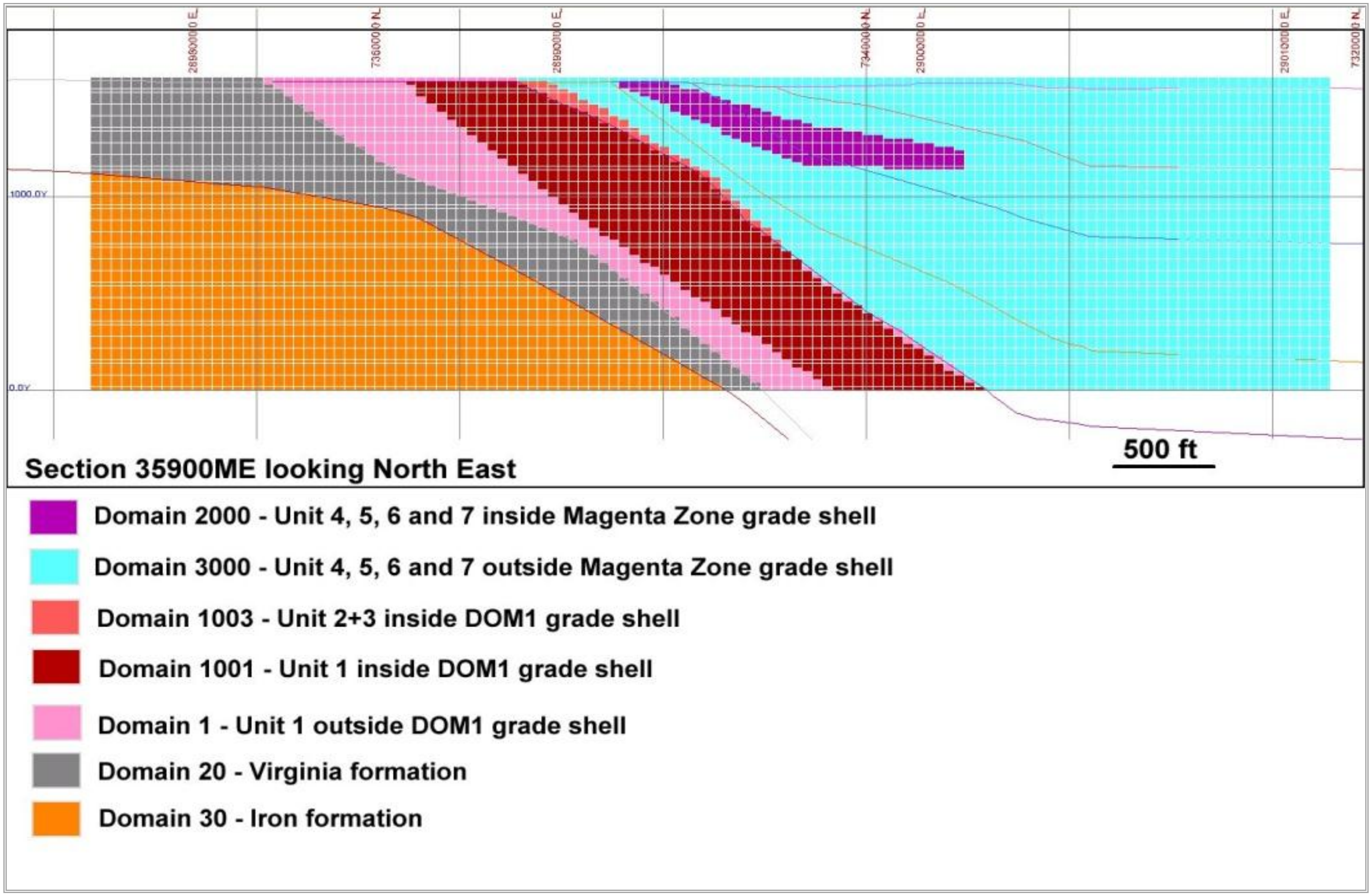
Coordinate	Minimum	Maximum
Easting	2892834.810	2912791.563
Northing	728838.736	745038.007
Elevation	0.00	1620

A unit model was assigned a code corresponding to the integer code of the lithological units. Blocks in this model have a value of 30, 20, 1, 3, 5, 6, or 7. A domain model was coded using the DOM1SOL, MAGZONE, and two Virginia Formation inclusions wireframe named CODE21 and RAMP-07 in the database. Blocks in this model have values of 1000 for the DOM1 grade shell, 2000 for the Magenta Zone grade shell, and 21 or 23 for the two major Virginia Formation inclusions. The final grade domain code was calculated in the Rocktype model using a block model manipulation script where the block integer code was assigned according to the matrix in Table 14-14 and illustrated in Figure 14-14 graphically.

Table 14-14: Grade Domain Coding Matrix

Domain Code	Unit Code						
	30	20	1	3 (2+3)	5 (4+5)	6	7
-	30	-	-	-	-	-	-
-	-	20	-	-	-	-	-
23	23	23	23	23	23	23	23
22	22	22	22	22	22	22	22
1000	-	-	1,001	1,003	-	-	-
2000	-	-	2,000	2,000	2,000	2,000	2,000
3000	-	-	-	3,000	3,000	3,000	3,000

Figure 14-14: Final Grade Domain Code in the Gemcom© Rocktype Model



14.9 Interpolation Plan

Interpolation was carried out in five passes with an increasing search radius coupled with a decreasing sample density restriction. The interpolation plan used for the NorthMet Deposit allows for a limited soft boundary across the grade shell domain DOM1 and its surrounding unit code. The soft boundary search was limited to the most restrictive Pass 1 search in order to avoid high grade smearing into the lower grade areas or vice versa, as the search ellipsoid becomes larger in the subsequent passes. With the exception of DOM1 grade shell boundary, the remaining grade domains were treated as hard boundaries.

The search ellipsoids orientation and dip were tweaked in this resource estimate to coincide better with the average strike and dip angle of the NorthMet Deposit. Grade shell DOM1 shows an average azimuth of 59.6° and dips towards the southeast at 28.6°. The Magenta Zone is flatter, exhibiting a strike of 51.7° dipping southeast at 14.5°. Units 1 and 20 were kept at the average deposit strike of 56.06° and dipping southeast at 30°.

Search ranges were based on the density of diamond drilling and the two main ore domain copper correlograms. Generally, the ratio between the major and semi-minor axis is 0.56 while the ratio between the semi-minor and minor axis was kept around 0.23 for Pass 1 to Pass 4 inclusively. The incremental ratio of the major axis between passes was 0.5, 0.66 and 0.45 respectively for Pass 1 to Pass 2, Pass 2 to Pass 3 and Pass 3 to Pass 4.

Table 14-15 summarizes the ellipsoid dimensions used in the different passes while Table 14-16 summarizes the search angle and search restriction imposed on the high grade outliers as described in the capping section (Section 14-4) of this report.

A series of model in the block matrix called Nbsamp1, Nbsamp2, Nbsamp3 and Nbsamp4 recorded the number of samples used to interpolate the blocks. These models were used in a block manipulation script to fill a PassNb model with a value of 1, 2, 3 or 4 representing at what pass a given grade was interpolated.

The target domain code and sample code controls the soft/hard boundary of the model. When a block is interpolated with a given target domain code the software will load the point file according to the grid listed in Table 14-17 and Table 14-18.

Table 14-15: Ellipsoid Dimensions

	Ellipsoid dimension (in ft)			Number of Samples Used			
	X	Y	Z	Min	Max	Max per hole	Comment
Pass 1	300	170	40	6	15	5	Minimum of two holes required
Pass 2	600	340	80	6	15	5	Minimum of two holes required
Pass 3	900	500	115	2	15	5	

	Ellipsoid dimension (in ft)			Number of Samples Used			
Pass 4	2,000	1,100	265	2	15	5	
Pass 5	8,000	6,000	1,200	2	15	5	Use to fill un-interpolated blocks

Table 14-16: Sample Search Parameters (all passes)

	Search Angle			Search Restriction Size and High Grade Threshold Value Used								
	Z	X	Z	Z	X	Z	Au (ppb)	Cu (%)	Ni (%)	Pd (ppb)	Pt (ppb)	S (%)
Dom 20, 22, 23	0	30	0	75	75	75	80	0.7	0.18	1000	200	7.5
Dom 1	-6	29	0	75	75	75	500	1.8	0.6	1600	450	7.5
Dom 1001	-6	29	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Dom 1003	-6	29	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Dom 3000	-5	18	0	75	75	75	500	2.1	0.4	4000	700	8
Dom 2000	4	15	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 14-17: Pass 1 – Target Domain Code and Sample Code Used

	20	1	1001	1003	3000	2000	22	23
20	x							
1		x	x					
1001		x	x					
1003				x	x			
3000				x	x			
2000						x		
22							x	
23								x

Table 14-18: Pass 2, 3, 4 and 5 – Target Domain Code Sample Code Used

	20	1	1001	1003	3000	2000	22	23
20	x							
1		x						
1001			x					
1003				x				
3000					x			
2000						X		
22							x	
23								x

The density model was initialized with the unit average density from Table 14-18. The density data collected by PolyMet was interpolated into the model using a simple inverse distance model with a fairly restrictive search ellipse of 300 ft x 300 ft x 75 ft. The minimum number of samples was set to six, the maximum was fifteen and a maximum of five samples per hole was imposed. In total, 3.22% of all the blocks in the model were interpolated by the inverse distance method.

14.9.1 Minor Elements

AGP carried out a geostatistical study of the elements that may have a measurable effect on stockpile drainage water quality for waste characterization and environmental purposes. The thirteen elements analyzed were silver, arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), manganese (Mn), molybdenum (Mo), phosphorus (P), lead, antimony (Sb), vanadium (V), zinc (Zn). The water quality elements grades were interpolated using an inverse distance square technique in a separate block model in GEMS version 6.04. The model matrix was replicated from the main resource grade model and thus occupies the same space.

14.10 Classification of Mineral Resources

Several factors are considered in the definition of a resource classification:

- Canadian Institute of Mining (CIM) requirements and guidelines
- experience with similar deposits
- spatial continuity
- confidence limit analysis
- geology

No environmental, permitting, legal, title, taxation, socio-economic, marketing or other relevant issues are known to the author that may affect the estimate of mineral resources. Mineral resources tabulated in section 14-11, are not mineral reserves and do not have demonstrated economic viability. Reserves can only be estimated on the basis of an economic evaluation that are used in a Pre-Feasibility or Feasibility Study of a mineral project and are tabulated in section 15-3 of this report.

Four confidence categories exist in the model. The usual CIM guidelines of Measured, Indicated and Inferred classes are coded 1, 2 and 3 respectively. A special code 4 called “Fill” in this report represents what are typically un-interpolated blocks. NorthMet requires that all blocks in the model carry sulphur value in addition to the six primary grade elements for environmental purposes and therefore a fourth and fifth pass was used, with a large search ellipsoid, so that all blocks in the model are populated with a grade value.

Typically, confidence level for a grade in the block model is reduced with the increase in the search ellipsoid size along with the diminishing restriction on the number of samples used for the grade interpolation. This is essentially controlled via the pass number of the interpolation plan describe in the previous section. A common technique is to categorize a model based on the pass number and distance to the closest sample. In numeric models with hard boundaries between grade domains the technique has a tendency to stripe the model with measured category in close proximity with inferred category. If the interpolation uses a minimum number of holes similar to pass 1 and pass 2 in the current model, this effect can be aggravated showing an indicated category in between drill holes where a series of blocks were interpolated with the pass 1 with a minimum of 2 drill holes restriction while the blocks located directly on the drillholes could not see the next hole end up classified as inferred.

For the NorthMet Deposit, AGP elected to classify the mineral resource primarily using the Pass number from the interpolation plan with help from a core area model to minimize having blocks in the measured category in close proximity with blocks in the inferred category.

The core area model represents the density of the drilling in the resource model based on two components; the position of the drillholes and the number of drillholes surrounding the blocks in the matrix. The model was created as follows:

- A model in the block model matrix called DDH175 was first created by assigning the percentage of the blocks inside a 175 ft extruded drillhole trace. The model was then interpolated with a inverse distance methodology using octant search with a round ellipse of 300 ft x 300 ft x 60 ft in order to fill the spaces in the immediate vicinity of the drill hole 175 ft extruded trace. The model contains values from 0 to 100% representing how far a block center is from a 175 ft extruded drillhole trace where 100% means the block is fully within the trace of the drillhole shown in the top right inset image of Figure 14-15.
- A second model called NBHoles was created in the block model matrix containing the same number of drillholes that are visible from a given block in the model within a 300 ft search bubble. The model contains values from 0 to 15 representing the number of drillholes visible within a 300 ft search bubble from the block center shown in the bottom left inset of Figure 14-15.
- A third and final model called Core was constructed in the block model matrix containing the combination of the DDH175 model and the NBHoles model weighted at a 25/75 ratio between the DDH175 and NBHoles model respectively. This procedure essentially eliminated the stripping effect visible in the DDH175 model for holes near the fringe area of the core while giving more weight to the number of drillholes visible from a block center. The resulting model carries an empirical value from 0 to 81.25 (average 7.131) describing more or less the number of drillholes visible to a block center in relation to the proximity to the nearest hole. A high value is well within the

core area drilled by PolyMet's NorthMet staff geologists while a low value is near the fringe. The core area values are shown in the main image Figure 14-15.

Figure 14-15: Core Area with Drillhole Traces

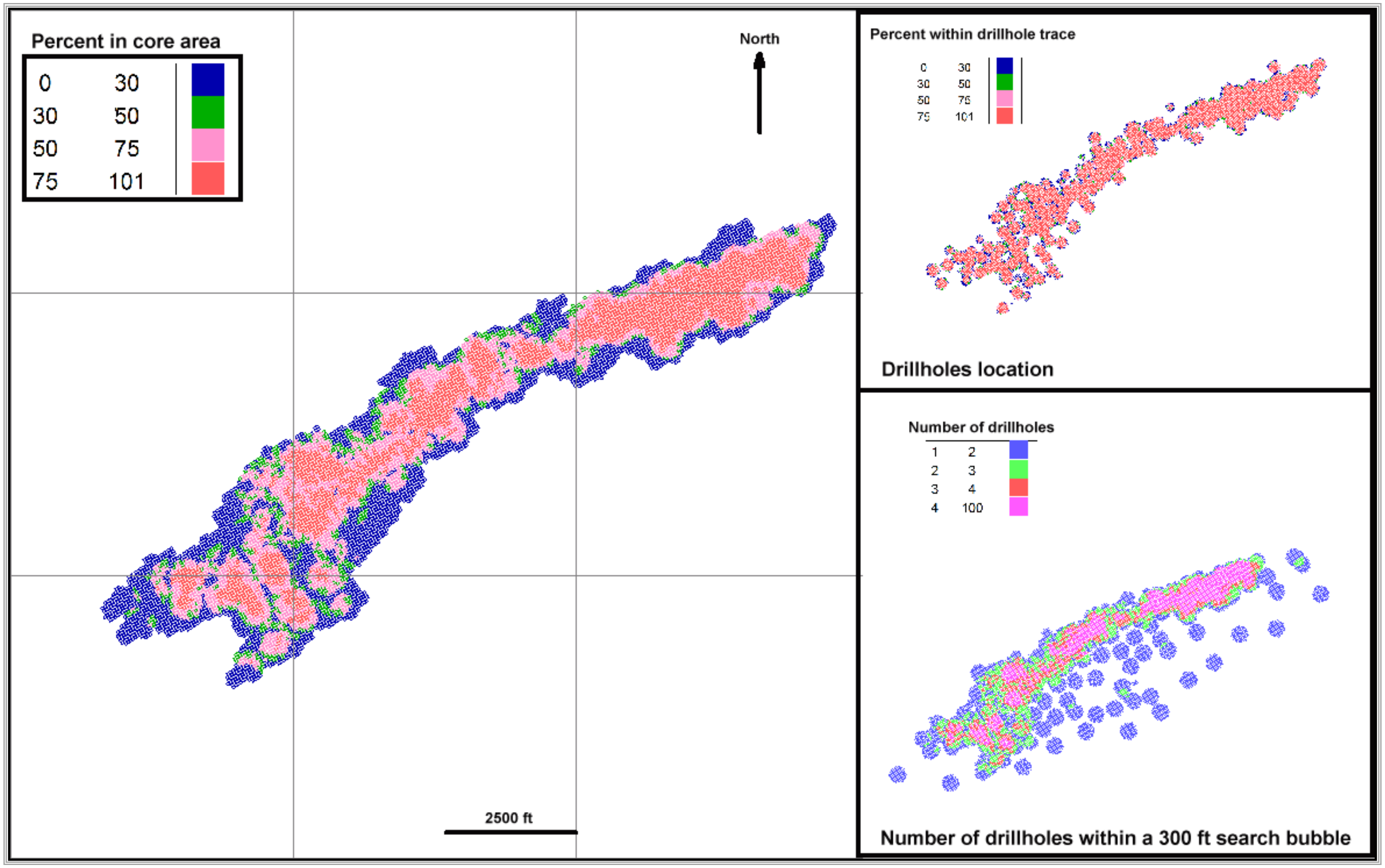
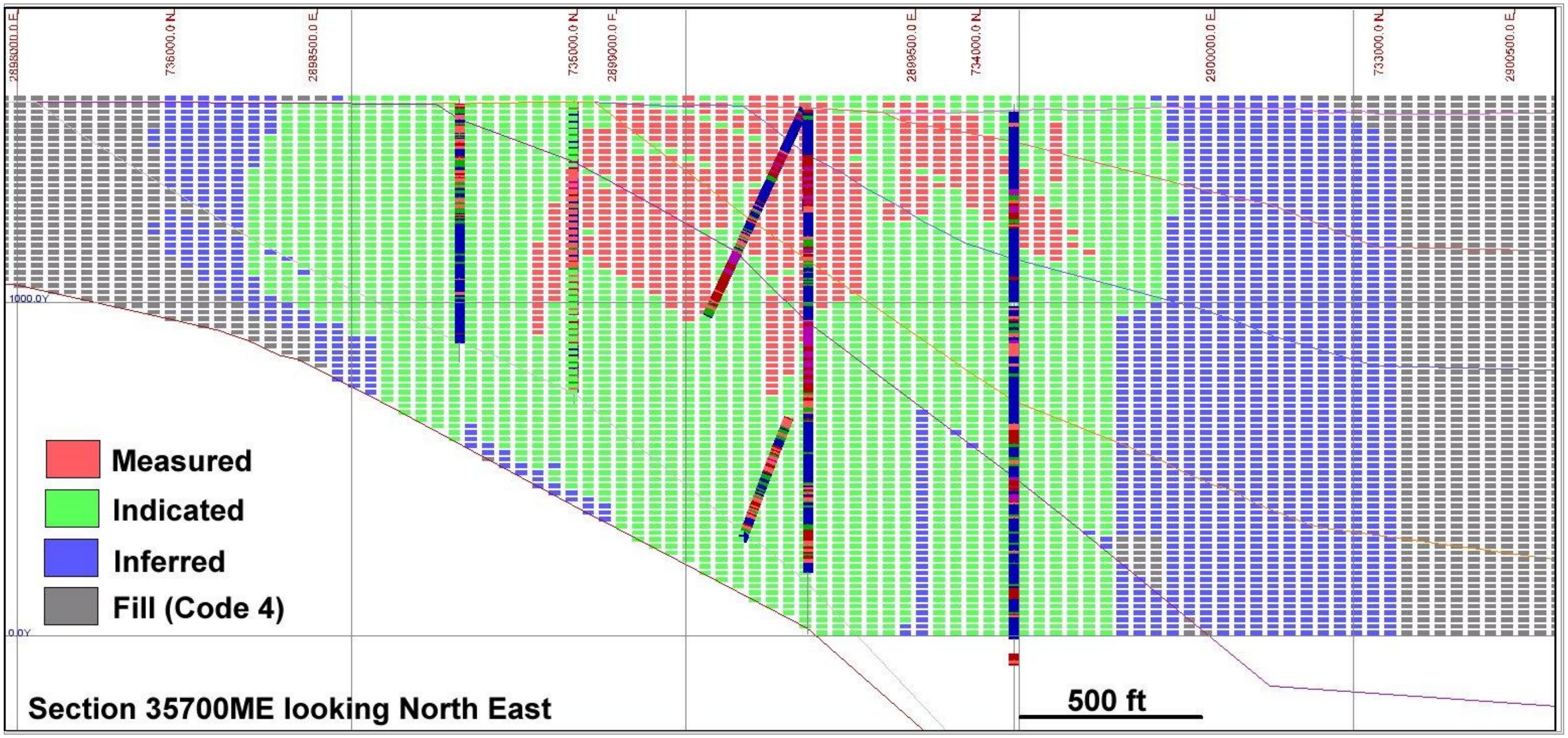


Figure 14-16: Section 35700ME Classification Model



The category model was coded using the pass number to define the Measured, Indicated and Inferred category in combination with the core area model as per schedule in Table 14-9 where a block located outside the core area was likely to be downgraded in category. The procedure allowed the fine tuning of the measured category.

Table 14-19 summarizes the classification parameters used for the category models. Based on the criteria outlined in

Table 14-20, 3% of the blocks estimated at the NorthMet project are classified as Measured, 14% of the blocks are Indicated and 22% of the blocks are Inferred. The remaining blocks are either non-interpolated, category 4 or "fill." Figure 14-6 shows a representative section of the category model.

Table 14-19: Classification Parameters

Pass Number	Inside Core	Outside Core
Pass 1	Measured if Core value > 75	Indicated
Pass 2	Indicated	Indicated
Pass 3	Indicated	Inferred
Pass 4	Inferred	Fill
Pass 5	Fill	Fill

Table 14-20: NorthMet Project Category Model Tabulation

Unit	Total No. of Blocks	Measured		Indicated		Inferred		Non-Interpolated or Fill	
		No. of Blocks	%	No. of Blocks	%	No. of Blocks	%	No. of Blocks	%
20, 1, 3, 5, 6, 7	2,829,567	109,992	3	560,643	14	880,740	22	1,278,192	32
30 or Air	1,113,351	-	0	-	0	-	0	1,113,351	28
Total Block	3,942,918								

14.10.1 Net Metal Value Formula

For comparison purposes, AGP was requested by PolyMet to use the same metal price and recovery figures used previously in the report titled "Technical Report on the Results of a Definitive Feasibility Study of the NorthMet Project" authored by D.J. Hunter and dated October 2006 and also used in the September 2007 resource model.

Net Metal Value is calculated as follows:

1) For all elements a net metal price is calculated:

Net Metal Price = (Metal price - Refining, insurance and transport charge)

2) For each element, a factor is calculated:

   a) *For Copper and Nickel (expressed in %):*

   *Factor = Net Metal Price * Recovery Ore to Conc. * Recovery Conc. To Metal * Conversion % to lbs*

   b) *For Cobalt (expressed in ppm):*

   *Factor = Net Metal Price * Recovery Ore to Conc. * Recovery Conc. To Metal * Conversion ppm to % * Conversion % to lbs*

   c) *For Platinum, Palladium and Gold (expressed in ppb):*

   *Factor = Net Metal Price * Recovery Ore to Conc. * Recovery Conc. To Metal * Conversion ppb to ppm * Conversion ppm to troy oz*

3) For all elements, the value per tonne is calculated in US$:

   *Value/tons = grade * factor*

4) Total NMV is the addition of the Value per tons for each element:

NMV = Value/tons Cu + Value/tons Ni + Value/tons Co + Value/tons Pt + Value/tons Pd + Value/tons Au

Table 14-21 lists the price, recoveries, refining, insurance and transportation charge used in the calculation. Conversion factors used are:

- percent to pounds per short ton multiply by 20
- ppm to percent multiply by 0.0001
- ppb to ppm multiply by 0.001
- ppm to troy ounces multiply by 0.02917 or (1/34.285).

Table 14-21: NMV Input Parameters

Metal in Model	Unit	Metal Price ($)	Refining, Insurance and Transport ($)	Recovery Ore – Concentrate	Recovery Concentrate – Metal
Copper (%)	US$/lb	1.25	0.00	0.9420	0.980
Nickel (%)	US$/lb	5.60	1.40	0.7250	0.970
Cobalt (ppm)	US$/lb	15.25	6.10	0.4200	0.970
Platinum (ppb)	US$/troy oz	800.00	18.00	0.7690	0.945
Palladium (ppb)	US$/troy oz	210.00	17.00	0.7960	0.945
Gold (ppb)	US$/troy oz	400.00	9.50	0.7570	0.885

14.11 Mineral Resource Tabulation

Table 14-22 shows resources below the overburden bottom surface to 0.00 elevation for Unit 20, 1, 3 (2+3), 5 (4+5), 6 and 7. The base case is using a cut-off grade of 0.2% copper.

Table 14-22: Resource Model Summary at 0.2% Cu Cut-off

Cut-off @ 0.2% Cu	Volume (M ft3)	Density (st/ft3)	Tonnage (M st)	Cu (%)	Ni (%)	S (%)	Pt (ppb)	Pd (ppb)	Au (ppb)	Co (ppm)
Measured	1,530.3	0.093	141.9	0.338	0.094	0.81	81	301	42	77
Indicated	3,244.0	0.093	300.2	0.318	0.087	0.78	81	287	41	72
M+I	4,774.3	0.093	442.1	0.325	0.089	0.79	81	292	41	73
Inferred	1,712.8	0.093	158.7	0.329	0.088	0.73	86	315	43	55

Table 14-23 shows the resource sensitivity to changes in cut-off with the base case cut-off highlighted.

Table 14-23: Cumulative Resource Model Results at Various Cu % Cut-offs (for sensitivity only)

Cut-off	Volume (M ft3)	Density (st/ft3)	Tonnage (M st)	Cu (%)	Ni (%)	S (%)	Pt (ppb)	Pd (ppb)	Au (ppb)	Co (ppm)
Measured										
>0.5	126.1	0.093	11.7	0.574	0.140	1.08	124	485	62	89
>0.4	395.8	0.093	36.7	0.485	0.125	1.01	108	417	55	86
>0.3	852.5	0.093	79.1	0.411	0.110	0.93	95	360	49	82
>0.2	**1530.3**	**0.093**	**141.9**	**0.338**	**0.094**	**0.81**	**81**	**301**	**42**	**77**
>0.1	2529.3	0.093	234.4	0.263	0.077	0.67	64	232	33	71
Indicated										
>0.5	207.2	0.093	19.2	0.577	0.131	1.04	138	509	69	80
>0.4	629.8	0.093	58.3	0.487	0.117	0.97	119	438	61	77
>0.3	1503.5	0.093	139.2	0.404	0.103	0.89	100	365	51	74
>0.2	**3244.0**	**0.093**	**300.2**	**0.318**	**0.087**	**0.78**	**81**	**287**	**41**	**72**
>0.1	7078.7	0.092	654.2	0.223	0.066	0.65	54	187	29	66
Inferred										
>0.5	137.4	0.093	12.8	0.607	0.139	1.04	160	635	85	66
>0.4	349.3	0.093	32.4	0.512	0.119	0.91	139	531	72	62
>0.3	875.8	0.093	81.3	0.411	0.105	0.83	108	407	53	58
>0.2	**1712.8**	**0.093**	**158.7**	**0.329**	**0.088**	**0.73**	**86**	**315**	**43**	**55**
>0.1	3133.6	0.092	289.6	0.246	0.068	0.62	62	221	32	52

Table 14-24 reports resources above an elevation of 0.00 ft using an NMV value of US$7.42 derived from the same metal prices and recoveries used previously in the Hunter, 2006 report and also in the Wardrop resource model dated September 2007.

Table 14-24: Resource Model Summary at US$7.42 NMV

Cut-off @ US$7.42 NMV	Volume (M ft3)	Density (st/ft3)	Tonnage (M st)	Cu (%)	Ni (%)	S (%)	Pt (ppb)	Pd (ppb)	Au (ppb)	Co (ppm)	NMV (US$)
Measured	2,185.03	0.093	202.5	0.285	0.083	0.71	71	258	36	74	14.58
Indicated	5,319.88	0.093	491.7	0.256	0.075	0.69	66	231	34	70	13.20
M+I	7,504.91	0.093	694.2	0.265	0.077	0.69	68	239	35	71	13.60
Inferred	2,484.53	0.092	229.7	0.273	0.079	0.65	73	263	37	56	13.97

14.12 Block Model Validation

The NorthMet grade models were validated by two methods:

- Visual comparison of colour-coded block model grades with composite grades on section plots.
- Comparison of the global mean block grades for ordinary kriging, inverse distance, nearest neighbour models, composite grades and raw assay grades.

14.12.1 Visual Comparisons

The visual comparisons of block model grades with composite grades show a reasonable correlation between the values. No significant discrepancies were apparent from the sections reviewed.

14.12.2 Global Comparisons

The grade statistics for the raw assay grade, composite grade, ordinary kriging, nearest neighbour and inverse distance models, are tabulated below in Table 14-25. Figures 14-17 and 14-18 show the differences. Grade statistics for composite mean grade compared to raw assay grade indicated a normal reduction in values for all elements. The block model mean grade when compared against the composites also indicated a normal reduction in values for all elements.

Percent changes in metal content shown in Table 14-26 between the nearest neighbour, inverse distance and ordinary kriging model are in very close agreement among all three methods with less than 2.0% difference in all elements except for cobalt showing 3.1% difference between the ordinary krig model and the nearest neighbour model.

Table 14-25: Global Grade Comparison at 0.00 Cu% Cut-off

Source	Cu (%)	Ni (%)	S (%)	Pt (ppb)	Pd (ppb)	Au (ppb)	Co (ppm)
Assay	0.160	0.055	0.44	40	140	21	62
Composite	0.119	0.041	0.38	31	105	16	47
Block NN with MII*	0.059	0.023	0.26	16	51	8	30
Block ID with MII	0.060	0.024	0.26	16	51	8	30
Block OK with MII	0.060	0.024	0.26	16	51	8	31
Block OK with MIIF*	0.052	0.022	0.24	15	45	6	30

Note: * MII – Measured, Indicated and Inferred. MIIF – Measured, Indicated, Inferred and Filled

Figure 14-17: Global Grade Comparison for Unit 1-7, Cu %, Ni % and S %

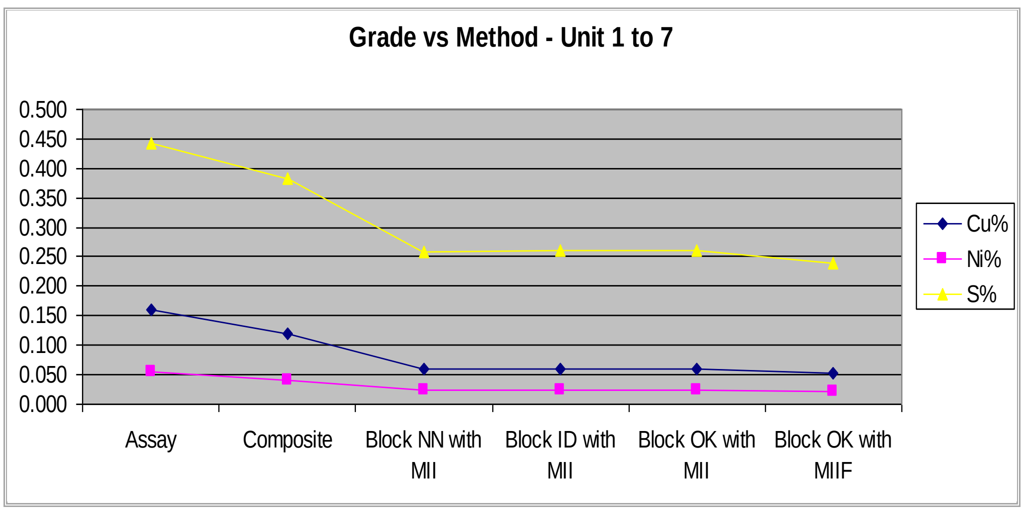


Figure 14-18: Global Grade Comparison for Unit 1-7, Pt (ppb), Pd (ppb), Au (ppb) and Co (ppm)

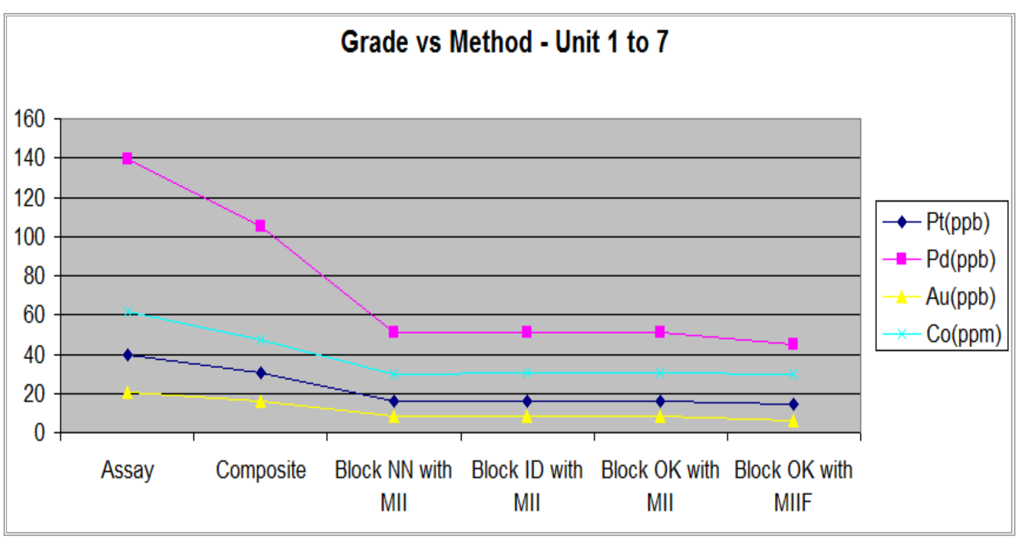


Table 14-26: Global Comparison at 0.00 Cu% Cut-off (Percent Difference in Metal Content)

Method	Cu % Diff	Ni % Diff	S % Diff	Pt % Diff	Pd % Diff	Au % Diff	Co % Diff
NN - Base case	0	0	0	0	0	0	0
OK – NN	1.9	1.6	0.6	1.4	1.0	1.2	3.1
ID – NN	1.5	0.8	0.6	1.3	0.6	0.8	1.6
OK – ID	0.4	0.8	0.0	0.1	0.4	0.5	1.5

14.12.3 Block Model Comparison with the Previous Resource Estimate

The December 2007 resource estimate was compared with the figure listed in Table 17-23 of the Wardrop, September 2007 report.

Volumes and tonnages were compiled for the December 2007 resource estimate from the overburden surface down to the 0.00 ft elevation. A NMV cut-off of US$7.42 was selected using the same metal price and recoveries used in the previous estimate.

Results shown in Table 14-27 indicated a slight increase of 15.5 million short tons in the Measured category and 40.5 million short ton in the Indicated category for a total of 56 million short tons or 8.1% increased in the Measured plus Indicated category. The Inferred Resource dropped by 21.9 million short tons or 9.5%.

Grades in the Measured and Indicated categories dropped slightly for copper and nickel and increased slightly for platinum, palladium, gold and cobalt grade elements. Copper changed by -0.3%, nickel by -0.5%, platinum by +2.1%, palladium by +1.8%, gold by +2.1% and cobalt by +0.1% as shown in Figure 14-19.

The contained metal value shown in Table 14-28 increased for all elements by about 10% in the Measured and Indicated categories. Copper increased by 8.5%, nickel by 8.2%, platinum by 11.1%, palladium by 10.8%, gold by 11.0% and cobalt by 8.9% as shown in Figure 14-20.

Figure 14-19: Resource above 0.00 ft Comparison – Grade

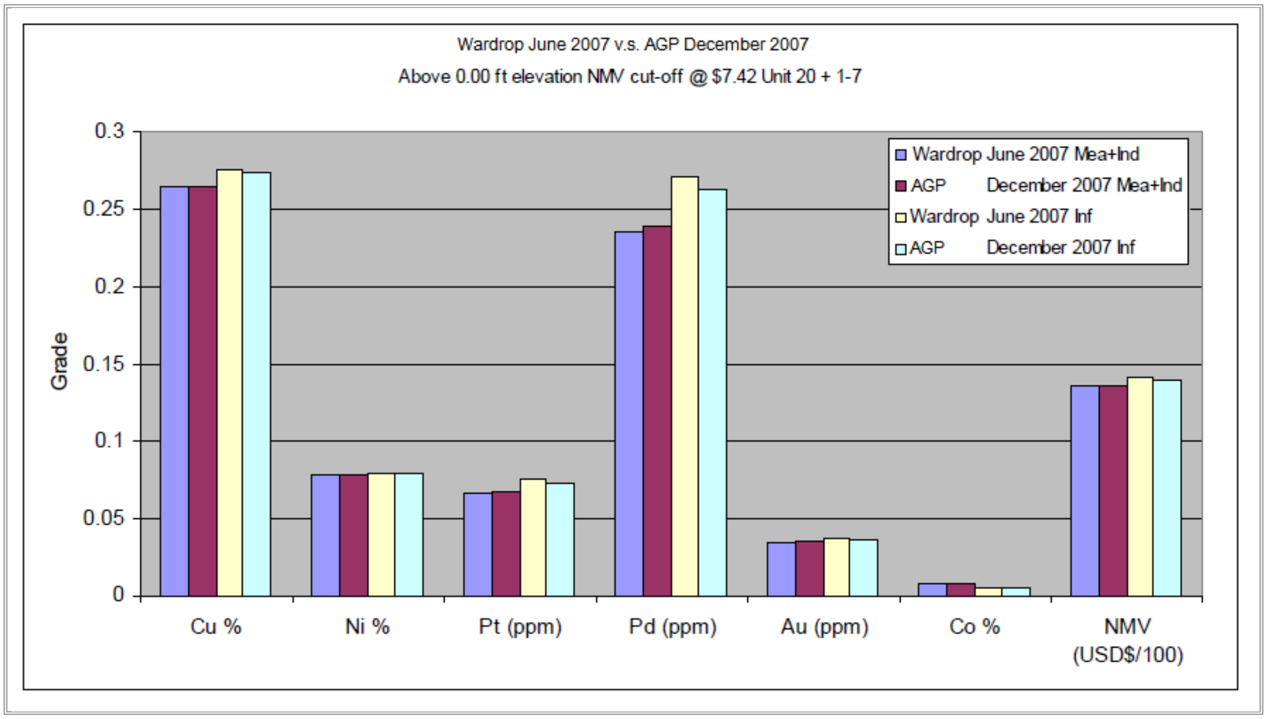


Figure 14-20: Resource above 0.00 ft Comparison – Product

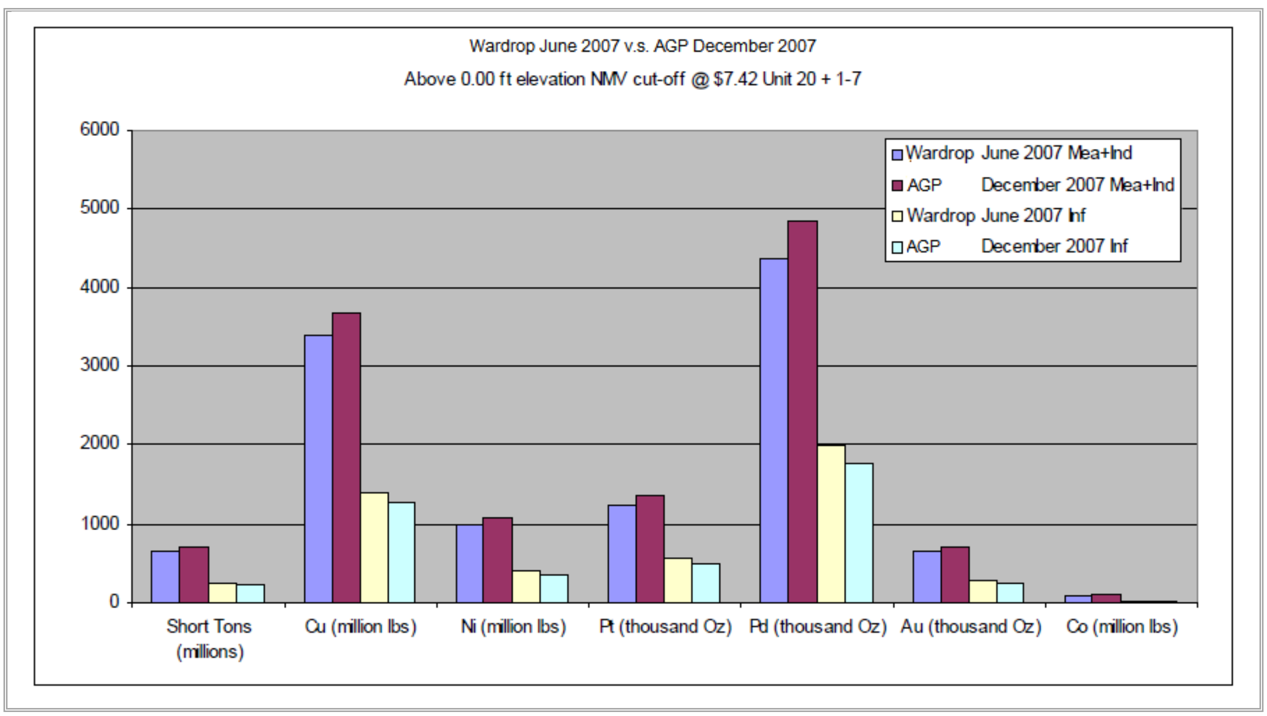


Table 14-27: Resource above 0.00 ft Comparison – Grade at US$7.42 NMV Cut-off

Source	Tonnage (Mst)	Cu %	Ni %	S %	Pt (ppb)	Pd (ppb)	Au (ppb)	Co (ppm)
Wardrop Jun 2007 - Measured	187.0	0.287	0.084	0.72	68	256	35	73
AGP Dec 2007 - Measured	202.5	0.285	0.083	0.71	71	258	36	74
	15.5	**-0.5%**	**-0.8%**	**-0.8%**	**3.9%**	**1.1%**	**2.7%**	**0.3%**
Wardrop Jun 2007 - Indicated	451.1	0.256	0.075	0.68	65	226	34	70
AGP Dec 2007 - Indicated	491.7	0.256	0.075	0.69	66	231	34	70
	40.6	**-0.1%**	**-0.4%**	**0.7%**	**1.4%**	**2.2%**	**1.8%**	**0.0%**
Wardrop Jun 2007 - Mea + Ind	638.2	0.265	0.078	0.69	66	234	34	71
AGP Dec 2007 - Mea + Ind	694.2	0.265	0.077	0.69	68	239	35	71
Difference (Dec - Jun)	**56.086**	**-0.001**	**0.000**	**0.002**	**1.414**	**4.255**	**0.701**	**0.075**
% Difference (Dec-Jun)	**8.8%**	**-0.3%**	**-0.5%**	**0.2%**	**2.1%**	**1.8%**	**2.1%**	**0.1%**
Wardrop Jun 2007 - Inferred	252	0.275	0.079	0.64	76	272	37	56
AGP Dec 2007 - Inferred	230	0.273	0.079	0.65	73	263	37	56
Difference (Dec - Jun)	**-21.921**	**-0.002**	**0.000**	**0.013**	**-3.450**	**-8.800**	**-0.476**	**0.544**
% Difference (Dec-Jun)	**-8.7%**	**-0.6%**	**-0.2%**	**2.0%**	**-4.5%**	**-3.2%**	**-1.3%**	**1.0%**

Table 14-28: Resource above 0.00 ft Comparison – Product at US$7.42 NMV Cut-off

Source	Tonnage (Mst)	Cu (Mlb)	Ni (Mlb)	S (Mlb)	Pt (Koz)	Pd (Koz)	Au (Koz)	Co (Mlb)
Wardrop Jun 2007 - Measured	187.0	1072	314	2680	372	1394	192	27
AGP Dec 2007 - Measured	202.5	1154	337	2879	418	1526	214	30
	15.5	**7.7%**	**7.5%**	**7.4%**	**12.5%**	**9.4%**	**11.2%**	**8.7%**
Wardrop Jun 2007 - Indicated	451.1	2314	680	6150	860	2969	442	63
AGP Dec 2007 - Indicated	491.7	2519	738	6749	950	3307	491	68
	40.6	**8.8%**	**8.5%**	**9.7%**	**10.5%**	**11.4%**	**10.9%**	**9.0%**
Wardrop Jun 2007 - Measured + Indicated	638.2	3,386	994	8,830	1,232	4,363	634	90
AGP Dec 2007 - Measured + Indicated	694.2	3,673	1,075	9,628	1,369	4,833	704	98
Difference (Dec - Jun)	**56.1**	**287.3**	**81.5**	**798.0**	**136.9**	**469.6**	**69.9**	**8.0**
% Difference (Dec-Jun)	**8.8**	**8.5**	**8.2**	**9.0**	**11.1**	**10.8**	**11.0**	**8.9**
Wardrop Jun 2007 - Inferred	252	1385	397	3204	560	1994	272	28
AGP Dec 2007 - Inferred	230	1257	361	2983	488	1761	245	26
Difference (Dec - Jun)	**-21.9**	**-128.8**	**-35.5**	**-221.0**	**-71.9**	**-232.7**	**-26.9**	**-2.2**
% Difference (Dec-Jun)	**-8.7**	**-9.3**	**-8.9**	**-6.9**	**-12.8**	**-11.7**	**-9.9**	**-7.8**

15 MINERAL RESERVE ESTIMATES

15.1 Key Assumptions/Basis of Estimate

Mineral Reserves for Northmet are supported by a LOM plan which was developed using the following key parameters.

15.1.1 Pit Slopes

The June 2006 Golder report provided parameters for the Reserve statement. The Golder report was also used as the basis for the DFS Update.

The Golder report indicated inter-ramp angles of 51.4 degrees for all sectors, except one, were possible. That one sector utilized an inter-ramp angle of 55.1 degrees and was achieved with a bench face angle of 70 degrees versus the other sectors 65 degree face angle. In all cases, a berm width of 32.8 feet (10 metres) was considered.

The area impacted by the increased bench face angle was minimal. To simplify the pit design, all areas were designed with a bench face angle of 65 degrees, 32.8 foot berm width to achieve an inter-ramp angle of 51.4 degrees.

15.1.2 Stope *Considerations*

The NorthMet Deposit outcrops in the project area. It is lower grade than typical underground deposits and more disseminated, not providing focused areas of higher grade ore. Due to this, AGP considered only an open pit configuration. No underground mining methods were examined for the purposes of stating reserves.

15.1.3 Dilution and Mining Losses

The Mineral Resource estimate for Northmet is considered to be internally diluted. Additional external dilution adjustments were made at the time of ore and waste delineation for mine planning purposes.

To all blocks above cutoff, an examination of contact dilution was completed. The blocks surrounding an individual block being queried were examined to determine if they were below cutoff. If they were, their weighted average grade was estimated. This was applied to block and a diluted grade by element determined. On average, the dilution percentages for the entire model were:

- Copper = 2.2%
- Nickel = 2.5%
- Platinum = 2.4%
- Palladium = 2.6%
- Gold = 2.3%
- Cobalt = 0.8%

AGP assumed that the ore loss was equal to the dilution tonnage, so the effect of dilution was only a reduction in overall grade but the tonnage remained constant. Considering the bulk nature of mining proposed, AGP deemed this to be appropriate.

15.2 Conversion Factors from Mineral Resources to Mineral Reserves

Mineral Reserves have been determined from Mineral Resources by taking into account geologic, mining, processing, economic parameters and permitting requirements and are therefore classified in accordance with the CIM Definition Standards for Mineral Resources and Mineral Reserves.

15.3 Mineral Reserves Statement

The Qualified Person for the Mineral Reserve estimate is Gordon Zurowski, P.Eng, a principal of AGP Mining Consultants Inc.

Mineral Reserves are reported at commodity prices of:

- Copper = $1.25 /lb
- Nickel = $5.60 /lb
- Platinum = $800.00 /troy ounce
- Palladium = $210.00 /troy ounce
- Gold = $400.00 /troy ounce
- Cobalt = $15.25 /lb

These prices were used to generate the DFS pit shell, within which the reserves were contained. This pit shell is the same design as outlined in the DFS study published October 2006 and developed by Australian Mine Design & Development Pty Ltd. (AMDAD). This pit shell was applied to the updated resource model.

A mining cutoff was used by AGP that was determined on a block by block basis with the following formula:

Block Value ($) = Gross Metal Value – Mining Cost – Processing cost – G&A.

Where:

- Block Value = net value of the block in dollars
- Gross Metal Value = value of metals considering price, recovery and downstream costs
- Mining Cost = cost to mine ore and waste adjusted for haulage path
- Processing Cost = cost to process ore tonnes
- G&A = anticipated General and Administrative costs

The block value was stored in each block and a cutoff where the block value was greater than or equal to $0.01. This implies that the block would make $0.01 or greater of net revenue (not considering capital) to mine the block and process it for the contained metal. Blocks with a value of $0.00 or less were deemed to be waste material.

Table 15-1 Updated Reserve Estimate – September 2007

Class	Tonnage (Mst)	Grades (Diluted)					
		Copper (%)	Nickel (%)	Platinum (ppb)	Palladium (ppb)	Gold (ppb)	Cobalt (ppm)
Proven	118.1	0.30	0.09	75	275	38	75
Probable	156.5	0.27	0.08	75	248	37	72
Total	274.7	0.28	0.08	75	260	37	73

The following notes should be read in conjunction with Table 15-1:
Rounding as required by reporting guidelines may result in apparent summation differences between tons, grade and contained metal.
Tonnage and grade measurements are in Imperial units.
The reserves are bound within the DFS pit shell.

15.4 Factors That May Affect the Mineral Reserve Estimate

The mine reserves are based on the complete DFS pit shell from the 2006 study, using the updated geologic resource as of September 2007. AGP has developed and prepared costing for a larger pit, but restricted the final phase in the detailed work to maintain similar production tonnage to the September 2007 reserve statement. If Polymet were to decide to extend the mine life, the additional phase (32.5 million tons) could readily be brought into the reserve category indicating potential upside to the project with an additional 2.8 years.

A sustained higher metal price regime has the potential to allow expansion of the existing pit phases both laterally and to depth. In addition, higher metal prices may assist in lowering the cutoff grade within each phase if sufficient plant and stockpile capacity exist.

The project is pursuing environmental permitting which may restrict the overall potential of the proposed mine, although the resources outside the current permit plan indicates that further constraint is unlikely. Any conditions from the permitting review may have the potential to reduce the overall size of the project. These would need to be examined in detail to see what impact, if any potential conditions may have.

16 MINING METHODS

16.1 Background

PolyMet requested an update of the 2006 DFS plan to take into consideration various changes since the release of the DFS report. These included:

1) Additional drill results which resulted in an updated and reinterpreted NorthMet resource model used for this report,

2) Updated capital and operating costs from vendors and suppliers to reflect current market conditions,

3) Change in equipment selection criteria to larger more productive fleets,

4) Implement owner operated mining rather than contractor mining,

5) Altered mining sequence to improve the mine environmental footprint.

The 2007 resource update was the basis for the updated production schedule developed in this DFS Update. This resource update was a collaborative effort between AGP and Polymet team members. The impact of adding new resources to the NorthMet project were to be examined to allow Polymet management understand the full potential of the NorthMet Deposit and its potential for future mining enhancements.

The property was visited by AGP mining personnel in October 2007. This was to become familiar with the deposit, Polymet personnel and their areas of expertise. It was also to better understand what opportunities may exist in the area of the NorthMet Deposit to assist in improving overall project economics and environmental footprint.

Capital and operating cost estimates in U.S. dollars were determined with current parameters from suppliers and vendors. PolyMet and AGP personnel worked together to determine the complete capital requirements and ensure items were not forgotten in the overall cost estimate.

An internal study examined the potential benefit of larger mining equipment to reduce operating cost and mine emissions. This study indicated that bulk mining fleets offered cost savings that needed to be fully quantified. This was examined.

The DFS project economics utilized contract mining for operating costs. PolyMet management felt that costs savings to the overall project could be achieved by operating the mine themselves and limit the contracting to maintenance and other support services. This was considered for the reserves update.

Subsequent changes that will be incorporated into project proposal to be described in the Supplemental Draft EIS include altering the mining sequence so that the eastern pit becomes available for backfilling.

With this direction, AGP was instructed to create an update of the DFS plan in sufficient detail to allow a new 43-101 report be issued if required. An updated reserve statement was to be developed at the culmination of the work.

16.2 Geotechnical

No update on the geotechnical parameters has been completed since receipt of Golder's June 2006 report. The Golder report was used as the basis for the DFS Update.

The Golder report indicated inter-ramp angles of 51.4 degrees for all sectors, except one, were possible. That one sector utilized an inter-ramp angle of 55.1 degrees and was achieved with a bench face angle of 70 degrees versus the other sectors 65 degree face angle. In all cases, a berm width of 32.8 feet (10 metres) was considered.

The area impacted by the increased bench face angle was minimal. To simplify the pit design, all areas were designed with a bench face angle of 65 degrees, 32.8 foot berm width to achieve an inter-ramp angle of 51.4 degrees.

16.3 Mining Model Development

The geologic block model was constructed in Gemcom© by AGP with the assistance of PolyMet personnel. This model was then imported into Minesight© for use in the pit optimizations and production schedule development. The dimensions of the models remained the same for the mining models. Items that were brought across were:

- Rock Type
- Density
- Classification (Measured, Indicated and Inferred)
- Rock Type
- Unit
- Domain
- Specific Gravity
- Copper grade (%)

- Nickel grade (%)
- Sulphur (%)
- Platinum grade (parts per billion)
- Palladium grade (parts per billion)
- Gold grade (parts per billion)
- Cobalt grade (parts per million)

PolyMet provided topography and overburden surfaces for use in both the geologic model and mining model.

A recovery item was included in the mining model to consider the impact lower grades would have on recovery. A fixed recovery for all grade items was used in DFS which AGP deemed potentially optimistic for very low grade material without detailed testing at the lower grades.

To examine the impacts of lower grade, a fixed tail recovery formula was applied to each block for each grade item. PolyMet provided the tail grades that had been determined from the previous round of metallurgical testing for the copper and nickel grades. The assumption was made that below this tail grade, the recovery would be zero. The lower limits used for the DFS recoveries were:

- Copper 0.25% Cu
- Nickel 0.101% Ni

It was also assumed that if the copper recovery was zero, the platinum, palladium, gold and cobalt recoveries would also be zero. While practically this would not be the case, with little information to define the recoveries for these elements at the low levels AGP believed this to be a reasonable approach to examine sensitivity of the model to this parameter.

The DFS recoveries used have been shown in the Table 16-1.

Table 16-1 DFS Recoveries and Fixed Tail Grades

Grade Element	DFS Recovery (%)	Fixed Tail Grade (%)	DFS Update Recovery (%)
Copper	92.33	0.025	Variable
Nickel	70.34	0.030	Variable
Platinum	72.69		72.69
Palladium	75.24		75.24
Gold	67.04		67.04
Cobalt	40.75		40.75

The recovery for copper in each block was completed with the logic shown in Table 16-2.

Table 16-2 Recovery Calculation for Copper and Nickel

Grade Element	Recovery %	Formula
Copper		
Copper % < 0.025%	0%	RCu = 0%, RPt, RPd, RAu, RCo = 0%
0.025% < Copper % < 0.25%	variable	RCu = ((Cu% - 0.025)/Cu%) x 100
Copper % > 0.25%	92.33%	RCu = 92.33%
Nickel		
Nickel % < 0.03%	0%	RNi = 0%
0.03% < Nickel % < 0.101%	variable	RNi = ((Ni% - 0.03)/Ni%) x 100
Nickel % > 0.101%	70.34%	RNi = 70.34%

The recovery items in the model are:

- RCu = Copper recovery
- RNi = Nickel recovery
- RPt = Platinum recovery
- RPd = Palladium recovery
- RAu = Gold recovery
- RCo = Cobalt recovery

The calculated recoveries were used in the economic pit determination.

16.4 Economic Pit Development

In the determination of the economic pits, various items were required. These included:

- Metal prices
- Mining cost
- Milling cost
- General and Administrative costs
- Geotechnical parameters

Metal prices for use in the design of the economic pit shells were based upon the DFS values. A second price regime was examined to determine the benefit a slight change in metal price would have on the overall pit size.

The three-year average price was examined for the period of October 12th, 2004 to October 12, 2007 for comparison to the DFS values. Those values have been illustrated in Table 16-3 with the other two price regimes.

Both of the metal price scenarios were below the current 3-year average prices highlighting the conservative approach taken to the long-term mine development.

Table 16-3 Metal Price Comparison

	Units	3 Year Average Metal Prices	DFS Metal Prices	Economic Case Metal Price
Copper	$/pound	2.52	1.25	1.50
Nickel	$/pound	11.01	5.60	6.50
Platinum	$/ounce	1,076	800	900
Palladium	$/ounce	283	210	225
Gold	$/ounce	555	400	450
Cobalt	$/pound	19.21	15.25	15.25

Table 16-4 shows the metal prices used and the realized values for economic pit determination. The realization values were provided by PolyMet based on the work completed previously for the DFS and represent the net metal price with consideration for transportation, treatment and refining.

Updated cost estimates since the completion of the DFS design have allowed a refining of the mining cost. This included fuel and electricity prices as well as equipment operating cost estimates obtained from vendors. An examination of the processing, general and administrative and rail haulage costs was also completed. These have been compared to the DFS values in Table 16-5.

Table 16-4 Economic Pit Shell Metal Prices and Realized Value

	Units	DFS Metal Prices	Realization Value	Net Price
Copper	$/pound	1.25	0%	1.25
Nickel	$/pound	5.60	25%	4.20
Platinum	$/ounce	800	18.00 $/ounce	782
Palladium	$/ounce	210	17.00 $/ounce	193
Gold	$/ounce	400	9.50 $/ounce	390.50
Cobalt	$/pound	15.25	40%	9.15

Table 16-5 Updated Pit Optimization Costs

Cost Item	Units	DFS	Updated DFS
Mining	$/ton	$1.30	$1.01
Incremental Haulage	$/ton/20 foot bench	$0.02	$0.00
Rail Haulage	$/ton ore	$0.25	$0.16
Processing	$/ton ore	$5.96	$6.97
General & Administrative	$/ton ore	$1.62	$0.51

The total mining cost of $1.01 per ton mined was based on the average cost over the life of the mine. This balances mining at the lower depths with mining at higher elevations as phases would be depleted and new phases initiated. The lower cost was also developed using 240 ton trucks matched to 29 cubic yard hydraulic shovels versus the smaller sized fleet that had been proposed for the DFS.

The total for rail haulage, processing and G&A in the DFS was $7.83 per ton of ore. PolyMet provided the updated costs for rail haulage, processing and G&A which were $7.64 per ton of ore.

A review of the previous design indicated that an overall angle of 48 degrees was suitable for use in the economic pit development as it mimicked the final DFS design with ramps included.

A series of economic pits were developed to examine the impact of:

- Metal Prices
- Recoveries

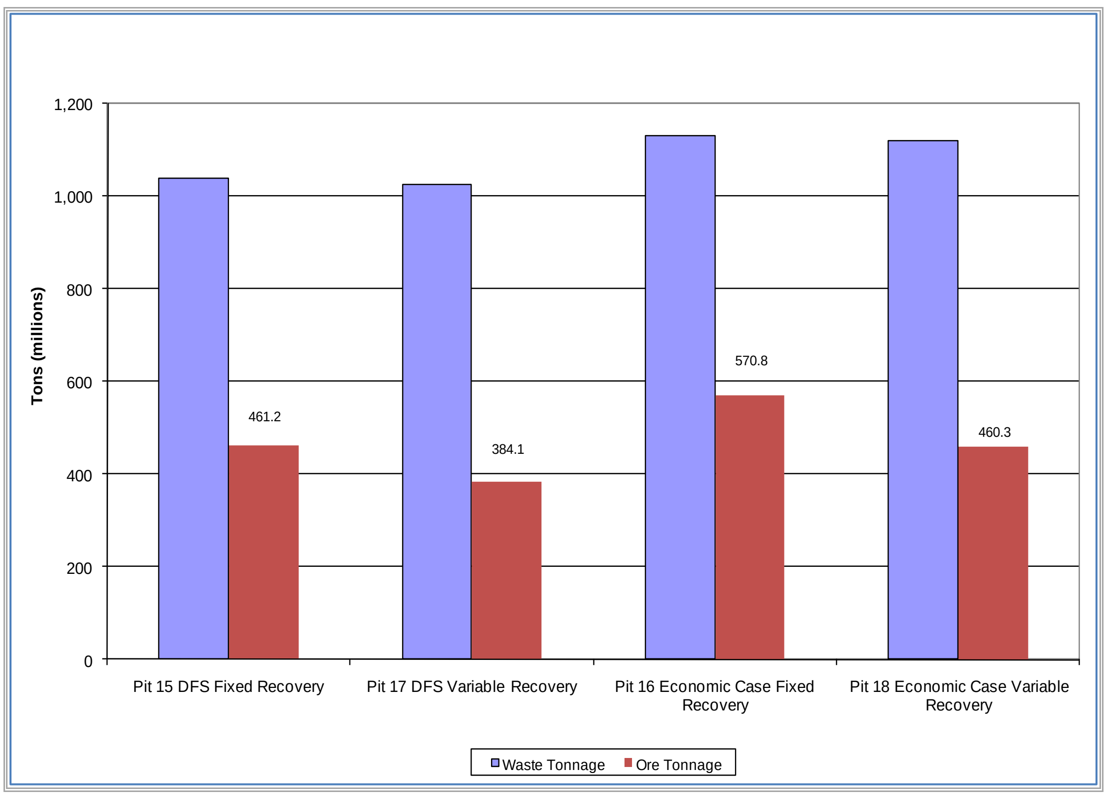
The economic pit shell routine used in Minesight© incorporated a Lerch-Grossman routine. The first set of economic pits utilized DFS costs with both fixed and variable recovery. The next set used the Economic Case metal prices for both fixed and variable recovery. In both sets, the variable recovery resulted in an ore tonnage reduction when compared to the fixed recovery for the same metal price scenario. For the DFS price case, this was a 20 % reduction while the Economic case was a 24% reduction. The Economic case with its higher metal prices included additional lower grade material from a lowering of the internal cutoff versus the DFS price case. This resulted in a greater influence of the lower recoveries for the low grade ore. Further testing of the recovery at low grades would be required prior to development.

The results of that analysis have been included in Table 16-6 and depicted in Figure 16-1.

Table 16-6 Economic Pit Shell Results

		DFS Prices		Economic Case Prices	
Item	Units	Fixed Recovery	Variable Recovery	Fixed Recovery	Variable Recovery
Ore	tons (millions)	461.2	384.1	570.8	460.3
Copper	%	0.29	0.32	0.27	0.30
Nickel	%	0.08	0.09	0.08	0.09
Platinum	ppb	77	82	70	77
Palladium	ppb	270	291	245	272
Gold	ppb	39	41	36	39
Cobalt	ppm	74	76	73	74
Waste	tons (millions)	1,039.0	1,023.3	1,130.4	1,119.1
Total	tons (millions)	1,500.2	1,407.4	1,701.2	1,579.4
Strip Ratio		2.25	2.66	1.98	2.43

Figure 16-1: Economic Pit Shell Comparison



The economic pit which considered the DFS metal prices and variable recovery was used for the updated NorthMet pit design. This was designated Pit 17 based on the iteration that was examined. This represented a conservative approach to the determination of the economic pit with the inclusion of the variable recovery and the DFS prices.

The economic pit represented the ultimate pit shape. Phasing was required to optimize the mining sequence for production purposes and waste stockpile management. Additional pit optimizations were completed that considered a reduction in metal prices relative to the Base Case pit (Pit 17). The reductions ranged from:

- -10%
- -12%
- -14%
- -16%
- -18%
- -20%

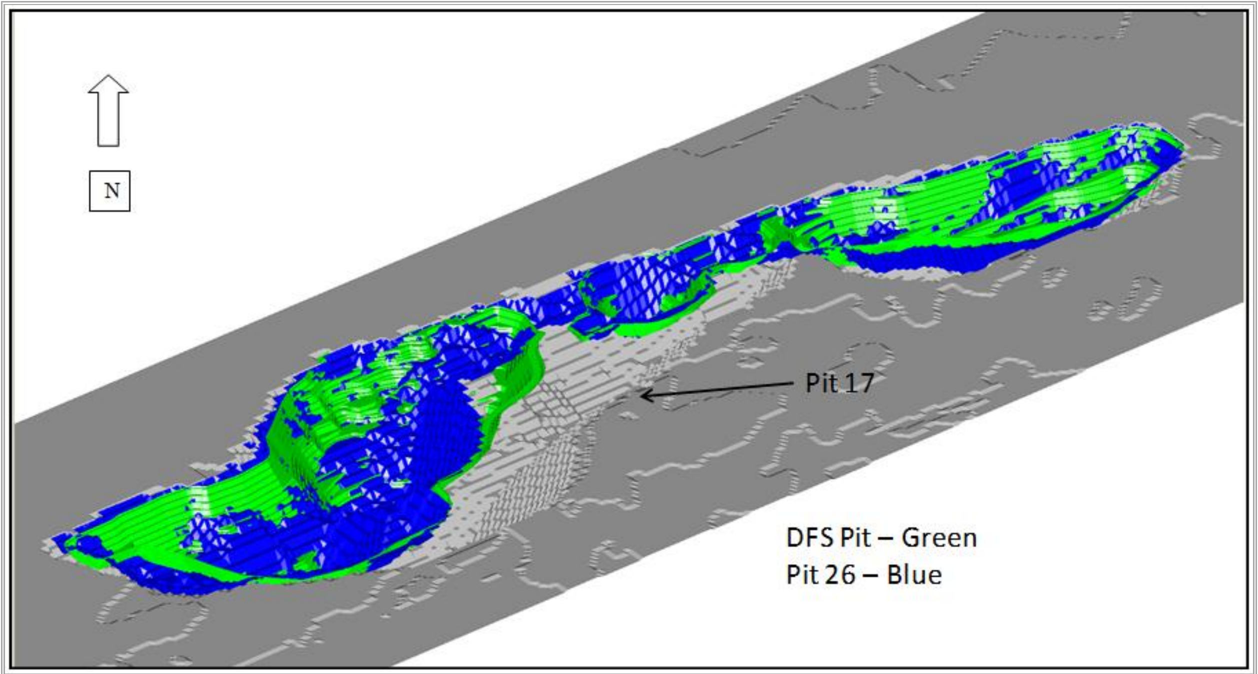
These price reductions were applied to all the metals not just copper and nickel. The realized metal prices used have been shown in Table 16-7. Based on the analysis, shell 26 (-18%) mimicked the DFS pit and was chosen for use in the development of the final design.

Table 16-7 Realized Metal Price Values

	Copper $/pound	Nickel $/pound	Platinum $/ounce	Palladium $/ounce	Gold $/ounce	Cobalt $/pound
Base Case	1.25	4.20	782.00	193.00	390.50	9.15
-10%	1.13	3.78	703.80	173.70	351.45	8.24
-12%	1.10	3.70	688.16	169.84	343.64	8.05
-14%	1.08	3.61	672.52	165.98	335.83	7.87
-16%	1.05	3.53	656.88	162.12	328.02	7.69
-18%	1.03	3.44	641.24	158.26	320.21	7.50
-20%	1.00	3.36	625.60	154.40	312.40	7.32

This indicated that the DFS pit was well within the metal price regime chosen with much lower prices than used in the Base Case design. This shell has been shown in Figure 16-2 for comparison with the Base Case (Pit 17) as the base topography. There were two distinct lobes mined in the smaller configuration; an eastern and western side. This same arrangement was implemented in the final design. Pit 26 extends further to the west on the western side while it is slightly smaller on the north east side of the western area. This concept was incorporated into the final design.

Figure 16-2: Comparison of DFS Pit against Pit 26 (-18% metal price) with Base Case (Pit 17)



16.5 Final Pit Design

The final design, for the purpose of this technical report, took Pit 26 and broke it into three areas and several phases within each area. The areas were east, west and middle. This was based on economic pit development with prices reduced by 30, 35 and 40 percent. In this way, the most economic material was highlighted and was targeted with an earlier phase. The eastern side had five discrete phases developed, while both the east and west had three phases each. These are shown in Figure 16-3 in an abbreviated form. The values ending in"E" refer to eastern pits, in "W" are west and "M" are the middle pits.

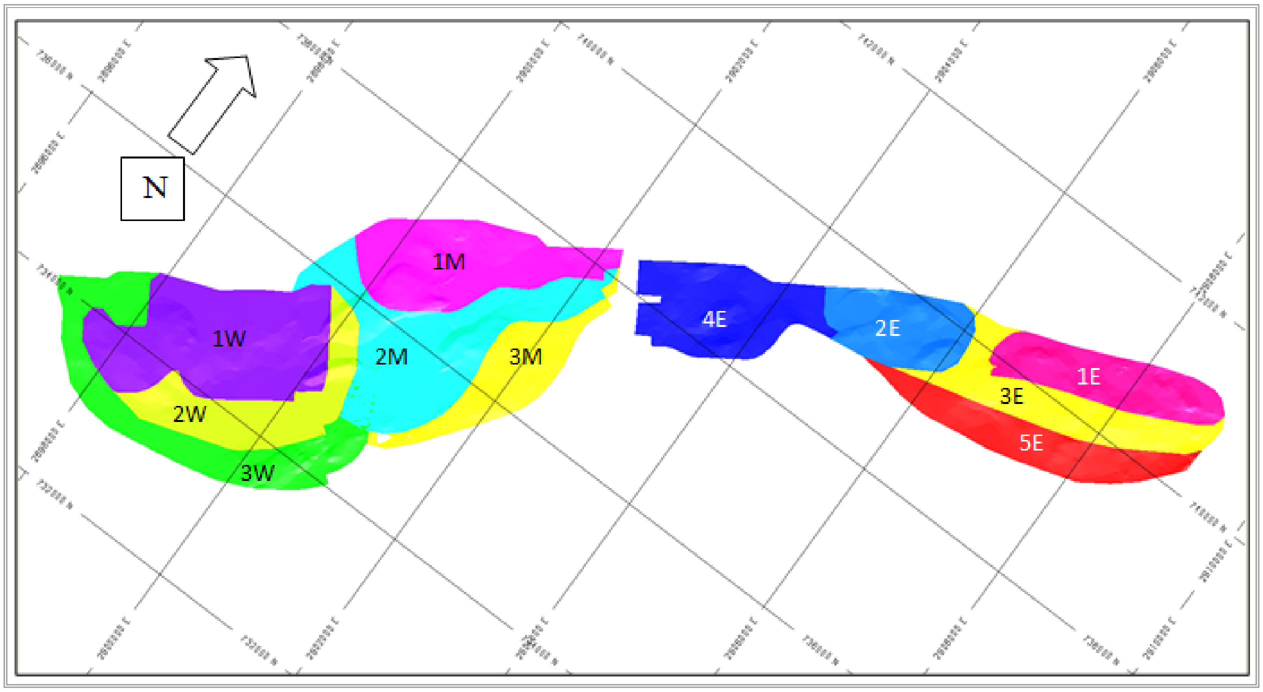
As previously stated, detailed mine planning, waste characterization and waste handling are being updated for the Supplemental Draft EIS.

The eleven phases were developed following the Golder recommendations of:

- Inter-ramp angle = 51.4 degrees
- Bench face angle = 65 degrees
- Safety bench width = 35 feet
- Safety bench interval (vertical) = 100 feet

Mining in the pit was designed for 240 ton trucks. A road width of 122 feet was required to allow 3.5 times the truck width plus berm and ditches. All ramp gradients were at 8%.

Figure 16-3: Mine Areas and Phases



Reserves for each of the mining phases was calculated and tabulated. The cutoff used was based on a net value calculation. Each block was assigned a mining cost, processing cost, general and administrative cost and revenue. These were then calculated on a block by block basis with the following logic:

- Value per block = Revenue – Mining cost – Processing - G&A cost
- Value per ton = Value per block/ block tonnage
- Revenue = grade item recovery x element grade x realized price x block tons
- Mining Cost = block tons x mining cost
- Processing Cost = block tons x processing cost
- G&A Cost = block tons x G&A cost

The cutoff for the reserves was based on the value per ton being greater than zero dollars:

- Cutoff Value per ton > $0.00

The result was a net value per ton mined or net smelter value. The average net value by phase has been shown inFigure 16-4 and Table 16-8.

Figure 16-4: Phase Net Value per Ton

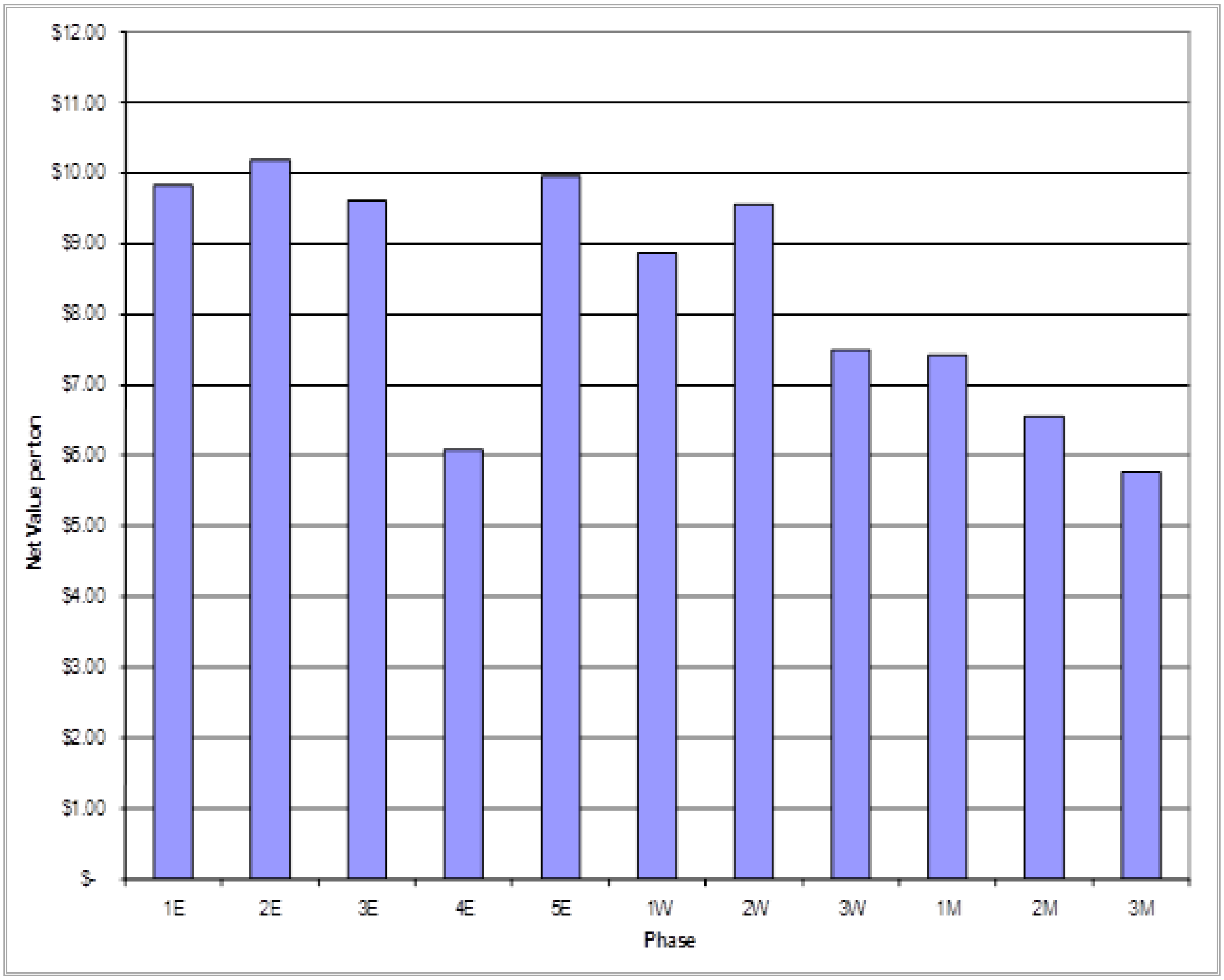


Table 16-8: Net Value per Phase and Area

	East					West			Middle		
Phase	1E	2E	3E	4E	5E	1W	2W	3W	1M	2M	3M
$/ton	9.83	10.18	9.61	6.09	9.97	8.86	9.56	7.50	7.43	6.55	5.77
Average	$9.27/ton					$8.49/ton			$6.50/ton		

This analysis indicated that all the east phases should be mined prior to the west and middle phases, except for phase 4E. Phase 4E extended into the center portion of the deposit where drilling has been limited and the grades lower resulting in a lower net value. This phase would be mined last in any mining sequence to maximize value.

These phases were used in the development of the mine production schedule.

The metal prices used in the cutoff were the economic model case with the realized values. Fixed recoveries were also used as no laboratory testing at the low grades had been completed at the time of the update. By increasing the metal value, the cutoff dropped which assisted in waste management by directing marginal ore material to the processing plant rather than a lined stockpile. The parameters for the cutoff calculation have been tabulated below in Table 16-9.

Table 16-9: Cutoff Calculation Parameters

	Cutoff Metal Prices	Realization Value	Net Price	Recovery
Copper	$1.50 / pound	0 %	$1.50 / pound	92.33 %
Nickel	$6.50 / pound	25 %	$4.88 / pound	70.34 %
Platinum	$900 / ounce	18.00 $/ounce	$882 / ounce	72.69%
Palladium	$225 / ounce	17.00 $/ounce	$208 / ounce	75.24 %
Gold	$450 / ounce	9.50 $/ounce	$440.50 / ounce	67.04 %
Cobalt	$15.25 / pound	40 %	$9.15 / pound	40.75 %

16.6 Production Schedule

The criteria for the mining schedule provided by PolyMet initially were:

1) 32,000 tons per day mill feed rate

2) 5 million ton limit to low grade stockpile size

These were based on the DFS mine plan reflecting the orginal Environmental Assessment Worksheet and the Draft EIS published in 2009. The key criteria have been honoured in the updated mine schedule.

A difference between the Updated DFS and the DFS mine plan was the development focus for the east pits. The DFS considered a balanced approach to manage strip ratio. The “east side first” approach offered advantages in waste management by allowing backfilling of the eastern pits with waste from the west and middle pits.

While the net value may be lower in some of the west pits than the east, the strip ratio for the initial cut, 1W, is substantially lower than 5E. The practicality of mining and maintaining sufficient feed to the mill required this to be developed prior to the completion of the phase 5E.

Prior to calculating each phase’s final resource and developing the production schedule, the dilution grade for each element needed to be determined. Dilution was estimated on a block by block basis rather than as an overall average. In this manner, discrete ore blocks would be properly assessed with higher dilution. Ore blocks surrounded by other ore blocks would not be treated adversely in a grade reduction. For massive deposits such as NorthMet, this approach provided a more realistic estimate of the expected dilution.

Each block in the model had the following dimensions:

- X = 50 feet
- Y = 50 feet
- Z = 20 feet

Initial estimates for the type of equipment that would be mining the deposit were a 29 cubic yard hydraulic excavator. This class of hydraulic excavator has a bucket 13 feet wide. Considering the hydraulic excavator's capabilities and the nature of the deposit a dilution width of 5 feet was deemed reasonable and applied.

To calculate the dilution for one side of the block being diluted, the following was assumed:

1) Block volume = 50 feet x 50 feet = 2,500 square feet

2) Dilution (one side) = 50 feet x 5 feet = 250 square feet

3) Dilution Percentage = 250 ft2/(250 ft2 + 2,500 ft2) = 250 ft2/(2,750 ft2)= 9.1%

The percentage dilution by the number of diluting sides has been summarized in Table 16-10.

Table 16-10 Dilution Percentages

Block Sides Exposed	Dilution %
0	0.0%
1	9.1%
2	16.7%
3	23.1%
4	28.6%

Each block in the model was queried, and its surrounding blocks examined. The number of below cut-off blocks surrounding each individual block was recorded in the model. This number was then used to determine the dilution percentage in accordance with the calculated values shown in Table 16-11. The appropriate percentage was then stored in the block model.

To determine the grade of the dilution material, the model was queried for the grade of each block below cut-off surrounding the individual block. This information was extracted to an

ASCII file then loaded into a drill hole database. This database was used to interpolate the dilution grade based on an inverse distance relationship. The grade of the diluting material was then stored in each individual block.

The diluted grade for resource determination was then estimated with the following formula:

- DCu = (100-Dilution %) x Cu% + (Dilution % x CuWst)

Where:

- DCu = diluted copper grade
- Dilution % = dilution percentage
- Cu% = undiluted copper grade
- CuWst = copper grade of the diluting material

This same methodology was applied to all of the grade items in each block. The total pit design that matches the DFS pit was examined to determine the diluted and undiluted grades for each element. The variation in the final grade has been shown in Table 16-11.

The overall dilution percentage was very low which was expected due to the massive nature of the NorthMet Deposit.

It was assumed that the ore loss was equal to the dilution as the value was similar to what would be expected for ore loss. This resulted in no increase in tonnage, but a grade reduction of approximately 2.5%, depending on the element considered.

Table 16-11 Diluted Grade Comparison

	Copper (%)	Nickel (%)	Platinum (ppb)	Palladium (ppb)	Gold (ppb)	Cobalt (ppm)
Undiluted Grade	0.280	0.082	76.5	262.2	37.9	73.8
Diluted Grade	0.274	0.080	74.7	255.6	37.1	73.2
Dilution %	2.2	2.5	2.4	2.6	2.3	0.8

Waste management at NorthMet was considered critical to the overall effectiveness of the project. Waste categorization was based on criteria that had been established in the DFS study. Those criteria were not changed for this update.

Overburden material was modelled to be all material that was beneath the topography surface, but overlain on the bedrock. This material was tracked separately as it was not required to be stockpiled in a lined facility.

The rock waste classification was based on the sulphur percentage and the copper sulphur ratios. The waste categorization followed the criteria outlined in Table 16-12.

Table 16-12 Waste Categorization

Waste Category	Element Criteria
Category 1	Block value < 0.12% S
Category 2	Block value < 0.12% S or 0.12% S < Block value < 0.31% S with Cu/S ratio < 0.3
Category 3 (Lean Ore)	0.12% S < Block value < 1.0% S with Cu/S ratio > 0.3
Category 3	0.31% S < Block value < 1.0% S with Cu/S < 0.3
Category 4	Block Value > 1.0% S or Virginia Formation rock (including Virginia Formation floaters)

These categories were used in the final scheduling of the material. In the case of the Category 3 (Lean Ore) material, this was combined with the Category 3 waste for scheduling purposes.

Resources for each phase were once again estimated with a cutoff value of $0 per ton and resulting diluted grades output. Economic case realized metal prices were used with fixed recoveries as per the DFS. The waste tonnage by category type was also output at the same time. These resources were stored in the mine scheduling spreadsheet and from this the production schedule developed.

The impact of elevating the cutoff grade and stockpiling material in the initial years was considered. An examination of the cutoff grade indicated that a cutoff of $7.00 per ton or greater yielded a reasonable increase in feed grade while being able to maintain the stockpile level at 5 million tons. Resources were output with a cutoff bin of $0 per ton and $7.00 per ton. The higher grade material was to be processed first while the lower grade material stockpiled until later in the mining sequence.

Eleven phases were designed to fit within the footprint of the previous DFS pit. Total resources for those phases have been shown in Table 16-13.

The waste material classification was reinterpreted from the drilling that was completed to further define the magenta zone. This resulted in the Category 3 and 4 waste tonnage totals exceeding previously established limits from the EIS. For this reason, PolyMet opted to reduce the size of the pit mined to ensure the stated tonnage limits were not exceeded for the current mine permitting process. This was accomplished by excluding Phases 3W and 3M.

Table 16-13: Updated DFS Pit Tonnages

	Tons	Diluted Grades					
		Copper (%)	Nickel (%)	Platinum (ppb)	Palladium (ppb)	Gold (ppb)	Cobalt (ppm)
Ore	306,252,000	0.27	0.08	74.8	256.0	37.1	73.3
Waste							
Overburden	23,420,000						
Category 1&2	297,828,000						
Category 3	113,783,000						
Category 4	12,550,000						
Total Waste	447,580,000						

The resulting tonnage of ore and waste plus their associated grades have been tabulated in Table 16-14. These tonnages were used for the final production schedule in determining an updated operating cost, equipment requirements and capital cost.

Table 16-14: Final Updated DFS Pit Tonnages

	Tons	Diluted Grades					
		Copper (%)	Nickel (%)	Platinum (ppb)	Palladium (ppb)	Gold (ppb)	Cobalt (ppm)
Ore	223,956,000	0.28	0.08	75.1	264.5	37.6	73.3
Waste							
Overburden	18,520,000						
Category 1&2	210,151,000						
Category 3	64,789,000						
Category 4	10,350,000						
Total Waste	303,810,000						

While this tonnage is less than the reported reserve, the larger pit design indicates that with the updated model, more material is possible to convert to reserve. AGP has opted to maintain the existing reserve base and the costing exercise was optimized for a reduced mine tonnage.

At a plant production rate of 32,000 tons per day, 11.67 million tons of ore was required annually. The ore processing ramp up schedule was over a one year period from the start of the concentrator. This resulted in the first year achieving only 8.76 million tons processed. The ore reserves contained within the modified pit design allowed for 20 years of ore processing. The ore tonnage by phase resulting from this schedule has been shown in

Figure 16-5. The plant feed grades for copper and nickel has been shown in Figure 16-6. A significant dip in the feed grade occurred in Years 15, 16 and 17 that resulted from the timing of the various phases and location of material. Attempts at smoothing that grade release during this time were made but were unsuccessful.

Only one year of pre-production mining was required to provide sufficient ore material for the processing plant. The ore was located very near surface, which allowed for rapid preparation of ore inventory in the phases. Waste mining was focused on developing the eastern pits first to allow the backfilling of those pits earlier. The result of this action was a significant waste mining requirement in the first five years upfront due to the higher strip ratio of later phases of the eastern pit. From Year 6 to Year 12 the waste mining requirements were more stable, then climb to mine the last phases at a higher strip ratio. The waste mining requirement by phase has been shown graphically in Figure 16-7. Total material mined annually has also been illustrated in Figure 16-8.

Figure 16-5 Production Schedule Ore Tonnage by Phase

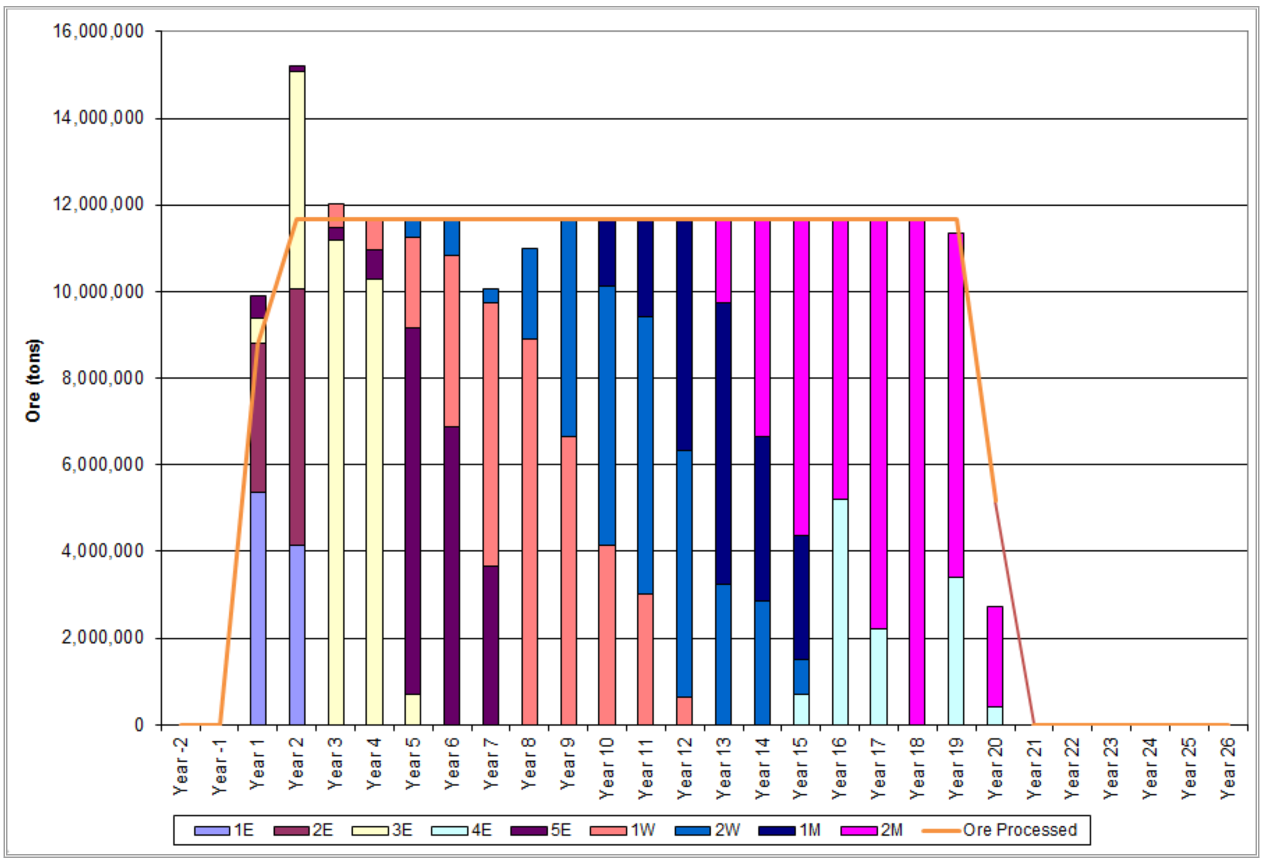


Figure 16-6 Plant Feed Grades – Copper and Nickel

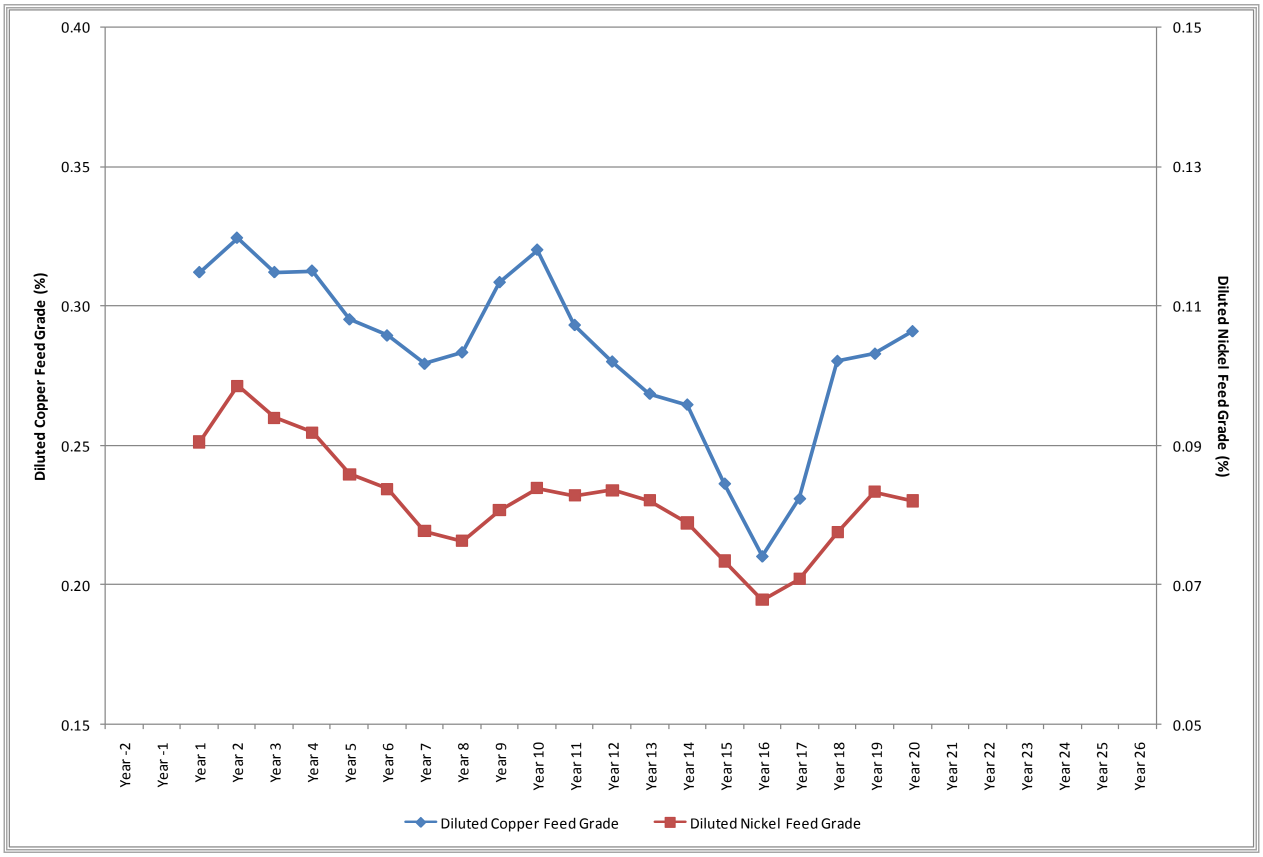


Figure 16-7 Waste Tonnage By Phase

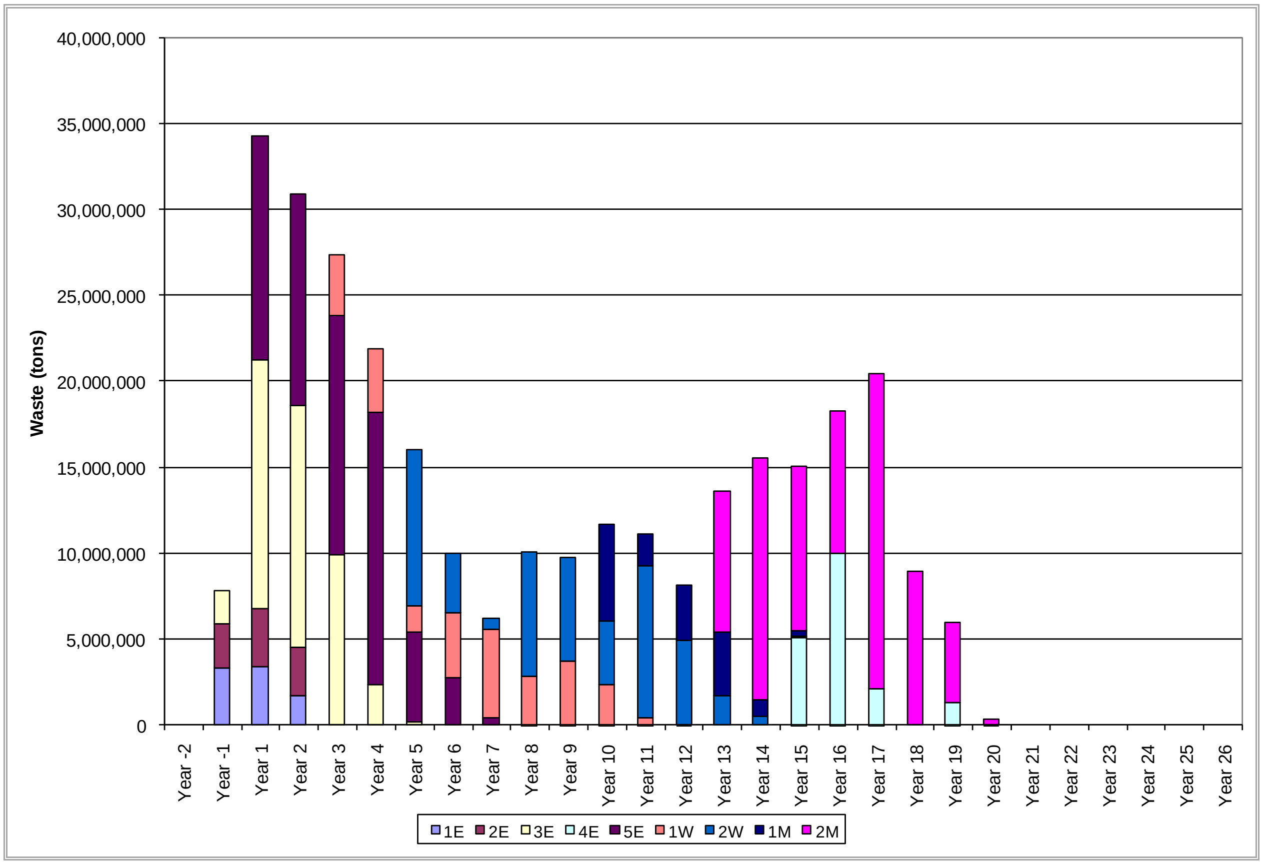
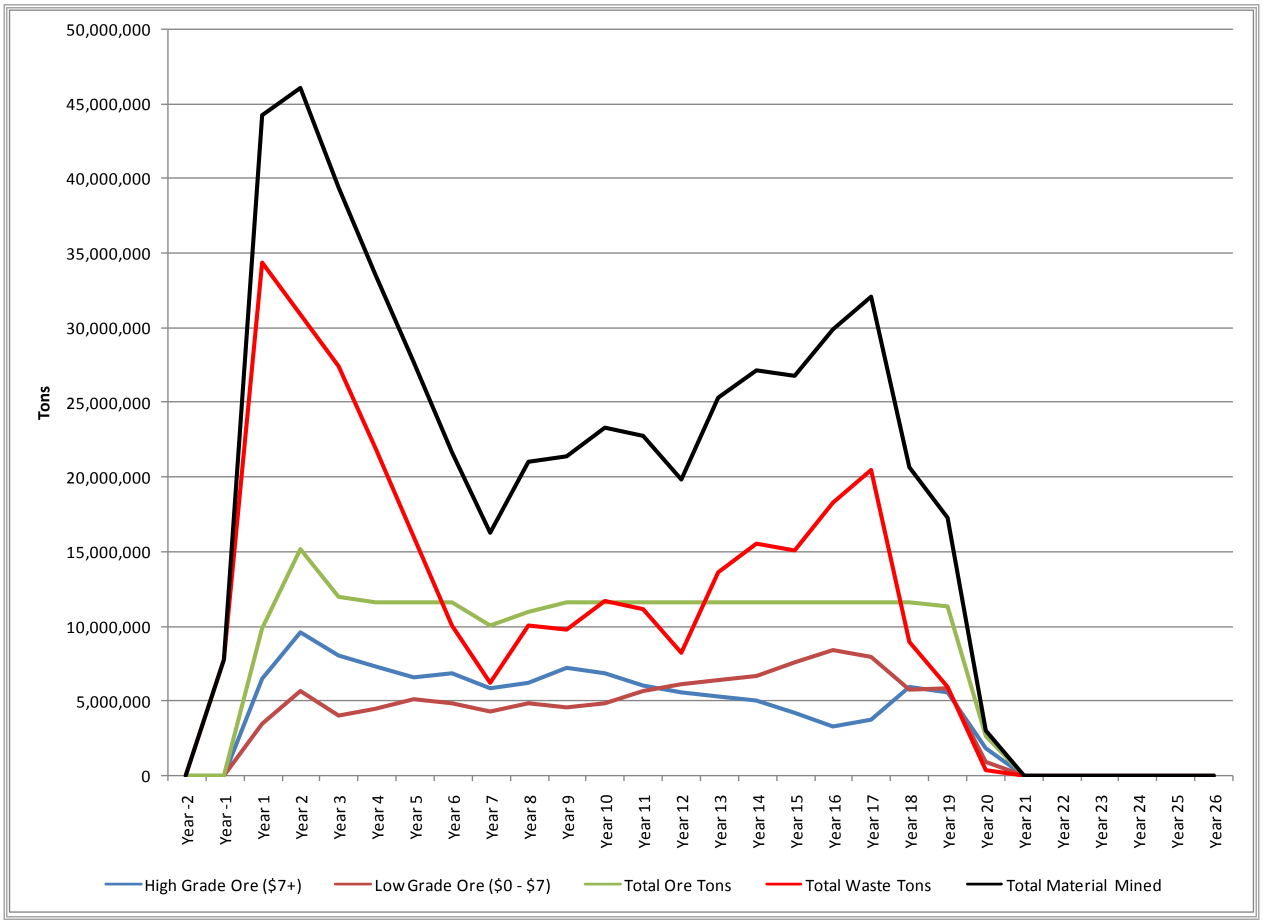


Figure 16-8 Total Material Movement by Year



16.7 Waste Management

This section describes waste management plans at October 15, 2007 as modified for the 2008 DFS Update. Plans being incorporated into the Supplemental Draft EIS that will be incorporated in a new Technical Report once all the details have been finalized include backfilling some waste into the East Pit once it has been mined out in year 11 of operations. A portion of the newmly mined waste will be taken directly to the East Pit, while selected waste material from the first eleven years (stored in stockpile) will be rehandled and moved to the East Pit for final placement.

Minnesota design criteria were used in the slope configuration for the stockpiles as per the DFS. These were:

- Face Slope = 22 degrees (1 Vertical: 2.5 Horizontal)
- Lift Height = 40 feet
- Berm Separation = 40 feet vertically
- Berm Width = 30 feet

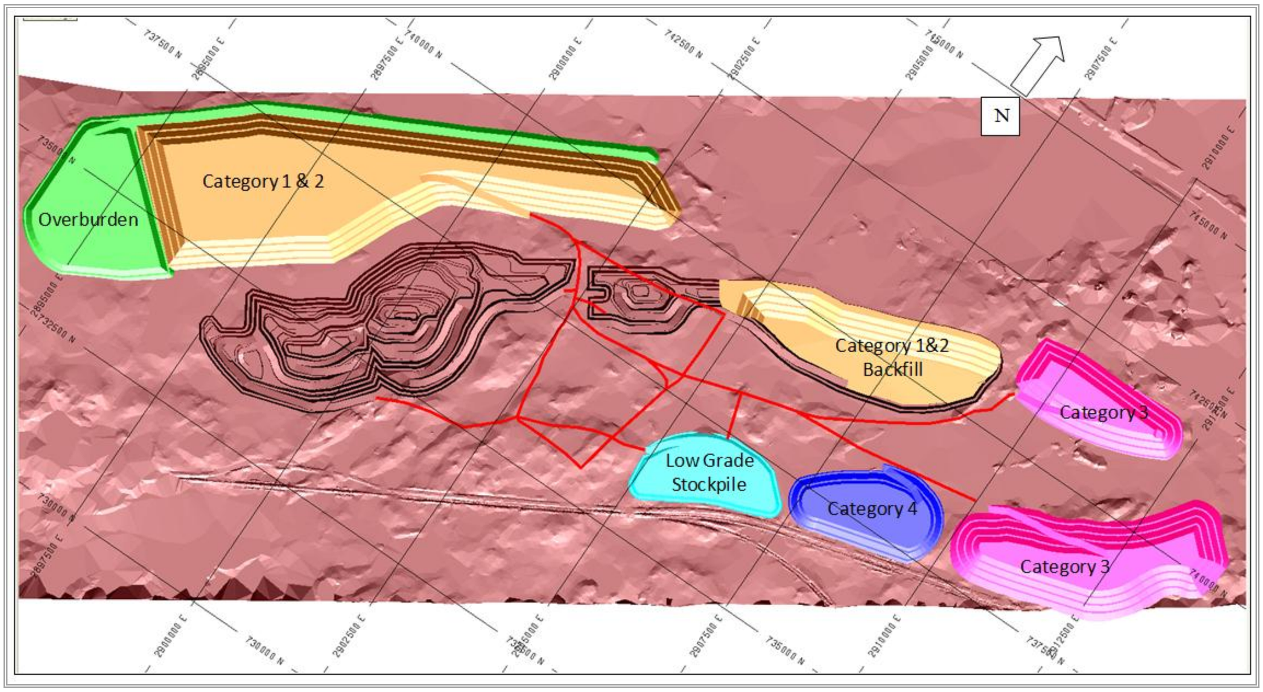
The location, footprint and height of the dumps set in the DFS and in the preparation of the 2009 Draft EIS were used as outlines for the DFS Update, but have subsequently been altered to include East Pit backfill, the elimination of some dumps, and redesign of the remaining permanent dump.

In the DFS Update, overburden material was the first material mined and stockpiled in the northwest corner of the property, on the footwall side of the NorthMet Deposit. A finger dyke was built at the 1640 level along the northwest edge extending to the south in a shape similar to a golf club. Once that design had been completed, additional material was placed on top of the southern end until required for reclamation purposes. A total of 10.3 million loose cubic yards of storage were required and designed. The design for the overburden stockpile has been shown in Figure 16-9..

Material was stockpiled in the northwest area adjacent to the overburden stockpile until Year 8. The overburden toe dyke assisted in controlling drainage from this stockpile by containing and redirecting to the water control systems present on the property. A total of 61.2 million loose cubic yards of material were stored in this stockpile.

East pit mining in this study had been accelerated to permit backfilling of waste material from the western and middle sections of the NorthMet Deposit. This was intended to allow selected waste rock to be placed in the mined out east pits as shown in Figure 16-9 and stored sub-aqueously after Year 8.

Figure 16-9 Waste Stockpile Locations with Final Pit Outline– DFS Update not SDEIS Plan



Backfilling in the east pit was not available until Year 8, after phase 5E had been completed. For this evaluation, backfilling of the east pit followed this protocol:

1) Material would be backfilled first along the footwall in a 140 foot wide finger dump at the 1590 elevation,

2) Backfill of the remainder of the east pits would be from the bottom up,

3) Water would be allowed to rise and stabilize at the predicted level of 1592 elevation.

Selective rock types were to be used in the backfill and, under the DFS Update plan, the entire east pit was not backfilled. Subsequent changes to the plan that will be incorporated in the Supplemental Draft EIS include filling the East Pit to create a wetland environment.

All of the material mined in the current production schedule was stored in the stockpiles as outlined in Figure 16-9.

16.8 Mine Operations and Equipment

Mining of the NorthMet Deposit and the economic pit cost parameters were based on bulk mining methods 365 days per year. The waste rock and ore would be drilled, blasted, loaded and hauled with conventional drills, trucks and hydraulic shovels.

Ore will be hauled directly to the truck dump/feeder facility for loading on the rail cars. Stockpile ore would be placed in a lined storage area to the east of the truck dump. The direct ship ore would be hauled to the NorthMet processing facility and discharged above the primary crusher. Rehandle of the stockpile ore would be accomplished by a loader and truck hauling to the truck dump/feeder from the stockpile or direct load into railcars.

Waste material will be categorized from the drill and blast results and modelling. This would then be dispatched at the shovel face to the appropriate stockpile location. As much as possible, reclamation of the waste stockpiles will occur concurrently with the mining. Overburden material will be reclaimed from the stockpiles (if no direct ship material was available) and placed on the dump. This will allow for revegetation of the waste stockpile current with mining.

The original DFS had envisaged the use of 100 ton trucks, but with the scale of the deposit, much larger trucks were considered. A review was made of various fleet configurations that varied truck capacity and shovel types. The result of that analysis indicated that the 240 ton truck configuration matched with a hydraulic shovel provided the most cost effective method of developing the NorthMet Deposit.

The hydraulic shovel offered several benefits to the particular needs of NorthMet. Selective mining of the ore was planned to be achieved by mining ore on a 20 foot bench while bulk mining waste on a 40 foot bench. Hydraulic shovels, due to their unique operating configuration, were better suited to this task without sacrificing productivity. Cable shovels require a higher bench face to be consistently more productive.

In the current mining environment of equipment supplier shortages, cable shovels were difficult to obtain in a shorter time frame at a reasonable cost. New hydraulic shovels were available in one year while cable shovels were at least two years. From a cost perspective, cable shovels were approximately 2.5 times the cost of a comparable sized hydraulic shovel. For these reasons, the economics favoured the use of hydraulic shovels at NorthMet.

To meet the production needs for the NorthMet project, it was anticipated that two 31 cubic yard hydraulic excavators would be required with a 21.5 cubic yard front end loader as backup. The hydraulic shovels would be in an electric powered configuration for operating cost reasons and also reduction of site emissions.

Typical blasting in the Iron Range of Minnesota has been with a 16" diameter holes. Golder completed an evaluation of the rock at NorthMet to determine what would be correct. Utilizing the KuzRam model, Golder recommended a smaller bit diameter of 12 ¼". This recommendation was examined in detail with updated drill operating costs and the recommendation remained to use a 12 ¼" diameter borehole. The drills specified though were capable of drilling the more locally common 16" diameter hole, should it prove more cost effective once mining progressed.

PolyMet had already purchased a used electric drill with the capability that was going to be refurbished prior to mining commencing. A second drill of comparable size was considered but in a diesel configuration to provide flexibility with multiple phases. This would allow for rapid drill deployment.

Support equipment included tracked and rubber-tired dozers with graders and small front end loaders. Two large and two small water trucks were envisaged for use to control dust and water the drills for dust suppression. A large rubber tired dozer was included in the fleet of dozers. This was to provide flexibility either at the shovel face or on the dumps without the excessive travel time concerns raised with conventional track dozers. A smaller track dozer was planned for use to manage the tailings facility.

Stockpile turnover rehandle annually was estimated to be in the order of 320,000 tons per year. This was based on the assumption that 5 weather days would affect the pit that would require ore to be loaded from the stockpile and replenished. An additional 5 days of maintenance for the feeder was planned which required direct loading of ore from the stockpile to the train. This was also included in the 320,000 tons per year requirement.

16.9 Reserves in DFS Update Plan

A portion of the total reserves outlined in Section 15 are to be mined. That portion in the current plan has been shown in Table 16-15 and Table 16-12.

Table 16-15 Diluted Mineral Reserves in DFS Update Plan

Category	Tons	Copper (%)	Nickel (%)	Platinum (ppb)	Palladium (ppb)	Gold (ppb)	Cobalt (ppm)
Proven	116,430,500	0.30	0.09	77	279	39	74
Probable	107,548,000	0.27	0.08	73	249	37	73
Total	223,978,500	0.28	0.08	75	265	38	73

Table 16-16 Diluted Mineral Reserves by Category and Phase in DFS Update Plan

Category	Tons	Copper (%)	Nickel (%)	Platinum (ppb)	Palladium (ppb)	Gold (ppb)	Cobalt (ppm)
Proven							
1E	8,271,800	0.31	0.09	74	293	37	69
2E	5,820,100	0.31	0.09	75	316	37	76
3E	22,085,400	0.31	0.09	67	279	37	77
4E	5,880,400	0.22	0.08	71	272	35	75
5E	17,720,300	0.32	0.09	69	303	36	72
1W	16,321,500	0.29	0.08	96	286	48	73
2W	13,952,300	0.32	0.09	97	289	46	77
1M	11,827,100	0.29	0.08	68	249	35	74
2M	14,551,600	0.28	0.08	70	240	35	72
Sub-total	116,430,500	0.30	0.09	77	280	39	74
Probable							
1E	1,222,400	0.27	0.08	66	245	31	66
2E	3,547,000	0.30	0.09	77	325	38	72
3E	5,711,900	0.28	0.08	63	265	35	73
4E	6,075,900	0.21	0.07	65	285	35	69
5E	2,860,400	0.27	0.08	58	250	30	73
1W	20,439,500	0.30	0.08	82	258	41	77
2W	19,673,400	0.31	0.08	96	282	44	76
1M	10,494,800	0.24	0.08	60	212	31	72
2M	37,522,700	0.24	0.07	65	223	33	69
Sub-total	107,548,000	0.27	0.08	73	249	37	73
Total	223,978,500	0.28	0.08	75	265	38	73

17 RECOVERY METHODS

The 2006 Technical Report described in detail the recovery methods contained in the DFS. Since then, PolyMet has simplified the proposed metallurgical process that will be used to process the ore to recover base metals, gold and PGE metals. Previous plans included two autoclaves and a copper solvent extraction/electro-wining ("SX-EW") circuit to produce copper metal along with value added nickel-cobalt hydroxide and precious metals precipitate products.

PolyMet now plans to build the Project in two phases, comprising:

- Phase I: produce and market concentrates containing copper, nickel, cobalt and precious metals
- Phase II: process the nickel concentrate through a single autoclave, resulting in production and sale of high grade copper concentrate, value added nickel-cobalt hydroxide, and precious metals precipitate products.

The changes reflect continued metallurgical process and other project improvements as well as improved environmental controls that are being incorporated into the Project. The advantages, compared with the earlier plan, include a better return on capital investment, reduced financial risk, lower energy consumption, and reduced waste disposal and emissions at site.

The Process Plant will consist of a Beneficiation Plant and Hydrometallurgical Plant. The processing steps that would be involved in each operation are described below. The Process Plant would also include a Tailings Basin, Hydrometallurgical Residue Facility and a rail car maintenance shop.

17.1 DFS Metallurgical Testwork

The aim of the DFS testwork program was to develop and demonstrate a complete process flowsheet for treatment of polymetallic sulphide material from the NorthMet Deposit with an average head grade of approximately 0.31 % copper, 0.09 % nickel, 0.08 g/t platinum, 0.28 g/t palladium and 0.04 g/t gold. The flowsheet arising from this testwork subsequently served as the basis on which the plant was designed to process 32,000 short tons (29,030 metric tonnes) per day or 11.68 million short tons (10.6 million metric tonnes) per year of run of mine (ROM) ore.

The process route selected for recovering the base metals and AuPGMs is based on the mineralogy and involves an initial concentration step to recover the sulphide minerals and AuPGMs by crushing, grinding and bulk sulphide flotation. The bulk sulphide concentrate is then treated by a hydrometallurgical process that includes chloride-assisted pressure oxidation leaching (POX) with subsequent metal recovery. Copper is recovered as LME grade cathode. Nickel and cobalt are recovered together as a mixed hydroxide precipitate. The gold and PGM are collected in a precipitate with some copper and sulphur. The mixed hydroxide precipitate and gold-PGM precipitate are refined off-site by off-take parties. The advantage of this hydrometallurgical method is that all the base metals and AuPGMs are extracted in a single step (the chloride assisted POX) and can be subsequently separated and recovered onsite.

There are two waste streams from the ore processing plant. Flotation tailings are pumped directly to a separate storage facility. The hydrometallurgical plant residue is formed by mixing the final POX residue with gypsum, iron/aluminium hydroxide and magnesium hydroxide residues. This combined residue is placed in the lined hydrometallurgical residue facility.

The development and demonstration of this process has taken place via several integrated pilot plant testwork campaigns from as early as 1999. A thorough review of the most recent 2005 and 2006 testwork has been presented in the DFS with findings and conclusions from all pilot campaigns incorporated into the current plant design.

17.1.1 Testwork History

Testwork in 1997 and 1999-2000

PolyMet launched an intensive testwork program in 1998 and 1999-2001 to examine the potential for hydrometallurgical processing of the NorthMet ore. After extensive analysis, flotation of Cu, Ni, and AuPGM to a bulk concentrate followed by a high temperature, chloride-assisted POX approach was selected, and the process was fully demonstrated at the bench scale.

Pilot Plant Campaigns 1999-2001

Pilot plant campaigns were completed in 1999-2001 at Lakefield to produce a bulk concentrate from the NorthMet ore and to investigate the recovery of Cu, Ni, and AuPGMs from the bulk concentrate. The flotation process to produce the bulk concentrate included rougher, scavenger and cleaner unit operations. The final bulk concentrate contained 14.7% Cu, 3.05% Ni, 32.9% Fe, 0.14% Co, 26.7% S, 1.41 g/t Au, 2.22 g/t Pt and 9.9 g/t Pd.

Bulk concentrate was ground to P80 of 15 µm, a fine grind being important for complete extraction of AuPGM, and re-pulped to approximately 10% solids in an agitated vessel prior to injection into a six-compartment autoclave. The autoclave operated at conditions identified in earlier batch scale testwork to be optimum: 225° C, 690 kPa oxygen gas overpressure and 120 minutes residence time. The discharge residue was filtered and the pressure leach solution treated in a number of ways to recover AuPGMs from the PLS. The AuPGM depleted liquor was then stage neutralised to pH 2.0, using limestone, and copper cathode was produced via conventional SX/EW. A portion of the raffinate was bled from the circuit and set aside with the balance of the raffinate recycled as a cooling solution to the autoclave. The main autoclave pilot plant operated successfully for 14 days including a 10-day integrated run with Cu SX raffinate recycled back to the autoclave.

A further pilot plant was used to demonstrated a process for treatment of raffinate that included rejection of Al and Fe, and production of high purity nickel and cobalt metals by a solvent extraction and electrowinning process.

Testwork in 2005-2006

The 2005-2006 pilot plant program was overseen by Bateman and undertaken to confirm the entire metallurgical flowsheet feasibility from ore processing to final product recovery, to provide the design basis for the process plant, to collect extensive environmental data and to optimise aspects of the process, in particular:

- Increasing sulphide recovery from the ore to the bulk flotation concentrate (to minimise environmental impacts of sulphide in tailings).
- Recycling of a portion of the leach residue to the autoclave for improved AuPGM extraction and autoclave design optimisation (reduced autoclave sizing).
- Precipitant selection and optimisation for iron reduction and AuPGM recovery.
- Investigation of an option to separate Co and Zn via solvent extraction prior to Ni hydroxide precipitation, as an alternative to precipitation of a mixed Ni-Co-Zn hydroxide product.
- The pilot-scale testwork program evaluated continuous and fully integrated testing of the proposed flowsheet in several phases, accompanied by bench scale variability and optimisation testwork:
- Phase 1 – Comminution and Flotation
- Phase 2 – Leaching and Metal Recovery (Cu Cathode, AuPGM Precipitate and Ni-Co Mixed Hydroxide Precipitate) from the Phase 1 Flotation Concentrates
- Phase 3 – Testing of Solvent Extraction and Electrowinning for Cu, Ni and Co and Precipitation for Separate Nickel, Cobalt and Zinc Product Recovery (Hydroxides)
- Phase 4 – Optimization Flotation and Autoclave Bench and Pilot Plant Testing in March–April 2006.

In 2005, a 44 short ton bulk sample of large diameter diamond drill core was delivered to Lakefield for flotation testwork and subsequent production of concentrate for hydrometallurgical pilot plant program. Another nine short tons of drill core sample was provided in April 2006 for additional pilot scale testwork.

17.1.2 Comminution and Flotation Testwork

Each composite was tested separately using optimised comminution and flotation parameters established in previous testwork.

The flotation pilot testwork provided bulk concentrate products for further hydrometallurgical testing.

Comminution Testwork

Comminution parameters were determined for the composites and show a high level of consistency. The ore can be broadly categorised as mildly abrasive and towards the higher end of the hardness scale. A review of the specifications of the existing crushing and grinding equipment has confirmed that it is more than capable of reducing the particle size to suit flotation at the required throughput.

Average values determined from Bond tests for the rod and ball mill work indices were 13.4 and 15.5 kWh/t respectively, and 0.40 for the abrasion index.

17.1.3 Flotation Laboratory Batch and Locked Cycle Testwork Outcomes

This work mimicked the flowsheet derived from past testing and confirmed that the metallurgical behaviour of all composites was consistent. The flowsheet adopted a standard rougher scavenger circuit followed by two stages of cleaning. A regrind mill on the combined scavenger concentrate and first cleaner tailing was also included to ensure middling particles (particles containing both sulphides and gangue) underwent further size reduction.

The testwork confirmed optimum flotation parameters for maximum sulphide and base metals recovery to the concentrate, and determined:

- a reagent regime, including:
- flotation collector (potassium amyl-xanthate, PAX) dosage rate;
- copper sulphate addition as an activator to enhance metal and sulphide recovery; and
- combined frother of 3:1 MIBC:DF250.
- a selected grind size of 125 µm for flotation piloting feed.
- total rougher and scavenger time of 15 minutes.
- flotation pilot plant outcomes

A total of 53 short tons were processed, in four composite groupings. Flotation performance was similar for all composites and circuit changes were introduced to enhance sulphide recovery to concentrate and thus reduce sulphur content of the tailings.

The bench and pilot plant work confirmed the importance of copper sulphate ($CuSO4$) as an activator for sulphide mineral flotation. The addition of copper sulphate to a conditioning step prior to the scavenger flotation step successfully reduced the sulphur grade of the final tailings to ≤0.15%, thus meeting PolyMet's objective of minimising possible environmental impacts of sulphur in tailings.

Table 17-1 shows flotation circuit performance for non-activated versus activated pilot-scale tests in 2005.

Table 17-1: Impact of Copper Sulphate on Pilot Plant Recovery

Description	Distribution, %					
	Cu	Ni	S	Pt	Pd	Au
Non-activated	94.3	69.3	72.4	69.1	75.8	58.5
Activated	94.2	72.5	82.2	67.5	83.1	57.9

The additional flotation pilot testwork undertaken in 2006 was able to confirm the reagent regime, provide a reduction in overall residence time (and hence circuit size), and attain similar metals recoveries and reduced sulphide in tailings. The additional work also led to refinement of the circuit to include a scavenger conditioning stage and splitting scavenger concentrate (first scavenger concentrate directly to the cleaner circuit and the second scavenger concentrate to the regrind mill before returning to the rougher circuit) to reduce the solids loading in the regrind circuit.

The range of grade for concentrates produced in the 2006 testwork is shown below in Table 17-2.

Table 17-2: Concentrate Composition from 2006 Piloting

Grade	Assays					
	Cu (%)	Ni (%)	S (%)	Au (g/t)	Pt (g/t)	Pd (g/t)
Concentrate	7.16-10.1	1.66-2.20	18.4-21.5	0.65-1.28	1.17-1.59	5.76-6.71

Flotation pilot testing covered a range of samples with head grades from 0.27% to 0.41% Cu and from 0.094% to 0.122% Ni. In the grade range tested, flotation recovery did not appear to change with head grade hence a constant flotation recovery was used.

Flotation tailings and concentrate were tested by Outokumpu Technology (solid-liquid separation equipment vendors) in a continuous, high rate thickening rig to determine flocculant and thickening design parameters.

A detailed mineralogical analysis was made on flotation tailings.

17.1.4 Hydrometallurgical Bench Testwork – 2005

Pre-Piloting

Hydrometallurgical pre-piloting bench testwork was conducted to optimise circuit conditions for the pilot-scale testwork, in particular temperature, residence time and reagent additions for a number of unit operations. The results of this testing were then incorporated into the pilot plant design and operating philosophy.

During and Post-Piloting Bench Testwork

A number of bench programs were undertaken to provide important information for final design. These included:

- AuPGM stability studies - The stability of the leached Au and PGM species in the autoclave discharge were tested by timed sampling of slurry taken from the pilot plant discharge. This was important to confirm that the Au and PGM would not be re-precipitated and lost during the post autoclave solid-liquid separation steps. The stability of Au and PGM in solution was proven to be independent of agitation and temperature within the range of conditions tested.
- Rheology - Rheology tests were carried out on slurry samples recovered from the Pilot Plant operation.
- AuPGM concentrate upgrading - Autoclave testwork was conducted to upgrade the Au and PGM content of the AuPGM concentrate. This was done by selective re-leaching of base metals and sulphur from the AuPGM concentrate product, at both high and low temperatures. This work confirmed a window of temperature to upgrade the AuPGM precipitate (with an optimum average temperature at 195 °C). It was possible to upgrade the AuPGM precipitate from approximately 1,000 g/t (Au+Pt+Pd) to 16,000 g/t (Au+Pt+Pd).
- Co and Ni recovery from SX strip liquor - The separation of cobalt and nickel by solvent extraction (Phase 3 of the piloting referred above) was successful in producing separate and pure products. Cobalt was recovered in bench scale testwork as a cobalt hydroxide by treating the cobalt strip liquor with magnesium hydroxide slurry. Nickel precipitation was performed as part of the pilot plant continuous operation.

17.1.5 Hydrometallurgical Pilot-Scale Test Campaigns

The flowsheet tested during the August-September 2005 pilot campaign covered POX through to recovery of Cu, AuPGMs, Ni, Co, and Zn. The autoclave feed material consisted primarily of the concentrates produced in the flotation piloting described above, as well as some concentrate remaining from year 2000 testwork. This concentrate, which had been carefully stored in a freezer, was used to extend the circuit running time and provide additional product for characterisation.

A separate pilot campaign was conducted in October 2005 to test an option for separate recovery of Ni, Co and Zn hydroxide products via a Co/Zn SX circuit.

An additional autoclave pilot program was performed in April 2006. This short program was designed to confirm the viability of recycling a portion of the autoclave leach residue for improved AuPGM recovery and shorter autoclave residence time (1.1 hours of residence time instead of the 2 hours used in the “non-recycle” configuration.

The pilot plant design was developed by Bateman using a metallurgical flowsheet produced by METSIM modelling software. METSIM is an industry standard metallurgical simulation and design computer software package and METSIM models developed by Bateman were delivered to the Lakefield staff for design and operation of the pilot plant facilities.

As part of the hydrometallurgical pilot plant design, corrosion coupons were strategically placed in various parts of the circuit to obtain information on materials selection for the commercial plant.

Outcomes and conclusions from hydrometallurgical pilot plant work are summarized below in Table 17-3.

Table 17-3: Pilot Plant Test Outcomes and Conclusions

Flowsheet Area	Pilot Plant Conditions and Outcomes
POX	Optimum autoclave operating parameters included: operating at 225°C, ~3,100 kPag Total Pressure, ~800 kPa O2, 10 g/L chloride and a 1.1 hour first pass residence time. Metals extractions were shown to improve by the introduction of a 200% residue recycle stream (i.e., a 2:1 ratio of leach residue to fresh feed). Average extractions for metals at optimum conditions were: Cu 99%, Ni 99%, Co 98%, Au 89%, Pt 93% and Pd 94%.
AuPGM Recovery	Au and PGM were precipitated from solution by adding CuS, recycled from the residual Cu recovery circuit. Recoveries were excellent with below detection limit values for AuPGM remaining in solution, and corresponded to a minimum precipitation efficiency of Au 88%, Pt 98% and Pd 99.5%. Further testwork led to the reintroduction of sulphur dioxide (SO_2) in the final flowsheet as a reductant for iron prior to CuS addition. This reduces the consumption of CuS and limits the elemental S content of the concentrate. The SO_2 pre-reduction system was tested and piloted in the year 2000 pilot plant at Lakefield.
Solution Neutralisation	This circuit operated to a pH of 1.3-1.4 using ground limestone addition while gypsum thickener underflow was recycled as seed to the first reactor. Analysis of the gypsum residue reported insignificant base metal content and low residual carbonate (0.07%).
Copper Solvent Extraction	Copper was extracted at 40° C in 3 counter current stages, scrubbed in 1 stage (to prevent chloride transfer to Cu electrowinning) and stripped in 2 stages.

Flowsheet Area	Pilot Plant Conditions and Outcomes
	Two organic extractants, Acorga® M5640 and LIX® 973NS LV, were pilot tested. Orfom® CX80CT diluent was used in each case. Recovery of Cu to the strip liquor averaged 95.5% for both extractants, producing raffinate with Cu <1.0 g/L from PLS ranging 18-25 g/L Cu. No evidence of crud formation during testing was noted.
Copper Electrowinning	A total of 69 kg of copper metal was produced. Cathodes were harvested twice during the campaign. Four cathodes were sampled for purity – 2 from each extractant cycle. Cathodes from Cycle 2 met LME grade A specifications while cathodes from Cycle 1 showed minor contamination of Pb and S attributed to erratic temperature control during test start-up.
Raffinate Neutralisation	Raffinate is neutralized prior to recycle of raffinate as cooling solution back to the autoclave. This is necessary to reduce the free acid level in the autoclave product solutions and prevent the formation of basic ferric sulphate (BFS). The pH set points for raffinate neutralisation varied between 1.2-1.5 and were controlled via limestone slurry addition. Loss of Ni and Co to the residue was minimal.
Iron Removal	A portion of neutralized raffinate solution was directed to nickel and cobalt recovery. The first step in the Ni and Co recovery circuit is iron removal by oxidation and neutralization. Ferrous iron was oxidised to ferric iron by addition of gaseous oxygen and were removed from solution (along with aluminium) by hydroxide precipitation. Limestone was added to achieve the target pH of 4.2. Iron removal residue consisted predominantly of gypsum with low levels of iron and aluminium hydroxides. Ni and Co losses in the residue were minimal. Iron and aluminium removal efficiencies were 99.9% and 94.1% for this circuit.
Aluminum Removal	A separate stage of aluminium removal was included in the pilot plant circuit. In practice, this circuit did not consume limestone, as pH naturally rose to 4.6-4.7 due to an excess of alkalinity from the iron removal stage. Iron and aluminium removal efficiencies were 71% and 96% respectively (to give overall precipitation efficiencies of nearly 100% after two stages).
Residual Copper Recovery	Residual copper was precipitated as copper sulphide (CuS) using sodium hydrosulphide (NaSH), and was collected for use in AuPGM recovery. Stoichiometric addition of NaSH was required for copper precipitation. Solution analysis confirmed precipitation of 92% of the Cu for this circuit, with insignificant co-precipitation of Ni and Co.
Mixed Hydroxide Precipitation Stage 1 (HP1)	Ni and Co were precipitated as a mixed hydroxide using magnesium hydroxide slurry to a target efficiency of 85%. The mixed hydroxide precipitates collected during the pilot plant analysed 31.5-36.3% Ni, 1.67-1.92 % Co, 0.31-0.37% Cu, 0.51-0.59% Fe, 4.27-4.84% Zn and 0.62-1.04% Mg.
Mixed Hydroxide Precipitation Stage 2 (HP2)	This circuit recovered residual nickel and cobalt from solution by precipitation with hydrated lime slurry at pH 8. Precipitate was thickened and recycled to the neutralisation circuit (where the residual metal hydroxides redissolved). Removal efficiency of residual Ni and Co from the feed solution averaged 93% and 92%

Flowsheet Area	Pilot Plant Conditions and Outcomes
	respectively giving overall precipitation efficiencies through the two stages of hydroxide precipitation of nearly 100% for both Ni and Co.
Magnesium Removal	Magnesium was removed from the barren solutions after Ni and Co recovery by addition of hydrated lime slurry to pH 9. Mg precipitation was close to the target 50%. The magnesium hydroxide – gypsum product slurry was thickened, with overflow used as process water and underflow directed to tails. The absence of pay metals in the feed to magnesium precipitation resulted in negligible Ni and Co losses (0.14% and <0.02% respectively).
Co/Zn Solvent Extraction	The cobalt and zinc solvent extraction circuit was run as part of the campaign to produce purified metal hydroxides (rather than mixed hydroxide precipitation). Bulk Co/Zn extraction was achieved in 4 stages at pH 5.0-5.5 and 55° C, using 5 %v/v Cyanex® 272 extractant in Orfom® SX80CT diluent. The higher temperature favoured Co extraction and displacement of co-extracted Mg. Co stripping then proceeded in 3 stages at pH 3 and 45oC, before Zn stripping in 2 stages at pH <1 and 40°C. Co extraction rates greater than 96% were achieved, with raffinate grades of below 10 ppm Co. Zinc extraction was greater than 99.9%. No evidence of crud formation during testing was noted and the circuit operated smoothly.

A variety of specialist vendors for thickening, filtration and flocculant selection were present during piloting to perform bench tests on slurry samples withdrawn from the operating pilot plant. The results of this testing have been used to provide equipment design parameters.

Flotation and hydrometallurgical piloting provided data for the development of a flowsheet generating maximum overall base and precious metal recoveries to final marketable products. The DFS engineering design incorporates the data from the various pilot campaigns that provides confidence for the capital cost and operating cost estimates.

17.2 Design Criteria and Process Overview

Key Design Criteria:

- Ore Feed 32,000 st/d (1,333 st/h)
- Plant Availability 90.0%

Crushing:

- Number of stages 4
- Feed to crushers F80 740 mm
- Primary crusher discharge P80 83 mm
- Secondary crusher discharge P80 39 mm
- Tertiary crusher discharge P80 11.4 mm

- Quaternary crusher discharge P80 8 mm

Milling:

- Rod Mill Work Index 13.4 kWh/t
- Ball Mill Work Index 15.6 kWh/t
- Abrasion Index 0.403
- Feed to Rod Mills F80 – 8 mm
- Milled product P80 – 120 µm

Flotation (Residence Time/ Number of Stages):

- Rougher Flotation 7 min, 1 stage
- Scavenger Flotation 38 min, 1 stage
- Cleaner Flotation 15 min, 2 stages
- Concentrate Grind P80 – 15 µm
- Pressure Oxidation
- Temperature 225 °C
- Pressure 3,380 kPag
- Retention Time 1.1 h
- Solids Recycle Ratio 200% (residue recycle to fresh feed ratio)

Tailings:

- Flotation 34,300 dry st/d
- Hydrometallurgical 2,430 dry st/d (now reduced)
- Power 69 MW (at steady state draw, now reduced)

The process plant design has been reviewed by PolyMet representatives plus external and Bateman process auditors and has subsequently been used as the basis for the capital and operating costs presented.

17.2.2 Process Overview

Existing equipment will be reinstated and used for both coarse and fine ore crushing (including gyratory and cone crushers), and in the ore milling circuit (including rod and ball mills). The flotation plant is a new circuit that will be housed in the existing Concentrator building.

Coarse Ore Crushing

In the coarse crushing area, ROM ore (with a top feed size of 48 inch /1,200 mm) is reduced in two stages to 100% passing 3 inch (75 mm) prior to further size reduction in the fine crushing circuit at an average feed rate of 1,666 st/h (1,512 mt/h). ROM ore is delivered by rail from the open pit and dumped sequentially from 100 short ton side tipping rail cars into a 110 short ton dump pocket above the 60 inch (1200 hp/900 kW) gyratory primary crusher. Following primary crushing, the ore gravitates to a second stage of crushing in three parallel 36-inch (540 hp/400 kW) gyratory crushers. The discharge from the secondary crushers is conveyed to a coarse ore bin above the fine crushers, which has a live capacity of approximately 2,200 tons, which is equivalent to approximately 80 minutes of continuous feed.

Fine ore crushing – The coarse crushed product is further reduced in two stages to 8 mm suitable for feed to the milling circuit. Coarse crushed ore is delivered to a coarse ore storage bin that extends the length of the Fine Crushing Building. Since only three fine crushing lines will be reactivated only a portion of the total live storage capacity will be used. From the coarse ore bin material gravitates to three parallel fine crushing lines, each line consisting of a 7 ft (470 hp/350 kW) standard cone tertiary crusher discharging onto two double deck vibrating screens from where oversize discharges to two 7 ft (470 hp/350 kW) short head quaternary cone crushers. The screen undersize material passes directly to the conveyor below, which also collects quaternary crusher products. The final crushed product is conveyed to a fine ore bin in the Concentrator Building, which has a live mill feed storage capacity of approximately 17 hours.

Ore Grinding

The milling circuits liberate sulphide minerals contained in the ore through a process of particle size reduction. The milling circuit comprises twelve parallel circuits each consisting of a 12 ft diameter and 15 ft long 800 hp (600 kW) rod mill feeding a 1,250 hp (930 kW) ball mill operating in closed circuit with a cyclone, with a circulating load of 250%. Each rod mill receives a proportion of finely crushed ore, approximately 128 st/h (116 mt/h) at P80 of 8 mm, and discharges product to a ball mill, which produces milled product at P80 120 of µm.

Sulphide Flotation

The objective of the flotation circuit is to recover a bulk sulphide concentrate containing the base and precious metals whilst rejecting largely siliceous tailings. The concentrate produced is then fed to the POX in the hydrometallurgical plant.

Milled primary cyclone overflow along with flotation regrind cyclone overflow is split to two parallel trains of rougher/scavenger flotation. Rougher concentrate from both trains is combined and undergoes two stages of cleaner flotation to reduce mass and increase sulphide grade ahead of POX. Scavenger concentrate is combined with Cleaner One tailings and is fed to a regrind circuit, which includes one regrind mill operating in closed circuit with a regrind cyclone. The regrind cyclone overflow is directed back to the head of flotation.

Scavenger tailings are pumped to the flotation tailings facility.

Flotation requires a number of reagents and make-up storage tanks and dosing pumps are provided within a nearby dedicated flotation reagents area.

Concentrate Fine Grind

The final cleaner concentrate is mixed with flocculant and thickened, and the resulting underflow is pumped to a fine grinding ISA Mill to produce the POX feed at P80 of 15 µm.

Flotation Tailings

Flotation tailings are pumped to the established Tailings Basin. Existing seepage collection systems will be augmented and upgraded to more efficiently capture seepage and return it to the basin.

17.3 Phase I Plant Design

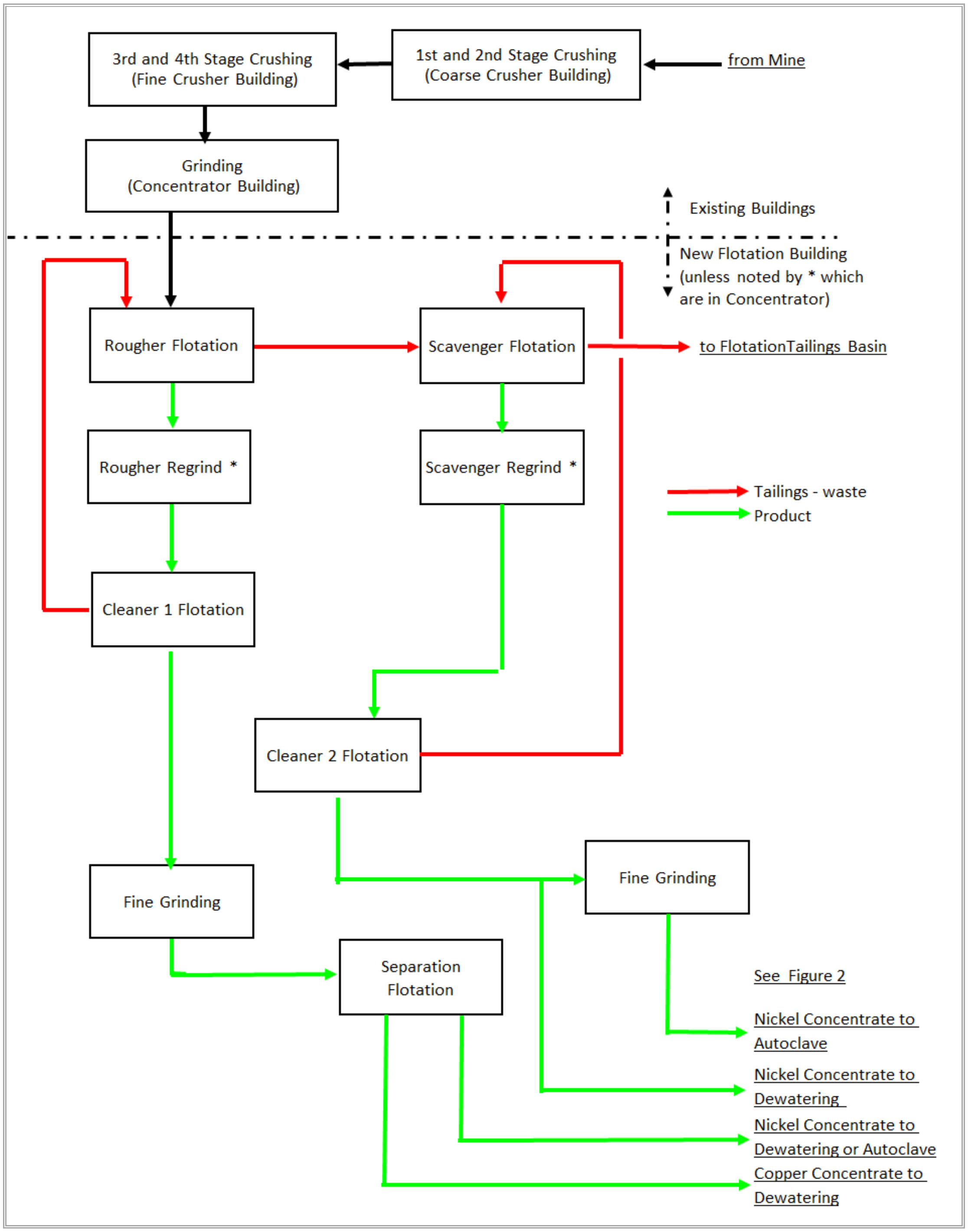
As set out in the introduction to this section, PolyMet now plans to build the Project in two phases:

- Phase I: produce and market concentrates containing copper, nickel, cobalt and precious metals
- Phase II: process the nickel concentrate through a single autoclave, resulting in production and sale of high grade copper concentrate, value added nickel-cobalt hydroxide, and precious metals precipitate products.

The changes reflect continued metallurgical process and other project improvements as well as improved environmental controls that are being incorporated into the Project. The advantages, compared with the earlier plan, include a better return on capital investment, reduced financial risk, lower energy consumption, and reduced waste disposal and emissions at site.

The purpose of the beneficiation process (Figure 17-1) is to produce final separate concentrates. One of the separate concentrates will be a copper concentrate. The other separate concentrates would be differing grades of nickel concentrate. The nickel concentrates can be blended in various combinations. The concentrates could be shipped to customers, used as a feedstock to the hydrometallurgical process, or divided for both uses. PolyMet expects that the Beneficiation Plant would be operational two years before the Hydrometallurgical Plant and during that period, all concentrates would be shipped to customers. Once the Hydrometallurgical Plant becomes operational some or all of the nickel concentrates would be feedstock to the hydrometallurgical process. The decision to ship or process concentrates would be based on equipment maintenance schedules, customer requirements and overall Project economics.

Figure 17-1: Beneficiation Plant Simplified Process Flow Diagram



The Beneficiation Plant processes include ore crushing, grinding, flotation, dewatering, storage and shipping. Crushing and grinding would occur in the existing Coarse Crusher

Building, Fine Crusher Building and Concentration Building, all of which remain from the LTVSMC operations. Flotation would occur in a new Flotation Building. Dewatering, storage and shipping would occur in a new Concentrate Dewatering/Storage Building.

17.3.1 Ore Crushing

In Ore Crushing, ore as large as 48 inches in diameter would be delivered by rail from the mine to the Coarse Crusher Building where each car would be emptied into a primary crusher at an average feed rate of 1,667 tons/hour (t/h). From the primary crusher, ore would move by gravity to four parallel secondary crushers. A conveyor system would move the ore, 80% of which would now be smaller than 2.5 inches, to the coarse ore bin located in the Fine Crusher Building.

The coarse crushed ore would be fed into parallel fine crushing lines. Each line would consist of a tertiary crusher, two quaternary screens and two quaternary crushers. The crushed ore would be transferred to the fine ore bin located in the Concentrator Building. At this stage, approximately 80% of the ore in the fine ore bin would be smaller than 0.315 inch.

17.3.2 Ore Grinding

Ore Grinding, which occurs in the Concentrator Building, would reduce the ore particle size to the point at which 80% would be less than 120 µm (4.7 x 10-3 inches). In Ore Grinding, the fine ore bin would feed into parallel mill lines. Each line would consist of a rod mill in series with a ball mill. The ore would pass through the rod mill once and the ground ore would be delivered to the ball mill. The ground ore would re-circulate through the ball mill until the particle size would be small enough for flotation.

The existing Coarse and Fine Crushing Building and Ore Grinding emission control systems will be replaced with components that meet or exceed the particulate emission standard required of new sources at taconite plants. To reduce space-heating requirements, emission control system exhaust would be able to be recycled to the buildings. The material collected would be mixed with water and added to the milling circuit. This means that the solids removed from the air stream would be recycled to the process and no solid waste management would be required and no water would be lost. Because water would be added to the mill lines and the beneficiation process would be wet from that point on, there would be no need for particulate emission control systems downstream of the fine ore bin.

In the event of a power failure, all process fluids would be contained within the Concentrator Building and recycled to the process when power has been restored. This same containment and recycle system would contain and control any minor spills.

17.3.3 Flotation

Once at a size of 120 µm, the ore would be processed in Flotation to recover the base and precious metal sulfide minerals. Flotation would consist of rougher and scavenger flotation lines followed by cleaner stages in a new Flotation Building and would produce separate nickel and copper concentrates.

In Flotation, separation of the sulfide minerals would be achieved using a collector/frother combination. Air would be injected into each flotation cell and the cell would be mechanically agitated to create air bubbles that would pass upward through the slurry in the cell. The frother (methyl isobutyl carbinol and polyglycol ether, or MIBC/DF250), would provide strength to the bubbles and the collector (potassium amyl xanthate, or PAX) would cause the sulfide minerals to attach to the air bubbles. The material attached to the bubbles would be concentrate and the material remaining in the slurry would be tailings.

The Rougher Flotation tailings would go to Scavenger Flotation where collector and frother would be added, along with copper sulphate as a flotation activator. The activator would ensure that the particles that would be difficult to float (i.e., contain minor amounts of sulfide) would be recovered in the concentrate, which reduces the total sulphur content of the tailings. The concentrate from Scavenger Flotation would go through Scavenger Regrind to Cleaner 2 Flotation. Cleaner 2 Flotation tailings would go back to Scavenger Flotation feed, while the nickel rich Cleaner 2 Flotation concentrate would be sent through Fine Grinding 2 to the Hydrometallurgical Plant or directly to Concentrate Dewatering. The tailings from Scavenger Flotation would be sent to the Flotation Tailings Basin. Rougher Flotation concentrate would be fed through Rougher Regrind to Cleaner 1 Flotation. Cleaner 1 Flotation tailings would go back to Rougher Flotation feed, while the concentrate would be sent through Fine Grinding 1 to Separation Flotation. Separation Flotation would produce a copper concentrate and two nickel concentrates. The copper concentrate would go to Concentrate Dewatering. The nickel concentrates would go to Concentrate Dewatering or to the Hydrometallurgical Plant.

The Scavenger Flotation tailings would be pumped to the Flotation Tailings Basin where the solids would settle and be stored permanently. The clear water would be re-circulated to the mill process water system.

In the event of a power failure, all process fluids would be contained within the Flotation Building and recycled to the process when power has been restored. This same containment and recycle system would contain and control any minor spills.

17.3.4 Concentrate Dewatering/Storage

Concentrate Dewatering/Storage would be used to dewater and store copper and nickel concentrates and to load those concentrates into covered rail cars. Concentrate Dewatering/Storage would be within the new Concentrate Dewatering/Storage Building.

The copper and nickel concentrates would each be delivered to separate dewatering lines each with a filter that would reduce concentrate moisture content to approximately 8 to 10%. The water removed by the filter would be returned to the Beneficiation Plant.

Each filtered concentrate would be conveyed to separate stockpiles within an enclosed 10,000 ton storage facility for loading into covered rail cars. The storage facility would store about 7 to 10 days of production capacity when flotation concentrate would be directed to Concentrate Dewatering/Storage. The storage facility would have a concrete floor and provisions to wash wheeled equipment leaving the facility to prevent concentrates from being tracked out of the facility.

In the event of a power failure, all process fluids would be contained within the Concentrate Dewatering/Storage Building and recycled to the process when power has been restored. This same containment and recycle system would contain and control any minor spills.

17.3.5 Processing Parameters

Table 17-4 shows PolyMet's estimates for daily production rates and size reduction through the processing steps in the beneficiation process. The rates and sizes provided are the values PolyMet would use to design plant piping and equipment.

Table 17-4: Design Processing Parameters

Step	Input			Output		
	Material	Rate (st/d)	Size (")	Material	Rate (st/d)	Size (")
Ore Crushing	Ore	32,000	48	Ore	32,000	0.315
Ore Grinding	Ore	32,000	0.315	Ore	32,000	4.7 x 10-3
Flotation	Ore	32,000	4.7 x 10-3	Conc.	374 to Hydrometallurgical Plant and 286 to Concentrate Dewatering, or 660 to Concentrate Dewatering	1.8 x 10-3
				Tailings	31,340	4.7 x 10-3
Conc. Dewatering	Conc.	660	7.1 x 10-4	Dried Ni and Cu Conc.	286 copper, and 374 nickel	7.1 x 10-4

Water needed for the milling and flotation circuits would primarily be return water from the Tailings Basin, which would include treated Mine Site process water. Any shortfall in water requirements would be made up by raw water from Colby Lake using an existing pump station and pipeline.

17.3.6 Process Consumables

PolyMet anticipates the raw materials shown in Table 17-5 would be consumed by the Beneficiation Plant processes.

Table 17-5: Beneficiation Plant Consumables

Consumable	Quantity	Mode of Delivery	Delivery Condition	Storage Location	Containment
Grinding Media (metal alloy grinding rods and balls)	15,600 t/a	Rail (13 rail cars/mo)	Bulk	Concentrator Building	None required
Flotation Collector (PAX)	1,171 t/a	Truck (2-3 trucks/mo)	Bulk bags	Reagents Building	None required
Flotation Frother (MIBC and DF250)	1,007 t/a	Tank truck (2-3 trucks/mo) 1	Bulk	Reagents Building	Separate 13,200 gal storage tanks
Flotation Activators (copper sulphate)	592 t/a	Truck (1-2 trucks/mo)	Bulk bags	Reagents Building	9,200 gal Activator Storage Tank
Flocculant (MagnaFlox 10)	16.5 t/a	Truck (1 truck/2 mo)	1,875 lb bulk bags	Reagents Building	None required
Gangue Depressant (CMC)	1073 t/a	Truck (2-3 trucks/mo)	Bulk bags	Reagents Building	None required
pH Modifier (hydrated lime)	10,279 t/a	Tank Truck (1-2 trucks/day)	Bulk	Reagents Building	Storage Silo

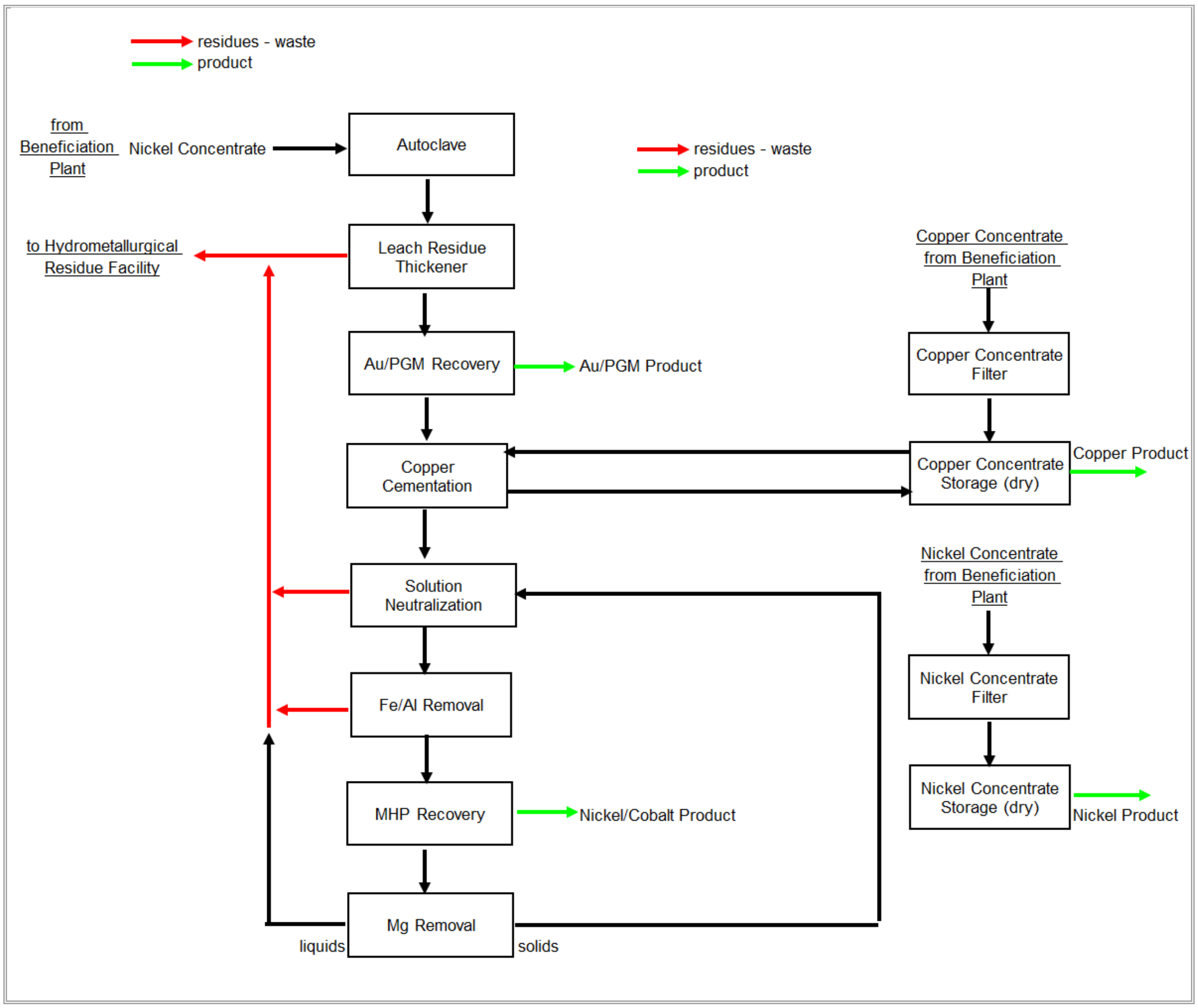
17.4 Phase II – Hydrometallurgical Plant

Hydrometallurgical processing technology would be used for the treatment of concentrates. This process would involve high pressure and temperature autoclave leaching followed by solution purification steps to extract and isolate platinum group, precious metals and base metals. All equipment used in the hydrometallurgical process would be located in a new Hydrometallurgical Plant Building.

Once the Hydrometallurgical Plant becomes operational some of the concentrates produced in the Beneficiation Plant would be feedstock to the hydrometallurgical process. The feedstock would be a combination of the separate nickel concentrates produced by the Beneficiation Plant. The decision to ship or process concentrates would be based on equipment maintenance schedules, customer requirements and overall Project economics.

PolyMet expects that the autoclave would be operational two years after the Beneficiation Plant becomes operational. A simplified process flow diagram for the hydrometallurgical process is shown on Figure 17-2.

Figure 17-2: Hydrometallurgical Plant Simplified Process Flow Diagram



17.4.1 Autoclave

In the Autoclave, the sulfide minerals in the concentrate would be oxidized and dissolved in a solution. Gold and platinum group metals would dissolve as soluble chloride salts. The solid residue produced would contain iron oxide, jarosite and any insoluble gangue (non-ore silicate and oxide minerals) from the concentrate. Generation of acid from the oxidation of major sulfide minerals would result in leaching of the silicate, hydroxide and carbonate minerals present in the concentrate.

Mine Waste Water Treatment Facility sludge (to recover metals and provide disposal of remaining solids) and hydrochloric acid (to maintain the proper chloride concentration in the solution to enable leaching of the gold and platinum group metals) would be added to the concentrate before the Autoclave. The Autoclave would be injected with oxygen gas supplied by a cryogenic oxygen plant at a rate that would be controlled to ensure complete oxidation of all sulfide sulphur in the concentrate.

Slurry discharging from the Autoclave would be sent to the Leach Residue Thickener where solids would be settled with the aid of a flocculant. The Leach Residue Thickener underflow would be filtered to produce a filter cake, which would be washed, re-pulped, combined with other hydrometallurgical residues and pumped to the Hydrometallurgical Residue Facility. The Leach Residue Thickener overflow would go to Gold and Platinum Group Metals (Au/PGM) Precipitation.

17.4.2 Gold and Platinum Group Metals (Au/PGM) Recovery

The product produced by Au/PGM Recovery would be a filter cake made up of a mixed gold and platinum group metals sulfide precipitate. The filter cake would be put into either bulk bags or drums for sale to a third party refinery. The remaining solution would go to Copper Cementation.

17.4.3 Copper Cementation

Copper concentrate from dry concentrate storage would be re-pulped and the solution from Au/PGM Recovery would be contacted with the re-pulped copper concentrate. Copper would precipitate mostly in the form of copper sulfide. The enriched copper concentrate would be filtered and bled back into the copper concentrate stream ahead of filtration. All solutions would remain in the hydrometallurgical process. The remaining solution would then go Solution Neutralization.

17.4.4 Solution Neutralization

Solution Neutralization would be used to neutralize acids formed as a result of the upstream process. Solution from Copper Cementation would go to Solution Neutralization. Calcium in the form of either limestone or lime would be added. The result of the calcium addition would be the formation of gypsum that would be filtered to produce a gypsum filter cake. This filter cake would be washed, re-pulped, combined with other hydrometallurgical residues and pumped to the Hydrometallurgical Residue Facility. The solution remaining after neutralization would go to Iron and Aluminum Removal.

17.4.5 Iron and Aluminum Removal

Solution Neutralization would feed Iron and Aluminum Removal. Limestone, steam and air would be added to cause the aluminum and iron to precipitate. The precipitated metals would be filtered to produce a filter cake, which would be washed, re-pulped, combined with other hydrometallurgical residues and pumped to the Hydrometallurgical Residue Facility. The remaining solution would be sent to Mixed Hydroxide Precipitation.

17.4.6 Mixed Hydroxide Product (MHP) Recovery

Copper-free solution from Iron and Aluminum Removal would be reacted with magnesium hydroxide to produce nickel and cobalt precipitate. The precipitated metals would be filtered to produce a filter cake. The final mixed hydroxide product would have an approximate composition of 97% nickel and cobalt hydroxides with the remainder as magnesium hydroxide. The high quality mixed hydroxide filter cake would be packaged for shipment to a third party refiner. The remaining solution would go to Magnesium Removal.

17.4.7 Magnesium Removal

Lime slurry would be added to the solution from MHP Recovery to facilitate magnesium precipitation. The resulting slurry would be pumped to the Hydrometallurgical Residue Facility along with other residues. The solids would settle in the residue cell to be stored permanently while the clear water would be reclaimed continuously to the Hydrometallurgical Plant process water system.

17.4.8 Process Consumables

The raw materials described below as well as those summarized in Table 17-5 would be consumed by the Hydrometallurgical Plant processes. Table 17-6 provides additional information regarding processing reagents deliveries, capacity and nominal use at the site.

Table 17-6: Materials Consumed by the Hydrometallurgical Plant Processes

Consumable	Quantity[1]	Mode of Delivery	Delivery Condition	Storage Location	Containment
Sulphuric acid3	1.500 t/a	Tanker (2 tank cars/ mo)	Bulk	Adjacent to General Shop Building	31,965 gal storage tank with secondary containment
Hydrochloric acid	3.590 t/a	Tanker (3 tank cars/mo)	Bulk	Adjacent to General Shop Building	36,120 gal storage tank with secondary containment
Cobalt Sulphate3	18 t/a	Freight (1 delivery/mo)	67 lb bags in powder form	General Shop Building	In bags and batch mixed when needed
Guar Gum (Galactosol) 3	6.5 t/a	Freight (1 delivery/mo)	70 lb bags in powder form	General Shop Building	Batch mixed on a daily basis (0.5% solution w/w)
Liquid Sulphur Dioxide	1.433 t/a	Tanker (2 tank cars/mo)	Bulk	Adjacent to General Shop Building	30,000 gal pressurized storage tank with secondary containment
Sodium Hydrosulphide3	513 t/a	Tanker Truck (2-3 tankers/mo)	Bulk as a 45% solution with water (w/w)	Adjacent to General Shop Building	25,750 gal storage tank
Limestone	125,000 t/a	Rail (1 100-car trains/week from April to October)	Bulk	Stockpiled on site	Berms/ditches around outdoor stockpile with water that has contacted limestone collected and added to the plant process water.
Lime	4.344 t/a	Freight (75 loads/mo)	Bulk	Adjacent to General Shop Building	Lime Silo and 21,000 gal storage tank
Magnesium Hydroxide	4.866 t/a	Tanker (7 tank cars/mo)	60% w/w magnesium hydroxide slurry	Adjacent to General Shop Building	Magnesium Hydroxide 270,000 gallon Storage Tank
Caustic (NaOH)	33 t/a	Tanker Truck (1 load/mo)	50% w/w solution	General Shop Building	1,300 gal storage tank

Consumable	Quantity[1]	Mode of Delivery	Delivery Condition	Storage Location	Containment
Flocculant (MagnaFloc 342)	14 t/a	Freight	1,543 lb bulk bags of powder	Main Warehouse	In bags and batch mixed regularly as 0.3% w/w solution
Flocculant (MagnaFloc 351)	90 t/a	Freight	1,543 lb bulk bags of powder	Main Warehouse	In bags and batch mixed regularly as 0.3% w/w solution
Nitrogen (used in Hydrometallurgical Plant)2	19,113 t/a	NA	NA	NA	NA

Note: [1]Nitrogen used in the Hydrometallurgical Plant would be produced as a byproduct in the Oxygen Plant and no shipping or storage would be required

17.4.9 Hydrometallurgical Process Water

A separate Hydrometallurgical Plant process water system would be required due to the different nature of the process solutions involved in the hydrometallurgical and beneficiation processes. Hydrometallurgical process water would contain significant levels of chloride relative to the water in the milling and flotation circuits. The system would distribute water to various water addition points throughout the Hydrometallurgical Plant and would receive water from the Hydrometallurgical Residue Facility (water that was used to transport hydrometallurgical residue to the facility). Make-up water would come from flotation concentrate water and raw water.

17.5 Required Process Services

The Plant Site would require various services to perform its functions. These services would be in addition to site infrastructure needs. These services are summarized in Table 17-7.

Table 17-7: Plant Site Services

Service	Source	Source Location	Needed for
Compressed Air	Duty/standby arrangement of rotary screw type compressors	General Shop Building	Provide air at a pressure of 100 psig for plant services
Instrument Air	Air withdrawn from the plant air receiver to an instrument air accumulator and dried in a duty/standby arrangement of driers and air filters	General Shop Building	Provide air for instruments
Steam	Natural gas-fired boiler	Hydrometallurgical Plant	Generates heat needed for start up of the autoclaves
Diesel Fuel Storage	Existing Locomotive Fuel Oil facility (storage is discussed in more detail in	Area 2 Shop	Diesel for locomotives

Service	Source	Source Location	Needed for
	Section 3.1.2.8)		
Gasoline Storage	Existing storage facility – two 6,000 gal tanks	Main Gate	Gasoline for vehicles
Raw Water	Water from Colby Lake via an existing pumping station and pipeline (see Section 4.1)	Stored in the Plant Reservoir	Plant fire protections systems, plant potable water systems, make up water for grinding and flotation process water and hydrometallurgical plant process water
Potable Water	Existing Processing Plant potable water treatment plant would be refurbished and reactivated	Near the Plant Reservoir	Potable water distribution system includes the Area 1 and Area 2 Shops
Fire Protection	Existing fire protection system would be refurbished, reactivated and extended to new buildings	Plant Reservoir	Area 1 and Area 2 Shops have independent fire protection systems
Oxygen	440 t/d Oxygen Plant. Plant process takes in ambient air, compresses it and separates the oxygen from nitrogen and other trace atmospheric gases. Oxygen would be transported via pipeline to plant processes and nitrogen and trace gases would be returned to the atmosphere.	Adjacent to Concentrator	Plant processes

17.6 Plant Site Air Quality Management

All active areas at the Plant Site, including the Tailings Basin, would be subject to a Fugitive Dust Control Plan approved by MPCA for managing fugitive dust generated at material handling locations, unpaved roads and areas potentially subject to wind erosion. The emission control systems on plant processes would have automated monitoring and alarming of operating parameters that indicate off-spec performance with auditable procedures to track the actions taken by operating and maintenance personnel in response to the alarm. Periodic stack testing would demonstrate compliance and confirm the proper alarm points.

17.7 Comments on Section 17

The modifications to the flowsheet since the DFS was completed in September 2006 reduce the technical risks during start up (because initial production of concentrates use very established technology). The permitting delays have provided PolyMet with an unusual opportunity to review and analyze its plans, resulting in a technically and economically stronger project.

The biggest technical risk in the DFS was the start-up of the hydromet circuit – fine-tuning the process chemistry to achieve expected recoveries and commercial product standards. With the revised schedule, PolyMet will have commercial sales of copper and nickel concentrates during ramp-up of the hydromet circuit.

18 PROJECT INFRASTRUCTURE

As reported in the DFS, one of the key elements of this project is that infrastructure is well established, generally in good condition and, in most cases, requires only minor modification to accommodate new installation. Existing infrastructure and services include:

- incoming HV power (138 kV) from the Minnesota Power grid
- power distribution within and around the existing facilities
- water supply and distribution
- sewage collection system (though treatment plant must be replaced)
- guard house and related security facilities
- offices, changing rooms, meeting rooms, lunch rooms
- sample preparation and analytical laboratories
- warehouses and storage facilities
- road and on-site railroad system
- railroad connection to common carrier rail network
- workshops
- natural gas supply
- communications
- mine railroad and locomotive services and refuelling facilities
- tailings disposal facilities.

All the above were evaluated in detail to determine their suitability and cost effectiveness of re-use and cost estimates have been included to refurbish the existing facilities and return them to a condition suitable for safe re-use by PolyMet. In 2010 and 2011 a program of testing and refurbishing the major electrical equipment of switchgear, transformers and MCCs was initiated which has confirmed that most of these assets can be reactivated for the NorthMet project.

In addition to the various and extensive offices available at the Coarse Crushing facility, the Fine Crushing building, in the Concentrator, associated with the General Workshop, the Unit Rebuild Workshop and the warehouse complex, PolyMet has also acquired the former LTVSMC Administration Building located away from the main industrial area on the public road from Hoyt Lakes. This building previously housed 150-200 administration staff. PolyMet intends to use this building during the construction phase to accommodate engineering and construction management staff. Existing telecommunications, networking and fibre optic connections within the building are functional and can be fully reactivated at minimal cost.

Historically the Mesabi Iron Range has been the centre of a very large and extensive iron ore mining industry with six world-class taconite iron ore mining operations in production at this time. To support this mining activity, the area has a very well developed infrastructure, which includes excellent roads, extensive railroads, access to ocean shipping via the nearby ports of Duluth/Superior, reliable grid power, engineering support services and service providers as well as a significant pool of skilled labour for construction as well as operations. PolyMet will benefit from the existence of this infrastructure, which will facilitate construction and provide simplified and reliable shipping logistics for equipment, parts, consumables and product export.

18.1 Road and Logistics

18.1.1 Ore Haulage

The LTVSMC taconite mining operation depended entirely on rail transport of ore to the Primary Crusher. To minimise capital cost, PolyMet plans to re-use large parts of the former LTVSMC railroad system, which will be refurbished to transport run of mine ore approximately nine miles from the NorthMet open pit to the Primary Crusher at a planned rate of 32,000 st/d, 365 d/a.

Ore will be mined conventionally and transported by mine haul trucks to a rail transfer hopper located near the pit rim. With a live storage capacity of 3,600 tons, the rail transfer hopper will allow for rapid and efficient loading of rail cars while effectively separating and de-coupling the mining and rail haulage systems. Storage capacity provided by the rail transfer hopper plus the adjacent ore stockpile will allow a degree of independence between the mining and the rail haulage systems; however, limitations on ore storage capacity in the crushing system and at the Concentrator will require railroad haulage to operate 7 days per week, year round to ensure concentrator feed can be maintained.

The rail transfer hopper will be constructed from reclaimed and refurbished components of two approximately similar structures, which PolyMet has acquired from Cliffs. Built in the latter part of the 1990s and known as “Super Pockets”, the two former LTVSMC rail transfer hoppers transferred taconite ore very efficiently from mine haul trucks to rail cars until closure in 2001. PolyMet has already recovered for re-use the mechanical, hydraulic and electrical components of these two hoppers and proposes to build a single, purpose-built structure, similar to the original LTVSMC hoppers, on the south side of the NorthMet pit. The newer equipment will be refurbishment for reactivation while the second, older, set will be retained and refurbished in due course as operating spares.

Figure 18-1 shows one of the two LTVSMC transfer hoppers operating with taconite. Equipment condition is good and estimates for its refurbishment have been obtained from original equipment manufacturers. PolyMet is confident that the re-built system will work efficiently and cost-effectively.

To connect the rail transfer hopper to the Primary Crusher, a total of 10,600 ft of new track will be constructed along with installation of 1,600 new ties and 3,000 ft of new rail in existing track. The existing Main Line will not require upgrading as it has remained in irregular service since closure of the LTVSMC facilities. The new sections of track construction will include 5,000 ft of spur line to connect the transfer hopper to the existing main line, and 5,600 ft of new track to connect the mainline and existing track running to the Primary Crusher. Much of the latter will utilise former rail bed from which ties and rail were removed prior to acquisition by PolyMet. Design includes provision adjacent to the rail transfer hopper for direct loading of railcars using front-end loaders in the event of hopper breakdown or non-availability.

Figure 18-1: LTVSMC Rail Transfer Hopper in Operation

To connect the rail transfer hopper to the Primary Crusher, a total of 10,600 ft of new track will be constructed along with installation of 1,600 new ties and 3,000 ft of new rail in existing track. The existing Main Line will not require upgrading as it has remained in irregular service since closure of the LTVSMC facilities. The new sections of track construction will include 5,000 ft of spur line to connect the transfer hopper to the existing main line, and 5,600 ft of new track to connect the mainline and existing track running to the Primary Crusher. Much of the latter will utilise former rail bed from which ties and rail were removed prior to acquisition by PolyMet. Design includes provision adjacent to the rail transfer hopper for direct loading of railcars using front end loaders in the event of hopper breakdown or non-availability.

The rail infrastructure will be refurbished to safely meet operational requirements at minimal capital cost with periodic rail and tie replacement during mine life to maintain serviceability.

PolyMet has acquired from Cliffs 120 side dumping, 100-ton capacity DIFCO railcars formerly used by LTVSMC to transport run of mine taconite to the Primary Crusher. These rail cars, which are not self-dumping, are very robust and have been inspected by KOA who have developed an estimate to restore the fleet to operational condition. The strategy is to initially restore the fleet to safe and reliable operating condition at minimal cost. Once the mine is operational and generating cashflow, rolling stock will undergo progressive restoration/rebuilding as required to minimise operating costs for the remaining mine life.

18.1.2 Minesite Infrastructure

Mine Site Facilities

Apart from the rail-loading hopper, facilities at the NorthMet mine site will be kept to a minimum. A covered field service and refuelling facility with temporary storage tanks will be set up near the rail transfer hopper. As is common at taconite mining operations in the area, fuel oil will be supplied direct to the end-user by a local supplier who will also be responsible for its storage and distribution. In much the same way, a local supplier of explosives and blasting accessories will provide an ‘in-hole’ service delivering and placing explosives directly into blast holes. The supplier will be responsible for storing and delivering explosives and hence no onsite explosives magazine will be required.

Mine and Railroad Offices and Staff Facilities – Area 2 Workshops & Offices

Offices and change-house facilities for mine and railroad operating and technical personnel will be provided by refurbishing existing facilities located adjacent to the railroad and about two miles east of the Primary Crusher. Known as the Area 2 Shop, this facility includes a large building which will house the refurbished offices and personnel facilities as well as a workshop, complete with overhead crane that will be set up for railroad rolling stock maintenance.

Mine Mobile Equipment Maintenance Facility – Area 1 Truck Shop

This study assumes the mining contractor will be responsible for equipment fleet maintenance and that all associated costs are included in the contract rates used to develop mine operating costs. PolyMet now owns the former LTVSMC mine mobile equipment maintenance complex known as the Area 1 Truck Shop (Figure 18-2). This will be refurbished and reactivated for use by the mining contractor. Area 1 Truck Shop is a purpose-built, fully enclosed, winterised, heavy mobile equipment maintenance facility located about one mile west of the process plant site. Comprising six truck bays (capable of accommodating haul trucks up to 240 ton payload class), three miscellaneous heavy equipment bays, a two-stall, enclosed truck wash down bay and associated shops, lunch room, offices, storage capacity, change house and ablution amenities, this facility is ideal for maintaining the mining equipment fleet. Although it is located about nine miles from the mine site, access between the two will be in part via the existing, upgraded Dunka Road and in part through former LTVSMC mine areas (now inactive) to avoid mixing light and heavy vehicular traffic in the vicinity of the Area 2 Offices. The minor inconvenience of having to move equipment between the mine and the workshops is offset by having a ready-made, comprehensive maintenance facility available at very low capital cost.

Figure 18-2: Area 1 Truck Shop viewed from the southeast showing the tracked equipment bays and tyre shop

Mine Site Electrical Power Distribution

Electrical power for the major items of mining equipment (excavators, blast hole drills, dewatering pumps, powering the rail transfer hopper facility and for ancillary services) will come from the nearby 138 kV transmission line owned and operated by local power utility, Minnesota Power (MP). For cost estimation purposes, it has been assumed that the power utility will provide the main step down transformer at the mine site as well as the connection from the 138 kV transmission line. From there power will be distributed around the open pit by means of a single circuit line suspended from wooden poles. This supply line will be extended periodically as required by the changing nature of the ongoing mining operation. PolyMet has already acquired sufficient 4,160 V, skid-mounted substations to meet the start-up requirements of the mining fleet though it is anticipated that additional substations and extension of the in-pit power line will be required in years 6 and 12.

18.1.3 Existing Beneficiation Plant & Equipment

Assessment Methodology & Engineering Philosophy

At closure, the former LTVSMC facilities were a fully operational, well maintained, going concern. Shut down had been systematic and there was an expectation that the plant would be re-started at some point in the future. Prior to the start of the DFS preliminary engineering studies by Optimum Project Services Ltd., Penguin Automated Systems, Inc. and Bateman assessed the major elements of the crushing plant, milling and tailings disposal facilities and determined they were fit for the purpose of crushing and milling NorthMet ore. The exception was the original taconite flotation equipment, which is to be removed and replaced with larger capacity, state-of-the-art flotation equipment engineered specifically for NorthMet ore. It was PolyMet's expectation, therefore, that much of the plant could be reactivated at minimal cost, with up-grades restricted to areas such as environmental controls and dust extraction where stringent compliance standards are expected.

To assess the condition of existing equipment and hence to determine the risks and costs associated with re-starting it, detailed site inspections were carried out by qualified individuals who had previously worked at and knew the plant intimately. In addition to drawing on the personal experience and knowledge of former LTVSMC employees, detailed and pertinent operating data, maintenance records and reports, and supervisors' shift logs were reviewed to provide a detailed picture of the condition of the plant at closure. During July and August 2006, a number of motors including those for a crusher, a rod mill, a ball mill, feeders and various drives were successfully test-started to confirm reactivation assumptions. Existing instrumentation was also reviewed to confirm the extent to which it could be reactivated. The number of test failures was minimal thereby adding confidence that the selected plant can be re-started with limited refurbishment. Appropriate allowances are made in the Capital and Operating cost estimate for refurbishment prior to restarting equipment and subsequent staged maintenance.

Because the original LTVSMC plant had a capacity (90,000 lt/d) nearly three times larger than that required by PolyMet, part of the design and commissioning philosophy assumed reactivation of sufficient plant and equipment to meet the expected ramp-up schedule with subsequent reactivation of additional equipment to provide spare capacity when major scheduled overhauls or maintenance work is required.

Another aspect of design philosophy relates to the use of spare equipment. There is a large amount of equipment available to PolyMet, which does not need to be immediately reactivated. Therefore, PolyMet intends to refurbish some of this surplus equipment progressively to provide spares in the event of breakdown, or additional capacity in the event that some existing equipment does not perform as expected.

Requirements for Re-commissioning Existing Plant Facilities

Based on detailed plant condition assessments, the following activities will be necessary to refurbish and reactivate the ore beneficiation facilities.

- The existing plant facilities will be cleaned up and made safe ahead of refurbishment work. This work will include removal of debris as well as asbestos removal and mitigation.
- Buildings are structurally in very good condition and need only minor repairs including some minor roof patching and drain pipe replacement due to freezing damage.
- Crusher maintenance records were used to determine remaining wear life and to plan and schedule subsequent maintenance. Liners and wear materials will be replaced where remaining life was identified as less than 25% original or where obviously required. Other items needing attention in the Coarse Crushing facility include the rebuild of an existing Pioneer feeder and replacement of one METSO apron feeder.
- In the Fine Crushing facility, equipment from four of the original seven lines was sold and removed prior to acquisition by PolyMet. The planned production rate requires only three fine crushing lines, each line consisting of one 7 ft standard tertiary cone crusher in series with two 7 ft quaternary shortheads. These will be arranged so as to maximise live storage capacity in the overhead coarse ore bin. There are also a variety of spare crusher frames, bowls, mantles, drive motors, conveyors and feeders, which will be refurbished for use as spares. Using LTVSMC maintenance records verified by field inspection, it was determined that only one of the three tertiary crushers requires new liners and a frame repair. The six quaternary crushers have good liners in place and will only require servicing prior to start-up. The six existing single deck screens between the tertiary and quaternary crushers will be replaced with new double deck screens for increased screening efficiency.
- Conveyors 3A, 4B and 5N will be reactivated to transport fine crushed ore to the ore beneficiation building storage bins. As elsewhere, maintenance records were used to determine the condition of conveyor drives, bearings, trippers, feeders and related components. Visual inspection of conveyor idlers indicated about 10% would need replacement prior to start-up. Chute work will be replaced where worn.

Of the 34 original rod/ball mill grinding lines (Figure 18-3), only twelve will be needed for 32,000 t/d capacity. Mill lines 1-N to 12-N inclusive will be reactivated, though it is proposed to use and relocate the mills with the most remaining liner life.

There are also three 12 ft 2" by 23 ft 4", 1500 hp regrind mills, one of which will be reactivated to regrind scavenger concentrate, while regrind mill 3S will be used to produce a limestone slurry for acid neutralisation in the hydrometallurgical plant. The third mill will be available as stand-by.

Figure 18-3: Rod Mill - Detail

The concentrator upper bay is equipped with two overhead cranes, one 200 ton capacity and one 25 ton capacity, which range over the full length and breadth of the milling level. These cranes are functional and will require only inspection and re-certification before reactivating. These cranes also provide tremendous operational and maintenance flexibility as they have sufficient lifting capacity to pick up and move a mill shell (rod or ball) complete with media charge to a central maintenance area.

Based on mill throughput records and maintenance records, a liner replacement schedule was developed which optimises remaining liner life and forms the basis of mill capital and operating cost estimates.

The large number of redundant mills and associated feed equipment will allow PolyMet to progressively refurbish units as required for spares. Moreover, in the unlikely event that existing equipment does not perform as expected, additional milling capacity can be brought on line quickly and cheaply.

A new sulphide flotation circuit will be installed. A feature of mill building design was the use of gravity feed wherever possible to minimise pumping.

The existing raw, domestic, mill, service and fire water systems will be reactivated with only limited refurbishment necessary. The original facilities made extensive use of pumped hot water and steam for plant heating; however, to avoid costly overhaul of this system, new gas-fired heating equipment will be installed and, where necessary, existing gas-fired equipment will be reconditioned. (The plant site is served by a natural gas pipeline with up to 13,000 M cu ft/day of natural gas at 125 psi, which far in excess of PolyMet's consumption estimates.

The primary substation was operated continuously with a power draw of 130 MW and since LTVSMC closure parts of this substation have been kept in operation, albeit at reduced load. PolyMet will re-commission it to service the existing plant site facilities, the new hydrometallurgical plant facilities and the new mine service area.

Included in the acquisition of the Erie Plant were large numbers of spare electric motors of all sizes, MG sets, electrical switching gear, starters, motor controls and associated electrical gear.

18.2 Waste Storage Facilities

18.2.1 Flotation Tailings Management

Flotation tailings would be placed on the former LTVSMC tailings basin. The existing former LTVSMC tailings basin is unlined and was constructed in stages beginning in the 1950s. It was configured as a combination of three adjacent cells, identified as Cell 1E, Cell 2E and Cell 2W and was developed by first constructing perimeter starter dams and placing tailings from the iron-ore process directly on native material. Perimeter dams were initially constructed from rock and subsequent perimeter dams were constructed of coarse tailings using upstream construction methods. The LTVSMC tailings basin operations were shut down in January 2001 and have been inactive since then except for reclamation activities consistent with a MDNR approved Closure Plan.

The NorthMet flotation tailings would be deposited in slurry form through a system of pumps and moveable pipelines. Tailings would go into Cell 2E for the first seven years of operation, then into both Cells 1E and 2E. Tailings would be deposited by gravity flow over discharge beaches when necessary and otherwise subaqueously via movable diffusers throughout the pond. The small and fairly uniform grind size of the tailings would allow for a fairly consistent particle size distribution to be achieved, minimizing segregation of coarse and fine portions. The dam would be raised using the LTVSMC bulk tailings. Tailings beaches would exist along the northern and northeastern dams of Cell 2E and the southern and eastern dams of Cell 1E.

The tailings would settle out of the slurry and the decanted water would be allowed to pond and be collected using a barge pump back system. The barge system would consist of a primary pump barge in Cell 1E, an auxiliary pump barge in Cell 2E, piping from the primary pump barge to the Beneficiation Plant and piping from the auxiliary pump barge to Cell 1E. The auxiliary pump barge would not be needed once the cells combine to form one cell. The return water pipelines would be moved as dams are raised (up to the maximum of 1,732 ft amsl to keep the pipeline at or near the top of the dam. The return water pipes would be fitted with a relief drain valve to allow for water to be drained back to ponds in case of shutdown during winter operations to avoid damage to the pipes from freezing or suction. Pumps would also be fitted with deicing mechanisms to avoid freezing.

18.2.2 Hydrometallurgical Residue Management

The hydrometallurgical process would generate residues from five sources:

- autoclave residue from the leach residue filter
- high purity gypsum from the solution neutralizing filter (depending on the market, this may become a saleable product, but is currently planned to be managed as a waste)
- gypsum, iron and aluminum hydroxide from the iron and aluminum filter
- magnesium hydroxide precipitate from the magnesium removal tank
- other minor plant spillage sources.

In addition to the above listed sources, solid wastes from the wastewater treatment facility at the mine sire (WWTF) would be recycled directly into the Hydrometallurgical Plant to recover metals. The WWTF solids would be similar to the Hydrometallurgical Residue Facility materials, consisting primarily of gypsum, metal hydroxides and calcite. These hydrometallurgical residues, which would include the non-recoverable metal portion of the solid wastes from the WWTF, would be combined and disposed of in the Hydrometallurgical Residue Facility as described below.

18.2.3 Hydrometallurgical Residue Cell Design and Operations

The Hydrometallurgical Residue Facility would consist of a lined cell located adjacent the southwest corner of Cell 2W of the former LTVSMC tailings basin. The cell would be developed incrementally as needed, expanding vertically and horizontally from the initial construction and would initially be designed to accommodate approximately 2,000,000 tons or six years of operations. The cell would be filled by pumping the combined hydrometallurgical residue as slurry from the Hydrometallurgical Plant. A pond would be maintained within the cell so that the solids in the slurry would settle out, while the majority of the liquid would be recovered by a pump system and returned to the plant for reuse. The residue discharge point into the cell would be relocated as needed to distribute the residue evenly throughout the cell.

18.3 Water Management

Water would be consumed at the Plant Site in both the Beneficiation Plant and the Hydrometallurgical Plant. For the most part, water operations within these two plants would operate independently. The only exceptions would be the transfer of flotation concentrate from the Beneficiation Plant to the Hydrometallurgical Plant and the combining of filtered copper concentrate and solution from Au/PGM Recovery in the Copper Cementation process step.

18.3.1 Hydrometallurgical Plant

All water that enters the Hydrometallurgical Plant would be consumed within the hydrometallurgical process, exiting as steam or becoming entrained within the solid waste residues or products generated through the hydrometallurgical process. The average annual water demand rate for the Hydrometallurgical Plant is estimated at 240 gpm, but varying from 114 to 406 gpm monthly as operating and climatological variations occur. At the same time, hydrometallurgical process residues would be disposed in the lined Hydrometallurgical Residue Facility, where the solids would settle out and the water would pond on the cell. To the extent possible, water that would be used to transport residue to the facility would be returned to the Hydrometallurgical Plant; however, some losses would occur through evaporation, storage within the pores of the deposited residue, or liner leakage to groundwater. In addition, water that would be contained in process fluids, should spillage of these fluids occur, would remain within the Hydrometallurgical Plant buildings and be returned to the appropriate process streams.

18.3.2 Beneficiation Plant

Within the Beneficiation Plant, water would be used to carry the ore through the grinding, flotation and separation steps, then to transport the tailings to the Tailings Basin. To the extent possible, water that would be used to transport tailings to the basin would be returned to the Beneficiation Plant, however some losses would occur through evaporation, storage within the pores of the deposited tailings, or seepage to groundwater under the Tailings Basin.

In addition, water that would be contained in process fluids, should spillage of these fluids occur, would remain within the Beneficiation Plant buildings and be returned to the appropriate process streams.

18.3.3 Tailings Basin

The primary source of process water for the Beneficiation Plant and the Hydrometallurgical Plant would be the Tailings Basin, which includes treated water piped from the Mine Site. Process water needs above and beyond that would be pumped from Colby Lake.

The Tailings Basin would be the final collection for process water that flows through the Beneficiation Plant and process water pumped from the Mine Site. Direct precipitation and run-off from the process areas at the Plant Site would also be directed to the Tailings Basin. Water that seeps from the toe around the perimeter of the Tailings Basin and emerges as surface seepage would be collected and returned to the Tailings Basin. Current surface seepage as well as any new surface seepage that develops during NorthMet operations will be collected. During times of high water flow from the Mine Site, which could result in excess water in the tailings basin, the recovered groundwater seepage would be pumped to a new Waste Water Treatment Plant located south of the Tailings Basin. These water management methods would result in no new direct surface discharge of process water at the Plant Site or Mine Site during operations and would minimize water needed via water appropriation from Colby Lake.

18.4 Camps and Accommodation

The LTVSTC operations employed approximately 1,400 people when they were shut in 2001. Hoyt Lakes was originally built to provide homes and a community for people working at the operations. Several other cities near the NorthMet Project are well equipped with schools, hospitals and other services.

18.5 Comments on Section 18

The existing plant and associated infrastructure immediately related to the plant and within the community are key attributes of the NorthMet Project. In view of the slower permitting process than what was originally expected, PolyMet plans to update its assessment of work needed at the existing facilities. However, the basic infratstructure remains in good shape, even if more electrical and other work needs to be done than was contemplated in the DFS.

19 MARKET STUDIES AND CONTRACTS

In the 2006 DFS Technical Report, PolyMet set out an analysis of the markets for the three products it then contemplated. As described elsewhere, PolyMet now plans to produce copper and nickel concentrates initially, then upgrade the nickel concentrate into a nickel-cobalt hydroxide and a precious metals precipitate.

An essential part of these revised plans is PolyMet's ability to market these products. In September 2008, PolyMet announced that it had entered into a long-term marketing agreement with Glencore whereby Glencore will purchase all of PolyMet's products (metals, concentrates or intermediate products). Pricing is based on London Metal Exchange with market terms for processing – in the case of copper concentrates, the benchmark is annual Japanese smelter contracts.

19.1 Market Studies

Since most of PolyMet's products are actively traded on terminal markets with active forward pricing, PolyMet has not conducted any specific market studies. Metal prices used in mineral resource and reserve calculations are substantially below recent levels and PolyMet.

19.2 Commodity Price Projections

Resource and reserve estimates have been based on prices substantially below recent market levels.

Table 14-21 summarizes metal prices used in resource and reserve estimation, prices used is the economic analysis in the DFS, prices used in the May 2008 DFS update, and three-year trailing average prices to June 31, 2012.

Copper and nickel are the most important metals for PolyMet. In the DFS, PolyMet estimate that copper would contribute 46% of net revenues, nickel-cobalt 38% and precious metals 16%.

19.3 Contracts

In 2008, PolyMet entered into an agreement with Glencore whereby Glencore will purchase all of PolyMet's products (metal, intermediate products, or concentrates) on independent commercial terms at the time of the sale. Glencore will take possession of the products at site and be responsible for transportation and ultimate sale.

19.4 Comments on Section 19

In view of Glencore's position as the world's largest trader of commodities, with especially strong positions in copper and nickel, there are no material risks associated with PolyMet's product marketing.

20 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

PolyMet commenced the environmental review and permitting process in early 2004. In October 2005, the DNR published its Environmental Assessment Worksheet Decision Document establishing the DNR as the lead state agency and the USACE as the lead federal agency for preparation of an EIS for the Project.

In 2006 the Lead Agencies selected Environmental Resources Management, a leading global provider of environmental, health and safety, risk, and social consulting services, as independent environmental contractor (the "EIS contractor") to prepare the EIS. The EIS Contractor team included members with expertise and experience in mining sulfidic ores. Several other government agencies (including the USFS, the Bois Forte Band of Chippewa and the Fond Du Lac Band of Lake Superior Chippewa) joined the EIS preparation team as cooperating Agencies, which brought their special expertise to the process.

In January 2007, PolyMet submitted a detailed project description (DPD) to state and federal regulators. The DPD laid out development plans and proposed environmental safeguards including a mine plan, a wetland mitigation plan, air and water quality monitoring plans and a closure plan with closure estimate. Since then, PolyMet has submitted a supplemental DPD as well as more than 100 supporting research studies, including comprehensive mine waste characterization studies, water quality modelling and air quality modelling.

Under state and federal guidelines and regulations, a Draft EIS identifies the environmental impact of a proposed project as well as evaluating alternatives and ways to mitigate potential impacts. PolyMet was involved in the process of alternative/mitigation development and had input into the technical and economical feasibility of potential alternatives and mitigations. The EIS Contractor prepared a series of preliminary versions of the Draft EIS that were reviewed and commented on by the Lead Agencies, other governmental agencies, and PolyMet.

In November 2009, the Lead Agencies published the PolyMet Draft EIS with formal notification of publication in the Minnesota Environmental Quality Board (EQB) Monitor and the Federal Register, which started a 90-day period for public review and comment, which ended on February 3, 2010. During this period, the lead Agencies held two public meetings – one in the town of Aurora, MN near the Project location and one in Blaine, MN in the metropolitan Minneapolis-St. Paul area.

The Lead Agencies received approximately 3,800 submissions containing approximately 22,000 separate comments, including an extensive comment letter from the EPA in its role as reviewer of projects that could impact the environment. Several other governmental agencies including the United State Forest Service (USFS) and Tribal cooperating agencies took part in the environmental review process.

On June 25, 2010, the Lead Agencies announced that they intended to complete the EIS process by preparing a Supplemental Draft EIS (SDEIS) that incorporates the land exchange proposed with the USFS Superior National Forest and expands government agency cooperation. The USFS joined the USACE as a federal co-lead agency through the completion of the EIS process. In addition, the EPA joined as a cooperating agency. The DNR remains the state co-lead agency.

On October 13, 2010, the USACE and the USFS published a Notice of Intent to complete the SDEIS, which will:

- supplement and supersede the Draft EIS and respond to concerns identified by the EPA and other comments on the Draft EIS
- incorporate potential effects from the proposed land exchange between the USFS Superior National Forest and PolyMet

Public review of the scope of the land exchange ended on November 29, 2010. The Notice of Intent stated that the proposed land exchange would eliminate conflicts between the United States and private mineral ownership and consolidate land ownership to improve Superior National Forest management effectiveness and public access to federal lands. The proposed exchange is in accordance with Forest Service Strategic Plan Goals to provide and sustain long-term socioeconomic benefits to the American people, conserve open space, and sustain and enhance outdoor recreation activities.

The NorthMet mine site encompasses approximately 2,840 of the 6,650 acres of land proposed for exchange to private ownership; the remaining federal property would improve intermingled and inefficient ownership patterns.

The lands that would be received by the Superior National Forest consist of forest and wetland habitat as well as lake frontage. These lands would enhance public recreation opportunities and complement existing federal ownership by eliminating or reducing private holdings surrounded by Superior National Forest land.

The EIS Contractor and the Lead Agencies are making continued progress toward completion of the SDEIS. The SDEIS follows the Council on Environmental Quality (CEQ) recommended organization under the US National Environmental Policy Act and the Minnesota Environmental Policy Act content requirements:

- Chapter 1.0 – introduction
- Chapter 2.0 – describes the SDEIS development and scoping process
- Chapter 3.0 – describes the Proposed Action and alternatives

- Chapter 4.0 – summarizes the existing conditions
- Chapter 5.0 – presents the direct and indirect environmental consequences
- Chapter 6.0 – describes the cumulative effects on the surrounding environment
- Chapter 7.0 – compares alternatives
- Chapter 8.0 – lists other considerations
- Chapter 9.0 – is the list of preparers.

Once all aspects of environmental modelling, including quality assurance/quality control have been completed, the results will be incorporated into a preliminary SDEIS that will be available for review by the cooperating Agencies (including the EPA). Comments from the cooperating Agencies will be incorporated as appropriate, which will then be published for public review and comment. A final EIS will consider those comments.

20.1 Policy, Legal, and Regulatory Framework

The Policy, Legal and Regulatory Framework was described in Chapter 1 of the Draft EIS dated October 2009. This will be updated in the same Chapter of the Supplemental Draft EIS when it is published for public review.

The primary regulatory framework comprises the National Environmental Policy Act and the Minnesota Environmental Policy Act.

20.1.1 National Environmental Policy Act (NEPA)

NEPA requires that federal agencies consider the potential environmental consequences of proposed actions in their decision-making process. The law's intent is to protect, restore, or enhance the environment through well-informed federal decisions. The Council on Environmental Quality (CEQ) was established under NEPA for the purpose of implementing and overseeing federal policies as they relate to this process.

In 1978, the CEQ issued Regulations for Implementing the Procedural Provisions of NEPA. Section 102(2)(c) of NEPA mandates that the lead federal agency must prepare a "detailed statement for legislation and other major federal actions significantly affecting the quality of the human environment." Such projects include any actions under the jurisdiction of the federal government or subject to federal permits; actions requiring partial or complete federal funding; actions on federal lands or affecting federal facilities; continuing federal actions with effects on land or facilities; and new or revised federal rules, regulations, plans, or procedures. Any significant action with the potential for significant impacts requires the preparation of an EIS and a record of decision (ROD).

The USACE, during its review of PolyMet's permit application, determined that the Project would require the preparation of an EIS in accordance with the requirements of NEPA and the CEQ regulations. To comply with other relevant environmental statutes, the decision-making process for the Proposed Action involves a thorough examination of all pertinent environmental issues.

The USACE will use the Final EIS to develop the ROD for intent to issue a Section 404 Wetland Permit as needed for the Project to proceed.

Likewise, the USFS will use the Final EIS to develop the ROD for the proposed land exchange action.

20.1.2 Minnesota Environmental Policy Act (MEPA)

In addition to the NEPA process, Minnesota Statutes also require an environmental review of the Project. The MEPA environmental review process is a decision-making tool for state agencies. It informs the subsequent permitting and approval processes and describes mitigation measures that may be available. The MEPA process operates according to rules adopted by the EQB. However, the actual reviews are usually conducted by a local governmental unit or a state agency. The organization responsible for conducting the review is referred to as the Responsible Governmental Unit (RGU). The primary role of the EQB is to advise RGUs and state agencies on the proper procedures for environmental review and to monitor the effectiveness of the process in general. Because of its responsibility under Minnesota Rules for the review of all proposed mine projects, the MDNR is the RGU for the Project.

Minnesota Rules dictate that an EIS shall be prepared because the Project exceeds the threshold listed for construction of a new metallic mineral mining and processing facility. Under MEPA, the DEIS must be consistent with Minnesota Rules and the scoping determination.

The DNR will make an adequacy decision on the Final EIS, after which the Final EIS can be used to inform state permitting actions.

20.1.3 Land Exchange Requirements

Most of the public lands involved in the NorthMet Project were acquired by the United States under the authority of the Weeks Act of 1911. Other authorities that govern the land exchange between PolyMet and the United States include the the Federal Land Policy and Management Act of 1976, and the Federal Land Exchange Facilitation Act of 1988.

PolyMet plans to exchange surface rights with the United States under the Federal Land Policy and Management Act, which requires that a land exchange involves the transfer of equal valued land (if land values are not equal, the balance can be paid up to an amount of 25% of the land exchange value) and must also provide that the exchange preserves wetland functions with no net loss to the Federal estate and no increase flood hazards to the non-Federal estate.

The proposed land exchange will leverage the 2004 Superior National Forest Land and Resource Management Plan (Forest Plan). The land exchange and associated current and future land use must be consistent with the conditions, goals, and guidelines outlined in the Forest Plan. Additionally, the USFS must analyze whether the land exchange meets the goals set forth in the USDA Forest Service Strategic Plan FY 2007-2012 Goals (Strategic Plan). The proposed land exchange would strive to meet four of the seven Strategic Goals: provide and sustain benefits to the American people; conserve open space; sustain and enhance outdoor recreation opportunities; and maintain basic management capabilities of the Forest Service by reducing landlines and mineral conflicts.

The proposed land exchange would be designed to be consistent with the remaining goals and objectives of the Forest Plan, in light of specific land classifications. The proposed non-federal lands for land exchange would need to be incorporated within the adjacent federal ownership and managed in accordance with the Forest Plan direction for the particular Management Area.

The Forest Supervisor, as the Responsible Official for the Superior National Forest, will decide in a ROD whether to proceed with the proposed land exchange. The EIS will serve as the basis for the ROD.

20.2 Baseline Studies

Extensive baseline studies were described in Section 4 of the Draft EIS. This will be updated in the same Chapter of the Supplemental Draft EIS when it is published for public review.

These studies (Table 20-1) include data on local lakes and rivers that extend to the 1930s in some cases and cover: meteorological conditions, ground and surface water, wetlands, hydrology, vegetation (types, invasive non-native plants, and threatened and endangered species), wildlife (listed species and species of special concern, species of greatest conservation need and regionally sensitive species), aquatic species (surface water habitat, special status fish and macroinvertebrates), air quality, noise, socioeconomics, recreational and visual resources, and wilderness and other special designation areas (established and candidate research natural areas, unique biological areas, national historic landmarks, scenic byway, national recreation trail).

Table 20-1: Baseline Environmental and Environmental Engineering Studies

Winter Wildlife & Wildlife Habitat Survey	Completed

Winter Wildlife & Wildlife Habitat Survey	Completed
Summer Wildlife & Wildlife Survey	Completed
Wetland Delineation and Classification Survey	Completed
Threatened & Endangered Plant Species Surveys	Completed
Canada Lynx Study	Completed
Stream and Wetland Biological Surveys (fish and aquatic marco-invertebrates)	Completed
Stream Classification of Partridge River and Trimble Creek	Completed
Freshwater Mussel Survey in Trimble Creek and Embarrass Rivers	Completed
Soil Mapping	Completed
Background Surface Water Quality Monitoring in Partridge and Embarrass Rivers	Phase I Completed; Phase II ongoing indefinitely
Compilation of Existing Surface Water Quality Data	Completed
Hydrogeologic Investigation for the PolyMet – NorthMet Mine Site	Completed
Scoping Cultural Resources Assessment	Completed
Phase I Archaeological Survey	Completed
Wetland Hydrology Study	Indefinite monitoring

20.3 Environmental Issues

20.3.1 Comments on the Draft EIS

Public and agency comments on the Draft EIS were collected during the 90-day comment period. Submissions came from stakeholders including government agencies (federal, state, and local), the Bands, local businesses, non-governmental organizations, private individuals, and the Project proponent. A total of approximately 3,800 comment submissions were received.

On February 18, 2010, the Co-lead Agencies received a comment letter from the EPA. In the absence of an Agency Preferred Alternative that described a specific project plan that met applicable state and federal regulations, the EPA reviewed the least environmentally acceptable plans and determined that the Project could result in detrimental impacts to water resources, including wetlands. The EPA also believed that impacts to water resources were underestimated and that the Project could have long-term discharges.

The EPA recommended preparation of a Supplemental Draft EIS to assess the impact of a specific project plan and respond to comments on the Draft EIS. The EPA became a co-operating Agency engaged in the preparation and review of the SDEIS.

20.3.2 MPCA Guidance Regarding Wild Rice

In June 2010, the MPCA issued staff recommendations on the site-specific application of a Minnesota standard for wild rice in the Partridge and Embarrass River systems. This guidance applies a water quality standard of 10 mg/L of sulphate to waters used for the production of wild rice during periods when rice may be susceptible to damage by high sulphate levels. The recommendations were updated in March and June 2011, to discuss the variations in conditions from year to year and the travel and residence time of sulphate releases. The MPCA guidance also included tailings basin performance requirements regarding seepage discharges, limitations to sulphate contributions in surface waters, and monitoring requirements. Also addressed were comments and concerns, which MPCA received from interested parties.

PolyMet has undertaken extensive testwork to demonstrate that the NorthMet Project can meet these standards, which will be reflected in the Supplemental Draft EIS.

20.3.3 Other Issues

During the scoping for the proposed project, several issues were identified as possibly resulting in significant impacts, which would require information beyond what was included in the scoping EAW. Of specific interest was additional information related to fish and wildlife resources, threatened and endangered species, physical impacts on water resources, water appropriations, surface water runoff and erosion/sedimentation, waste water, solid waste, cumulative impacts, stockpile cover types, point and non-point source air emissions, noise, archaeology, visibility, compatibility with land use plans and regulations, infrastructure, asbestiform fibers, and the 1854 Ceded Territory.

Subsequent to publication of the Draft EIS, additional issues were identified for further development and discussion in the SDEIS. These included air impacts, wetland impacts, geotechnical stability, socioeconomics, and water resources impacts. As previously discussed, topic-focused workgroups were assembled from members of the Co-lead and Cooperating Agencies to further explore these issues.

In addition to addressing issues identified during scoping, the SDEIS will also address issues that have been identified as the understanding of the potential impacts of the Project has evolved.

20.4 Closure Plan

Closure plans for the NorthMet Project, including both the mine site and reclamation of at the Erie Plant site were described in Chapter 3 of the Draft EIS and will be updated in the same Chapter of the Supplemental Draft EIS when it is published for public review.

PolyMet plans to build and operate the NorthMet project in a manner that will facilitate concurrent reclamation, in order to minimize the portion of the Project that will need to be reclaimed at closure. In addition to a detailed closure plan, Minnesota Rules require the Company to submit an annual plan that identifies activities if operations ceased in the following year.

All buildings and structures will be removed and foundations razed, covered with soil and vegetated. Most demolition waste will be disposed in the existing landfill at site, but some that may have elevated contaminants will be handled and disposed separately.

During the last ten years of operations, the East Pit will be backfilled concurrently with mining of the West Pit. At the end of operations, the backfilled East Pit will be flooded, overflowing into the West Pit.

The mine walls will be sloped and revegetated and selective areas of the pit walls will be covered. Pit perimeter fencing will be installed and stockpiles will be covered.

These items are covered in detailed plans covering:

- Demolition of structures (buildings, sanitary systems, wells, power lines, pipelines and tanks) including waste disposal.
- Reclamation of the Mine Site – mine pit reclamation, stockpile reclamation, reclamation of water management systems, building areas, roads and parking lots, and removal of railroad tracks and culverts.
- Reclamation of the Plant Site – FTB reclamation, HRF reclamation, reclamation of water management systems, building areas, roads and parking lots, and removal of railroad tracks and culverts.
- Remediation of legacy Areas of Concern (AOCs) and ongoing mitigation of water quality at the Mining Area 5N and the Tailings Basin as well as plans to investigate for potential releases at the conclusion of operations.
- Ongoing monitoring and maintenance for the existing solid waste disposal facilities, reclamation maintenance.

20.4.1 Financial Assurance

Minnesota Rules require financial assurance instruments to cover the estimated cost of reclamation be submitted and approved by the DNR before a Permit to Mine can be issued.

Financial assurance must cover the reclamation and post reclamation activities. The plan and the amount are updated each year to reflect the work completed and the plan in the event that the Project closed during the following year. The instruments must be bankruptcy proof.

20.5 Permitting

Prior to construction and operation of the NorthMet Project, PolyMet will require permits from several federal and state agencies. The final EIS will incorporate comments, after which a subsequent Adequacy Decision by the MDNR and Record of Decision by the federal co-lead agencies are necessary before the land exchange can occur and various permits required to construct and operate the Project can be issued. Including:

20.5.1 Government Permits and Approvals for the Project

US Army Corps of Engineers
- Section 404 Individual Permit
- Section 106 Consultation

US Fish and Wildlife Service
- Section 7 Endangered Species Act (ESA) Consultation
- US Forest Service
- Land Exchange Approval

Minnesota Department of Natural Resources
- Permit to Mine
- Water Appropriations Permit
- Dam Safety Permit
- Permit for Work in Public Waters
- Wetland Replacement Plan approval under Wetland Conservation Act

Minnesota Pollution Control Agency
- Section 401 Water Quality Certification/Waiver
- National Pollutant Discharge Elimination System and State Disposal System (NPDES/SDS) Permits
- Solid Waste Permit
- Air Emissions Permit
- General Storage Tank Permit

Minnesota Department of Health
- Radioactive Material Registration (for measuring instruments)
- Permit for Non-Community Public Water Supply System
- Permit for Public On-site Sewage Disposal System

City of Hoyt Lakes
- Zoning Permit

City of Babbitt
- Building Permit

St Louis County

- Zoning Permit

Zoning PermitMinnesota has extensive experience of permitting and overseeing operation of large-scale iron ore mines. However, PolyMet is the first company to seek permits to construct and operate a copper-nickel mine. As such, the NorthMet Project is defining how established state and federal regulations will be applied to non-ferrous mines.

20.6 Considerations of Social and Community Impacts

Chapter 4.10 of the Draft EIS included extensive discussion of social and community impacts, which will be updated in the Supplemental Draft EIS when it is published for public review.

The Draft EIS observes that the NorthMet Project would have some effect throughout the eastern portion of the Mesabi Iron Range, including the cities of Aurora, Babbit, Hoyt Lakes, Tower, Ely, and Soudan. It also projects some indirect impacts on urban centers such as Duluth and Minneapolis.

St Louis County in general, and the Eastern Range in particular, have seen declining and aging populations – between 1980 and 2004, the population of the County declined by 11% to 199,000 and the population of Hoyt Lakes declined by 38% to 1,961. In the 2000 US Census, the average age of the Eastern Range cities was 44.2 years, compared with 39 for all of St Louis County and an average of 35 years in Minnesota.

Median family income was in the Eastern Range cities was $37,443 compared with $47,134 in St Louis County and $56,874 in the state as a whole. 55.3% of those over 16 in the Eastern Range were in the Labour force, compared with 62.7% in St Louis County and 71.2% in Minnesota.

According to the Draft EIS, employment in mining declined from 10,973, or 15% of the total 75,104 in St Louis County in 1980 to 5,326, or 7% of the total of 79,650 in 1990. By 2004, mining had declined further, to 2,752 or just 3% of the total of 92,668, ranking twelfth behind health care and social assistance (22%), retail (13%), accommodation and food (10%), education (8%), public administration (6%), manufacturing (6%), construction (4%), finance and insurance (4%), transportation and warehousing (4%), administrative waste services (3%), and other services (3%).

While St Louis Country accounted for just 3.6% of all jobs in Minnesota in 2004, it accounted for 53.6% of the mining jobs.

The Draft EIS also reported that, based on the 2000 US Census, there were 95,800 housing units in the Eastern Range Cities of which 10% were vacant.

Local infrastructure was designed to support these communities when they were larger. For example, the waste water treatment facility in Babbitt has a capacity of 500,000 gal/d with a daily load of 200,000 – 300,000 gal/d. The similar facility in Hoyt Lakes has the capacity to treat 1.2 Mgal/d, with maximum daily load of 670,000 gal/d and average daily loads of 250,000 to 300,000 gal/d.

As part of its input to the Supplemental Draft EIS, PolyMet engaged the University of Minnesota Duluth Labovitz School of Business and Economics' Bureau of Business and Economic Research (BBER) to assess the economic impact of the NorthMet Project on St Louis County, MN.

The BBER study used IMPLAN version 3.0 economic modelling and impact software created by MIG, Inc. The report estimates that, in addition to the 360 direct, full-time jobs, the NorthMet Project will create 631 indirect and induced jobs and contribute approximately $515 million directly and indirectly into the local economy each year.

While the local communities will be able to absorb likely levels of inward migration, the impact on employment levels and the overall local economies could be significant.

20.7 Discussion on Risks to Mineral Resources and Mineral Reserves

The mine plan being considered in the SDEIS contemplates mining approximately 234 million tons of ore over a twenty-year mine life. Any material change to that plan will require environmental review and any change resulting in a material change in the environmental impact will require further permitting.

Economic development of any mineral resources outside the mine plan will be dependent on additional environmental review and permitting.

20.8 Comments on Section 20

Environmental review and permitting is, perhaps, the biggest challenge facing any mining project in the US. PolyMet is well advanced in the process and actively engaged with relevant state and federal agencies. The project is well supported in the local community and will have important socio-economic benefits.

21 CAPITAL AND OPERATING COSTS

The Technical Report on the Results of a Definitive Feasibility Study of the NorthMet Project that was published in October 2006 detailed the capital costs for the Project to produce copper cathode as well as a mixed Ni/Co hydroxide and PGM precipitate. The process changes described in Section 17 of this update to the Technical Report reflect continued metallurgical process and other project improvements as well as improved environmental controls that are being incorporated into the Project.

PolyMet's last formal update of project scope and costs was in a press release in May 2008 – when total project costs for the two-autoclave plus SX-EW circuit were estimated to be $602 million. Of that total, approximately $127 million was attributed to the second autoclave and the copper SX-EW circuit.

In February 2011, PolyMet reported further refinement of the Project plans, which the Company plans to build the Project in two phases:

- Phase I: produce and market concentrates containing copper, nickel, cobalt and precious metals
- Phase II: process the nickel concentrate through a single autoclave, resulting in production and sale of high grade copper concentrate, value added nickel-cobalt hydroxide, and precious metals precipitate products.

The changes reflect continued metallurgical process and other project improvements as well as improved environmental controls that are being incorporated into the SDEIS. The analysis is based on likely metal market conditions. The advantages, compared with the earlier plan, include a better return on capital investment, reduced financial risk, lower energy consumption, and reduced waste disposal and emissions at site.

Of the total $602 million capital cost estimated in the DFS Update, approximately $127 million was attributed to the second autoclave and the copper circuit eliminated in the 2011 revision.

PolyMet plans to provide a detailed project update when the Project development plans now being analyzed in the SDEIS are finalized. This detailed project update will include revised mine plans, process and project improvements, and will incorporate the latest environmental controls and will conform to the Project that is being analyzed in the Supplemental Draft EIS and which PolyMet is permitting.

21.1 DFS Capital Cost Estimates

Capital cost estimates for the 2006 DFS were generated to an overall level of accuracy of -5% to +15% in order to provide a confident basis for project financing decisions. The following section summarises the basis and methodology for developing capital cost estimates to the required level of accuracy and confidence. Capital cost estimates are prepared with an April 2006 cost base without application of escalation and exclude Minnesota state sales tax.

21.1.1 Basis of Capital Cost Estimate

The capital cost estimate was developed on the basis of frozen design criteria and flowsheets and includes an initial and sustaining life of mine capital schedule. Components of the capital cost include:

- Initial capital is that required during the pre-production construction period necessary to bring the operation into production and includes EPCM, owner's costs, first fills, insurance, and commissioning costs.
- Sustaining capital includes replacement of capital plant and equipment and expansion or extension of facilities required to maintain operations, e.g., progressive construction of additional hydrometallurgical residue cells, major rail replacement programs, extension of the impermeable base of waste rock stockpiles, etc.
- The capital estimate is broken down by facilities, equipment items, freight, direct labour, construction, contractors' costs, and spares. Most of the equipment, services and materials will be sourced within the USA and therefore foreign exchange rate variations are unlikely to be significant.
- Contingency was assessed by Bateman using a sophisticated Monte Carlo risk assessment method that analysed key areas of the cost estimate separately and allocated contingency according to assessed risk and commensurate with estimate accuracy.
- State sales tax was excluded on the assumption that it would be recoverable.

The following summarises the basis on which the major components of the capital cost estimate were prepared.

- Mine Pre-production Costs: An estimate was developed by PolyMet from written quotes from four prospective mining contractors. Pre-production mining costs included mobilisation, preparation of site access and construction of initial haul roads, pre-stripping and initial waste removal in preparation for ramping-up to full mill production during Year 1. Material movement quantities were based on a production schedule developed by AMDAD.
- Waste Rock Stockpile Construction: In the absence of close spaced overburden drilling and sampling, excavation and fill volumes were estimated from an overburden thickness model based on drill hole logs, geophysical soundings and a limited number of test pits

which provided the basis for assumptions relating to soil types and characterisation. For environmental reasons waste rock stockpiles are required to be constructed with impermeable bases the construction costs of which were estimated from a combination of local contract earthmoving rates and recent project experience elsewhere.

- Mine Power Supply: For costing purposes it was assumed the power utility will provide at no cost the tap and connection to 138 kV transmission line and the main mine site step down transformer. The cost of constructing and periodically extending the 4160 V mine site wooden pole mounted, power reticulation line was based on a written quote from local power utility, Minnesota Power.
- Railroad: Railroad costs were estimated by Duluth-based KOA who specialise in railroad engineering and, therefore, were able to call upon reliable, recent local costs of services, construction and materials (rail, ties, etc.) Refurbishment costs for existing track were based on a detailed survey of its condition using recent local rates for similar work elsewhere.
- Rail Transfer Hopper: Design by KOA was closely based on two approximately similar loading hoppers built for LTVSMC in the mid- to late- 1990s. Current Iron Range construction labour rates were used with materials costs estimated against an engineered materials take-off. Costs for overhauling and refurbishing salvaged mechanical and hydraulic equipment were provided by original equipment manufacturers.
- Mine and Railroad Infrastructure: Refurbishment costs were based on preliminary architectural and engineering drawings with application of standard unit rates for refurbishment of offices, change houses and personnel facilities. Reactivation costs of Area 1 (mine equipment) and Area 2 Shops (railroad rolling stock maintenance) workshops were estimated from a combination of vendor/supplier quotes, allowances and standard rates for similar work elsewhere.
- Mine to Waste Water Treatment Plant (WWTP) Pipeline: Capital cost was developed from a quote for spiral-wound, steel pipe laid above ground with a factored allowance for installation. Costs for refurbishing existing pumps were supplied by a pump vendor.
- HV Electrical Sub-Station: Although parts of the sub-station remained active since closure, re-activation costs were based on LTVSMC operating and maintenance records, inspections by heavy current electrical contractors and engineers of the local electrical supply utility, Minnesota Power.

Ore Beneficiation Plant: Reactivation costs were based on:

- detailed plant condition surveys
- assessment of operating and maintenance records to determine remaining life in crusher and mill wear materials and liners
- vendor assessment of process control system hardware and I/O points
- vendor quotes for dust extraction system equipment

- vendor quotes for flotation equipment
- test starting of selected, representative electric motors to confirm re-start and start-up failure assumptions.

Hydrometallurgical Plant: Table 21-1 summarizes the basis of new plant capital cost estimates.

Flotation Tailings Basin – Seepage Recovery System Upgrade: Capital estimate was developed by Barr Engineering and based on recent, similar project experience and standard unit costs for pipe and earthworks. Tailings piping will consist of a combination of new and salvaged steel pipe and refurbishment costs of existing tailings pumps were provided by a local pump vendor`.

Hydromet Residue Cells: Excavation costs were developed by PolyMet from local earthmoving contractor unit rates with liner acquisition and placement costs derived from recent, local experience of constructing land fill and taconite tailings disposal facilities.

Table 21-1: Basis of New Plant DFS Capital Estimates

Process	Requirements
Process flowsheets	Optimized
Bench scale tests	Essential
Pilot scale tests	Recommended and completed
Energy and material balances	Optimized
Equipment List	Finalized
Facilities Design	
Plant capacity	Optimised
Equipment selection	Optimised
General arrangements - mechanical	Preliminary
General arrangements - structural	Preliminary
General arrangements - other	Outline
Piping	Based on single line drawings
Electrical	Based on single line drawings
Specifications	General
Basis for Capital Cost Estimate	
Vendor quotations	Multiple, preferably written
Civils	Derived from drawings
Mechanical and piping	Approximate quantities
Structural work	Derived from material take-off
Instrumentation	Derived from material take-off
Electrical work	Derived from material take-off

Process	Requirements
Indirect costs	Calculated
Project program/schedule	Critical path network
Expected contingency range	10-15%

Limestone Stockpiling and Handling System: cost based on preliminary engineering and materials take-off. Allowances for re-use of some components were also included.

Fresh Water Reticulation System: Costs were based on field examination and engineered estimates of refurbishment requirements. In the case of the fresh water pipeline from Colby Lake, historical maintenance records were used to estimate the amount of plastic, internal re-sleeving required to return the pipeline to operable condition.

Plant Site Infrastructure: Costs were based on field inspections and an assessment of historical maintenance and operating records. Where equipment or component refurbishment or replacement was necessary costs were derived from vendor and original equipment manufacturers quotes.

The capital cost schedule contains estimates for all environmental aspects of the study that resulted from technical evaluations and studies undertaken by Barr Engineering, SRK, Golder Associates and others.

The overall estimated initial and sustaining capital cost for developing the Project is shown in Table 21-2. Costs are estimated at a base date of April 2006 and exclude escalation. Equipment import duties, freight and insurance are included where appropriate but state sales tax (at 6%), which is recoverable, is excluded.

Table 21-2: Summary of Initial and Sustaining Capital Costs

	Initial (US$'000s)	Sustaining (US$'000s)
Direct Costs		
Mining & Mine site Infrastructure	18,489	24,354
Railroad	8,464	33,344
Erie Plant Beneficiation Plant	62,992	0
Hydrometallurgical Process Plant	191,996	3,170
Tailings & Residue Disposal	3,134	7,949
Total Direct Costs	285,075	68,817
Contingency	27,070	
Indirect Costs	67,495	2,970
Total Project Capital	379,640	71,787

21.2 DFS Update

In May 2008, PolyMet reported the results of an update to the DFS, which included:

- the sale of concentrate during the construction and commissioning of new metallurgical facilities resulting in a shorter pre-production construction period (under twelve months) and reduced capital costs prior to first revenues ($312 million vs. $380 million)
- mine plans (based on copper at $1.25/lb) reflect the increase in reserves and decrease in stripping ratio reported on September 26, 2007, the use of 240-ton trucks, and owner versus contract mine operations.

21.2.1 Basis of Estimate

The updated capital cost estimate is based on the original DFS, which was base-dated April 2006. For the updated DFS, capital costs have been captured, generally as follows:

- As part of project set-up and baselining, a work breakdown structure (WBS) was established for the Project. The project WBS is similar to the WBS used in the DFS but has some differences including the differentiation between Phase 1 and Phase 2 costs.
- Around 5,000 DFS cost records were entered into PolyMet's project cost control system
- (PRISM) to establish the DFS baseline budget.
- Costs for the complete scope of the DFS were escalated against relevant industry cost indices to bring them from April 2006 costs to February 2008, that being the most recent month for which cost indices were published at the time.
- Where the scope has changed since the DFS or where there had been developments that provided better scope, quantity or cost definition, costs were re-estimated.
- The revised estimate aims to be as complete as possible. As well as escalating DFS costs and capturing scope changes and growth, it includes:

Some costs that were not captured in the DFS captures costs that have been expended on the Project since the DFS as well as “costs to come.”

21.2.2 Labour Assumptions

The original estimate for the DFS included approximately $75 million for construction labour costs. While the stated base date of the DFS is April 2006, most of the craft labour rates for northern Minnesota were renegotiated in May and June 2006 and it has been determined that Bateman used the updated June 2006 rates in preparing the DFS costs.

Table 21-3 compares hourly labour rates (including fringes) for various crafts between June 2006 and for February 2008. Jamar Company submitted yhe rates for June 2006 for use in the DFS on October 27, 2006. The craft labour rates for February 2008 were extracted from the website for "Davis-Bacon wage determinations" for St Louis County, Minnesota.

Table 21-3: Comparison of Hourly Labour Rates

Craft	Jun 2006 ($)	Feb 2008 ($)	Change (%)
Asbestos Worker/Insulator	44.36	45.91	3.49
Boilermaker	46.47	48.32	3.98
Carpenter	35.44	36.79	3.81
Cement Finisher	35.05	36.45	3.99
Electrician (API)	46.19	48.03	3.98
Ironworker	43.13	45.11	4.59
Laborer	31.78	33.33	4.88
Millwright	38.30	39.70	3.66
Operator	43.19	45.03	4.26
Painter	37.68	39.08	3.72
Plumber/Pipefitter	44.82	46.62	4.02
Roofer	31.59	32.75	3.67
Sheet Metal Worker	42.72	44.41	3.96

Table 21-3 shows most of the craft rates have increased by approximately 4% from June 2006 to February 2008. Where possible, the escalation rates for each craft was applied directly to the labour estimate for the corresponding discipline (i.e., the rate for "cement mason" is applied to concrete accounts, the rate for "pipefitters" is applied to piping accounts, etc.). Due to the relative equality of the escalation rates for each craft, it has been determined that there is no appreciable change to the final escalation calculation by weighting the effects of typical crew mixes for each discipline.

21.2.3 Material Costs

Using the Bureau of Labour and Statistics Producer Prices Index Industry database, cost indices for the period between April 2006 and February 2008 were extracted for numerous materials and equipment groups. The cost indices were linked to the cost elements in the PolyMet cost database (PRISM) by Commodity Code. On the basis of the method used, the average escalation of materials and equipment for the original DFS scope is 10.6%.

21.2.4 Contingency

Contingency is an estimate provision to account for items, conditions or events for which the state, occurrence or effect is uncertain and that experience shows will likely result in additional cost. Contingency provisions are sometimes supported by statistical analysis using Monte Carlos simulations. In the case of this estimate:

Contingency means Estimating Accuracy Allowance (EAA), which is a provision to account for uncertainty related to estimated quantities and cost (rates) that have been used in the estimate.

There is no provision for unplanned (future) risks, sometimes referred to as Risk Contingency. That is, there is no provision in the estimate for any deviation from the Project as currently planned, including changes in scope, timing, quantities or costs.

A Monte Carlos has not been run on the data.

Estimating Accuracy Allowance has been applied at 10% of all other costs in the estimate except Owners Additional Costs.

21.2.5 Mine Capital Costs

Mine Pre-development (including Rail, Flotation Tailings & Hydromet Residues)

The following notes describe the basis upon which capital cost estimate for the mine, railroad tailings and residue facilities were updated for the Updated DFS. The notes refer to Table 21-4, which shows the initial capital costs for the areas listed.

The timing of costs reflects the year in which an action, piece of equipment or construction is required; it does not reflect when commitment is required to ensure timely delivery.

Table 21-4: Initial Capital Costs (US$'000)

Estimate Item	Year 1	Year 2
Haul road construction*	10,559	
Dunka Road upgrade incl. 2 road/rail crossings	1,132	
Stockpile construction - base, liners & sumps	16,582	3,865
Dikes, Perimeter Ditches, Stormwater Pond	4,763	
Process/contact water collection piping	3,523	1,174
Mine Area pre-stripping - overburden	8,738	
Construction Quality Testing	392	78
Site geotechnical drilling*	669	317
Pre-production drilling - grid & blasthole correlation*	1,230	
Pre-production drilling - East Pit footwall definition	512	

Royalty on State taconite waste rock @ $0.50/cu yd	510	
Total: Mine Pre-production Development	48,637	5,435
Waste Water Treatment Facility	4,553	
Central Pumping Station	1,781	
Treated Water Pipeline	2,303	
Total: WWTF, CPS & Treated Water Pipeline	8,637	
Railroad Construction & Refurbishment	9,892	216
Mine Site Infrastructure & Facilities	734	
Mining & Railroad Maintenance & Engineering	2,973	
Mine Site Power Supply & Reticulation	4,705	
Mine Lands Acquisition	3,300	
Tailings Basin	3,097	
Hydromet Residue Cell Construction	8,751	7,151

21.2.6 Mine Pre-production Development

All pre-production earthmoving, construction of stockpile foundations and liners, construction of ditches, dikes, run-off collection sumps, water conveyance and treatment arrangements at the mine site will be carried out by contractor. Costs are based on the March 2008 revised proposal by Ames Construction, Inc. Ames' proposal was submitted in response to a detailed scope of work prepared on behalf of PolyMet by Barr Engineering,

Inc. and unless otherwise noted, the Ames' estimates have been used as presented. Geotechnical drilling which will be required ahead of construction and most earthmoving

will be carried out by a specialist drilling contractor in conjunction with the principal earthmoving contractor. Barr prepared estimates of geotechnical drilling costs based on recent actual drilling costs and an estimate of the number of holes required for final design of stockpile liner foundations, access and haul roads, dikes and other mine site structures.

Contractors' scope for costing purposes has been limited to clearing and stripping overburden from the East Pit only. Site clearance and overburden removal from the West and Central areas of the mine may ultimately be carried out by the same contractor as used for East Pit pre-production development. For costing purposes West and Central area overburden removal costs have been included as mine sustaining capital. Similar unit rates were assumed for both contractor pre-production stripping and sustaining capital overburden stripping. (Note it is likely that any overburden stripping at NorthMet will be carried out by specialist contractor rather than by the owner because of the unsuitability of the mining fleet for operating on overburden).

Ames estimates reflect a diesel fuel price of US$3.00/gal. This is consistent with other areas of the Updated DFS.

Dunka Road upgrading costs include provision for the construction of two ground level rail track crossings suitable for use by heavy mine equipment.

The cost of stockpile foundations and liners has been distributed over the pre-production period and the first five years of operations to reflect the progressive manner in which stockpiles will be constructed and then extended.

Provision for the cost of stockpile covers is included in Closure Costs.

Costs for process and contact water collection piping connecting the various stockpile sumps, run-off collection sumps and settling ponds with the WWTF have been distributed over Years -1 and +1.

Although the majority of construction quality testing will be required during the pre-production development period, provision has been made to distribute testing to cover all construction and development work to the end of Year 6.

Heavy mine equipment will have to cross County Road 666 in order to access the Area 1 workshops. Barr (Hibbing) has estimated the cost of constructing a crossing from information provided by Mesabi Bituminous with additional provision for traffic control lights, area lighting and appropriate signage.

Geotechnical drilling and testwork will be required prior to construction of stockpile foundations and other mine infrastructure and facilities. Barr has recommended 430 holes be drilled during Years -1 (315 holes) and +1 (115 holes). Rotosonic and standard penetration test (SPT) drilling have been recommended as suitable methods of collecting overburden samples for testing and characterization though Rotosonic is approximately twice as costly per ft than SPT. Based on field experience with a Rotosonic rig during January 2008 it was assumed that SPT would be adequate for the majority of drilling and sampling purposes. For the purposes of this estimate it has been assumed that 80% of the required holes can be completed using SPT with the balance by Rotosonic.

Two campaigns of pre-production diamond drilling are required during mine pre-production development. A major campaign, consisting of 128 holes to an average depth of 150 ft on the same spacing as blast hole drilling, is required for ore grade control and comparison of diamond drill and blasthole sampling. A second campaign comprising 32 holes is required to better define the East Pit footwall location to minimize the amount of Virginia Formation to be mined. Drilling costs of US$50/ft are un-escalated, based on recent exploration drilling performance and include all drilling costs plus core logging, sample preparation activities, sample transport and laboratory analysis.

Capital cost of a mine site water treatment facility is based on the use of a portable, modular, treatment facility during the first three years of mine life during which time the characteristics of a permanent treatment facility will be determined. Installation and operation of this portable facility during the period up to delivery of first ore to the primary crusher have been treated as initial capital; thereafter its cost of operation has been treated as an operating cost. Barr Engineering developed costs for renting and operating the temporary facility from written estimates provided by several suppliers of portable water treatment plants of which GE (Water) is the preferred supplier. The cost of the temporary facility includes an allowance for providing temporary diesel generated power until the mine power is installed along with construction of a temporary hard standing pad and access track. Use of a portable, temporary facility ensures that availability of water treatment facilities does not delay start of hard rock mining. In addition, use of a temporary, portable plant allows the cost of constructing the permanent facility to be deferred.

The permanent WWTF will be constructed in Year 4 and the cost is based on the Ames quote together with an estimate by Barr of the cost of furnishing and installing all water treatment equipment and appropriate control systems.

Both the temporary and the permanent WWTF will utilize the same water collection system and flow equalization ponds. These will be constructed by the mine pre-production development contractor during the early part of Year -1 (2009) such that they are operational before the start of hard rock drilling and blasting.

21.2.7 Railroad

Track construction and refurbishment costs are based on the original DFS estimates prepared by Krech Ojard and subsequently updated by them in February 2008.

Not contemplated in the DFS is an additional rail spur at the mine site to allow trains to access to the ore surge pile loading ramp without having to pass under the transfer hopper loading chute. An estimator’s allowance has been used for this cost.

As was the case for the DFS, this estimate assumes that Owners crews will perform minor, routine track maintenance and that major maintenance such as rail grinding, tie replacement campaigns and rail replacement will be outsourced and treated as sustaining capital.

For the DFS Krech Ojard estimated a cost of US$10,000 to return each ore car to initial service. Thereafter each car would be rebuilt at a KOA estimated cost of US$25,000 which was treated as sustaining capital. These estimates were based on visual inspection of the rail car fleet. Subsequent (post-DFS) inspection of ore cars by another group of railroad specialists produced an unlikely revised estimate of US$1,700 per car for the initial return to service. For costing purposes, a return to service cost of US$6,000 per car was assumed. There was no change to the DFS estimate of US$25,000 for car re-build.

Krech Ojard updated the rail transfer facility construction cost estimate in March 2008 to include price escalation and modification of the DFS design to reduce the height of the main retaining wall that parallels the rail track.

For the DFS Krech Ojard determined that 30-car trains each pulled by two conventional 3,000hp mainline locomotives would be required. Subsequent re-evaluation has recommended the use of three trains comprising one 2,100hp multiple generator set locomotive pulling between 15 and 18 ore cars. Capital and operating costs are now based on maintaining 4 unit trains of 18 cars each (one unit being held as spare).

DFS costs were based on 30-car trains and assumed all 120-ore cars owned by PolyMet would be returned to service and subsequently rebuilt. Introduction of reduced length trains requires only 72 ore cars to be returned to service with significant cost saving.

Locomotive leasing costs are based on quotes for multiple generator set units, which offer significant emissions and fuel consumption reductions compared with the SD40-2 or -3 standard units used for the DFS.

21.2.8 Mine Site Infrastructure & Facilities

Costs for the relocation and erection of structures to serve as a field service facility and a field re-fuelling facility are based on DFS estimates updated in March 2008.

Not included in the DFS is provision of a fibre optic data link between the mine site and the Area 2 mine operations offices and Area 2 and the plant site. The current estimate assumes shared use of a fibre optic link to be installed by Minnesota Power between their 138kV mine site sub-station and the process plant with the cost of an extra 3,500 ft to connect the Area 2 office and the mine WWTF to the main fibre optic cable. The cost of installation is based on an estimate of US$9.40/ft by Minnesota Power and includes installation and appropriate hardware at each end of the cable.

The cost of re-surfacing the asphalt road between the Main Gate and Area 2 offices was estimated by Barr from recent actual costs for similar work by Mesabi Bituminous, Inc.

21.2.9 Mining & Railroad Maintenance & Engineering

Area 1 Shop refurbishment costs are based on updated DFS estimates by Krech Ojard. Area 2 facility upgrade costs are based on updated DFS estimates by Krech Ojard.

Cost of refurbishing the existing Area 2 locomotive refuelling and service facility is based on the use of outsourced third party refuelling direct from road tanker without the use of fixed, diesel fuel storage tanks.

The DFS assumed that Area 2 Shop would be refurbished and equipped to allow maintenance of ore cars. By re-arranging a part of the hydromet reagent storage facilities the original locomotive maintenance shops located within the main General Shop at the plant site became available and will now be refurbished for ore car maintenance and repair.

Because the General Shop is in good condition an unsupported cost provision of US$60,000 has been allowed for the minimal work required.

Estimates for the mine dispatch system range from US$2.5 million for a Modular Mining system to about US$900,000 for a Wenco system. For purposes of this estimate a value of US$1,500,000 has been used and is assumed to include hardware, software and interfacing units mounted on mining equipment.

The DFS estimate for a mine radio communication system has been updated and used herein.

21.2.10 Mine Site Power Supply and Reticulation

The cost of constructing a single circuit, wooden pole mounted conductor is based on a recent quote from Lake County Construction, a subsidiary of Lake County Power, of US$30/ft including placement of wooden poles, aluminium conductor and insulators.

In terms of an agreement, PolyMet is required to make periodic payments to Minnesota Power (MP) for the design and construction of the main 138 kV – 13.8 kV step down sub-station near the mine site. It is assumed an advance payment will be required during the per-production period (year -1) to enable MP to complete design and ordering of equipment for this sub-station.

21.2.11 Mine Equipment – Lease Costs

For costing purposes, it was assumed major items of mining equipment will be acquired under operating or “tax” leases. Estimates of operating lease costs were obtained from all manufacturers or vendors of major equipment and are current for the first quarter 2008.

Using vendor/manufacturer quotes Wardrop prepared a detailed, life of mine equipment leasing schedule, which reflected the probable reality of an operating mine. Lease terms offered are generally for a 60-month term with the option to replace the equipment at the expiry of the lease or to purchase the equipment at a residual value. Thus, in the case of haul trucks and excavators which would probably have economic life remaining after expiry of the standard lease term, it was assumed that these items were purchased and operated to retirement after which new units would be leased. Thus, in the cost summary tables presented elsewhere equipment lease costs are actually a combination of lease and buy-out costs.

Capital purchase costs were obtained for equipment and items that would not normally be leased. These have been separated from equipment leasing costs and are accounted as capital. Examples of capital equipment include haul truck and front end loader (FEL) tires, blast hole drill strings, trailing power cables, spare truck trays/boxes, spare excavator and FEL buckets and small equipment such as skid steer loaders, small FELs and some service vehicles.

21.2.12 Post Production Start

Provision has been made for diamond drilling for further definition of the Magenta Zone and ongoing reserve replacement once in full operation. Drilling costs are based on unescalated all-up, exploration diamond drilling costs of US$50/ft and are considered sustaining capital.

21.2.13 Tailings Basin

The cost of installing the proposed seepage collection system designed by Barr Engineering is based on the revised bid prepared by Ames Construction.

21.2.14 Hydromet Residue Cells

Based on the assumption that a market will be found within the first three years for the synthetic gypsum component of the residue stream, it will only be necessary to construct two residue storage cells. The first will operate for five years and take the full residue stream while the second will have capacity to accommodate the reduced residue stream over the remainder of mine life. Because two construction seasons will be required earthworks for the first cell will start in Year -1.

Cost estimates to construct hydromet cells are based on a recently updated quote prepared by Ames Construction. The Ames quote covers construction of the first cell and the initial lift of the second cell. Subsequent costs for constructing the remaining cells are based on Ames' quote.

It was assumed that construction of a second lift will occur during the third year of the first cell's operating life.

An estimate developed by Barr Engineering of $11 million has been included as sustaining capital for covering the first residue cell in Years 6 and 7. Cell closure will require supernatant to be decanted off the surface as residues settle. Once sufficiently dewatered, a layer of coarse taconite tailings will be placed over the top of residues on which a double membrane, synthetic cover will be placed. A further layer of tailings will be placed over the membrane followed by a layer of topsoil. Finally, the whole area will then be re-vegetated.

21.2.15 Process Plant

Outside of escalation since the DFS, the greater bulk of cost changes in the process plant arise in Phase 1. The main changes are summarized in the Table 21-5 below. The costs were estimated on the following general basis:

21.2.16 Crushing and Milling Equipment

The DFS estimate was based on a limited approach to refurbishment of the crushing and milling equipment assuming a year to ramp-up to the throughput of 32,000 tons of ore a day. This was based on an expected yearlong ramp-up of the hydrometallurgical plant. This period of ramp-up would allow considerable downtime in duplicate streams of the comminution circuit to rectify equipment failures. Only single stream items put the feed to the hydromet plant at risk. The change to production of concentrates as an interim product to generate revenue has revised the period of ramp- up to six months with consequent reassessment of the scope of work for refurbishment. For the DFS update, the following approach was taken:

- All of the equipment was classified in terms of criticality: High criticality was given to equipment that is a single item or in a single stream that will stop feed; Interim criticality was given to equipment that has a standby unit or a second stream is available where production will be impacted but not stopped; Low criticality was given to equipment that is located in multiple streams (e.g. the mills) and failure of a single unit will have minimum impact.
- For all equipment in the High and Intermediate categories, the condition of the equipment is in the process of being assessed as follows: External Inspection from which a condition report will be written that also identifies the requirement for additional investigation by disassembly; Internal Inspection as indicated by the condition report to inspect components that are not accessible from an external inspection; Maintenance Records are being accessed from a database maintained by Cliffs that indicates expected remaining life of wear components and turnaround time for replacement of parts.
- From these sources, an assessment of the most likely failure modes in operation (e.g., by wear or incident) is made based on past operating experience. For the High criticality equipment, the risk of failure is then assessed and a strategy for refurbishment and purchase of spares prior to start-up developed.

The assessment of the scope of work and budget is a “work in progress” at this time. For the DFS update, a consensus assessment on the above principles was made for all of the mechanical equipment based on the current level of understanding of PolyMet’s personnel. Changes to the DFS estimate include the following:

- An allowance of $3.5 million for refurbishing the North 60” gyratory crusher and all associated equipment.

- Recondition the spare bearing assembly for the 60” crusher before start-up and purchase a replacement bearing at start-up.
- Replace the central crusher lube system in the fine crushing building with individual lube units to each crusher (past operating experience of these crushers was unsuccessful at identifying major lube oil losses).
- The primary and secondary drives to conveyor 4B and a spare from 4A will be reconditioned for the single stream conveyor that transfers the crushed or to the north fine ore bins in the concentrator building.
- Fully disassemble and recondition all components of the tripper conveyors in the fine crushing building and the north side of the concentrator building.
- Relocate the mill lube oil rooms to provide space for the flotation equipment.
- Rebuild the mill sumps to provide additional freeboard (operating experience was that sumps overflowed or pumps sucked air).
- The refurbishment of elevators in the coarse and fine crushers was evaluated by the vendor that increased the DFS estimate by $300,000.
- Labour and materials was estimated for all platework refurbishment.
- Dust Collection.

PolyMet has accepted the recommendation of the MDNR to upgrade all of the wet scrubbers in the comminution buildings to bag-houses. This represents a significant change from the existing installation. The DFS estimates were based on refurbishing the existing equipment on the assumption that this would meet permitting requirements. Quotes have been obtained for 17 bag-houses and appropriate allowances added to rework the ducting and provide power and control equipment.

21.2.17 Flotation and Concentrates Handling

The original DFS cost estimate was effectively replaced by the split concentrates estimate for Area 25 – Flotation and Regrind. Areas 27 and 28, Nickel Concentrates Handling respectively, were new.

As part of FEED, Bateman produced a revised equipment list, which they used as the basis for estimating revised costs, and cost estimates for mechanical equipment, concrete, structural steel, and pipework. Costs for electrical/instrumentation were factored on mechanical equipment.

Table 21-5: Phase 1 Budget – Variance from DFS from Scope Changes (excludes tailings facilities)

Equipment & Facilities	Variance $'000
Crushing & Milling	8,663
Flotation & Regrind	15,224

Equipment & Facilities	Variance $'000
Flotation/Reagent Annex Building	4,005
Reagent Area Additions	1,587
HVAC (duplicate allowance in 2 areas of DFS budget)	-3,439
Copper Concentrate Filtration and Loadout	6,316
Nickel Concentrate Filtration and Loadout	6,732
In Plant Rail Facilities for Concentrate Transport	2,500
Utilities Re-estimate (increased allowance for reinstatement)	2,865
Total Variance – Phase 1	44,454

21.2.18 Owner (Corporate) Capital Costs

Owners Project Team

Costs totaling $6 million are included for PolyMet's project team in Denver and at Hoyt Lakes.

Mobile Equipment & Computing

The estimate includes provision for the purchase of an Enterprise Management System (Ellipse by Mincom) at $155,000 initial purchase price plus one year of "annual costs" at $94,000 as per a quotation to PolyMet.

There are no capital cost provisions for motor vehicles, computer hardware, software or network upgrades.

Commissioning spares, transport, vendor assistance and first fills

The estimate includes provisions for the following:

- commissioning spares - $2.066 million, factored on DFCs
- transport to site - $5.524 million factored on equipment costs
- vendor assistance - $1.586 million, factored on equipment costs
- first fill lubricants – $0.548 million, factored on equipment costs
- first fill reagents - $5.348 million
- insurance.

The estimate includes a provision for project insurance of $6,500,000, based on a proposal submitted to PolyMet by Willis of Minnesota (insurance brokers). $2.5 million has been allocated to Phase 1 and $4.0 million to Phase 2.

Owner's Additional Costs

Estimate provisions for Owner's "below the line" costs include:

- process and EPCM Fees remain unchanged from the DFS at $5 million and $7 million respectively
- USFS land exchange: $3.3 million
- wetlands mitigation costs: total of $7.1 million for land acquisition costs including option costs and the cost of developing wetland credits
- site closure liability: $23,600,000.

Closure Costs

Closure costs were estimated by Jim Scott and Kevin Pylka of PolyMet. The Contingency Closure Estimate assumes that the facility is closed the second year of operation and is the basis for financial assurance and will be updated annually. The End of Mine Life Closure Estimate assumes that the facility is closed at the end of the 20-year proposed mine life. Both estimates include all remediation obligations assumed with the acquisition of the Cliffs Erie property, even though PolyMet plans to complete many of those tasks prior to the end of mine life. All costs are in present day dollars.

- Contingency Closure Estimate 04-17-08: $45.4 million for the total scope (full hydromet)
- and $40.7 million for the concentrates only (i.e., Phase 1) scope
- The amounts included in the Project cost report for the Closure Estimates have been reduced by $23.6 million 'Owners Additional' costs as Current (Closure) Liability.

21.3 Operating Cost Estimates

Table 21-6 summarizes operating costs for the two steady state production scenarios: Production of copper and nickel rich concentrates only (split concentrates only);

- Production of copper concentrates with nickel, cobalt and zinc precipitate produced in a single autoclave and reduced hydrometallurgical circuit (Hybrid)
- Full hydrometallurgical plant producing copper cathode, nickel/cobalt hydroxide and AuPGM precipitate (Hydromet).

For comparison purposes, Table 21-6 includes estimates in the DFS, which included hydrometallurgical treatment of all concentrates and a copper extraction process to produce copper cathode.

Table 21-6: Distribution of Costs between Operating Modes

	Split Conc. Only ($'000)	Hybrid – Split Conc. plus one Autoclave ($'000)	Oct. 2006 DFS Full Hydromet ($'000)
Mine & Railroad	50,356	50,356	44,431
Beneficiation Plant	25,230	25,230	31,419
Flotation, Load Out & Tails	16,165	16,166	8,344
Hydromet		15,658	33,758
Plant Utilities	399	399	2,155
Reagents	408	551	620
Laboratory	115	115	
Process Plant Labour	10,452	16,631	5,400
G&A	11,007	11,007	2,587
Total	114,133	136,113	128,714
Average Operating Costs “Steady State” Operation			
US$/st Ore Milled	9.77	11.0065	11.02
US$/st Total Material Mined	4.22	5.03	4.01

21.3.1 Basis of DFS Estimate

Organization Structure & Human Resources

The process control philosophy and the philosophy upon which the organizational structure is based are closely related and together will govern the structure of the organization, the level and type of skills required and manning levels. As such these philosophies are central to how the operation will be run and hence the costs of running it.

The same broad philosophy applies to mine and railroad, the process plant and administrative services. In general, the organisational structure is intended to minimize the number of management layers while keeping the number of direct reports in each layer to a level that suits the activities involved and maximizes operational efficiency.

Staff and labour costs are based on the following;

- Operations will function 365 d/a, 24 h/d with three 8-hour shifts.
- Operations management and essential support services will be provided round the clock on a continuous basis with technical and general support, and general management services operating on day shift only Monday to Friday, excluding statutory holidays
- Laboratory services will be provided on a continuous basis.

- In the determination of labour rates there was no presumption regarding the use of union or non-union labour.

DFS labour rates and staff wages were based on then current base rates applicable at a nearby taconite mining and processing operation. Cost of employment burden (insurances, medical benefits, social security etc) was determined as a fixed percentage of base rate. Current estimates are based a recent evaluation of current local labour conditions. The cost of employment burden is based on a specified employment and benefits package costed based on actual quotes for provision of those benefits. Social security, employment tax and other statutory costs of employment were calculated according the appropriate legislated rates. On average, the value of the benefits and burden package amounted to 30% of base rate for management, technical and supervisory staff while that for equipment and plant operators was 37% of basic. The remuneration package will include a discretionary profit sharing component which varies with position in the organization but which is not included in these operating cost estimates. Table 21-7 summarizes base and benefit rates used.

Table 21-7: Labour Costs

Position	Base Rate (US$/a)	Benefit Rate (%)	Benefit Amount (US$/a)	Rate used for Costing (US$/a)
General Manager	150,000	30	45,000	195,000
GM Admin Assistant	50,000	30	15,000	65,000
Division Manager	120,000	30	36,000	156,000
Clerk	50,000	30	15,000	65,000
Area Manager	100,000	30	30,000	130,000
Manager – operations (shift)	70,000	30	21,000	91,000
Manager – operations Support	70,000	30	21,000	91,000
Manager – dispatch/control room	70,000	30	21,000	91,000
Technical Staff – assigned - shift	70,000	30	21,000	91,000
Technical Staff – assigned – support	70,000	30	21,000	91,000
Manager – Technical/Administrative	100,000	30	30,000	130,000
Technical Staff - Engineer	70,000	30	21,000	91,000
Technical Staff – Technician	60,000	30	18,000	78,000
Administrative Staff	60,000	30	18,000	78,000
Equipment Operator	62,000	37	22,940	84,940
Process Technician	60,000	37	22,200	82,200
Maintenance Technician	62,000	37	22,940	84,940
Electrical/Instrumentation Technician	66,000	37	24,420	90,420

Reagents & Consumables

Mine Site Water Treatment Facility: the cost and consumption of reagents required for the mine site water treatment plant were determined by Barr Engineering from quotes obtained from specialist providers of water treatment technologies and from comparable costs at other treatment facilities. Dosage and consumption rates will only be determined with confidence once the treatment facility is operational so there is some risk that actual reagent costs may be different from those assumed for this exercise.

Mine Operations: The mining operation will require few chemicals or reagents though principal among these will be dust suppression agents for haul and access roads and de-icing chemicals for winter use. Costs for this exercise were based on comparable use at nearby taconite mines. Explosives and blasting accessory costs are based on current vendor quotes. Ground engaging tool (GET) costs were estimated from vendor quotes for such items as drill bits and drill rods with useful life assumptions based on experience and typical usage rates at local taconite mines.

Process Plant: Reagent and oxygen consumption rates were determined from Metsim modelling and were optimised during the various pilot-scale test programs carried out at SGS Lakefield Research. Wear materials and grinding media consumption rates were estimated from Bond work and abrasion indices calculated from standard laboratory tests of NorthMet material derived from drilling.

Reagents and consumable quantities are defined in terms of steady state operations. During the detailed design, excursion limits will be further investigated to allow for start-up, commissioning and normal plant variations that sometimes occur as a result of operating practises or changes in plant feed characteristics. First fill reagents are not considered in the operating cost model summary as these are considered as capital cost items.

An allowance in each plant area has been included for consumables such as lubricants, greases, rags, welding electrodes and other miscellaneous items.

In most cases, the same reagent consumption rates used in the DFS were used in this exercise because, with the exception of flotation testwork designed to better define the mixed concentrates only option, no other testwork has been performed since the DFS that would lead to a significant change in the estimates of reagent consumption rates. The unit costs of most reagents were updated based on vendor or manufacturer written quotes with appropriate allowances for transport to site where necessary. Local (within the USA) sources of reagents were selected. Most quotes are current for the 1st Quarter 2008 and needed no escalation.

The late arrival of an updated quote for high purity magnesium hydroxide slurry $Mg(OH)2$ prevented the inclusion of a more reliable unit price than that provided originally by

Bateman. The impact of this omission may be in the order of US$0.01/ton milled and further investigation is recommended during the next project phase.

Maintenance & Repairs

The underlying philosophy is that for mine, railroad and process plant routine inspections, routine service and minor repairs will be carried out by PolyMet staff and technicians whereas major repairs, major scheduled maintenance, major component change-out and unit rebuilds will be outsourced to specialists of whom there are several on the Iron Range and its environs.

Mine Equipment: Maintenance costs are principally based on manufacturers recommendations and typical, comparable practice usually on the basis of a factored percentage (factored for location) of initial cost.

Plant Equipment: Process plant equipment repair and maintenance costs are based on a weighted factored approach. In the case of existing crushing, milling, bulk material transport, pumping equipment and existing infrastructure facilities known, historical costs were taken into consideration. While the factoring approach to cost estimation is reasonably reliable for flotation equipment, filters, thickeners etc. maintenance on the autoclaves and the SX-EW plant operating under PolyMet conditions is largely unknown.

In the same way as for the DFS, the current operating cost model has allowed for maintenance costs as a percentage of the direct capital cost for the Project. This equates to approximately 4% to 5% per annum and is based on known maintenance requirements for similar processing facilities of this type. These costs do not include the purchase of recommended spare parts prior to commissioning and ramp-up. Operating and commissioning spares are assumed to be capitalised for the first year of operation. Maintenance costs are expected to increase over the life of the mine as equipment ages due to normal and wear and tear though this is not reflected in the current estimates.

Outsourced Service

As described above, major mine equipment and process plant maintenance will be outsourced. Other outsourced activities may include site security, janitorial services, certain environmental monitoring and sampling activities and periodic tailings dam safety inspection, testing and reporting.

In the mine, transport to site and placement of explosives in blastholes will be carried out by a local vendor of explosives products and blasting costs are based on quotes for the provision of such a service. Similarly, a local vendor will transport fuel oil and lubricants to site and will be responsible for operating day storage tanks and re-fueling equipment and locomotives directly from mobile tankers.

Electric Power

Power costs are based on PolyMet's agreement with Minnesota Power (MP) with provision for escalation due to environmental upgrades and renewable energy initiatives. A flat unit rate of US$0.06/kWh has been used, based "large" customer rates.

Mine power consumption was based on installed motor power with application of a utilization factor based on expected hours of equipment use.

Beneficiation, flotation and hydromet plant power consumption was calculated from the detailed electric motor list and application of a similar utilization factor as used for mine equipment. Power consumption for offices, workshops and support facilities was generally based on an allowance where specific information on installed power was not available.

Power consumption for the Hybrid option was estimated as a function of the amount of nickel rich concentrate that requires treating. For motors such a sump pumps where the utilisation is expected to be less than 85%, the power consumption is assumed to be the same as the Hydromet option. For all other motors, the power consumption is lower by a factor of copper consumption mass divided by the nickel concentrate mass.

Fuel Oil

The unit cost of fuel oil is assumed to be US$3.00/gal though discussions with prospective vendors indicate that hedging and other commercial arrangements may be used to minimize the effects of variable crude oil prices.

The majority of fuel oil is consumed in the mine area and vehicle and equipment consumption rates are based on manufacturers' estimates of typical consumption rates in comparable applications elsewhere. Fuel consumption by ore haulage locomotives was derived from manufacturers' haulage simulations using the planned track profile and proposed pulled load parameters.

General and Administrative Cost

The major G&A cost component is staff and labour (including plant and mine technical support services and the laboratory).

The annual cost of running an administrative organization was developed from experience at Iron Range taconite mines and covers such things as security, office equipment, heat and lighting, communications, overtime, property insurance, office supplies, computer system license fees, admin building maintenance, janitorial services, and allowances for travel and meetings.

Note that while laboratory staff are part of the Technical Services and Support Division and hence fall under the general heading of G&A, the costs of laboratory equipment maintenance, power, reagents and consumables are included in Plant operating costs.

21.3.2 Mine Operating Costs

A significant difference between this estimate and the DFS is the change from contractor to Owner mining. While pre-production mine development will remain a contracted activity it is now intended that PolyMet will acquire and operate its own mining fleet (Table 21-8). To minimize up-front capital costs the majority of the mining fleet will be leased. Leases can be of two types, each with its own specific tax implications though for the purposes of this costing exercise it has been assumed that all leased equipment will be acquired on operating or "tax" leases. Because of potentially significant tax and cashflow implications further financial analysis isrecommended before selection of the specific type of leasing or purchasing instrument.

Table 21-8: Mine Equipment Capital Costs

Equipment	Model	No. Required	Purchase Price	Monthly LeasePayment (based on 60 month lease, except locos)
Electric Hydraulic Shovel	Komatsu PC5500	2	$10,566,000 ea. With spare bucket, power cable, switch house and dispatch system	$153,542 ea.
240 ton Haul Truck	Caterpillar 793 C	9	$3,050,500 ea. With tires, one third cost of a spare box and dispatch system	$44,856.78 ea. w/o tires
Large FEL	Caterpillar 994	1	$4,127,392 with tires, chains , spare bucket and dispatch system	$57,491.48 w/o tires
Electric Rotary Blasthole Drill	Bucyrus 59R (used and rebuilt)	1	$3,707,000 ($1,075,000 for the used drill, $2,632,000 to rebuild)	NA
Diesel Rotary Blasthole Drill	Atlas-Copco PV351	1	$4,199,679 including freight, drill string, power cable and dispatch system	$72,700.00
Large Bulldozer	Caterpillar D11T with ripper	2	$2,015,277 with one half cost of a spare blade and dispatch system	$29,971.39 ea.
Large Rubber Tired Dozer	Caterpillar 854G	1	$1,990,840 with tires, spare blade and dispatch system	$27,893.96 w/o tires
Rubber Tired Dozer	Caterpillar 834H	1	$1,127,800 with tires, cable reel system and dispatch	$15,999.65 w/o tires

Equipment	Model	No. Required	Purchase Price	Monthly LeasePayment (based on 60 month lease, except locos)
			system	
Front End Loader	Caterpillar 988	1	$894,655 with tires, spare bucket and dispatch system	$12,631.30 w/o tires
Road Grader	Caterpillar 16M	1	$716,600 with tires and dispatch system	$9,963.47 w/o tires
Road Grader	Komatsu GD675	1	$271,500 with tires and dispatch system	$3,687 with tires
Bulldozer (Tailings Basin)	Caterpillar D8TLGP	1	$738,610 with dispatch system	$11,850.00
Utility Excavator with Hammer	Caterpillar 345CL	1	$780,000 with breaker hammer and dispatch system	$6,859.34
Utility Haul Trucks	Caterpillar 777	2	$1,551,112 with tires, spare rock box and dispatch system	$24,961.47 ea. w/o tires
Water/Sand Truck	Kenworth/Sterling	2	$350,000 ea. With sand spreading box	$2,025 ea. (rate for an International chassis instead of Kenworth/Sterling
Tool Carrier	Caterpillar IT38GII	1	$375,000 with forks, bucket and snow plow attachments	$5,473.57
Skid Steer Loader	Komatsu SK1026-5N	2	$39,900	$716 ea.
Lowboy and Tractor	125 ton Load King Trailer with International Tractor	1	$331,500	$5,649
Tire Handler with Front End Loader	Komatsu WA 500	1	$535,000	$8,474
Crane 90-ton	Grove RT890E	1	$709,500	$8,988
Light Plants	Almand Maxi-Lite ML-6	5	$14,500	$263 ea.
Pumps	Gorman-Rupp S8C1 Submersible	3	$45,000 ea.	$573 ea.
Pump/Service		1	$250,000	$2,518 (rate for an
Truck				International chassis)
Pickup Trucks		5	$35,000 ea.	$400.00 estimated each
Crew Cab Pickup Trucks		3	$40,000 ea.	$500.00 estimated each

Equipment	Model	No. Required	Purchase Price	Monthly LeasePayment (based on 60 month lease, except locos)
Crew bus	Used, re-conditioned	2	$30,000 ea.	
Fire Truck	Used, re-conditioned	1	$290,000	
Ambulance	Used, re-conditioned	1	$100,000	
Locomotives	NREC 3GS-21C N-Viromotive	4	$1,789,000 ea. With remote control	$650.00 ea. per day

Note: * "All lease payments shown above, except for locomotives are monthly and based on a standard 60 month lease term. Locomotive lease terms are quoted as a daily rate with not fixed term.

The total cost of leasing mining equipment and mine railroad locomotives over a 20-year mine life is US$193.8 million dollars of which US$19.9 million will be required during operating years 1 and 2.

21.4 Comments on Section 21

PolyMet plans to complete a full update of both capital and operating costs when the detailed design is finanalized as a result of the environmental review and permitting process. It estimates that capital costs (other than for mine equipment) have been increasing at approximately 3% a year since 2008, mine equipment costs are more volatile, reflecting shorter-term demand. PolyMet anticipates some expansion of scope of environmental protection measures, which may result in a more substantive change in capital costs.

Operaing costs reflect the cost of labour and consumables, especially power. PolyMet's long-term power contract with Minnesota Power is an important factor in stablizing its operating costs.

22 ECONOMIC ANALYSIS

The following economic analysis reflects the DFS. The impact of the DFS Update in 2008 is described in Section 22.2. In February 2011, PolyMet announced that it planned to build the Project in two phases:

- Phase I: produce and market concentrates containing copper, nickel, cobalt and precious metals
- Phase II: process the nickel concentrate through a single autoclave, resulting in production and sale of high grade copper concentrate, value added nickel-cobalt hydroxide, and precious metals precipitate products.

The changes reflect continued metallurgical process and other project improvements as well as improved environmental controls that are being incorporated into the Supplemental Draft EIS. The advantages, compared with the earlier plan, include a better return on capital investment, reduced financial risk, lower energy consumption, and reduced waste disposal and emissions at site.

This revised plan reduces the DFS Update capital cost estimate by approximately $127 million. PolyMet did not report detailed economic impact of these project changes but the impact will have been positive owing to reduced capital and operating costs. This analysis will be included in the full project update once all of the details of environmental mitigation measures have been finalized in the Supplemental Draft EIS.

22.1 DFS Economic Analysis

The DFA economic evaluation is based on proven and probable reserves of 181.7 million tons and a mining rate of 32,000 tons per day (11.68 million tons per annum). Changes to the basic assumptions and their impacts are discussed later in this section.

All resource and reserve analysis and mine modelling have been based on the following metal prices, reflecting prices that were relevant during the preparation of the DFS, namely: copper - $1.25/lb, nickel - $5.60 per pound, cobalt - $15.25/lb, palladium - $210 per ounce, platinum - $800 per ounce and gold - $400 per ounce. This price scenario equates to a NMV of $16.09 per ton. Key DFS statistics are shown in Table 22-1.

Table 22-1: Key DFS Statistics

Reserves and Resources			
Measured & Indicated (M+I) Resources 1	422.1 M tons	Copper equivalent grade	0.86% Cu
Inferred Resources	120.6 M tons	Copper equivalent grade	0.80% Cu
Proved and Probable Reserves	181.7 M tons	Copper equivalent grade	0.96% Cu
Mining			
Life of Mine average total mining rate	81,070 t/d	Plant feed rate	32,000 t/d
Initial mine life (permit application)	20 years		
Production – annual average in 1st five years			
Copper cathode (high grade)	72,057 Mlb	Precious metals (Pt, Pd, Au)	105,984 oz
Nickel in hydroxide	15,400 Mlb	Cobalt in hydroxide	0.727 Mlb
Life-of-Mine operating costs per ton			
Mining cost per ton of rock mined	US$1.14	Processing cost per ton milled	US$6.99
Mining cost per ton of ore mined	US$3.13	General, Admin & other per ton milled	US$0.66
Capital Costs			
Initial Direct Cost	US$285.1 M		
Contingency	US$27.1 M		
Total	US$312.1 M		
Indirect Costs	US$67.5 M		
Total Initial capital	US$379.6 M		
Sustaining capital (20-year project)	US$71.8		
Economic Summary – NI 43-101 Base Case			
IRR after tax	26.7%		
After tax NPV @ 7.5%	US$595.4 M		
Average annual EBITDA in first 5 years	US$175.3 M		

22.1.1 Economic Assumptions

Metal price assumptions for reserve analysis and pit design are deliberately conservative. The U.S. Securities and Exchange Commission (SEC) allows reserves to be estimated using three-year trailing average prices to the date of the reserve report, namely $1.61/lb for copper, 6.52/lb for nickel and $234, $896, and $597 per ounce respectively for palladium, platinum and gold. This price scenario equates to a NMV of $19.55 per ton.

The Base Case for economic modelling in the DFS uses metal prices that are slightly lower than those allowed by the SEC, namely: copper - $1.50/lb, nickel - $ 6.50/lb, palladium - $225/oz, platinum - $900/oz, and gold - $450/oz for a NMV of $18.67 per ton.

These prices are substantially lower than the average in July 2006 of $3.50/lb for copper, $12.06/lb for nickel, and $322, $1,241 and $634 per ounce respectively for palladium, platinum, and gold with a NMV of $36.61 per ton.

As a middle ground, we have used a market-related formula taking the weighted average of the three-year trailing average price at the end of July 31, 2006 (60%) and the average two-year forward price in July, 2006 (40%.) These prices are: $2.25/lb for copper, $7.80/lb for nickel and $274, $1,040, and $540 per ounce respectively for palladium, platinum and gold with a combined NMV of $24.82. This is the price scenario that has been applied to the case referred to herein as the NI 43-101 case.

22.1.2 Key Data and Economic Analysis

The economics reported in the DFS reflect the initial mine plan which in turn is based on the 2004 Environmental Assessment Worksheet for an ore processing rate of 32,000 tons per day for an initial period of 20 years. As previously described, the pit plan is not fully optimized and the 20-year permit application covers significantly less than half of the measured and indicated resources already defined.

Table 22-2 sets out DFS Base Case metal price assumptions and process recovery and key operating data for the average of the first five years of full-scale production. These data comprise metal content of the three products described above, the contribution to net revenue after third-party processing costs, estimates of cash costs for each metal using a co-product basis whereby total costs are allocated to each metal according to that metal's contribution to the net revenue, cash costs on a by-product basis whereby revenues from other metals are offset against total costs and those costs divided by production – this analysis is included for copper and for nickel. The final columns show the increase or decrease in the EBITDA with a change in the price of each metal.

Table 22-2: Base Case Price and Operating Assumptions and Key Production Numbers

		Assuptions		Average of First Five Years					
			Metal		Contribution	Cash Costs		Sensitivity	
		Base Case	Recovery	Production	to net revenue	co-product	by product	Δ Price	Δ EBITDA
		$lb or Oz	%	mlbs or oz	%	$/lb or $/oz	$/lb or $/oz	$/lb or $/oz	$'000
Copper	lb	1.5	92.3%	72.058	46.0%	0.81	0.06	0.10	6,990
Nickel	lb	6.5	70.3%	15.401	34.1%	2.84	-1.46	0.10	1,195
Cobalt	lb	15.25	40.7%	0.727	3.8%	6.67	n/a	0.10	56
Palladium	oz	225	75.2%	75,995	6.7%	113	n/a	10	737
Platinum	oz	900	72.7%	20,531	7.8%	477	n/a	10	199
Gold	oz	450	67.0%	9,459	1.8%	239	n/a	10	92
Total precious	oz			105,984	16.3%		n/a	10	1,028

The price assumptions included July 2006 average prices (shortly before publication of the DFS), the Base Case and the NI 43-101 case described previously. The table shows a sensitivity analysis of a ± 10% change in the Base Case metal price assumptions.

Table 22-3 sets out key financial statistics – the internal rate of return on the future capital investment and the present value of the future cash flow (including capital costs) using a 5% and 7.5% discount rate on both a pre-tax and an after-tax basis. The bottom section of the table shows the average over the first five years of full-scale production for gross revenue (before royalties and third-party processing fees), net revenues (after those costs) and EBITDA.

The price assumptions included July 2006 average prices (shortly before publication of the DFS), the Base Case and the NI 43-101 case described previously. The table shows a sensitivity analysis of a ± 10% change in the Base Case metal price assumptions.

Table 22-3: Economic Projections on a Range of Metal Price Assumptions

		Average July 2006	Price Assumptions			
			Main Cases		Sensitivity	
			Market Case 3-year trailing plus 2-year forward	Base Case	Base -10%	Base +10%
Metal Prices						
Copper	$/lb	3.50	2.25	1.50	1.35	1.65
Nickel	$/lb	12.06	7.80	6.50	5.85	7.15
Cobalt	$/lb	14.52	16.34	15.25	13.73	16.78
Palladium	$/oz	322	274	225	203	248
Platinum	$/oz	1,241	1,040	900	810	990
Gold	$/oz	634	540	450	405	495
Financial Summary						
Pre-tax						
IRR	%	61.0%	34.2%	17.4%	11.4%	22.9%
PV discounted at 5%	$'000	2,606,279	1,210,792	450,643	217,282	684,003
PV discounted at 7.5%	$'000	2,034,062	910,978	298,807	110,911	486,702
Post-tax						
IRR	%	47.4%	26.7%	13.4%	8.6%	17.8%
PV discounted at 5%	$'000	1,931,367	873,022	295,515	117,455	472,983
PV discounted at 7.5%	$'000	1,388,430	595,358	161,924	28,036	295,167
First 5 years:						
Average gross revenue	$'000	504,438	341,417	259,111	233,200	285,022
Average net revenue	$'000	440,257	303,147	228,067	205,091	251,044
Average EBITDA	$'000	312,382	175,273	100,193	77,216	123,169

During the first five years of full-scale production, cash costs of production (excluding amortization of capital) on a co-product basis (allocating costs to each metal according to its contribution to revenue) and using Base Case metal price assumptions are projected at $0.81/lb for copper, $2.84/lb for nickel, and $113, $477, and $239 per ounce respectively for palladium, platinum, and gold.

Alternatively, using the by-product method whereby revenues from other metals are offset against costs of a primary metal, the five-year average cash cost of copper would be $0.06/lb or, if NorthMet were viewed as a nickel mine, nickel costs would be minus $1.46/lb.

After state and federal taxes, the Base Case rate of return is 13.4% and the present value of the future cash flow discounted at 7.5% per annum is $162 million. During the first five years of full-scale operation, EBITDA (Earnings before Interest, Taxation, Depreciation, and Amortization, or operating cash flow) is projected to average $100 million a year.

A $0.10/lb change in the copper or nickel price would increase or decrease average annual EBITDA during the first five years of full-scale operation by $7.0 million and $1.2 million respectively and a $10/oz change in all of the precious metal prices (palladium, platinum, and gold) would increase or decrease the five-year average annual EBITDA by $1.0 million.

22.1.3 2008 DFS Update

Capital Costs

Since the September 2006 DFS, and on a like-for-like basis, the total capital cost has increased by 36% to $516.8 million. This increase reflects both cost inflation and design scope changes since the DFS, including facilities needed to ship concentrate during the construction and commissioning of the new hydrometallurgical plant.

In addition, PolyMet anticipated $85.1 million of expenditures on measures to protect the environment, over and above the measures contemplated in the DFS. $76.6 million for mining equipment that was assumed to be provided by a mining contract in the DFS has been incorporated as an operating lease in updated operating costs.

PolyMet has previously stated that it has been reviewing the possibility of selling concentrate during the construction and commissioning of new metallurgical facilities. This staged approach shortens the initial construction period, makes the Project less sensitive to the delivery schedule for long lead-time equipment such as autoclave vessels, and means that PolyMet can commence operations of the mine, the existing crushing and milling plant, the existing tailings disposal facilities, and the new flotation circuit, before starting the new hydrometallurgical plant.

As a result of the staged approach, the total capital required prior to initial production and sales declines to $312.3 million, which includes $64.7 million of additional environmental safeguards for this level of activity (Table 22-4).

Table 22-4: Capital Costs (US$ M)

	Full Project	*Change from DFS*	Initial Concentrate Sales
Definitive Feasibility Study	379.8		138.7
Escalation and other scope changes	137.0	*36%*	108.9
Total	516.8		247.6
Environmental measures	85.1		64.7
Total change	222.1	*58%*	173.6
TOTAL	601.9		312.3

Operating Plans and Costs

The overall mining and operating plan remains the same as that defined in the DFS and which forms the basis of the plan being analyzed in the environmental impact statement. PolyMet intends to mine 32,000 tons of ore per day for an operating life of twenty years, processing a total of 224 million tons of ore.

The mine plan continues to be based on the following metal prices: copper - $1.25/lb, nickel - $5.60 per pound, cobalt - $15.25/lb, palladium - $210 per ounce, platinum - $800 per ounce, and gold - $400 per ounce.

Operating costs per ton of ore processed have increased to $13.33 from $11.02 in the DFS reflecting higher fuel, mine equipment, and other consumable costs, as well as general inflation. The cost of mining and delivering ore to the plant is now estimated at $4.31 per ton compared with $3.80 per ton in the DFS. The increase in mining costs has been partially offset by the lower strip ratio, larger mining equipment, and owner versus contractor operation.

The economic analysis is based on SEC-reserve standards, namely the three-year trailing average, which we calculated at April 30, 2008 (the end of our first fiscal quarter). This price deck is copper - $2.90/lb, nickel - $12.20/lb, cobalt - $23.50/lb, palladium - $320/oz, platinum - $1,230/oz, and gold - $635/oz. While these prices are somewhat higher than those used on the economic analysis in the DFS, each price is well below current market levels – in the first quarter of 2008, the following prices prevailed: copper - $3.52/lb, nickel - $13.09/lb, cobalt - $46.37/lb, palladium - $441/oz, platinum - $1,867/oz, and gold - $925/oz.

This translates into copper cash costs of $1.05 per pound using a co-product basis to calculate costs, compared with the DFS estimate of $0.81/lb. Taking revenues from the other metals as a deduction against costs, the co-product basis shows a cost of $(0.28) per pound compared with $0.06 per pound in the DFS.

Economic Summary

Key economic metrics include earnings before interest, tax, depreciation, and amortization (EBITDA) which is projected to increase to $217.3 million on average over the first five years of operations from $175.3 million estimated in the DFS. The net present value of future cash flow (after tax) discounted at 7.5% is estimated to be $649.4 million compared with $595.4 million in the DFS, and the after tax internal rate of return is now estimated at 30.6% compared with 26.7% in the DFS. The table below also sets out the affect on EBITDA of a 10% change in each metal price.

Table 22-5: Key Economic Highlights

		Update May-08	DFS Sep-06
Operating plan			
Proven and probable reserves	million t	274.7	181.7
Ore mined - life of operation	million t	224.0	181.7
Overburden removed (capitalized under site preparation)	million t	18.5	-
Waste	million t	285.3	302.3
Operating costs per ton processed			
Mining and delivery to plant	$/t	4.31	3.80
Processing	$/t	8.07	6.75
G&A	$/t	0.94	0.46
Total	$/t	13.33	11.02
Metal price assumptions (SEC-standard)			
Copper	$/lb	2.90	2.25
Nickel	$/lb	12.20	7.80
Cobalt	$/lb	23.50	16.34
Palladium	$/oz	320	274
Platinum	$/oz	1,230	1,040
Gold	$/oz	635	540
Economic summary			
Annual earnings before interest, tax, depreciation and amortization (EBITDA) - average first five years	$ million	217.3	175.3
Net present value of future after tax cash flow discounted at 7.5%	$ million	649.4	595.4
Internal rate of return (after tax)		30.6%	26.7%
Sensitivity: 10% ± price = $Δ million in EBITDA			
Copper	$ million	18.6	15.7
Nickel	$ million	13.3	9.3
Cobalt	$ million	0.9	0.9
Palladium	$ million	1.7	2.0
Platinum	$ million	1.7	2.1
Gold	$ million	0.3	0.5
Copper costs			
cash - co-product method	$/lb	1.05	0.81
cash - by-product method	$/lb	(0.28)	0.06

Table 22-6: Metal Prices

		DFS Base Case	DFS Market Case	DFS Update	06/30/12 3-year trailing average
Metal Price					
Copper	$/lb	1.50	2.25	2.90	3.56
Nickel	$/lb	6.50	7.80	12.20	9.47
Cobalt	$/lb	15.25	16.34	23.50	17.69
Palladium	$/oz	225	274	320	684
Platinum	$/oz	900	1,040	1,230	1,689
Gold	$/oz	450	540	635	1,485
After tax:					
Internal rate of return	%	13.4%	26.7%	30.6%	
PV dicounted at 7.5%	$ millions	161.9	595.4	649.4	

22.2 Comments on Section 22

PolyMet plans to complete a full update of both capital and operating costs when the detailed design is finanalized as a result of the environmental review and permitting process.

In addition to reflecting the scope and cost of this design, the update will also reflect current metal market conditions.

23 ADJACENT PROPERTIES

There are no adjacent properties that PolyMet is proposing to explore or drill as part of any drilling program or other evaluation. There are several other deposits in the Duluth Complex, including the Mesaba project owned by Teck Resources, Serpentine owned by Encampment Resources, and the Nokomis project owned by Twin Metals, a join venture between Duluth Metals and Antofagasta.

Twin Metals has retained Bechtel Corporation to conduct a prefeasibility study on the Nokomis project. Teck completed an internal prefeasibility study on Mesaba when it was seeking to acquire the Erie Plant.

24 OTHER RELEVANT DATA AND INFORMATION

24.1 US Steel Assays (1960s and 1970s)

US Steel assays are derived from old records which are incomplete in terms of QA/QC details. There are, however, less than ~200 US Steel assays remaining in the database that have not been replaced by more recent assays.

Gatehouse (2000a) summarizes the US Steel sampling and assaying:

USX 'bx' diameter drilling and 10 ft intervals (late60s-70s) was sampled using anvil splitting and prepared and analysed by the central USX laboratory. Sample rejects were kept as –6# and –20# material produced by gyratory and rolls crushers respectively. The precise techniques are not available but given the era, the style of analyses done at that time, and nature of the company it is highly probable that total copper and nickel assays were produced using AAS. No Au or PGMs were analysed. No quality control has been found for this work.

There are 1,790 ACME aqua regia re-assays of samples previously assayed by US Steel. Averages for US Steel and ACME, respectively are copper 0.39% and 0.39%; nickel 0.14% and 0.09%. Two-hundred and seventeen check assays by Chemex are available. Averages for US Steel and Acme, respectively, are copper 0.25% and 0.25%; nickel 0.11% and 0.08%. Thus, US Steel copper assays match, on average, both those by ACME and Chemex. Nickel appears high in the US Steel assays, which may partly be a result of a more total digestion used. Acme's acid digestion was weaker than that used by Chemex.

24.1.1 Status of Nickel Assays

Gatehouse (2000b) summarizes the status of the Ni assays:

- Against Genalysis ICP (4B), Chemex partial aqua regia assays are strongly biased as should be expected. On average, the Chemex preferred assays used for the resource calculation are biased low by 5-6% against Genalysis totals. The clear conditional bias in this data is also as expected and consistent with Lakefield metallurgical reports of a proportion of the nickel resident in silicates. Bias changes from about 20% at 500-600 ppm to no recognizable bias at greater than about 0.3% Ni. This pattern is consistent with higher proportions of Ni being resident in sulfide at higher grades. Lakefield metallurgical reports suggest that Ni in silicates is variable between 200 and 700 ppm. This is also consistent with Co results.
- In summary, the NorthMet Ni resource is based on partial digest results. At worst, the average bias would be 5% lower than total results. This does not necessarily

alter the economics of the Project as it may eventuate that Lakefield head assays on which recoveries have been predicated may prove themselves similarly biased.

24.1.2 Status of Copper Assays

Gatehouse (2000b) summarizes the status of the copper assays:

- On average, preferred Chemex aqua regia assays are biased low by about 2% against Lakefield XRF results (2A) , by 5% against Genalysis total acid digest ICP (2B) and by 1-2% against Chemex total digest ICP(2C). Such results are consistent with the low partitioning of Cu into silicates and represent a limit of a tolerable assay outcome. Biases of much greater than 5% are not acceptable and require improved assay.
- Given the notionally total nature of Genalysis and Lakefield assays it is probable the Chemex aqua regia used in the resource data is low biased from an accurate result by less than 5% on average. This bias is conservative and would have no negative impact on resource figures.

24.1.3 Status of Cobalt Assays

Gatehouse (2000b) summarizes the status of the cobalt assays:

- The Chemex aqua regia digestions are significantly low biased, on average about 20%, against Genalysis total assays. The bias is conditional and significantly increases with lower grade. Though the number of samples is smaller, the same effect can be seen between Chemex aqua regia and Chemex total digest ICP.
- Cobalt forms a very small portion of the value of the resource and, for economic purposes and factoring through metallurgical recoveries, its resource value is likely to be currently underestimated by around 20%. A small upside exists on the value of the resource by virtue of underestimated resource cobalt being related to total cobalt used in metallurgical calculations.

24.1.4 Status of the Palladium Assays

Gatehouse (2000b) summarizes the status of the palladium assays:

- On average, Chemex is biased about 2% high against both Genalysis and Lakefield. Bias is not conditional against Lakefield. Chemex bias is conditional against Genalysis' NiS assay and increases with grade. It is not considered significant given the nugget imprecision between assay types due to sub-sampling and signified by the large dispersion in the …scatter points. However, this situation should be monitored with ongoing quality control in the event that it might become significant with changing mineralized domain.

24.1.5 Status of the Platinum Assays

Gatehouse (2000b) summarizes the status of the platinum assays:

- On average, Chemex is biased low against both Genalysis NiS assays(6B) and Lakefield lead oxide fire assays(6A). Further a conditional bias against Genalysis is similar to that of palladium and similar ongoing monitoring is recommended.

24.1.6 Status of the Gold Assays

Gatehouse (2000b) summarizes the status of the gold assays:

- As with Platinum, gold by virtue of its low abundance is subject to significant sub-sampling nugget effects. Though biases are apparent, the low contribution of Au to economic value means they are not significant at this time. However, quality control monitoring should be continued.
- Against Becquerel NAA (7C), a very good reference technique for gold analyses, Chemex gold is biased low by 20%. The low levels (50 ppb) and severe nugget effects render this insignificant. On average, Chemex is biased low against both Genalysis NiS assays and Lakefield lead oxide fire assays. Further, a conditional bias against Genalysis is similar to that of palladium.
- Extraction of Au into NiS during fire assay is inefficient. The low bias of Genalysis against Chemex (7B) is expected and not relevant.
- The low bias of Lakefield against Chemex is largely a function of assay imprecision at very low grades and is not significant…

24.1.7 Summary – Copper, Nickel, Cobalt

Gatehouse (2000b) summarizes the status of the copper, nickel and cobalt assays:

- Chemex aqua regia assays, on which the Cu Ni Co resources are based, are biased low by a small amount. The total economic impact will be less than 5%, which is acceptable for resource assays. Never the less, it is highly probable that there remains an inherent bias.
- Initial results for a limited number (54) of samples from the recent metallurgical drilling program support Gatehouse’s prediction. Cobalt and nickel assays from 4-acid digestions being 14% and 5%, respectively, higher than assays based on aqua regia. Copper values are similar.
- A number of batches assayed in 2000 had included PolyMet standards (N1-3). Some of these have nickel assays that report approximately 10 to 20% above the recommended value though significantly more batches understate nickel. Copper values were largely accurate.

24.1.8 Summary – Platinum Group Elements and Gold

Gatehouse (2000b) summarizes the status of the platinum group element and gold assays:

- Though some evidence for conditional biases exist between lead oxide and NiS fire assay for PGEs the low level is acceptable for lead oxide fire assay to be used for ongoing resource assessment. However, of lesser economic significance, the strong negative bias of gold in NiS analyses and its greater cost and expertise required for good assays, strongly mitigates against the NiS technique. However, NiS fire assay for PGEs should be used for quality control monitoring as an ongoing precaution against the potential for significant bias in different mineralized domains at NorthMet.
- It is well recognized that nickel-sulphide (NiS) assays underestimate gold. The only good reason to select NiS assaying is for the determination of rhodium, rhenium, etc (Bloom, pers comm).

25 INTERPRETATION AND CONCLUSIONS

AGP estimated a mineral resource for the NorthMet Deposit using data supplied by PolyMet. This data incorporates the 2007 summer drilling results that were available as of October 15, 2007. The model used the same interpolation methodology used in the Wardrop September 2007 report.

The pre-2007 dataset used by Wardrop was extensively verified by previous authors and the QP spot checked selected holes from the US Steel era and the PolyMet 1999, 2000 and 2005 drill campaign against the paper copies of the laboratory certificates. The 2007 drilling was verified by AGP using the electronic version of the laboratory certificate.

Model was interpolated using Ordinary Kriging with Inverse Distance Squared and Nearest Neighbour interpolation methods used for validation. No significant discrepancies exist between these methods.

Based on the review of the QA/QC, Data validation and statistical analysis of the data, AGP draws the following conclusions:

- AGP has reviewed the methods and procedures to collect and compile geological and assaying information for the NorthMet Deposit and found them meeting accepted industry standards and suitable for the style of mineralization found on the property.
- A mix of data type was use to generate the resource on the property including historical drill results drilled by US Steel data. Fourteen percent (14%) of the assayed footage is by Reverse Circulation (six inch) drilling; with the remainder by diamond coring was use in the resource estimate. PolyMet validated the RC drill results against twin (or near twin) drill hole and found them to be satisfactory. AGP's Principal Resource Geologist visited the site, reviewed some of the historical drill core and interviewed PolyMet staff. AGP believes that the information supplied for the resource estimate and used in this report is accurate.
- A QA/QC program comprising industry standard blank, standard and duplicate samples has been used on the Project since the 2005 drill program. QA/QC submission rates meet industry-accepted standards.
- Data verification was performed by AGP through site visits, collection of independent character samples and a database audit prior to mineral resource estimation. AGP found the database to be exceptionally well maintained and error free and usable in mineral resource estimation. AGP also believes that the information supplied for the resource estimate and used in this report is accurate.

- The specific gravity determinations are representative of the in-situ bulk density of the rock types.
- Sampling and analysis programs using standard practices provided acceptable results. AGP believes that the resulting data can effectively be used in the estimation of resources.
- Core handling, core storage and chain of custody are consistent with industry standards.
- In AGP's opinion the current drill hole database is adequate for interpolating grade models for use in resource estimation.
- Mineral resources were classified using logic consistent with the CIM definitions referred to in NI 43-101.
- AGP estimate the NorthMet resources (above a US$7.42 NMV cut-off) to contain 694.2 million short tons (629.8 million tonnes) in the Measured and Indicated categories grading at 0.265% copper, 0.077% nickel, 68 parts per billion (ppb) platinum, 239 ppb palladium, 35 ppb gold and 71 parts per million (ppm) cobalt. The Inferred category (above a US$7.42 NMV cut-off) totals 229.7 million short tons (208.4 million tonnes) grading at 0.273% copper, 0.079% nickel, 73 ppb platinum, 263 ppb palladium, 37 ppb gold and 56 ppm cobalt.
- The NMV formula used and described in Section 17.2.12 of this report includes gross metal price multiplied by the processing recovery minus refining, insurance and transportation charges and is the same formula used in the Hunter 2006 report.
- Above the 0.2% copper cut-off the NorthMet Deposit contains 442.1 million short tons (401.0 million tonnes) in the Measured and Indicated categories grading at 0.325% copper, 0.089% nickel, 81 ppb platinum, 292 ppb palladium, 41 ppb gold and 73 ppm cobalt. The Inferred category totals 158.7 million short tons (144.0 million tonnes) grading at 0.329% copper, 0.088% nickel, 86 ppb platinum, 315 ppb palladium, 43 ppb gold and 55 ppm cobalt.
- Comparing the AGP model with the previously published estimate, Table 17.23 of the Wardrop, September 2007 report, results show an increase of 15.5 million short tons (14.1 million tonnes) in the Measured category and 40.5 million short tons (36.7 million tonnes) in the Indicated category for a total of 56 million short tons (50.8 million tonnes) or 8.1% increase in the Measured plus Indicated category. The Inferred Resource tonnage dropped by 21.9 million short tons (26.4 million tonnes) or 9.5%. The comparison includes resources above a US$7.42 Net Metal Value (NMV) cut-off from surface down to the 0.00 ft elevation level.
- Compared with the Wardrop September 2007 estimate, grades in the Measured and Indicated categories dropped slightly for copper and nickel and increased slightly for platinum, palladium, gold and cobalt grade elements. Copper changed by -0.3%, nickel by -0.5%, platinum by +2.1%, palladium by +1.8%, gold by +2.1% and cobalt by +0.1%. However, the contained metal value increased for all elements by about

10% in the Measured and Indicated categories. Copper increased by 8.5%, nickel by 8.2%, platinum by 11.1%, palladium by 10.8%, gold by 11.0% and cobalt by 8.9%.

- The work carried out during the Summer 2007 drill program has met the primary objectives relating to the in-fill drilling.
- Reserves for the Northmet project contained within the DFS pit shell amounted to:

  Proven = 118.1 million tons Grading 0.30% copper, 0.09% nickel, 75 ppb platinum, 275 ppb palladium, 38 ppb gold and 75 ppm cobalt.

  Probable = 156.5 million tons Grading 0.27% copper, 0.08% nickel, 75 ppb platinum, 248 ppb palladium, 37 ppb gold and 72 ppm cobalt.

  Total Proven and Probable = 274.7 million tons Grading 0.28% copper, 0.08% nickel, 75 ppb platinum, 260 ppb palladium, 37 ppb gold and 73 ppm cobalt.
- Further increases in reserves are dependent upon the conditions outlined in the ongoing environmental review and permitting process.

26 RECOMMENDATIONS

AGP offers the following recommendations:

PolyMet should proceed with final design engineering and construction of the NorthMet Project as soon as permitting allows. Prior to construction, PolyMet should:

Review and update the scope of the Project design to reflect any changes resulting from the environmental review process and other project enhancements update the capital and operating cost estimates based on the scope review and current prices

Prior to detailed, pre-production planning a limited program of close spaced drilling is recommended. This program will have two objectives:

- To determine the optimum drill hole spacing for grade control and scheduling and,
- To acquire sufficient data to increase confidence in grade affecting the initial open pit production.

Budget for 625 large diameter (5 1/2") reverse circulation drill holes averaging 30 ft for a total of 19,050 ft is estimated at $40 /ft for an all in cost of $782,000 including a $20,000 mobilization charge. Cost is less if using a 3 1/2 " diameter.

All of these items are in PolyMet's budgets for activities before the start of construction, for a total of $3.0 million.

Various recommendations for further work resulted from this Updated DFS, which have subsequently been completed. These included:

1) Various recommendations for further work resulted from the Updated DFS. Some of this work has been completed as of October 2012.

1) **Development of a low-grade recovery relationship for copper and nickel and the other metals**
Development of a low-grade recovery relationship for copper, nickel and the other metals needs to be completed on low grade samples using a consistent metallurgical protocol. As the cutoff grade is dropped, the impact of lower grades becomes greater and also its impact on overall project economics.

2) **Updating of metal payment pricing and terms**
Metal prices and terms for mining planning purposes have not been updated since the DFS. With the introduction of concentrate sales, long-term marketing with

Glencore, and changes to metal markets, the current cut-off is likely to exclude mineralization that would be economic to mine and process.

3) **Stockpiling options possible to increase initial mill feed grade**
Current low grade ore stockpile limit is for 5 million tons of material. If the limit is increased to a higher value, the initial years mill feed grade can be increased improving overall project economics.

4) **Potential for daily mine ore production increase**
The NorthMet resource base and the geometry of the deposits could allow for an increase in ore tonnage.

27 CERTIFICATES OF QUALIFIED PERSONS

27.1 Pierre Desautels, P.Geo.

I, Joseph Rosaire Pierre Desautels, P.Geo, of Barrie, Ontario, do hereby certify that as one of the qualified person (QP) of this Technical Report, Updated Technical Report on the NorthMet Deposit dated 12 October 2012; and hereby make the following statements:

- I am a Principal Geologist with AGP Mining Consultants Inc., with a business address at 92 Caplan Avenue, Suite 246, Barrie, Ontario, L4N 0Z7.
- I am a graduate of Ottawa University (B.Sc. Hons., 1978).
- I am a member in good standing of the Association of Professional Geoscientists of Ontario, Registration #1362.
- I have practiced my profession in the mining industry continuously since graduation.
- I have read the definition of “qualified person” set out in National Instrument 43-101 (NI 43-101) and certify that, by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a “qualified person” for the purpose of NI 43-101.
- My relevant experience with respect to resource modeling includes 30 years’ experience in the mining sector covering database, mine geology, grade control, and resource modeling. I was involved in numerous projects around the world in both base metals and precious metals deposits.
- I visited the Project site from March 21st to March 23rd, 2007, and again from August 27th to August 29th, 2007, for a period of six days in total.
- I am responsible for the geology and resource portion of section 1, the complete section 2 and 3, section 4 with exceptions made for portion of the text that are outside my area of expertise and where I relied on the opinion of other experts as stated in section 3 of this report, the complete section 5 to 12, section 14, 23, 24 and a portion of section 25 and 26 of the technical report titled Updated Technical Report on the NorthMet Deposit.
- As of the date of this Certificate, to my knowledge, information, and belief, this technical report contains all scientific and technical information that is required to be disclosed to make the technical report not misleading.
- I am independent of the Issuer (PolyMet Mining Inc. (PolyMet)) as defined by Section 1.5 of the Instrument.
- I have read NI 43-101 and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

Signed and dated this 29th day of October 2012, at Barrie, Ontario.

“Original Signed and Sealed”

Pierre Desautels, P.Geo.

27.2 Gordon Zurowski, P.Eng.

I, Gordon Zurowski, P.Eng, of Stoufville, Ontario, do hereby certify that as one of the qualified person (QP) of this Technical Report, Updated Technical Report on the NorthMet Deposit dated 12 October 2012; and hereby make the following statements:

- I am a Principal Mine Engineer with AGP Mining Consultants Inc., with a business address at 92 Caplan Avenue, Suite 246, Barrie, Ontario, L4N 0Z7.
- I am a graduate of the University of Saskatchewan, B.Sc. Geological Engineering 1989.
- I am a member in good standing of the Association of Professional Engineers of Ontario, Registration #100077750.
- I have practiced my profession in the mining industry continuously since graduation.
- I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that, by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purpose of NI 43-101.
- My relevant experience includes the design and evaluation of open pit mines for the last 24 years.
- I visited the Project site from October 9 to October 11th, 2007 for a period of three days in total.
- I am responsible for the mining portion of Section 1.4, the complete section 15 and 16 and a portion of section 26 of the technical report titled "Updated Technical Report on the NorthMet Deposit."
- As of the date of this Certificate, to my knowledge, information, and belief, this technical report contains all scientific and technical information that is required to be disclosed to make the technical report not misleading.
- I am independent of the Issuer PolyMet Mining Inc. (PolyMet) as defined by Section 1.5 of the Instrument.
- I have read NI 43-101 and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

Signed and dated 29th day of October 2012, at Stoufville, Ontario.

"Original Signed and Sealed"

Gordon Zurowski, P.Eng.

27.3 David Dreisinger, Ph.D., P. Eng., F.C.I.M., F.C.A.E.

I, David Dreisinger, Ph.D., P.Eng., F.C.I.M., F.C.A.E. of Delta, British Columbia, do hereby certify that as one of the qualified person (QP) of this Technical Report, Updated Technical Report on the NorthMet Deposit, dated 12 October 2012; and hereby make the following statements:

- I am the President of Dreisinger Consulting Inc. with a business address at 5233 Bentley Crescent, Delta British Columbia.
- I am a graduate of Queen's University of Kingston, Canada, B.Sc. Metallurgical Engineering 1980 and Ph.D. Metallurgical Engineering, 1984.
- I am a Fellow of the Canadian Academy of Engineering and am a member in good standing of the Association of Professional Engineers and Geoscientists of British Columbia (Registration Number 15803).
- I have practiced my profession continuously since graduation.
- I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that, by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purpose of NI 43-101.
- My relevant experience includes being employed in research and teaching at the University of British Columbia since 1984, currently holding the title of Professor and Chairholder, Industrial Research Chair in Hydrometallurgy in the Department of Materials Engineering. I have provided consulting services to the global metallurgical industry since 1987.
- I visited the Project site on numerous occasions starting in January, 2004. Additionally, I have made visits to the SGS Minerals Laboratory in Lakefield, Canada to observe metallurgical testing of the Project ore since 2004.
- I am responsible for the mineral processing portion of Section 1, and the complete section 13 and 17 of the technical report titled "Updated Technical Report on the NorthMet Deposit."
- As of the date of this Certificate, to my knowledge, information, and belief, this technical report contains all scientific and technical information that is required to be disclosed to make the technical report not misleading.
- I am not independent of the Issuer PolyMet Mining Inc. (PolyMet) as defined by Section 1.5 of the Instrument. I currently serve as a director of PolyMet Mining Inc.
- I have read NI 43-101 and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

Signed and dated 25th day of October 2012, at Lima, Peru.

"Original Signed and Sealed"

David Dreisinger, Ph.D., P.Eng.

27.4 William Murray, P.Eng.

I, William Murray, P.Eng, of Richmond, British Columbia, do hereby certify that as one of the qualified person (QP) of this Technical Report, Updated Technical Report on the NorthMet Deposit dated 12 October 2012; and hereby make the following statements:

- I am President of Optimum Project Services Ltd. with a business address at 6640 Gibbons Dr., Richmond, British Columbia.
- I am a graduate of the Strathclyde University of Glasgow, Scotland, B.Sc. Electrical Engineering 1971.
- I am a registered Professional Engineer in the Province of British Columbia and a member in good standing of the Chartered Engineers of the United Kingdom.
- I have practiced my profession in the mining industry continuously since graduation.
- I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that, by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purpose of NI 43-101.
- My relevant experience includes a 40 year career with involvement at progressive stages of seniority in the evaluation and building of projects around the world in coal, iron, base metals and gold. My initial jobs with Anglo American of South Africa allowed exposure to all aspects of mine development including resource estimates; mine planning; process development; design engineering; and cost estimates. My work in recent years has also included economic valuations and market related aspects of mine development.
- I visited the Project site in the fall of 2003 and have been to site numerous times and deeply involved in its development ever since.
- I am responsible for the broad project description and execution plan; specific land deals, market and off-take; capital and operating costs and economic analyses as described in sections 1, 4, 18, 19, 20, 21 and section 22 of the technical report titled "Updated Technical Report on the NorthMet Deposit."
- As of the date of this Certificate, to my knowledge, information, and belief, this technical report contains all scientific and technical information that is required to be disclosed to make the technical report not misleading.
- I am not independent of the Issuer PolyMet Mining Inc. (PolyMet) as defined by Section 1.5 of the Instrument.
- I have read NI 43-101 and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

Signed and dated 25th day of October 2012, at Richmond, British Columbia.

"Original Signed and Sealed"

William Murray, P.Eng.

APPENDIX A

LIST OF HOLES INCLUDED

Index_PK	HOLE-ID	LOCATIONX	LOCATIONY	LOCATIONZ	LENGTH	AZIMUTH	ri	Number of assays	Holes to use in Oct 2007 resource update USE_RES	Holes to use in Oct 2007 Category model update USE_CAT	Excluded because…
1	26010	2901437.05	737285.1	1600	620	315	-50	68	TRUE	TRUE	
2	26011	2901438.05	737285.1	1600	455	0	-90	62	TRUE	TRUE	
3	26013	2903509.09	738810	1609	740	315	-60	97	TRUE	TRUE	
4	26015	2902513.07	737970.05	1604	893	315	-50	95	TRUE	TRUE	
5	26017	2902513.07	737970.05	1604	861	0	-90	152	TRUE	TRUE	
6	26021	2901548.04	737115.1	1603.5	608	0	-90	108	TRUE	TRUE	
7	26022	2899208.03	736592.2	1605	606	0	-90	90	TRUE	TRUE	
8	26023	2899376.02	736242.2	1605	725	0	-90	92	TRUE	TRUE	
9	26024	2899020.05	736971.2	1605	586	0	-90	2	TRUE	TRUE	
10	26025	2897248.95	734144.32	1611	1042	0	-90	188	TRUE	TRUE	
11	26026	2900282.03	736611.16	1618	715	0	-90	131	TRUE	TRUE	
12	26027	2898935.97	735013.24	1606	910	0	-90	155	TRUE	TRUE	
13	26028	2901346.05	737425.1	1600	381	315	-50	51	TRUE	TRUE	
14	26029	2896069.92	733266.38	1631	1181	0	-90	75	TRUE	TRUE	
15	26030	2901877.02	736551.1	1620	1094	0	-90	214	TRUE	TRUE	
16	26031	2902822.05	737465.05	1599.5	1116	0	-90	166	TRUE	TRUE	
17	26032	2904871.1	739292.94	1612	690	0	-90	121	TRUE	TRUE	
18	26033	2903827.07	738322	1616	1104	0	-90	178	TRUE	TRUE	
19	26034	2907793.1	739488.83	1603.5	1375	0	-90	171	TRUE	TRUE	
20	26035	2909137.15	741037.74	1604	915	0	-90	11	TRUE	TRUE	
21	26036	2909495.13	740478.74	1597	1237	0	-90	162	TRUE	TRUE	
22	26037	2902569.11	739044.03	1605	301	315	-45	18	TRUE	TRUE	
23	26038	2902731.1	738796.03	1614	405	0	-90	46	TRUE	TRUE	
24	26039	2902186.04	737259.08	1607	956	0	-90	158	TRUE	TRUE	
25	26040	2910768.14	740924.69	1598	679	0	-90	2	TRUE	TRUE	
26	26041	2902208.09	738462.05	1611	387	0	-90	43	TRUE	TRUE	
27	26042	2902234.99	735973.1	1595	1946	0	-90	116	TRUE	TRUE	
28	26043	2904187.05	737768	1604.5	1559	0	-90	158	TRUE	TRUE	
29	26044	2902731.1	738796.03	1614	205	0	-90	40	TRUE	TRUE	
30	26045	2901062.02	736495.14	1600	926	0	-90	132	TRUE	TRUE	
31	26046	2903134.07	738176.02	1604.5	945	0	-90	128	TRUE	TRUE	
32	26047	2904272.09	738841.97	1612	800	0	-90	118	TRUE	TRUE	
33	26048	2903255.02	736780.05	1599.5	1902	0	-90	77	TRUE	TRUE	
34	26049	2905262.08	738718.94	1605	1207	0	-90	215	TRUE	TRUE	
35	26050	2904546.03	737215.99	1599	2005	0	-90	31	TRUE	TRUE	
36	26051	2904679.07	738249.97	1604	1454	0	-90	94	TRUE	TRUE	
37	26052	2905898.04	737796.93	1596	1866	0	-90	210	TRUE	TRUE	
38	26053	2900642	736066.16	1595.5	1018	0	-90	130	TRUE	TRUE	
39	26054	2899606.98	735157.22	1598	776	0	-90	101	TRUE	TRUE	
40	26055	2901005.88	735441.56	1594	1672	0	-90	212	TRUE	TRUE	
41	26056	2899898.96	734666.22	1593	1693	0	-90	189	TRUE	TRUE	
42	26057	2900714.04	737036.14	1599.5	608	0	-90	105	TRUE	TRUE	
43	26058	2899969	735799.19	1612	817	0	-90	95	TRUE	TRUE	
44	26059	2901850.06	737817.08	1605	608	0	-90	74	TRUE	TRUE	
45	26060	2903508.09	738811	1609	812	0	-90	116	TRUE	TRUE	
46	26061	2903473.05	737632.02	1601.5	1277	0	-90	171	TRUE	TRUE	
47	26062	2901404	735939.14	1595	1477	0	-90	198	TRUE	TRUE	
48	26063	2904997.04	737705.97	1596	1957	0	-90	89	TRUE	TRUE	
49	26064	2902511.02	736677.08	1597	1496	0	-90	211	TRUE	TRUE	
50	26065	2906642	736717.93	1591	2466	0	-90	49	TRUE	TRUE	
51	26066	2905621.06	738194.93	1602	1677	0	-90	110	TRUE	TRUE	
52	26067	2907581.02	737346.88	1594	2147	0	-90	18	TRUE	TRUE	
53	26068	2906939.06	738443.88	1603	1458	0	-90	165	TRUE	TRUE	
54	26069	2908505.05	738374.83	1597	2006	0	-90	206	TRUE	TRUE	
55	26073	2902918.95	734849.11	1602	2494	0	-90	26	TRUE	TRUE	
56	26074	2909843.05	738592.77	1593.5	2095	0	-90	21	TRUE	TRUE	
57	26075	2905261.98	736112.99	1596	2505	0	-90	32	TRUE	TRUE	
58	26076	2906567.13	740157.86	1611	1180	0	-90	67	TRUE	TRUE	
59	26077	2901501.09	738389.08	1610	374	0	-90	30	TRUE	TRUE	
60	26078	2900042.02	736328.18	1614	904	0	-90	64	TRUE	TRUE	
61	26079	2900718.02	736471.15	1598	864	0	-90	115	TRUE	TRUE	

62	26080	2897981.9	732966.32	1595	1925	0	-90	67	TRUE	TRUE
63	26081	2900628.91	733552.21	1580.5	2345	0	-90	23	TRUE	TRUE
64	26082	2899191	735772.22	1606	935	0	-90	102	TRUE	TRUE
65	26083	2898085.81	735001.31	1608	644	0	-90	86	TRUE	TRUE
66	26084	2896982.97	734571.32	1611	1354	0	-90	126	TRUE	TRUE
67	26085	2899883.05	737156.16	1606	535	0	-90	88	TRUE	TRUE
68	26086	2907815.14	740603.8	1617	574	0	-90	76	TRUE	TRUE
69	26086A	2907841.75	740555.44	1618.5	522	0	-90	105	TRUE	TRUE
70	26087	2909842.11	739938.74	1596	1675	0	-90	75	TRUE	TRUE
71	26088	2897013.1	738021.25	1608	885	0	-90	4	TRUE	TRUE
72	26089	2901885.16	740466.02	1605	837	0	-90	4	TRUE	TRUE
73	26090	2900318.97	735215.19	1596	1775	0	-90	237	TRUE	TRUE
74	26091	2901071.07	737853.11	1604	231	0	-90	24	TRUE	TRUE
75	26092	2900352.06	737587.14	1612.5	376	0	-90	41	TRUE	TRUE
76	26093	2898437.96	734500.27	1614	1085	0	-90	191	TRUE	TRUE
77	26094	2901768.93	734324.16	1587	2515	0	-90	73	TRUE	TRUE
78	26095	2901668.08	738115.08	1607	425	0	-90	31	TRUE	TRUE
79	26096	2907416.12	740097.83	1625.5	883	0	-90	44	TRUE	TRUE
80	26097	2898716.98	735278.24	1607	787	0	-90	150	TRUE	TRUE
81	26098	2899855.03	736596.18	1606	755	0	-90	115	TRUE	TRUE
82	26099	2908624.14	740721.77	1617.5	565	0	-90	57	TRUE	TRUE
83	26100	2900535.05	737306.14	1600	465	0	-90	60	TRUE	TRUE
84	26101	2900104.04	736883.16	1609	655	0	-90	103	TRUE	TRUE
85	26101A	2900127.81	736871.19	1609	320	0	-90	63	TRUE	TRUE
86	26102	2910773.14	740927.69	1598	1112	315	-60	3	TRUE	TRUE
87	26103	2900210.01	736051.18	1613	965	0	-90	59	TRUE	TRUE
88	26104	2903953.97	735678.05	1613	2445	0	-90	30	TRUE	TRUE
89	26105	2907693.15	740828.8	1616	212	315	-45	12	TRUE	TRUE
90	26106	2911459.09	739841.69	1600	1875	0	-90	194	TRUE	TRUE
91	26107	2909289	737156.83	1579.5	2431	0	-90	47	TRUE	TRUE
92	26108	2907435.14	740616.81	1616	167	315	-45	11	TRUE	TRUE
93	26109	2907130.14	740481.83	1620	242	326	-45	33	TRUE	TRUE
94	26110	2907194.14	740390.83	1621	162	325	-45	25	TRUE	TRUE
95	26111	2907488.14	740532.81	1619	162	325	-45	20	TRUE	TRUE
96	26112	2907763.15	740720.8	1615.5	222	315	-45	24	TRUE	TRUE
97	26113	2908144.15	740862.78	1622	214	326	-45	20	TRUE	TRUE
98	26114	2908558.15	740869.77	1619.5	293	329	-40	38	TRUE	TRUE
99	26115	2902489.98	735554.1	1593.5	2180	0	-90	41	TRUE	TRUE
100	26116	2903271.97	735461.08	1611	2245	0	-90	28	TRUE	TRUE
101	26117	2904463.94	734859.05	1588.5	2594	0	-90	53	TRUE	TRUE
102	26118	2906306.11	739553.88	1619.5	1145	0	-90	78	TRUE	TRUE
103	26119	2905621.96	735550.99	1569.5	2647	0	-90	24	TRUE	TRUE
104	26120	2906610.09	739022.88	1600	1080	0	-90	16	TRUE	TRUE
105	26121	2900706.95	734573.19	1594	2151	0	-90	89	TRUE	TRUE
106	26122	2904248	736460.02	1606	2242	0	-90	27	TRUE	TRUE
107	26123	2901374.96	734936.16	1599	2253	0	-90	66	TRUE	TRUE
108	26124	2901797.97	735367.13	1589	2415	0	-90	75	TRUE	TRUE
109	26125	2904627.98	735950.02	1596	2504	0	-90	24	TRUE	TRUE
110	26127	2908338.14	740565.78	1630	918	0	-90	39	TRUE	TRUE
111	26128	2907678.13	740244.81	1629	1008	0	-90	116	TRUE	TRUE
112	26141	2899286.95	734405.24	1592	1585	0	-90	220	TRUE	TRUE
113	26142	2899625.93	733889.24	1591	2118	0	-90	232	TRUE	TRUE
114	26143	2899169.91	733378.27	1591	2125	0	-90	228	TRUE	TRUE
115	98-086B	2907823.19	740544.44	1619	585	0	-90	114	TRUE	TRUE
116	98-105B	2907616.81	740731.75	1617	265	0	-90	52	TRUE	TRUE
117	98-108B	2907442.5	740618.81	1616	225	0	-90	43	TRUE	TRUE
118	98-113B	2908337	741005.75	1621.4	245	0	-90	47	TRUE	TRUE
119	98-113C	2908173.5	740850.25	1622.5	385	0	-90	73	TRUE	TRUE
120	98-114B	2908617.75	740875.56	1618	465	0	-90	92	TRUE	TRUE
121	98-201C	2907605.94	740428	1628.5	625	0	-90	125	TRUE	TRUE
122	98-202C	2908131.88	741094.94	1616	65	0	-90	9	TRUE	TRUE
123	98-203C	2908423.81	740845	1620.2	505	0	-90	99	TRUE	TRUE
124	98-204C	2908715.56	741032.88	1615	305	0	-90	59	TRUE	TRUE
125	98-205C	2908407.19	740603.5	1625	665	0	-90	132	TRUE	TRUE
126	98-206C	2908240.69	740644.75	1629	645	0	-90	128	TRUE	TRUE
127	98-207C	2907460.94	740264	1625.8	645	0	-90	127	TRUE	TRUE

128	98-208C	2907598.94	740291.88	1630.2	745	0	-90	149	TRUE	TRUE
129	99-301B	2902879.75	738507.25	1611	605	0	-90	121	TRUE	TRUE
130	99-302B	2904216.13	738941.19	1614	725	0	-90	146	TRUE	TRUE
131	99-303B	2902504.31	738525.63	1607.8	425	0	-90	84	TRUE	TRUE
132	99-304BC	2902815.56	737931.38	1605.3	890	0	-90	176	TRUE	TRUE
133	99-305BC	2903422	738283.94	1607	938	0	-90	187	TRUE	TRUE
134	99-306B	2904004.63	738854.25	1611.8	685	0	-90	137	TRUE	TRUE
135	99-307B	2905304.31	740009.56	1615.8	205	0	-90	39	TRUE	TRUE
136	99-308B	2905123	739591.81	1614	585	0	-90	115	TRUE	TRUE
137	99-309B	2904767.44	739109.56	1612	715	0	-90	142	TRUE	TRUE
138	99-310BC	2902393.88	737520.38	1613	868.5	0	-90	171	TRUE	TRUE
139	99-311B	2901831.69	737267.88	1605.5	705	0	-90	142	TRUE	TRUE
140	99-312B	2902047.75	737567.25	1605.5	745	0	-90	148	TRUE	TRUE
141	99-313B	2902746.38	738240.5	1609.3	745	0	-90	149	TRUE	TRUE
142	99-314B	2903068.75	739053.06	1617	405	0	-90	81	TRUE	TRUE
143	99-315B	2903637.63	739306.25	1609.8	365	0	-90	69	TRUE	TRUE
144	99-316B	2903381.63	739093.69	1609	445	0	-90	88	TRUE	TRUE
145	99-317C	2904072.06	739206.69	1605.5	650	0	-90	95	TRUE	TRUE
146	99-318C	2903737.25	738537.5	1608.5	910	0	-90	177	TRUE	TRUE
147	99-319B	2902495.75	738127.94	1606.3	585	0	-90	117	TRUE	TRUE
148	99-320C	2903377.75	738395.56	1614.5	916	78	-89.5	181	TRUE	TRUE
149	99-321B	2902177.5	738008.19	1607	665	0	-90	131	TRUE	TRUE
150	99-322B	2901833.38	738515.81	1610	165	0	-90	28	TRUE	TRUE
151	99-323B	2902072.25	738698.44	1614.3	225	0	-90	45	TRUE	TRUE
152	99-324B	2902136.88	738595.06	1613	305	0	-90	62	TRUE	TRUE
153	00-325B	2902202.75	738463.25	1611	325	0	-90	63	TRUE	TRUE
154	00-326C	2902282.5	737801.06	1610.3	870	319	-89.5	144	TRUE	TRUE
155	00-327C	2903151.69	738883.19	1610	500	88	-88.8	91	TRUE	TRUE
156	00-328B	2902062.63	738454.38	1612	305	0	-90	60	TRUE	TRUE
157	00-329B	2902372.94	738564.5	1607.8	385	0	-90	76	TRUE	TRUE
158	00-330C	2903329.25	738665.06	1609.5	650	210	-89	125	TRUE	TRUE
159	00-331C	2901958.56	738318.19	1610	375	0	-90	73	TRUE	TRUE
160	00-332B	2902410.81	738770.63	1609.8	185	0	-90	38	TRUE	TRUE
161	00-333B	2902433.44	738666.94	1609.8	345	0	-90	68	TRUE	TRUE
162	00-334C	2902621.81	737760.94	1603.8	969	272	-89.5	177	TRUE	TRUE
163	00-335B	2902622.38	738332.75	1608.5	665	0	-90	131	TRUE	TRUE
164	00-336B	2902833.06	738642.19	1611.5	485	0	-90	96	TRUE	TRUE
165	00-337C	2905438.44	739743.88	1611	600	55	-89.5	104	TRUE	TRUE
166	00-338B	2902900.75	738360.31	1610	745	0	-90	148	TRUE	TRUE
167	00-339C	2905235.56	739311	1608	699	0	-90	111	TRUE	TRUE
168	00-340C	2904942.25	738857.19	1605.8	1020	258	-89	204	TRUE	TRUE
169	00-341B	2902263.44	737901.13	1607.5	725	0	-90	145	TRUE	TRUE
170	00-342B	2901384.19	738028.5	1602	365	0	-90	73	TRUE	TRUE
171	00-343C	2903799	739093.69	1609.4	560	268	-88.8	103	TRUE	TRUE
172	00-344C	2900420.69	736390.94	1613.2	968.5	32	-89.5	176	TRUE	TRUE
173	00-345B	2900657.25	737856.38	1609.4	265	0	-90	53	TRUE	TRUE
174	00-346B	2900837.69	737632.88	1608	305	0	-90	60	TRUE	TRUE
175	00-347C	2899944.38	736155.81	1618.5	924	249	-89	185	TRUE	TRUE
176	00-348B	2900098.13	737540.75	1610.1	265	0	-90	53	TRUE	TRUE
177	00-349B	2900167.38	737380.06	1607.5	365	0	-90	72	TRUE	TRUE
178	00-350C	2901202	737062.75	1600.3	619	191	-89	119	TRUE	TRUE
179	00-351B	2900331.44	737073.5	1610	565	0	-90	115	TRUE	TRUE
180	00-352C	2900913.63	736788.94	1600.3	694	148	-88.5	134	TRUE	TRUE
181	00-353B	2900574.5	736831.25	1602.5	645	0	-90	128	TRUE	TRUE
182	00-354C	2901009.25	737344.63	1600.8	429	321	-89	83	TRUE	TRUE
183	00-355C	2901265.31	737674.75	1600	271	39	-89	52	TRUE	TRUE
184	00-356B	2900445.25	736945.44	1601.5	605	0	-90	120	TRUE	TRUE
185	00-357C	2902887.19	738494.69	1611	565.5	0	-90	112	TRUE	TRUE
186	00-358B	2900100.06	737103.75	1611	585	0	-90	116	TRUE	TRUE
187	00-359B	2901759.69	737857.25	1606.9	425	0	-90	85	TRUE	TRUE
188	00-360B	2901569.06	737793.44	1603	425	0	-90	83	TRUE	TRUE
189	00-361C	2904528.81	738984.56	1605.2	775	226.6	-89.2	155	TRUE	TRUE
190	00-362C	2905596.69	740055.06	1611.2	314	247.9	-89.5	63	TRUE	TRUE
191	00-363C	2905969.88	740101.88	1608	329	195.1	-89.6	65	TRUE	TRUE
192	00-364C	2906263.06	740205.13	1606.5	229	176.3	-89.6	45	TRUE	TRUE
193	00-365C	2906829.38	740349.56	1624	299	0	-90	60	TRUE	TRUE

194	00-366C	2907213.44	739829.75	1621.5	799	34.8	-88.6	160	TRUE	TRUE
195	00-367C	2908280.5	739993.13	1609	1195	217.4	-89.3	173	TRUE	TRUE
196	00-368C	2906789.25	739874.88	1620.7	969	170.8	-89.7	181	TRUE	TRUE
197	00-369C	2906974.88	739609.06	1613	959	0	-90	176	TRUE	TRUE
198	00-370C	2906476.63	739841.31	1622	878	0	-90	174	TRUE	TRUE
199	00-371C	2905617.81	739546.25	1611.8	780	0	-90	150	TRUE	TRUE
200	00-372C	2905789.25	739789.13	1614.7	740	0	-90	146	TRUE	TRUE
201	00-373C	2906177.44	739870	1608.3	700	0	-90	137	TRUE	TRUE
202	05-401M	2908154.54	740847.06	1622.5	349	0	-90	100	TRUE	TRUE
203	05-402M	2908154.54	740847.06	1622.3	229	326	-70	60	TRUE	TRUE
204	05-403M	2907826.73	740587.37	1617.5	504	0	-90	144	TRUE	TRUE
205	05-404M	2907826.73	740587.37	1617.5	349	326	-70	86	TRUE	TRUE
206	05-405C	2898596.74	734802.66	1607	769	324.9	-72	143	TRUE	TRUE
207	05-406C	2899252.78	735016.84	1602.5	757	326.8	-64.5	130	TRUE	TRUE
208	05-407M	2900473.67	737368.12	1602	354	0	-90	101	TRUE	TRUE
209	05-408M	2900473.67	737368.12	1602	303	326	-75	86	TRUE	TRUE
210	05-409C	2898573.02	735357.22	1607	488	326.4	-63.8	92	TRUE	TRUE
211	05-410C	2898268.8	734634.86	1614.5	737	322.1	-65.8	132	TRUE	TRUE
212	05-411M	2899616.91	735112.5	1597.5	639	0	-90	183	TRUE	TRUE
213	05-412M	2899616.91	735112.5	1597.5	699	326	-75	195	TRUE	TRUE
214	05-413C	2898805.55	735705.38	1607	388	324.6	-60.1	70	TRUE	TRUE
215	05-414C	2899614.41	734528.36	1593	1438	328.4	-64.5	224	TRUE	TRUE
216	05-415M	2900106.8	736865.54	1609	439	0	-90	110	TRUE	TRUE
217	05-416M	2900106.8	736865.54	1609	449	333	-75	128	TRUE	TRUE
218	05-417M	2900099.99	737055.86	1612	349	0	-90	101	TRUE	TRUE
219	05-418M	2900099.99	737055.86	1612	359	326	-75	102	TRUE	TRUE
220	05-419C	2899100.47	736024.1	1607	606	327.8	-64.8	112	TRUE	TRUE
221	05-420C	2899912.72	734765.04	1593	1535	322.7	-65.2	242	TRUE	TRUE
222	05-421C	2899309.36	734422.94	1592	320	0	-90	69	TRUE	TRUE
223	05-422C	2899309.36	734426.23	1592	702	326	-65	153	TRUE	TRUE
224	05-423C	2899541.16	735312.57	1600	687	326	-65	151	TRUE	TRUE
225	05-424C	2900617.21	735553.57	1595	1087	322.8	-65.9	144	TRUE	TRUE
226	05-425M	2908574.61	740831.21	1618	784	0	-90	227	TRUE	TRUE
227	05-426M	2908574.61	740831.21	1618	439	326	-75	100	TRUE	TRUE
228	05-427C	2900334.8	735697.59	1595.5	1058	326.2	-66.4	137	TRUE	TRUE
229	05-428C	2899688.32	735696.72	1601.5	687	326	-65.9	147	TRUE	TRUE
230	05-429G	2899427.95	734088.38	1591	1420	330.5	-64.9	209	TRUE	TRUE
231	05-430G	2899421.37	734094.93	1591	599	147.4	-45.9	71	TRUE	TRUE
232	05-431C	2899686.66	736933.89	1605	487	323.1	-65.5	106	TRUE	TRUE
233	05-432C	2899559.05	736658.06	1605	517	325.4	-66.4	112	TRUE	TRUE
234	05-433M	2907620.4	740285.19	1630	729	0	-90	203	TRUE	TRUE
235	05-434C	2900778.34	735310.95	1593	729	317.9	-65.4	94	TRUE	TRUE
236	05-435C	2899753.05	736369.54	1605	687	329.2	-66.1	148	TRUE	TRUE
237	05-436C	2904687.65	739533.06	1607	388	331.8	-50.2	74	TRUE	TRUE
238	05-437C	2903333.5	738668.18	1610	659	181.1	-89.5	114	TRUE	TRUE
239	05-438C	2903333.5	738668.18	1610	617	332.7	-83.8	136	TRUE	TRUE
240	05-439G	2900670.79	734756.21	1593	598	142.7	-46.5	74	TRUE	TRUE
241	05-440G	2900670.78	734759.49	1593	649	323.2	-64.8	72	TRUE	TRUE
242	05-441C	2904635.34	739382.03	1606	578	329.8	-50	80	TRUE	TRUE
243	05-442C	2904382.87	739224.18	1606	468	323.9	-49.3	86	TRUE	TRUE
244	05-443G	2900317.16	736616.42	1609	848	148.5	-47.1	95	TRUE	TRUE
245	05-444C	2905442.28	739727.32	1611	528	358.8	-89.6	117	TRUE	TRUE
246	05-445C	2905441.15	739728.11	1611	478	327.5	-75.8	105	TRUE	TRUE
247	05-446C	2899787.68	737465.65	1607	154	326	-45	22	TRUE	TRUE
248	05-447G	2902793.07	737893	1604	499	167.9	-46	55	TRUE	TRUE
249	05-448C	2905444.15	739724.71	1611	528	76.3	-89	104	TRUE	TRUE
250	05-449C	2907654.4	739386.1	1603	1135.5	325.2	-63.5	117	TRUE	TRUE
251	05-450C	2907151.8	739785.8	1619	868	324.3	-63.5	119	TRUE	TRUE
252	05-451C	2907335.4	739877.9	1624	865	336.8	-65.1	132	TRUE	TRUE
253	05-452C	2907906.6	739773.6	1620	968	321.1	-65.1	100	TRUE	TRUE
254	05-453C	2908126	740144.8	1623	857	327	-64.6	116	TRUE	TRUE
255	05-454C	2908240.6	740279.5	1626	795	326.6	-64.6	116	TRUE	TRUE
256	05-455C	2907805.3	739448.6	1601	1148	327.6	-64.1	97	TRUE	TRUE
257	05-456C	2908680.6	740079.9	1600	1168.5	321.9	-63.1	126	TRUE	TRUE
258	05-457C	2907453.9	739648.3	1616	938	324.7	-64.5	125	TRUE	TRUE
259	05-458C	2908956	740293.5	1606	1065	325.7	-65.5	122	TRUE	TRUE

260	05-459C	2907657.2	739760.2	1620.5	929	334.3	-64.9	115	TRUE	TRUE	
261	05-460C	2908893.9	740126.1	1602	1085	327.7	-66	106	TRUE	TRUE	
262	05-461C	2907420.5	740081.5	1626	768	326.8	-66.3	115	TRUE	TRUE	
263	05-462C	2906714.9	740080.5	1619.5	508	326.5	-64.5	75	TRUE	TRUE	
264	05-463G	2908874.2	740122.8	1601	248	145.1	-45.2	28	TRUE	TRUE	
265	05-464C	2906987.4	739989	1622.5	576.5	329.7	-64.4	84	TRUE	TRUE	
266	05-465C	2909081	740080	1596	1128	324.2	-65	95	TRUE	TRUE	
267	05-466C	2907128.3	740202.5	1622.5	567	329.9	-64.5	81	TRUE	TRUE	
268	05-467C	2908277.7	739534.6	1597	1268	329.4	-64.8	109	TRUE	TRUE	
269	05-468C	2909162.2	740707.3	1600	953	340.9	-65	84	TRUE	TRUE	
270	05-469C	2906817.4	739568.7	1611.5	946.5	322.1	-65.4	130	TRUE	TRUE	
271	05-470C	2909073.8	740552.9	1610	959	325.3	-70	68	TRUE	TRUE	
272	05-471C	2908028.3	739517.8	1602	1213	322.1	-66	114	TRUE	TRUE	
273	05-472C	2907201.5	739395.3	1604	925	330.7	-64.9	116	TRUE	TRUE	
274	05-473G	2908657.2	740431	1610	1059	325.4	-64.3	157	TRUE	TRUE	
275	05-474G	2908676.9	740417.9	1610	548	146.7	-55.2	57	TRUE	TRUE	
276	05-475C	2908603.6	741195.5	1610	184	326	-45	17	TRUE	TRUE	
277	05-476C	2906125	739502.2	1613	837	321.5	-63.8	124	TRUE	TRUE	
278	05-477C	2906036.8	739259.2	1610	1007	332.2	-63.9	150	TRUE	TRUE	
279	05-478C	2908323.3	740115.5	1613	1068	331.6	-64.9	148	TRUE	TRUE	
280	05-479G	2906406.9	739801.2	1621.5	668	319.6	-63.4	105	TRUE	TRUE	
281	05-480G	2906403.6	739794.6	1621.5	708	150.8	-45	80	TRUE	TRUE	
282	05-481C	2905869.5	739160.5	1606.5	958	327.5	-65.4	123	TRUE	TRUE	
283	05-482C	2907988.4	739908.3	1622	908	322.6	-66.1	117	TRUE	TRUE	
284	05-483G	2906722.5	739322.5	1601	1104.5	322	-64.4	156	TRUE	TRUE	
285	05-484G	2906722.5	739322.5	1601	308	143	-45.7	38	TRUE	TRUE	
286	05-485C	2907077	739270.4	1599.5	1098	323.1	-64.3	143	TRUE	TRUE	
287	05-486C	2905649.6	739176.7	1609	658	324.6	-63.2	82	TRUE	TRUE	
288	05-487C	2905804.1	738989.8	1605.5	905.5	324.2	-65.1	108	TRUE	TRUE	
289	05-488G	2906404.1	739381.1	1616	1238	139	-64.5	91	TRUE	TRUE	
290	05-489C	2906259	739279.2	1611	1058	332.3	-64.7	145	TRUE	TRUE	
291	05-490C	2904959.7	739792.7	1609	218	322.9	-45	41	TRUE	TRUE	
292	05-491C	2905297.9	739661.9	1613	458	327.5	-45.3	81	TRUE	TRUE	
293	05-492C	2905269.2	738979.2	1605.5	804	337	-64.7	121	TRUE	TRUE	
294	05-493G	2904950.2	739497.3	1609	300	325.8	-63.5	29	TRUE	TRUE	
295	05-494G	2904960.1	739487.5	1609	299	139.9	-45.1	29	TRUE	TRUE	
296	05-495C	2906470.2	739023.5	1601	1208	334.1	-65.6	164	TRUE	TRUE	
297	05-496C	2905288.5	739323.8	1609.5	714.5	328.4	-64.8	89	TRUE	TRUE	
298	05-497C	2901432.9	736644.2	1613	768	337.1	-64.1	127	TRUE	TRUE	
299	05-498C	2901806	737386.3	1605	598	326.3	-65.5	93	TRUE	TRUE	
300	05-499C	2901859.6	736582.4	1618	908	325.6	-64.8	149	TRUE	TRUE	
301	05-500C	2901288.7	736470	1615	838	322.9	-64.3	131	TRUE	TRUE	
302	05-501C	2902082.2	736940.4	1608	818	328.8	-69.7	134	TRUE	TRUE	
303	05-502C	2901158.1	735974.3	1595.8	1009	323.9	-63.8	161	TRUE	TRUE	
304	05-503H	2905727.1	740138.3	1608.5	269	32.1	-89.7	50	TRUE	TRUE	
305	05-504H	2906173.4	740145.4	1607	279	230.3	-89.7	54	TRUE	TRUE	
306	05-505H	2906386.6	740250.7	1608	298	353.3	-88.8	59	TRUE	TRUE	
307	05-506H	2906675.3	740300.3	1617.5	329	320.6	-71.2	58	TRUE	TRUE	
308	05-507H	2907055.9	740333.7	1621	383.5	311	-65	70	TRUE	TRUE	
309	05-508H	2906813.2	740208.6	1621	458	325.1	-82.1	79	TRUE	TRUE	
310	05-509H	2906973.7	740428.7	1621	348.5	250.5	-88.6	67	TRUE	TRUE	
311	07-510C	2904354.274	736073.795	1609.5	409	326	-67	45	TRUE	TRUE	
312	07-511C	2904701.411	736605.881	1593.8	306	0	-90	33	TRUE	TRUE	
313	07-512C	2903378.809	736484.578	1608	289	326	-70	29	TRUE	TRUE	
314	07-513C	2900491.602	734749.934	1592.5	418	330	-60	43	TRUE	TRUE	
315	07-514C	2900915.506	734992.846	1595	398	326	-75	47	TRUE	TRUE	
316	07-515C	2900789.803	734901.012	1594	398	324	-75	46	TRUE	TRUE	
317	07-516C	2900076.022	734021.856	1593	514	328	-70	71	TRUE	TRUE	
318	07-517C	2900222.067	734112.414	1593.5	478	322	-68	59	TRUE	TRUE	
319	07-518C	2900339.954	734299.624	1593.5	518	0	-90	72	TRUE	TRUE	
320	07-519C	2900129.619	734532.337	1592.5	478	0	-90	61	TRUE	TRUE	
321	07-520C	2900093.732	734374.771	1592.5	498	337	-70	74	TRUE	TRUE	
322	07-521C	2899949.473	734276.129	1592.5	426.5	324	-68	56	TRUE	TRUE	
323	07-522C	2899202.281	733517.073	1591.5	399	323	-68	50	TRUE	TRUE	
324	07-523C	2899211.712	733825.558	1592.5	336	336	-70	44	TRUE	TRUE	
325	07-524C	2899755.998	734170.858	1592	448	326	-70	64	TRUE	TRUE	

326	07-525C	2899458.242	733520.698	1590	388	0	-90	42	TRUE	TRUE	
327	07-526C	2899917.343	733764.153	1598	438	0	-90	56	TRUE	TRUE	
328	07-527C	2899167.674	734852.647	1602.3	398	0	-90	60	TRUE	TRUE	
329	07-528C	2898824.156	734067.879	1604.25	198	0	-90	25	TRUE	TRUE	
330	07-529C	2898778.077	734169.547	1606	148	326	-75	20	TRUE	TRUE	
331	07-530C	2898971.551	734274.819	1598	188	328	-67	25	TRUE	TRUE	
332	07-531C	2899305.713	734695.314	1596	198	326	-70	28	TRUE	TRUE	
333	07-532C	2899049.787	734665.436	1599	548	328	-70	97	TRUE	TRUE	
334	07-533C	2898977.662	734612.834	1601	650	326	-81.5	117	TRUE	TRUE	
335	07-534C	2901132.811	735265.482	1593	298	328	-70	36	TRUE	TRUE	
336	07-535C	2899563.466	735811.41	1601.8	356	332	-60	65	TRUE	TRUE	
337	07-536C	2900413.756	735550.02	1595.5	198	322	-67	27	TRUE	TRUE	
338	07-537C	2900400.225	735851.911	1595.5	596.5	330	-70	72	TRUE	TRUE	
339	07-538C	2899071.844	735348.043	1605	256	326	-70	46	TRUE	TRUE	
340	07-539C	2898780.905	734507.558	1606.5	589	326	-75	100	TRUE	TRUE	
341	07-540C	2898274.96	734936.773	1607	596	334	-70	112	TRUE	TRUE	
342	07-541C	2899964.597	735234.383	1595.5	600	322	-67	72	TRUE	TRUE	
343	07-542C	2898075.446	734440.981	1614.5	398	324	-60	58	TRUE	TRUE	
344	07-543C	2897953.687	734693.502	1608	715	324	-60	136	TRUE	TRUE	
345	07-544C	2897963.976	734362.072	1613	478	334	-65	73	TRUE	TRUE	
346	07-545C	2898210.212	734277.08	1614	619	328	-60	96	TRUE	TRUE	
347	07-546C	2900134.845	735529.956	1595.5	148	0	-90	20	TRUE	TRUE	
348	07-547C	2898131.668	734116.175	1613	498	321	-70.5	81	TRUE	TRUE	
349	07-548C	2897737.202	734617.735	1607.75	366	328	-65	68	TRUE	TRUE	
350	07-549C	2898620.269	734385.923	1612	169	323	-60	28	TRUE	TRUE	
351	07-550C	2898446.647	734159.258	1613	239	326	-75	38	TRUE	TRUE	
352	07-551C	2897372.287	735106.208	1607.75	384	331	-53	68	TRUE	TRUE	
353	07-552C	2897553.514	734555.138	1609	734	326	-70	141	TRUE	TRUE	
354	07-553C	2897661.285	734945.796	1607.75	539	326	-57.5	103	TRUE	TRUE	
355	07-554C	2897590.259	734072.788	1609.5	358	326	-67	64	TRUE	TRUE	
356	07-555C	2897328.05	733832.878	1610	300.5	326	-68	43	TRUE	TRUE	
357	07-556C	2897189.417	734433.23	1610	200	0	-90	39	TRUE	TRUE	
358	07-557C	2903626.309	738110.7	1610	617	0	-90	78	TRUE	TRUE	
359	07-558C	2899994.101	732809.304	1582	768.5	326	-45	81	TRUE	TRUE	
360	07-559C	2897784.367	733705.507	1605	218	326	-70	42	TRUE	TRUE	
361	07-560C	2897944.955	733863.24	1609.5	228	326	-70	40	TRUE	TRUE	
362	07-561C	2898447.016	733883.602	1610	308	326	-70	44	TRUE	TRUE	
363	07-562C	2898578.193	733949.411	1607	388	326	-70	69	TRUE	TRUE	
364	07-563C	2898673.584	733782.126	1603.5	298	0	-90	39	TRUE	TRUE	
365	07-564C	2898578.536	733696.444	1603	336.5	0	-90	51	TRUE	TRUE	
366	07-565C	2898204.396	733719.196	1604	286.5	326	-70	46	TRUE	TRUE	
367	07-566C	2898093.006	733581.218	1598.5	548	326	-70	78	TRUE	TRUE	
368	07-567C	2897955.376	733433.361	1595.5	378	326	-70	49	TRUE	TRUE	
369	07-568C	2897702.581	733515.063	1603	308	326	-70	45	TRUE	TRUE	
370	07-569C	2898667.896	733129.125	1592	408	326	-70	55	TRUE	TRUE	
371	07-570C	2897969.193	732918.164	1597	337	326	-45	45	TRUE	TRUE	
372	WW-1	2907521.42	740678.85	1617	260	0	-90		FALSE	FALSE	Water wells, no samples
373	WW-2	2905287.54	740009.69	1615.8	200	0	-90		FALSE	FALSE	Water wells, no samples
374	B1-066	2918487.5	741777.19	1600	2344	0	-90		FALSE	FALSE	Far from NorthMet deposit
375	B1-125	2914485.25	743517.69	1596	981	0	-90		FALSE	FALSE	Far from NorthMet deposit
376	B1-167	2914260	743854.5	1596	831	0	-90		FALSE	FALSE	Far from NorthMet deposit
377	B1-188	2913512.5	744773.69	1618	611	0	-90		FALSE	FALSE	Far from NorthMet deposit
378	B1-190	2913213.5	745053.13	1606	156	0	-90		FALSE	FALSE	Far from NorthMet deposit
379	B1-198	2913584	744401.88	1619	691	0	-90		FALSE	FALSE	Far from NorthMet deposit
380	B1-199	2914259	742538.5	1602	1259	0	-90		FALSE	FALSE	Far from NorthMet deposit
381	B1-200	2913193.25	744665.88	1599.2	317	0	-90		FALSE	FALSE	Far from NorthMet deposit
382	B1-201	2912849.75	744451.06	1599.6	580	0	-90		FALSE	FALSE	Far from NorthMet deposit
383	B1-416	2913025	744192.31	1594.1	365	0	-90		FALSE	FALSE	Far from NorthMet deposit
384	B1-419	2913696.25	743971.13	1596.8	758	0	-90		FALSE	FALSE	Far from NorthMet deposit
385	BA-3	2907892.5	731555.38	1550	3588	0	-90		FALSE	FALSE	Far from NorthMet deposit
386	BA-4	2913644	737367.94	1553.5	2677	0	-90		FALSE	FALSE	Far from NorthMet deposit
387	BA-5	2919339.5	735882.25	1580	3647	315	-85		FALSE	FALSE	Far from NorthMet deposit
388	11550	2894005.75	733292.81	1628	449	315	-70		FALSE	FALSE	Far from NorthMet deposit
389	13620	2892778	733507.81	1670	646	0	-90		FALSE	FALSE	Far from NorthMet deposit
390	13623	2893205.25	733035.81	1680	920	0	-90		FALSE	FALSE	Far from NorthMet deposit
391	A4-11	2895110.51	730758.3	1610	2214	0	-90		FALSE	FALSE	Far from NorthMet deposit

392	25415	2889814.25	740064.38	1614	465	0	-90		FALSE	FALSE	Far from NorthMet deposit
393	25416	2897018.25	743493.13	1610	446	0	-90		FALSE	FALSE	Far from NorthMet deposit
394	25417	2901709.25	744382.94	1609	495	0	-90		FALSE	FALSE	Far from NorthMet deposit
395	25418	2906726.5	747208.69	1609	485	0	-90		FALSE	FALSE	Far from NorthMet deposit
396	25420	2904273.25	746125.81	1605	518	0	-90		FALSE	FALSE	Far from NorthMet deposit
397	25421	2905338.25	744409.81	1600	465	0	-90		FALSE	FALSE	Far from NorthMet deposit
398	MW-05-02	2906159.45	736152.35	1584	18	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
399	MW-05-08	2897834.29	733183.8	1594	28.5	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
400	MW-05-09	2898246.6	737488.85	1614	13	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
401	OB-1	2901816.12	738537.42	1610	100	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
402	OB-2	2906010.16	740142.01	1608.5	100	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
403	OB-3	2907630.39	740867.98	1615.5	100	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
404	OB-3A	2907633.74	740875.69	1615.5	50	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
405	OB-4	2908229.96	741354.89	1618.8	100	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
406	OB-5	2909540.13	741756.16	1609.3	100	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
407	P-1	2902073.6	738712.69	1612	600	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
408	P-2	2906265.69	740235.58	1606.3	600	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
409	P-3	2907699.21	740960.52	1615	612	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
410	P-4	2909394.53	741554.1	1607	600	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
411	P-4A	2909388.13	741534.6	1606	313	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
412	SB-05-01	2907937.25	738169.47	1594	19	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
413	SB-05-03	2899821.13	732754.34	1583.5	20.5	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
414	SB-05-04	2897032.53	734503.9	1611	20	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
415	SB-05-05	2908242.46	741359.11	1618.5	18	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
416	SB-05-06	2903506.21	739577.42	1604	16	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
417	SB-05-07	2906248.13	740213.78	1606	17	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
418	SB-05-10	2898273.2	738704.07	1606	14.5	0	-90		FALSE	FALSE	Hydro Geology holes (no Assays)
419	V06-01	2907933.067	737148.395	1589	7	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
420	V06-02	2908129.185	737729.502	1600	1.5	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
421	V06-03	2908513.176	737697.2	1600	1	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
422	V06-04	2908513.796	737234.495	1585	6	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
423	V06-05	2909041.732	737533.828	1582.5	18	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
424	V06-06	2909041.09	738012.941	1589	2	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
425	V06-07	2909056.905	738455.979	1592	5	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
426	V06-08	2909154.794	738872.873	1594	12	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
427	V06-09	2908803.102	741743.802	1610	13	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
428	V06-10	2908297.93	741598.736	1618	6	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
429	V06-100	2913005.316	740420.38	1604	1	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
430	V06-101	2912232.663	739073.892	1598	3	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
431	V06-102	2912313.885	739684.377	1606	1	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
432	V06-103	2898780.611	732279.336	1598	13	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
433	V06-104	2898766.767	732814.222	1590.5	25	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
434	V06-105	2899429.808	732700.254	1590	38	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
435	V06-106	2907576.273	741377.903	1618.5	3	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
436	V06-107	2907015.489	741101.499	1608	6	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
437	V06-108	2906970.433	740438.555	1621.5	4	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
438	V06-109	2910932.306	739705.498	1595.5	27	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
439	V06-11	2907832.456	738762.809	1599	6	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
440	V06-110	2908768.977	737818.962	1593	2	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
441	V06-111	2907647.834	739399.193	1603	17	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
442	V06-112	2911188.775	741779.81	1602	5	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
443	V06-113	2911871.279	741829.947	1586	3	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
444	V06-114	2911569.742	741553.89	1608	2	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
445	V06-115	2911934.244	741370.608	1591	4	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
446	V06-116	2911146.711	741333.457	1605	8	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
447	V06-117	2908673.815	737815.553	1595.5	5	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
448	V06-118	2906310.042	741028.36	1604	42	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
449	V06-119	2905614.839	740656.608	1603.5	35	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
450	V06-12	2909786.333	737774.383	1592	9	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
451	V06-120	2904958.514	740659.012	1603	27	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
452	V06-121	2904332.171	740326.732	1603	15	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
453	V06-122	2903646.803	739961.556	1603.5	12	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
454	V06-123	2903678.68	740663.864	1603	34	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
455	V06-124	2905817.251	738986.542	1605.5	7	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
456	V06-125	2902978.151	739366.69	1603	17	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
457	V06-126	2903006.798	740029.614	1615	19	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock

458	V06-127	2902917.396	740626.748	1607	9	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
459	V06-128	2902328.366	739385.511	1603	17	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
460	V06-129	2902330.77	740041.836	1607	8	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
461	V06-13	2909749.664	738200.942	1593	16	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
462	V06-130	2902277.465	740639.018	1612	5	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
463	V06-131	2901635.846	739460.061	1603	12	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
464	V06-132	2901651.46	740054.054	1602.5	17	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
465	V06-133	2901630.932	740680.815	1601	16	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
466	V06-134	2906561.491	737048.109	1590	6	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
467	V06-135	2906599.969	737720.89	1592	5	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
468	V06-136	2900980.508	738724.103	1604	17	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
469	V06-137	2901002.596	739383.737	1605.5	11	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
470	V06-138	2901064.139	739987.636	1605	9	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
471	V06-139	2900407.091	738076.857	1607.5	7	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
472	V06-14	2909728.682	739165.704	1594.5	27	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
473	V06-140	2900373.467	738680.629	1614.5	7	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
474	V06-141	2900395.582	739320.574	1607.5	8	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
475	V06-142	2900394.652	740016.276	1604.5	14	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
476	V06-143	2899668.79	738029.926	1607	10	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
477	V06-144	2899740.089	738699.472	1614	9	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
478	V06-145	2899745.797	739339.395	1607	7	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
479	V06-146	2897289.665	733091.179	1609	13	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
480	V06-15	2898346.993	732610.198	1600	30	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
481	V06-16	2910334.104	737965.45	1591	9	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
482	V06-17	2910399.002	738513.564	1597	2	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
483	V06-18	2910391.388	739297.856	1595.5	12	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
484	V06-19	2910354.412	739954.126	1603	2	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
485	V06-20	2901882.814	733927.588	1585	41	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
486	V06-21	2902348.362	734256.374	1599	36	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
487	V06-22	2903400.892	734904.263	1593	14	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
488	V06-23	2905971.59	736459.911	1590	8.5	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
489	V06-24	2905987.342	736948.891	1596.5	8	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
490	V06-25	2905242.999	736514.722	1600.5	16	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
491	V06-26	2904551.869	735552.284	1587	7.5	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
492	V06-27	2907179.44	738745.527	1602	14	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
493	V06-28	2907049.069	738079.186	1594	4	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
494	V06-29	2907646.601	737869.964	1593.5	20	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
495	V06-30	2911731.719	738223.288	1596	1	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
496	V06-31	2911780.019	738912.487	1598	1	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
497	V06-32	2911071.288	738842.624	1594	4.5	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
498	V06-33	2911003.206	738222.311	1585	6	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
499	V06-34	2904027.173	735282.488	1595	15	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
500	V06-35	2909928.745	741702.647	1606	20	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
501	V06-36	2910477.131	741434.29	1604	1	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
502	V06-37	2912981.45	738638.443	1586	3	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
503	V06-38	2912944.636	739173.294	1587	24	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
504	V06-39	2912963.543	739757.443	1589	16	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
505	V06-40	2913583.705	739800.934	1600	5.5	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
506	V06-41	2912961.789	741066.795	1589	18	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
507	V06-42	2912344.579	741269.428	1589	8	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
508	V06-43	2911810.216	740868.358	1592.5	18	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
509	V06-44	2895089.244	731933.096	1613	54	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
510	V06-45	2894295.038	731971.411	1613	8	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
511	V06-46	2894244.868	732676.895	1623	21	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
512	V06-47	2894296.688	733188.899	1627	20	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
513	V06-48	2895003.02	732605.715	1626	41	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
514	V06-49	2911463.207	740241.109	1594.5	34	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
515	V06-50	2910846.426	740122.146	1595	34	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
516	V06-51	2895650.319	731996.199	1617	29	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
517	V06-52	2912703.08	740666.095	1591	23	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
518	V06-53	2913427.376	738914.695	1585	7	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
519	V06-54	2912322.036	738499.733	1601	1	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
520	V06-55	2910130.363	740626.553	1597	11	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
521	V06-56	2909173.737	739430.77	1595	18	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
522	V06-57	2908668.872	739055.992	1594.5	6	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
523	V06-58	2897829.025	732215.708	1601	15	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock

524	V06-59	2897176.057	732159.045	1613	36	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
525	V06-60	2896414.972	731970.972	1627	43	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
526	V06-61	2896496.212	732568.337	1621	31	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
527	V06-62	2896771.283	733005.162	1614	59	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
528	V06-63	2897352.218	732940.308	1601	40	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
529	V06-64	2895038.186	733301.468	1627	42	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
530	V06-65	2895040.584	733961.079	1625	17	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
531	V06-66	2894289.061	733983.043	1627.5	15	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
532	V06-67	2894284.944	734606.548	1629.5	13	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
533	V06-68	2895757.697	732678.922	1625	43	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
534	V06-69	2895701.131	733259.695	1633	55	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
535	V06-70	2895664.171	733902.845	1625	28	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
536	V06-71	2896153.234	733828.022	1617	22	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
537	V06-72	2896411.436	734609.396	1617	19	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
538	V06-73	2895535.309	734558.998	1623	13	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
539	V06-74	2895036.353	734669.905	1625	10	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
540	V06-75	2896997.976	735259.943	1614	4	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
541	V06-76	2896364.57	735298.475	1629	53	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
542	V06-77	2895622.968	735264.665	1629.5	40	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
543	V06-78	2895002.728	735273.68	1641	18	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
544	V06-79	2896983.9	735968.756	1612	9	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
545	V06-80	2896344.05	735918.674	1631	21	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
546	V06-81	2895684.457	735907.947	1625.5	15	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
547	V06-82	2895031.423	735900.509	1637.5	21	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
548	V06-83	2894388.194	735922.62	1621	13	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
549	V06-84	2894346.495	735203.887	1637	27	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
550	V06-85	2896398.985	736555.383	1613	6	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
551	V06-86	2895690.151	736557.716	1627.5	11	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
552	V06-87	2895043.68	736550.288	1630	16	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
553	V06-88	2895669.456	737309.181	1614.5	4	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
554	V06-89	2896293.1	737208.285	1615	7	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
555	V06-90	2896936.306	737202.583	1612	5	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
556	V06-91	2896943.752	736542.986	1611	10	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
557	V06-92	2897554.08	736583.18	1609	7	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
558	V06-93	2897594.4	735880.969	1606	8	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
559	V06-94	2898224.545	735826.025	1608	6	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
560	V06-95	2897588.693	735241.045	1606.5	18	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
561	V06-96	2898243.312	736515.191	1606	23	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
562	V06-97	2897546.647	737232.934	1611.5	9	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
563	V06-98	2898091.545	737122.088	1621	30	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
564	V06-99	2913566.265	740572.085	1605	1	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
565	V07-01	2899023.216	737353.049	1605.75	23	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
566	V07-02	2898514.526	737381.902	1606.5	38	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
567	V07-03	2899061.652	738058.648	1607	8	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
568	V07-04	2898428.265	738084.054	1610	5	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
569	V07-05	2897726.034	738056.861	1614	14	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
570	V07-06	2897023.838	738003.416	1608	9	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
571	V07-07	2897661.553	734745.617	1608	7	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
572	V07-08	2902799.568	737942.231	1605	16	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
573	V07-09	2903297.397	738671.416	1609.5	5	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
574	V07-10	2907647.892	739356.532	1601.5	8	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
575	V07-11	2898325.744	738674.609	1609	6	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
576	V07-12	2899050.955	738695.268	1612.5	11	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
577	V07-13	2899069.666	739427.094	1604.5	14	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
578	V07-14	2899653.011	735109.264	1597	4	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
579	V07-15	2899259.379	734987.316	1602	10	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
580	V07-16	2898272.14	734592.199	1616	12	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
581	V07-17	2897007.687	732910.312	1609	17	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
582	V07-18	2896803.101	733750.134	1611.5	11	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
583	V07-19	2904145.848	734882.291	1583	6	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
584	V07-20	2903854.22	734557.02	1581.5	41	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
585	V07-21	2904165.973	734557.438	1586	9	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
586	V07-22	2903860.379	734858.937	1583.5	16	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
587	V07-23	2903561.752	734858.536	1587.5	25	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
588	V07-24	2903564.625	735163.73	1601	15	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
589	V07-25	2903563.864	735731.448	1609.5	20	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock

590	V07-26	2903580.668	735436.125	1608.5	32	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
591	V07-27	2903856.292	735459.466	1607	35	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
592	V07-28	2903853.415	735157.554	1594	10	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
593	V07-29	2904135.62	735167.777	1589.5	10	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
594	V07-30	2904450.676	735151.791	1582.5	15	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
595	V07-31	2904759.108	735181.739	1577	18	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
596	V07-32	2905031.525	735149.289	1564.5	8	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
597	V07-33	2904752.976	734860.133	1576	8	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
598	V07-34	2903855.522	736033.747	1608	32	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
599	V07-35	2903838.727	736322.507	1603	13	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
600	V07-36	2904755.474	735444.263	1575.5	20	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
601	V07-37	2904469.952	735460.289	1591	15	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
602	V07-38	2904158.209	735453.308	1598	17	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
603	V07-39	2904177.498	735751.96	1608.5	23	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
604	V07-40	2904459.76	735719.522	1591.5	13	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
605	V07-41	2904745.22	735749.439	1580.5	16	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
606	V07-42	2899722.026	732585.789	1576	18	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
607	V07-43	2899990.705	732894.622	1587	13	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
608	V07-44	2903861.277	736637.572	1596	24	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
609	V07-45	2904133.663	736628.092	1596	18	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
610	V07-46	2904170.148	736339.359	1609.5	12	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
611	V07-47	2904150.893	736014.453	1615	19	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
612	V07-48	2904761.21	736061.214	1590	18	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
613	V07-49	2899983.78	733163.706	1597	14	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
614	V07-50	2900229.866	733190.289	1582	22	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
615	V07-51	2899740.923	733176.507	1591	39	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
616	V07-52	2899692.958	732237.898	1572	15	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
617	V07-53	2900027.537	732346.641	1570	16	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
618	V07-54	2900263.519	732566.826	1576	22	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
619	V07-55	2900283.618	732261.662	1567	28	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
620	V07-56	2900598.2	732600.091	1570	13	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
621	V07-57	2896566.261	734169.865	1611.5	28	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
622	V07-58	2899400.806	732303.139	1583	27	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
623	V07-59	2899997.633	732622.257	1575	25	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
624	V07-60	2900289.336	732891.741	1576	33	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
625	V07-61	2900581.426	732872.443	1582	1	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
626	V07-62	2902636.969	739287.475	1603	21	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
627	V07-63	2900915.328	738386.009	1603.5	8	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
628	V07-64	2898144.963	731543.399	1595.5	32	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
629	V07-65	2899400.458	732562.387	1587	19	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
630	V07-66	2899403.269	732913.524	1590	30	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
631	V07-67	2899682.224	732900.772	1584.5	17	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
632	V07-68	2897878.8	731805.572	1596	20	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
633	V07-69	2897885.719	731539.77	1594	18	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
634	V07-70	2910974.336	737726.751	1586	4	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
635	V07-71	2907064.209	736576.231	1573.5	7	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
636	V07-72	2897863.144	731244.393	1596	17	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
637	V07-73	2897518.262	731476.926	1598	26	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
638	V07-74	2900265.564	733488.964	1591.5	16	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
639	V07-75	2912755.364	738382.176	1584	21	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
640	V07-76	2909507.987	737334.276	1577.5	10	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
641	V07-77	2905558.891	735875.231	1577.5	9	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
642	V07-78	2906684.21	740979.636	1605	36	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
643	V07-79	2906034.813	740709.676	1604.5	33	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
644	V07-80	2912829.814	741598.237	1586.5	42	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
645	V07-81	2913233.84	741306.716	1588	20	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
646	V07-82	2913621.243	741175.971	1585.5	19	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
647	V07-83	2905293.47	740485.535	1603.5	37	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
648	V07-84	2904735.844	740301.019	1603	17	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
649	V07-85	2903941.779	740237.606	1603.5	14	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
650	V07-86	2902533.106	740882.2	1601.5	6	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
651	V07-87	2902135.966	740930.893	1600	15	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
652	V07-88	2901240.75	740434.172	1601.5	4	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
653	V07-89	2900043.787	739815.628	1602	10	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
654	V07-90	2900889.955	740181.019	1601.5	8	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
655	V07-91	2898640.231	739085.232	1605.5	12	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock

656	V07-92	2897774.525	738604.957	1608	17	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
657	V07-93	2897344.897	738407.485	1609	18	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
658	V07-94	2896626.881	737914.281	1611.5	10	0	-90		FALSE	FALSE	Vertical Electrical Sounding....pseudo hole for Bedrock
659	TPG1	2895255.428	732812.796	1627	20	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
660	TPG10	2909310.071	738095.342	1590.5	8	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
661	TPG11	2910688.459	738008.586	1591.5	6	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
662	TPG12	2909910.256	738355.392	1600	5	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
663	TPG13	2909796.165	737784.241	1593	9	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
664	TPG14	2909274.607	737622.744	1581.5	3.5	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
665	TPG15	2907926.434	737200.892	1590.5	11.5	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
666	TPG2	2897279.798	733107.574	1610	13	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
667	TPG3	2897020.831	732897.203	1608.5	15	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
668	TPG4	2896257.107	734678.103	1619	13.5	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
669	TPG5	2895791.315	734529.806	1621.5	14	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
670	TPG6	2895633.107	735044.81	1626	20	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
671	TPG7	2907688.484	738450.864	1602	3.5	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
672	TPG8	2908447.108	738021.99	1600	4.5	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006
673	TPG9	2908811.673	737792.767	1590	8.5	0	-90		FALSE	FALSE	Golder Test Pit...depth to bedrock testpits done in 2006

APPENDIX B

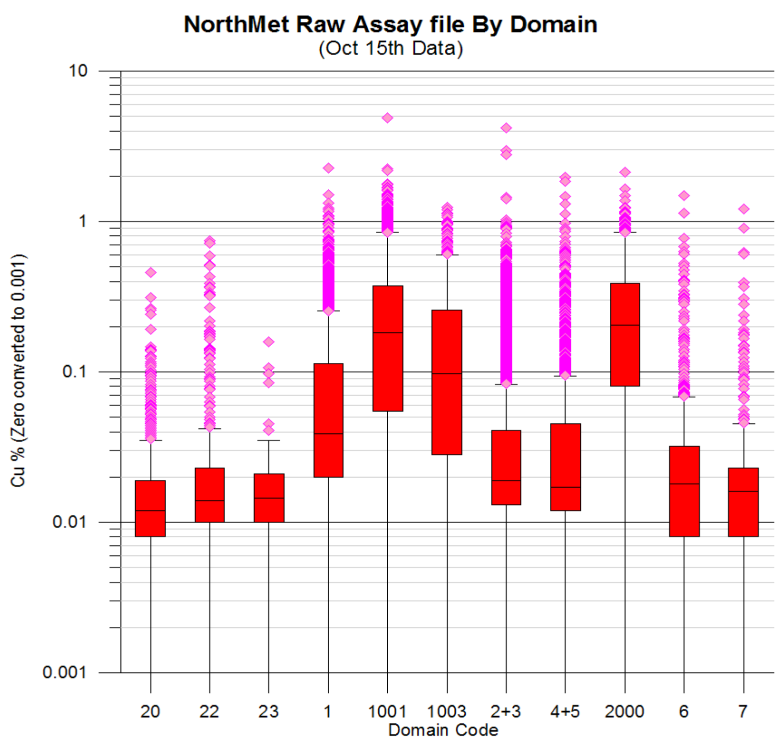
RAW ASSAY STATISTICS

Cu% -- NorthMet - Raw Assay file by Domain (Oct 15th data)

	20	22	23	1	1001	1003	2+3	4+5	2000	6	7
Number of values	1131	512	104	4822	14835	793	7026	2293	1903	884	459
Number of missing values	33,631.00	34,250.00	34,658.00	29,940.00	19,927.00	33,969.00	27,736.00	32,469.00	32,859.00	33,878.00	34,303.00
Sum	20.214	17.473	1.961	454.958	3,708.436	146.293	357.914	128.057	496.138	35.078	15.049
Minimum	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Maximum	0.457	0.744	0.159	2.280	4.890	1.250	4.170	1.960	2.130	1.488	1.210
Range	0.456	0.743	0.158	2.279	4.889	1.249	4.169	1.959	2.129	1.487	1.209
Mean	0.018	0.034	0.019	0.094	0.250	0.185	0.051	0.056	0.261	0.040	0.033
Median	0.012	0.014	0.015	0.039	0.182	0.098	0.019	0.017	0.205	0.018	0.016
First quartile	0.008	0.010	0.010	0.020	0.055	0.028	0.013	0.012	0.080	0.008	0.008
Third quartile	0.019	0.023	0.021	0.114	0.372	0.258	0.041	0.044	0.385	0.031	0.023
Standard error	0.001	0.003	0.002	0.002	0.002	0.008	0.001	0.003	0.005	0.003	0.004
95% confidence interval	0.002	0.007	0.004	0.004	0.004	0.015	0.003	0.005	0.011	0.006	0.008
99% confidence interval	0.002	0.009	0.005	0.005	0.005	0.020	0.004	0.007	0.014	0.008	0.011
Variance	0.001	0.006	0.000	0.019	0.059	0.048	0.014	0.015	0.056	0.009	0.008
Average deviation	0.012	0.034	0.010	0.087	0.187	0.163	0.052	0.061	0.183	0.039	0.033
Standard deviation	0.027	0.079	0.021	0.137	0.242	0.219	0.119	0.122	0.236	0.097	0.090
Coefficient of variation	1.525	2.306	1.110	1.449	0.969	1.187	2.331	2.191	0.907	2.437	2.740
Skew	7.750	5.633	4.534	3.993	1.909	1.915	14.133	6.677	1.533	7.902	8.634

Corrected Oct 26th data

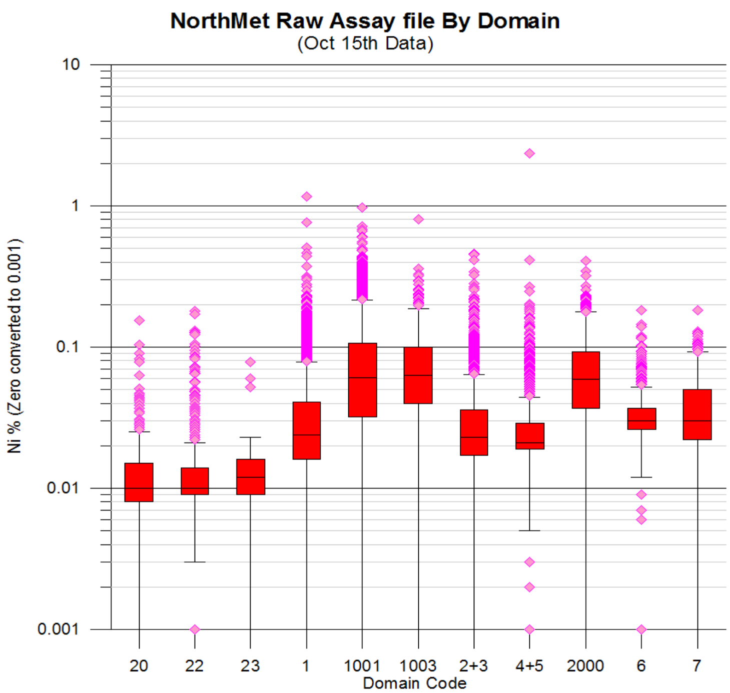
Note: Code 1, 2+3, 4+5, 6, 7 points are located outside the Magenta zone and Dom1 domain



Ni% -- NorthMet - Raw Assay file by Domain (Oct 15th data)											
	20	22	23	1	1001	1003	2+3	4+5	2000	6	7
Number of values	1131	512	104	4822	14835	793	7026	2293	1903	884	459
Number of missing values	33,631.00	34,250.00	34,658.00	29,940.00	19,927.00	33,969.00	27,736.00	32,469.00	32,859.00	33,878.00	34,303.00
Sum	13.222	8.383	1.412	167.893	1,139.537	59.747	207.042	65.238	132.123	28.823	17.437
Minimum	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Maximum	0.155	0.181	0.078	1.170	0.970	0.803	0.460	2.359	0.410	0.183	0.183
Range	0.154	0.180	0.077	1.169	0.969	0.802	0.459	2.358	0.409	0.182	0.182
Mean	0.012	0.016	0.014	0.035	0.077	0.075	0.029	0.028	0.069	0.033	0.038
Median	0.010	0.010	0.012	0.024	0.061	0.063	0.023	0.021	0.059	0.030	0.030
First quartile	0.008	0.009	0.009	0.016	0.032	0.040	0.017	0.019	0.037	0.026	0.022
Third quartile	0.015	0.014	0.016	0.041	0.106	0.099	0.036	0.029	0.092	0.037	0.050
Standard error	0.000	0.001	0.001	0.001	0.000	0.002	0.000	0.001	0.001	0.001	0.001
95% confidence interval	0.001	0.002	0.002	0.001	0.001	0.004	0.001	0.002	0.002	0.001	0.002
99% confidence interval	0.001	0.002	0.003	0.001	0.001	0.005	0.001	0.003	0.003	0.001	0.003
Variance	0.000	0.000	0.000	0.002	0.004	0.003	0.001	0.003	0.002	0.000	0.001
Average deviation	0.005	0.011	0.005	0.022	0.045	0.037	0.015	0.014	0.033	0.010	0.019
Standard deviation	0.009	0.020	0.010	0.039	0.059	0.055	0.024	0.054	0.043	0.016	0.026
Coefficient of variation	0.804	1.233	0.719	1.125	0.773	0.730	0.819	1.894	0.614	0.499	0.677
Skew	5.716	4.363	4.413	8.863	1.995	4.098	5.387	35.764	1.490	2.693	1.404

Corrected Oct 26th data

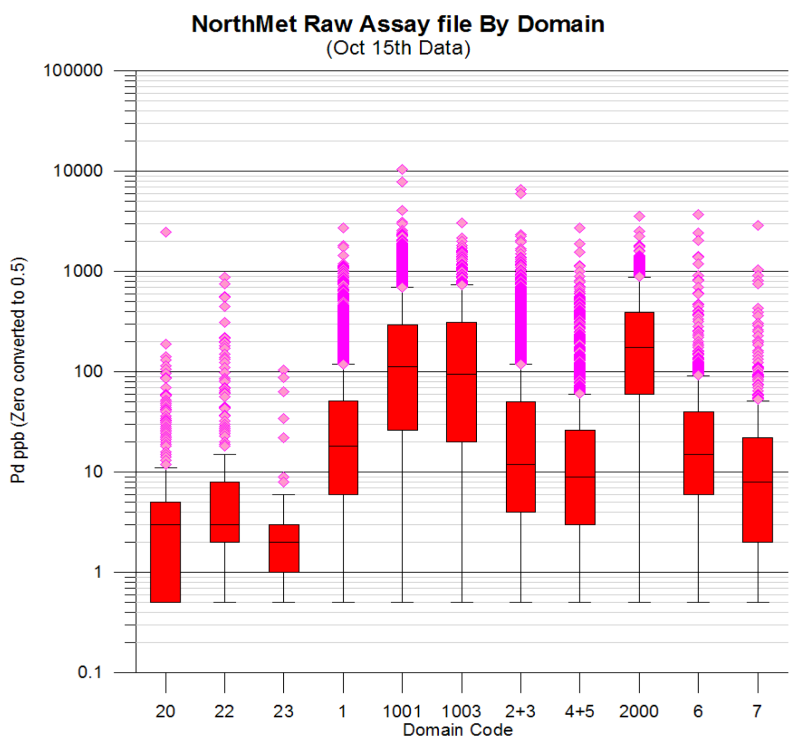
Note: Code 1, 2+3, 4+5, 6, 7 points are located outside the Magenta zone and Dom1 domain



Pd (ppb) -- NorthMet - Raw Assay file by Domain (Oct 15th data)	20	22	23	1	1001	1003	2+3	4+5	2000	6	7
Number of values	1131	512	104	4822	14835	793	7026	2293	1903	884	459
Number of missing values	33,631	34,250	34,658	29,940	19,927	33,969	27,736	32,469	32,859	33,878	34,303
Sum	8,923.5	9,652.0	526.0	270,243.5	3,137,356.5	180,564.5	402,948.0	87,899.5	514,621.5	46,907.0	17,425.5
Minimum	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum	2,453.0	868.0	104.0	2,710.0	10,386.0	3,040.0	6,610.0	2,690.0	3,540.0	3,680.0	2,860.0
Range	2,452.5	867.5	103.5	2,709.5	10,385.5	3,039.5	6,609.5	2,689.5	3,539.5	3,679.5	2,859.5
Mean	7.9	18.9	5.1	56.0	211.5	227.7	57.4	38.3	270.4	53.1	38.0
Median	3.0	3.0	2.0	18.0	112.0	94.0	12.0	9.0	174.0	15.0	8.0
First quartile	0.5	2.0	1.0	6.0	26.0	20.0	4.0	3.0	60.0	6.0	2.0
Third quartile	5.0	8.0	3.0	51.0	291.0	304.0	50.0	26.0	389.0	40.0	22.0
Standard error	2.2	3.3	1.4	1.8	2.4	11.6	2.2	2.5	6.8	6.6	7.6
95% confidence interval	4.3	6.4	2.9	3.6	4.7	22.7	4.2	4.9	13.4	13.0	14.9
99% confidence interval	5.7	8.5	3.8	4.7	6.1	29.9	5.6	6.4	17.6	17.1	19.6
Variance	5,480.4	5,494.0	216.7	16,359.0	83,709.6	106,230.0	32,745.0	14,271.0	88,917.0	38,629.0	26,310.0
Average deviation	9.4	26.3	5.8	61.9	192.4	221.5	68.9	47.6	216.1	61.8	48.4
Standard deviation	74.0	74.1	14.7	127.9	289.3	325.9	181.0	119.5	298.2	196.5	162.2
Coefficient of variation	9.4	3.9	2.9	2.3	1.4	1.4	3.2	3.1	1.1	3.7	4.3
Skew	32.0	7.6	5.5	6.8	6.3	2.9	19.3	10.0	2.5	11.7	12.9

Corrected Oct 26th data

Note: Code 1, 2+3, 4+5, 6, 7 points are located outside the Magenta zone and Dom1 domain

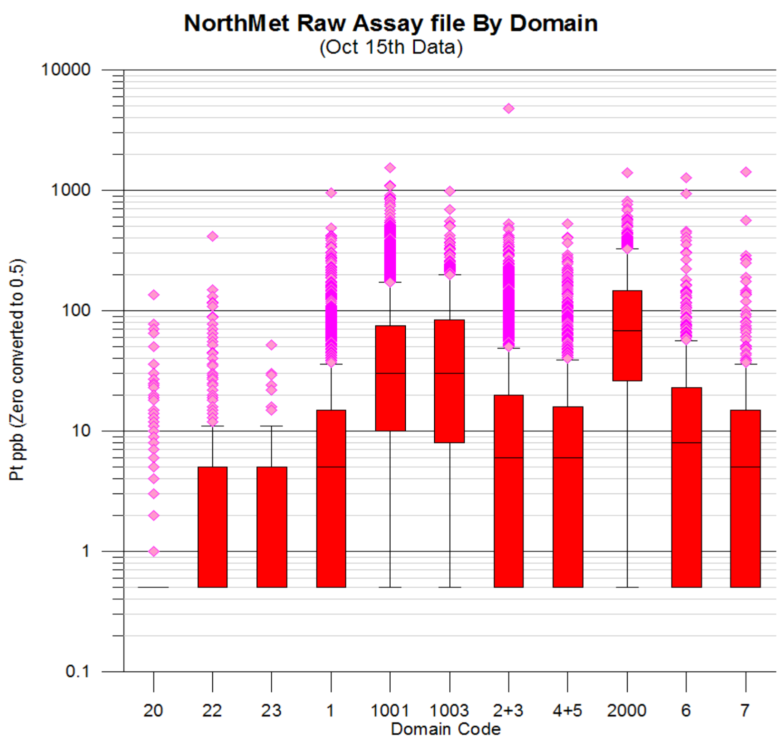


Pt (ppb) -- NorthMet - Raw Assay file by Domain (Oct 15th data)

	20	22	23	1	1001	1003	2+3	4+5	2000	6	7
Number of values	1131	512	104	4822	14835	793	7026	2293	1903	884	459
Number of missing values	33,631	34,250	34,658	29,940	19,927	33,969	27,736	32,469	32,859	33,878	34,303
Sum	2,635.5	3,291.0	376.0	77,372.5	806,785.5	49,069.0	135,309.0	37,284.0	192,654.5	20,056.5	8,876.0
Minimum	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum	135.0	412.0	52.0	953.0	1,535.0	987.0	4,780.0	525.0	1,390.0	1,270.0	1,430.0
Range	134.5	411.5	51.5	952.5	1,534.5	986.5	4,779.5	524.5	1,389.5	1,269.5	1,429.5
Mean	2.3	6.4	3.6	16.1	54.4	61.9	19.3	16.3	101.2	22.7	19.3
Median	0.5	0.5	0.5	5.0	30.0	30.0	6.0	6.0	68.0	8.0	5.0
First quartile	0.5	0.5	0.5	0.5	10.0	8.0	0.5	0.5	26.0	0.5	0.5
Third quartile	0.5	5.0	2.8	15.0	75.0	84.0	20.0	16.0	146.0	23.0	15.0
Standard error	0.2	1.1	0.8	0.5	0.6	3.1	0.8	0.7	2.5	2.3	3.7
95% confidence interval	0.4	2.1	1.5	1.0	1.2	6.2	1.6	1.4	4.8	4.5	7.2
99% confidence interval	0.5	2.7	2.0	1.3	1.5	8.1	2.1	1.9	6.3	5.9	9.5
Variance	44.7	577.1	59.7	1,293.0	5,196.2	7,800.0	4,580.0	1,246.0	11,550.0	4,628.0	6,132.0
Average deviation	2.9	8.6	4.7	17.5	48.2	58.8	21.8	17.9	77.9	24.4	23.4
Standard deviation	6.7	24.0	7.7	36.0	72.1	88.3	67.7	35.3	107.5	68.0	78.3
Coefficient of variation	2.9	3.7	2.1	2.2	1.3	1.4	3.5	2.2	1.1	3.0	4.0
Skew	10.8	11.0	3.7	8.3	4.0	3.6	50.4	5.8	2.6	11.4	13.9

Corrected Oct 26th data

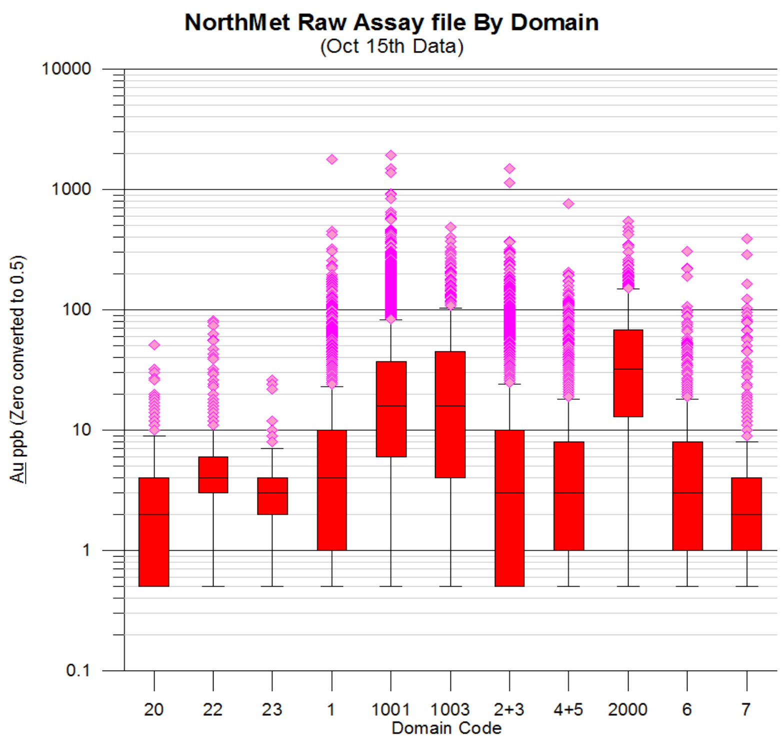
Note: Code 1, 2+3, 4+5, 6, 7 points are located outside the Magenta zone and Dom1 domain



Au (ppb) -- NorthMet - Raw Assay file by Domain (Oct 15th data)	20	22	23	1	1001	1003	2+3	4+5	2000	6	7
Number of values	1131	512	104	4822	14835	793	7026	2293	1903	884	459
Number of missing values	33,631	34,250	34,658	29,940	19,927	33,969	27,736	32,469	32,859	33,878	34,303
Sum	3,299.5	3,089.5	409.0	48,999.0	425,271.0	27,101.0	74,633.0	20,729.5	88,687.0	7,710.5	3,694.5
Minimum	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum	51.0	81.0	26.0	1,775.0	1,926.0	488.0	1,490.0	760.0	545.0	306.0	388.0
Range	50.5	80.5	25.5	1,774.5	1,925.5	487.5	1,489.5	759.5	544.5	305.5	387.5
Mean	2.9	6.0	3.9	10.2	28.7	34.2	10.6	9.0	46.6	8.7	8.0
Median	2.0	4.0	3.0	4.0	16.0	16.0	3.0	3.0	32.0	3.0	2.0
First quartile	0.5	3.0	2.0	1.0	6.0	4.0	0.5	1.0	13.0	1.0	1.0
Third quartile	4.0	6.0	4.0	10.0	37.0	45.0	10.0	8.0	68.0	8.0	4.0
Standard error	0.1	0.4	0.4	0.5	0.4	1.8	0.4	0.5	1.1	0.7	1.3
95% confidence interval	0.2	0.8	0.8	0.9	0.8	3.6	0.7	1.0	2.2	1.4	2.5
99% confidence interval	0.3	1.0	1.1	1.2	1.0	4.7	1.0	1.3	2.9	1.8	3.3
Variance	12.9	79.1	17.5	1,117.2	2,192.9	2,639.0	1,022.4	600.5	2,389.0	423.1	747.2
Average deviation	2.2	4.1	2.4	10.5	24.6	32.7	12.0	9.8	35.1	9.6	10.0
Standard deviation	3.6	8.9	4.2	33.4	46.8	51.4	32.0	24.5	48.9	20.6	27.3
Coefficient of variation	1.2	1.5	1.1	3.3	1.6	1.5	3.0	2.7	1.0	2.4	3.4
Skew	4.6	5.2	3.4	32.8	12.3	3.6	22.7	15.0	2.8	7.7	9.3

Corrected Oct 26th data

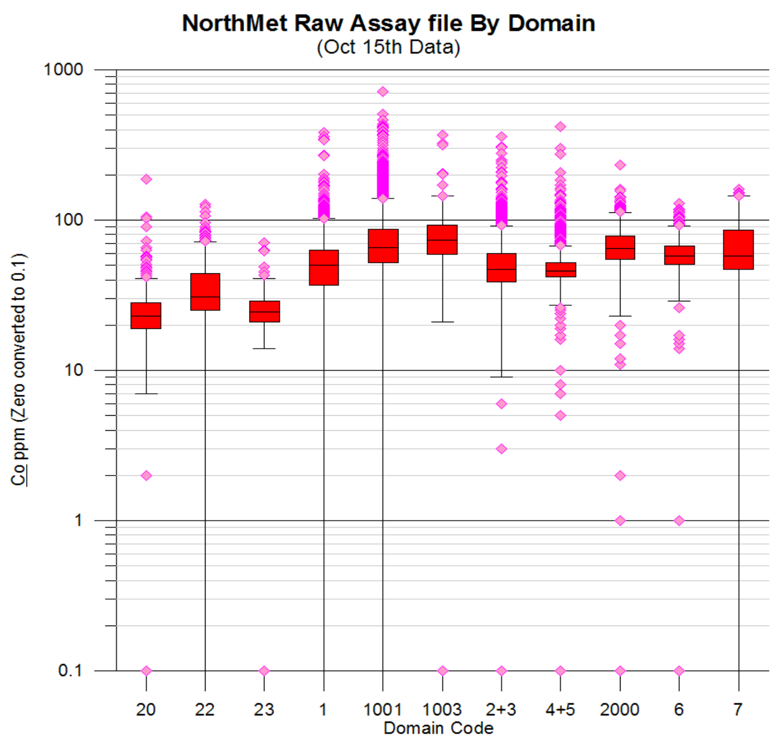
Note: Code 1, 2+3, 4+5, 6, 7 points are located outside the Magenta zone and Dom1 domain



Co (ppm) -- NorthMet - Raw Assay file by Domain (Oct 15th data)											
	20	22	23	1	1001	1003	2+3	4+5	2000	6	7
Number of values	1131	512	104	4822	14835	793	7026	2293	1903	884	459
Number of missing values	33,631	34,250	34,658	29,940	19,927	33,969	27,736	32,469	32,859	33,878	34,303
Sum	25,434.8	18,170.4	2,677.3	246,716.0	1,071,660.0	61,060.5	354,864.3	110,617.5	127,190.1	50,783.5	29,629.9
Minimum	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Maximum	188.00	128.00	71.00	385.00	713.00	367.00	361.00	421.00	232.00	129.00	160.00
Range	187.90	127.90	70.90	384.90	712.90	366.90	360.90	420.90	231.90	128.90	159.90
Mean	22.49	35.49	25.70	51.16	72.24	77.00	50.51	48.24	66.84	57.45	64.55
Median	23.00	31.00	24.50	50.00	66.00	74.00	47.00	46.00	65.00	58.00	58.00
First quartile	19.00	25.00	21.00	37.00	52.00	59.00	39.00	42.00	55.00	51.00	47.00
Third quartile	28.00	44.00	29.00	63.00	87.00	93.00	60.00	52.00	78.00	67.00	86.00
Standard error	0.38	0.73	1.02	0.36	0.28	1.12	0.25	0.45	0.45	0.63	1.62
95% confidence interval	0.74	1.43	2.02	0.70	0.54	2.20	0.49	0.88	0.89	1.24	3.19
99% confidence interval	0.98	1.88	2.67	0.92	0.72	2.90	0.64	1.15	1.16	1.63	4.19
Variance	163.50	270.80	108.00	620.70	1,144.00	997.60	437.80	460.50	389.20	352.30	1,205.00
Average deviation	8.22	12.18	6.72	17.18	23.44	22.02	14.44	11.29	14.72	12.31	26.71
Standard deviation	12.79	16.46	10.40	24.91	33.83	31.59	20.92	21.46	19.73	18.77	34.72
Coefficient of variation	0.57	0.46	0.40	0.49	0.47	0.41	0.41	0.44	0.30	0.33	0.54
Skew	2.29	1.68	1.46	2.37	2.77	2.20	2.30	4.25	0.76	(0.91)	0.35

Corrected Oct 26th data

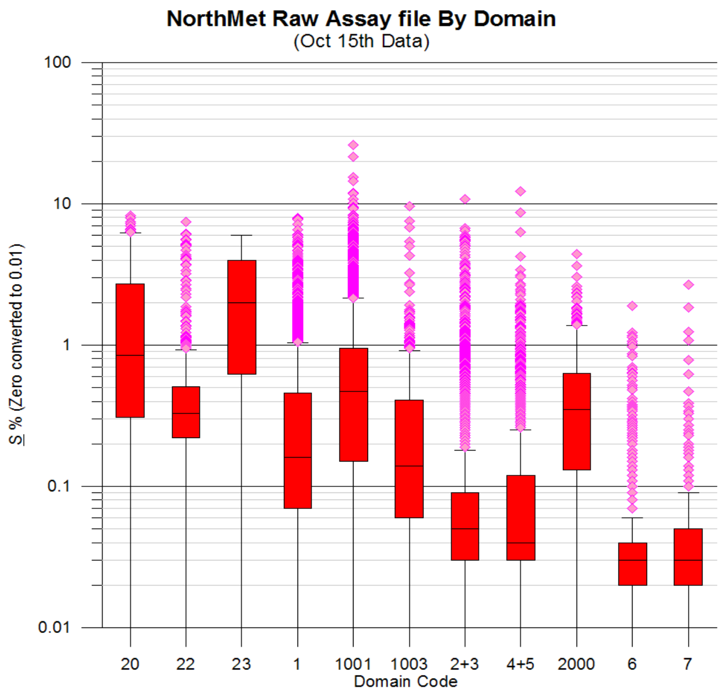
Note: Code 1, 2+3, 4+5, 6, 7 points are located outside the Magenta zone and Dom1 domain



S% -- NorthMet - Raw Assay file by Domain (Oct 15th data)											
	20	22	23	1	1001	1003	2+3	4+5	2000	6	7
Number of values	1131	512	104	4822	14835	793	7026	2293	1903	884	459
Number of missing values	33,631.00	34,250.00	34,658.00	29,940.00	19,927.00	33,969.00	27,736.00	32,469.00	32,859.00	33,878.00	34,303.00
Sum	1,841.110	309.020	237.200	2,018.430	9,974.240	271.300	959.270	378.980	813.300	51.900	28.180
Minimum	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Maximum	8.290	7.440	6.010	7.990	26.100	9.660	10.800	12.220	4.410	1.900	2.670
Range	8.280	7.430	6.000	7.980	26.090	9.650	10.790	12.210	4.400	1.890	2.660
Mean	1.628	0.604	2.281	0.419	0.672	0.342	0.137	0.165	0.427	0.059	0.061
Median	0.850	0.330	1.985	0.160	0.470	0.140	0.050	0.040	0.350	0.030	0.030
First quartile	0.310	0.220	0.630	0.070	0.150	0.060	0.030	0.030	0.130	0.020	0.020
Third quartile	2.710	0.510	3.970	0.460	0.950	0.410	0.090	0.120	0.620	0.040	0.050
Standard error	0.050	0.043	0.177	0.010	0.007	0.024	0.005	0.010	0.009	0.005	0.008
95% confidence interval	0.098	0.085	0.352	0.020	0.013	0.047	0.009	0.019	0.017	0.009	0.016
99% confidence interval	0.129	0.111	0.465	0.026	0.017	0.062	0.012	0.025	0.023	0.012	0.022
Variance	2.859	0.948	3.268	0.498	0.684	0.456	0.164	0.222	0.151	0.019	0.032
Average deviation	1.412	0.508	1.589	0.410	0.514	0.328	0.152	0.194	0.290	0.058	0.058
Standard deviation	1.691	0.974	1.808	0.706	0.827	0.676	0.405	0.471	0.388	0.139	0.180
Coefficient of variation	1.039	1.613	0.793	1.686	1.230	1.975	2.965	2.852	0.908	2.366	2.926
Skew	1.091	3.960	0.474	4.310	6.777	7.613	10.291	12.523	2.181	6.819	10.173

Corrected Oct 26th data

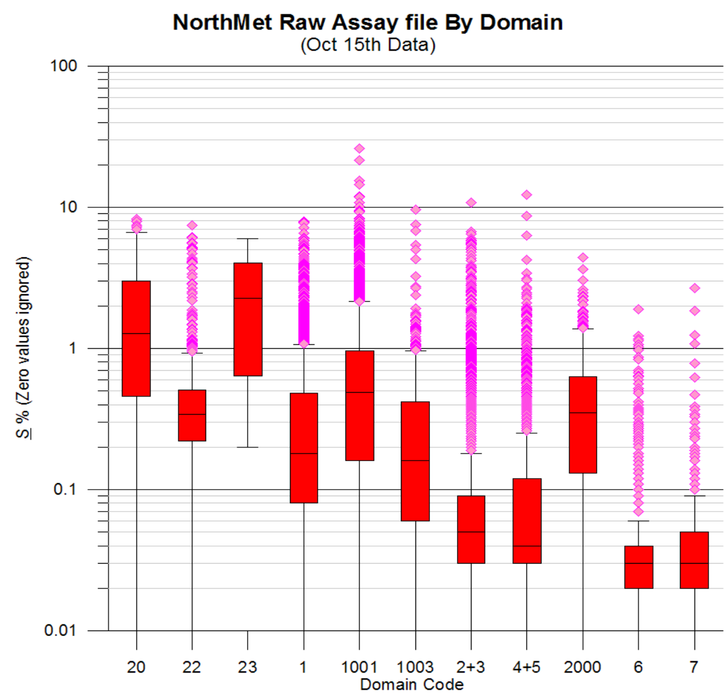
Note: Code 1, 2+3, 4+5, 6, 7 points are located outside the Magenta zone and Dom1 domain



S% -- NorthMet - Raw Assay file by Domain (Oct 15th data - Zero values ignored)											
	20	22	23	1	1001	1003	2+3	4+5	2000	6	7
Number of values	982	509	101	4634	14519	753	6792	2189	1894	843	427
Number of missing values	32,664.00	33,137.00	33,545.00	29,012.00	19,127.00	32,893.00	26,854.00	31,457.00	31,752.00	32,803.00	33,219.00
Sum	1,839.620	308.990	237.170	2,016.550	9,971.080	270.900	956.930	377.940	813.210	51.490	27.860
Minimum	0.010	0.010	0.200	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Maximum	8.290	7.440	6.010	7.990	26.100	9.660	10.800	12.220	4.410	1.900	2.670
Range	8.280	7.430	5.810	7.980	26.090	9.650	10.790	12.210	4.400	1.890	2.660
Mean	1.873	0.607	2.348	0.435	0.687	0.360	0.141	0.173	0.429	0.061	0.065
Median	1.270	0.340	2.260	0.180	0.490	0.160	0.050	0.040	0.350	0.030	0.030
First quartile	0.460	0.220	0.640	0.080	0.160	0.060	0.030	0.030	0.130	0.020	0.020
Third quartile	3.020	0.510	4.002	0.480	0.960	0.420	0.090	0.120	0.630	0.040	0.050
Standard error	0.054	0.043	0.178	0.011	0.007	0.025	0.005	0.010	0.009	0.005	0.009
95% confidence interval	0.105	0.085	0.354	0.021	0.013	0.049	0.010	0.020	0.017	0.010	0.018
99% confidence interval	0.139	0.112	0.468	0.027	0.018	0.065	0.013	0.026	0.023	0.013	0.023
Variance	2.835	0.952	3.207	0.511	0.689	0.475	0.169	0.232	0.150	0.020	0.034
Average deviation	1.416	0.510	1.571	0.418	0.514	0.335	0.155	0.201	0.290	0.060	0.061
Standard deviation	1.684	0.976	1.791	0.715	0.830	0.689	0.411	0.481	0.388	0.142	0.186
Coefficient of variation	0.899	1.607	0.763	1.643	1.208	1.915	2.917	2.787	0.903	2.322	2.846
Skew	0.966	3.952	0.449	4.251	6.806	7.494	10.138	12.287	2.185	6.672	9.844

Corrected Oct 26th data

Note: Code 1, 2+3, 4+5, 6, 7 points are located outside the Magenta zone and Dom1 domain



NorthMet - Raw Assay file by Unit -- Mean Grade

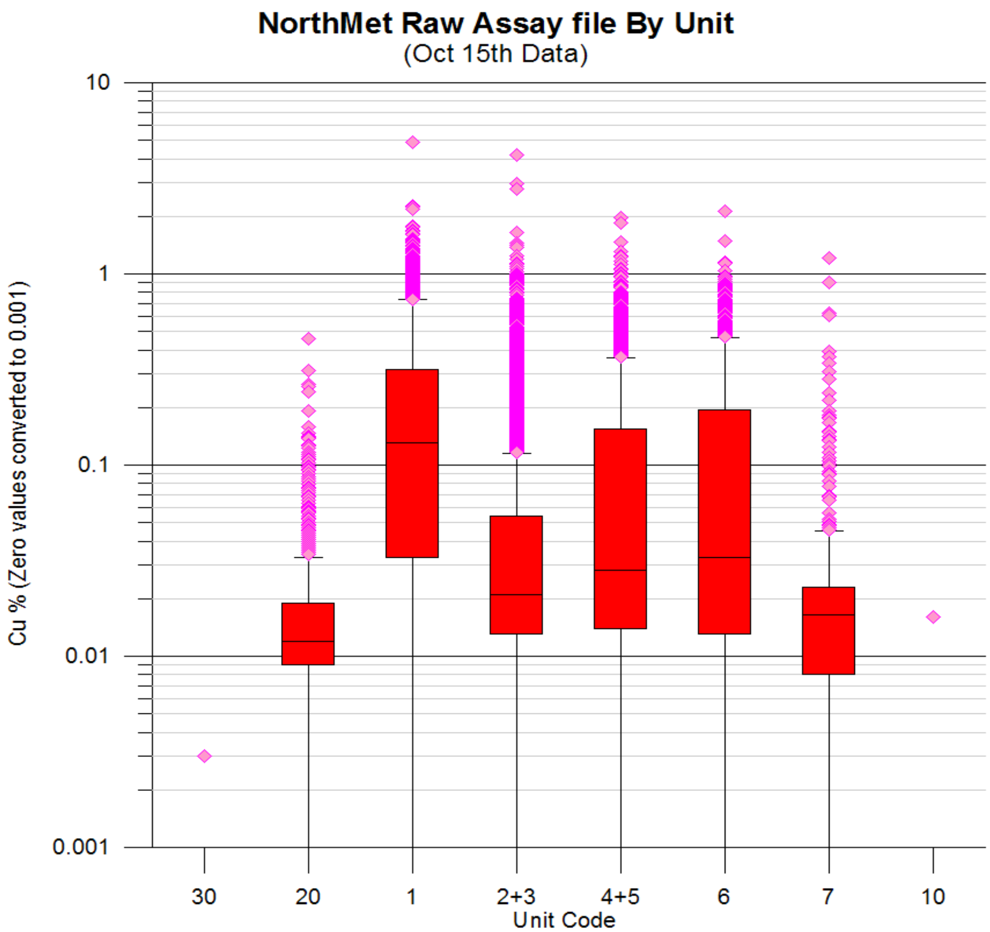
Unit code	30 (BIF)	20 (VF)	1	2+3 (3)	4+5 (5)	6	7	10 (Ovb)
Cu	0.001	0.017	0.211	0.067	0.118	0.142	0.033	0.001
Ni	0.001	0.012	0.066	0.034	0.040	0.051	0.038	0.001
Pd	0.5	7.2	172.2	76.3	112.8	147.0	39.0	0.6
Pt	0.5	2.2	44.7	24.3	42.7	59.1	19.6	0.6
Au	0.5	3.1	24.0	13.4	21.3	24.7	8.2	0.5
Co	0.22	23.18	66.86	52.83	53.51	63.62	64.55	0.23
S	0.02	1.54	0.61	0.17	0.25	0.22	0.06	0.01
S (no zeros)	0.24	1.74	0.63	0.18	0.26	0.23	0.07	0.03

NorthMet - Raw Assay file by Unit -- First Quartile

	30 (BIF)	20 (VF)	1	2+3 (3)	4+5 (5)	6	7	10 (Ovb)
Cu	0.001	0.009	0.033	0.013	0.014	0.013	0.008	0.001
Ni	0.001	0.008	0.025	0.017	0.020	0.028	0.022	0.001
Pd	0.5	0.5	15.0	4.0	4.0	10.0	2.0	0.5
Pt	0.5	0.5	5.0	0.5	0.5	6.0	0.5	0.5
Au	0.5	0.5	4.0	1.0	2.0	2.0	1.0	0.5
Co	0.10	19.00	48.00	40.00	44.00	54.00	47.00	0.10
S	0.01	0.30	0.11	0.03	0.03	0.02	0.02	0.01
S (no zeros)	#N/A	0.40	0.12	0.03	0.03	0.02	0.02	#N/A

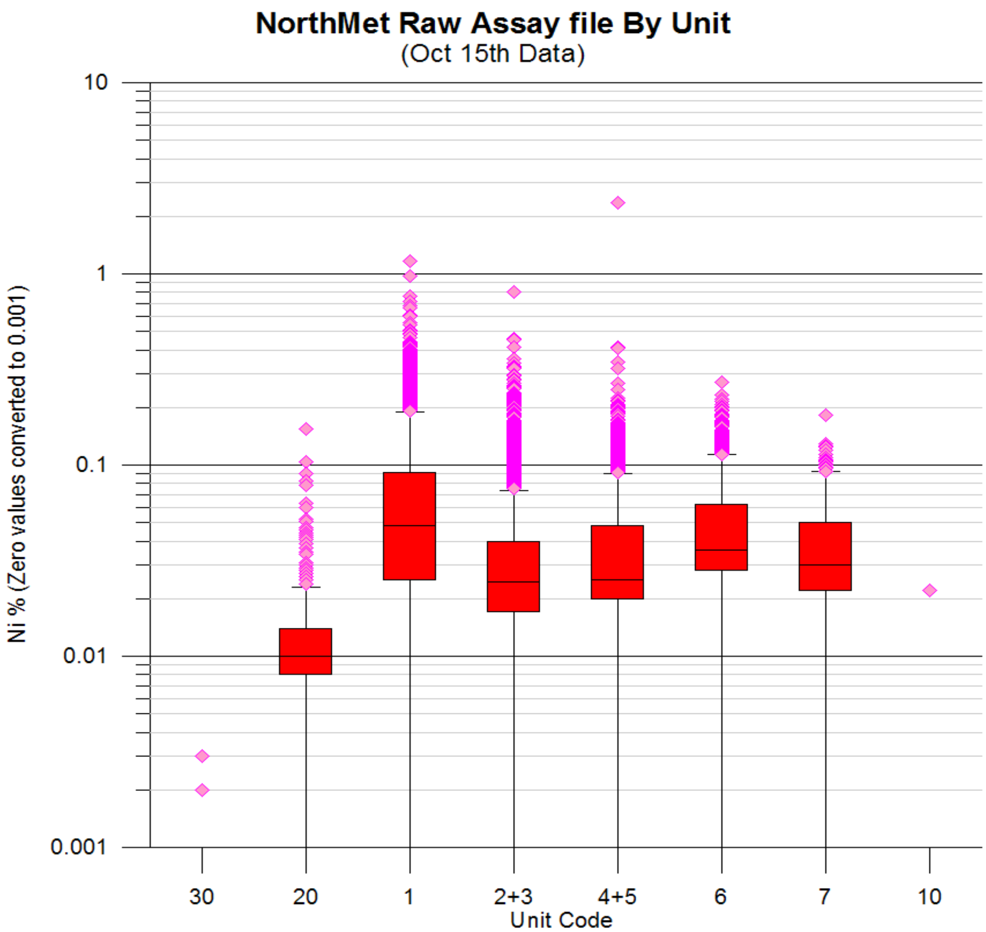
Cu% -- NorthMet - Raw Assay file by Unit (Oct 15th data)								
	30	20	1	2+3	4+5	6	7	10
Number of values	76	1370	19819	8164	3351	1596	462	365
Number of missing values	35,127.00	33,833.00	15,384.00	27,039.00	31,852.00	33,607.00	34,741.00	34,838.00
Sum	0.078	23.687	4,173.204	548.278	394.367	226.597	15.438	0.380
Minimum	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Maximum	0.003	0.457	4.890	4.170	1.960	2.130	1.210	0.016
Range	0.002	0.456	4.889	4.169	1.959	2.129	1.209	0.015
Mean	0.001	0.017	0.211	0.067	0.118	0.142	0.033	0.001
Median	0.001	0.012	0.130	0.021	0.028	0.033	0.017	0.001
First quartile	0.001	0.009	0.033	0.013	0.014	0.013	0.008	0.001
Third quartile	0.001	0.019	0.315	0.054	0.155	0.195	0.023	0.001
Standard error	0.000	0.001	0.002	0.002	0.003	0.005	0.004	0.000
95% confidence interval	0.000	0.001	0.003	0.003	0.006	0.011	0.008	0.000
99% confidence interval	0.000	0.002	0.004	0.004	0.008	0.014	0.011	0.000
Variance	0.000	0.001	0.053	0.021	0.033	0.047	0.008	0.000
Average deviation	0.000	0.011	0.175	0.073	0.127	0.156	0.034	0.000
Standard deviation	0.000	0.026	0.231	0.144	0.182	0.216	0.091	0.001
Coefficient of variation	0.224	1.476	1.095	2.146	1.543	1.523	2.714	0.754
Skew	8.718	8.047	2.122	8.518	2.783	2.487	8.399	19.105

After Oct 26th corrections



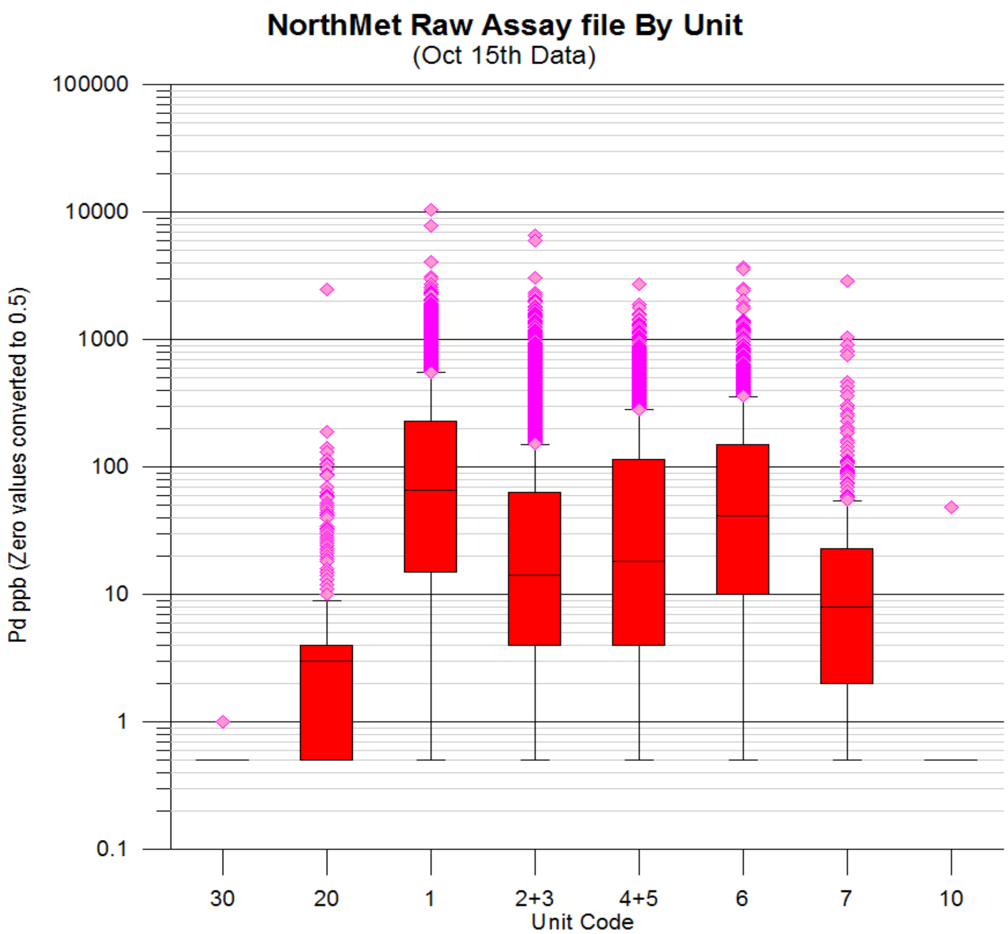
Ni% -- NorthMet - Raw Assay file by Unit (Oct 15th data)								
	30	20	1	2+3	4+5	6	7	10
Number of values	76	1370	19819	8164	3351	1596	462	365
Number of missing values	35,127.00	33,833.00	15,384.00	27,039.00	31,852.00	33,607.00	34,741.00	34,838.00
Sum	0.079	15.916	1,311.222	279.396	135.309	81.421	17.593	0.386
Minimum	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Maximum	0.003	0.155	1.170	0.803	2.359	0.270	0.183	0.022
Range	0.002	0.154	1.169	0.802	2.358	0.269	0.182	0.021
Mean	0.001	0.012	0.066	0.034	0.040	0.051	0.038	0.001
Median	0.001	0.010	0.048	0.024	0.025	0.036	0.030	0.001
First quartile	0.001	0.008	0.025	0.017	0.020	0.028	0.022	0.001
Third quartile	0.001	0.014	0.091	0.040	0.048	0.062	0.050	0.001
Standard error	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000
95% confidence interval	0.000	0.000	0.001	0.001	0.002	0.002	0.002	0.000
99% confidence interval	0.000	0.001	0.001	0.001	0.002	0.002	0.003	0.000
Variance	0.000	0.000	0.003	0.001	0.003	0.001	0.001	0.000
Average deviation	0.000	0.005	0.043	0.020	0.025	0.027	0.019	0.000
Standard deviation	0.000	0.009	0.058	0.033	0.053	0.037	0.026	0.001
Coefficient of variation	0.245	0.777	0.875	0.950	1.319	0.726	0.678	1.039
Skew	6.941	5.814	2.487	5.084	25.426	1.778	1.377	19.105

After Oct 26th corrections



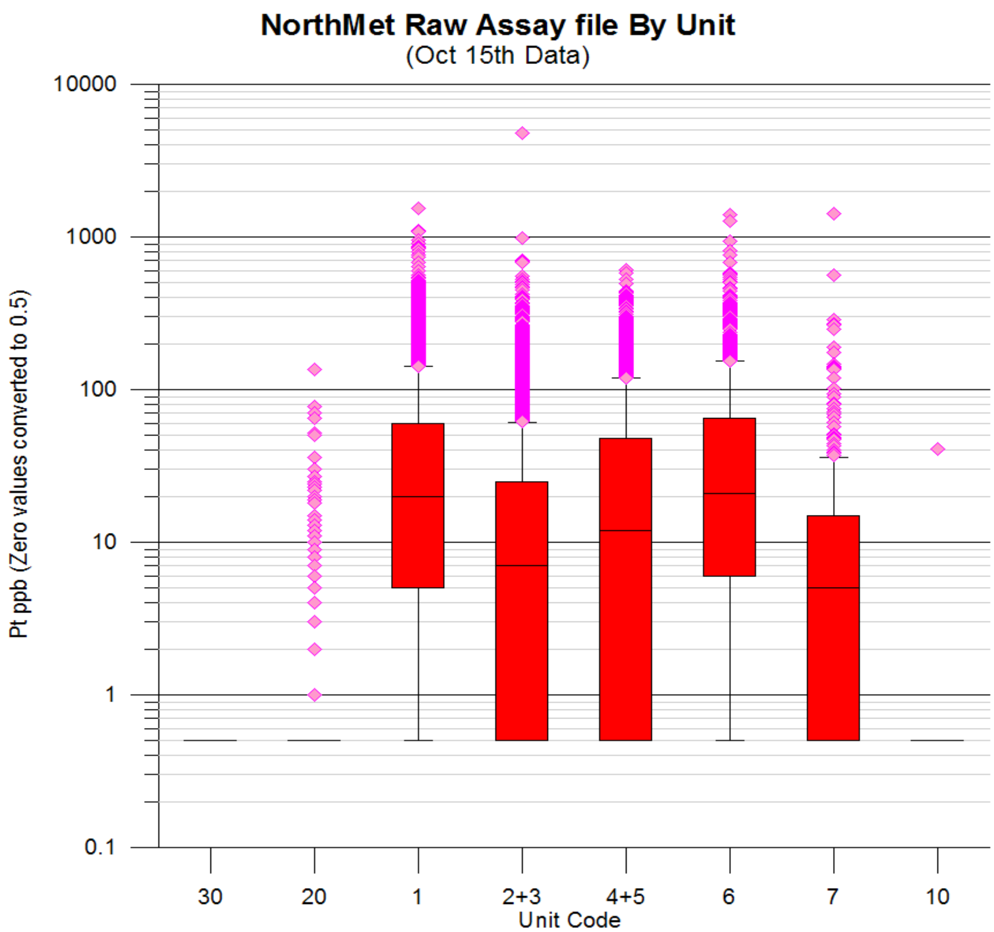
Pd (ppb) -- NorthMet - Raw Assay file by Unit (Oct 15th data)	30	20	1	2+3	4+5	6	7	10
Number of values	76	1370	19819	8164	3351	1596	462	365
Number of missing values	35,127	33,833	15,384	27,039	31,852	33,607	34,741	34,838
Sum	38.5	9,873.5	3,413,394.5	623,229.5	377,906.0	234,640.0	18,024.0	230.0
Minimum	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum	1.0	2,453.0	10,386.0	6,610.0	2,690.0	3,680.0	2,860.0	48.0
Range	0.5	2,452.5	10,385.5	6,609.5	2,689.5	3,679.5	2,859.5	47.5
Mean	0.5	7.2	172.2	76.3	112.8	147.0	39.0	0.6
Median	0.5	3.0	66.0	14.0	18.0	41.0	8.0	0.5
First quartile	0.5	0.5	15.0	4.0	4.0	10.0	2.0	0.5
Third quartile	0.5	4.0	228.0	63.0	112.0	148.0	23.0	0.5
Standard error	0.0	1.8	1.9	2.3	3.7	7.0	7.6	0.1
95% confidence interval	0.0	3.6	3.7	4.6	7.2	13.7	14.9	0.3
99% confidence interval	0.0	4.7	4.9	6.0	9.5	18.0	19.6	0.3
Variance	0.0	4,541.9	71,318.0	44,039.0	45,356.0	77,729.0	26,560.0	6.2
Average deviation	0.0	8.3	173.6	94.0	138.8	167.2	50.0	0.3
Standard deviation	0.1	67.4	267.1	209.9	213.0	278.8	163.0	2.5
Coefficient of variation	0.1	9.4	1.6	2.7	1.9	1.9	4.2	3.9
Skew	8.7	35.0	6.5	12.4	3.4	4.9	12.7	19.1

After Oct 26th corrections



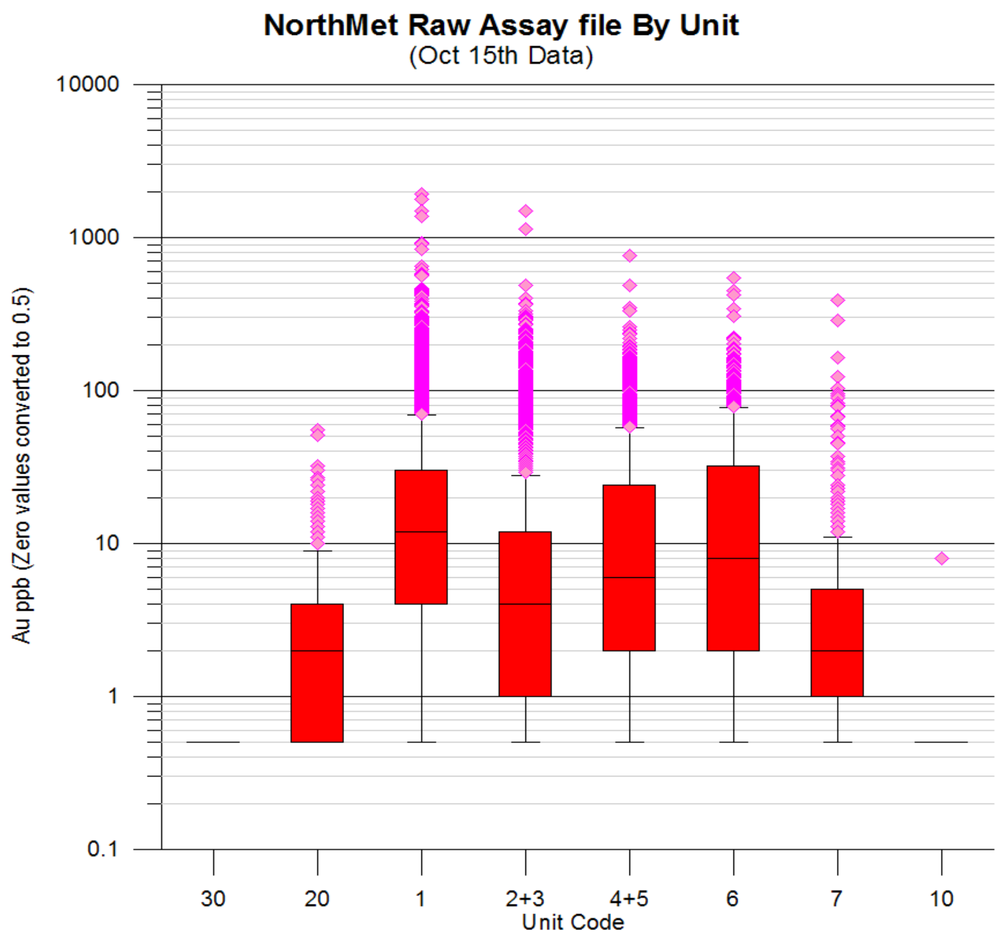
Pt (ppb) -- NorthMet - Raw Assay file by Unit (Oct 15th data)								
	30	20	1	2+3	4+5	6	7	10
Number of values	76	1370	19819	8164	3351	1596	462	365
Number of missing values	35,127	33,833	15,384	27,039	31,852	33,607	34,741	34,838
Sum	38.0	3,064.5	886,103.0	197,987.5	143,193.5	94,297.5	9,063.5	223.0
Minimum	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum	0.5	135.0	1,535.0	4,780.0	606.0	1,390.0	1,430.0	41.0
Range	-	134.5	1,534.5	4,779.5	605.5	1,389.5	1,429.5	40.5
Mean	0.5	2.2	44.7	24.3	42.7	59.1	19.6	0.6
Median	0.5	0.5	20.0	7.0	12.0	21.0	5.0	0.5
First quartile	0.5	0.5	5.0	0.5	0.5	6.0	0.5	0.5
Third quartile	0.5	0.5	60.0	25.0	48.0	65.0	15.0	0.5
Standard error	-	0.2	0.5	0.8	1.2	2.6	3.6	0.1
95% confidence interval	-	0.3	0.9	1.6	2.4	5.1	7.2	0.2
99% confidence interval	-	0.4	1.2	2.1	3.2	6.7	9.4	0.3
Variance	-	40.9	4,493.2	5,194.0	5,164.0	10,880.0	6,126.0	4.5
Average deviation	-	2.8	43.7	28.1	48.7	63.4	23.7	0.2
Standard deviation	-	6.4	67.0	72.1	71.9	104.3	78.3	2.1
Coefficient of variation	-	2.9	1.5	3.0	1.7	1.8	4.0	3.5
Skew	#DIV/0!	10.7	4.3	37.0	2.7	4.7	13.8	19.1

After Oct 26th corrections



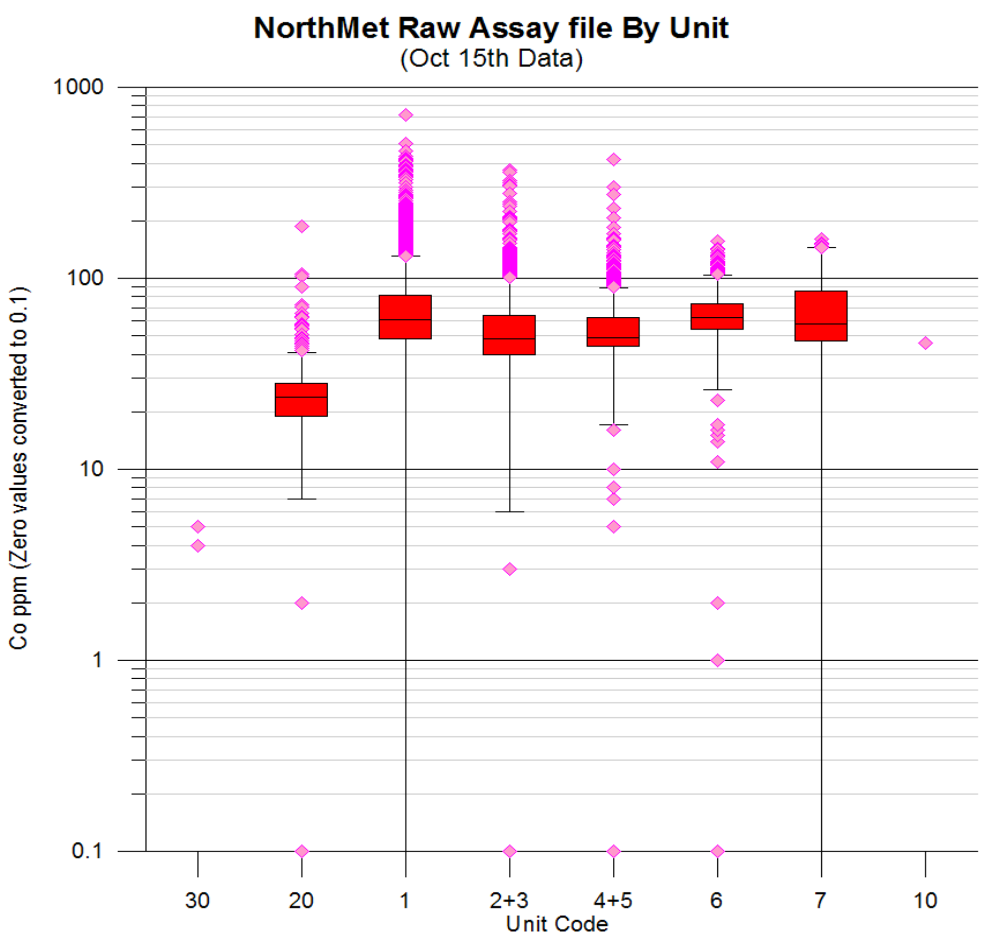
Au (ppb) -- NorthMet - Raw Assay file by Unit (Oct 15th data)								
	30	20	1	2+3	4+5	6	7	10
Number of values	76	1370	19819	8164	3351	1596	462	365
Number of missing values	35,127	33,833	15,384	27,039	31,852	33,607	34,741	34,838
Sum	38.0	4,263.0	475,508.5	109,297.0	71,316.0	39,430.0	3,809.0	190.0
Minimum	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum	0.5	55.0	1,926.0	1,490.0	760.0	545.0	388.0	8.0
Range	-	54.5	1,925.5	1,489.5	759.5	544.5	387.5	7.5
Mean	0.5	3.1	24.0	13.4	21.3	24.7	8.2	0.5
Median	0.5	2.0	12.0	4.0	6.0	8.0	2.0	0.5
First quartile	0.5	0.5	4.0	1.0	2.0	2.0	1.0	0.5
Third quartile	0.5	4.0	30.0	12.0	23.0	32.0	5.0	0.5
Standard error	-	0.1	0.3	0.4	0.7	1.0	1.3	0.0
95% confidence interval	-	0.2	0.6	0.8	1.3	2.0	2.5	0.0
99% confidence interval	-	0.3	0.8	1.0	1.7	2.6	3.3	0.1
Variance	-	14.4	1,978.6	1,256.0	1,436.0	1,682.0	758.1	0.2
Average deviation	-	2.2	22.5	15.4	23.9	26.4	10.3	0.0
Standard deviation	-	3.8	44.5	35.4	37.9	41.0	27.5	0.4
Coefficient of variation	-	1.2	1.9	2.6	1.8	1.7	3.3	0.8
Skew	#DIV/0!	5.4	14.3	15.9	5.0	4.3	9.1	19.1

After Oct 26th corrections



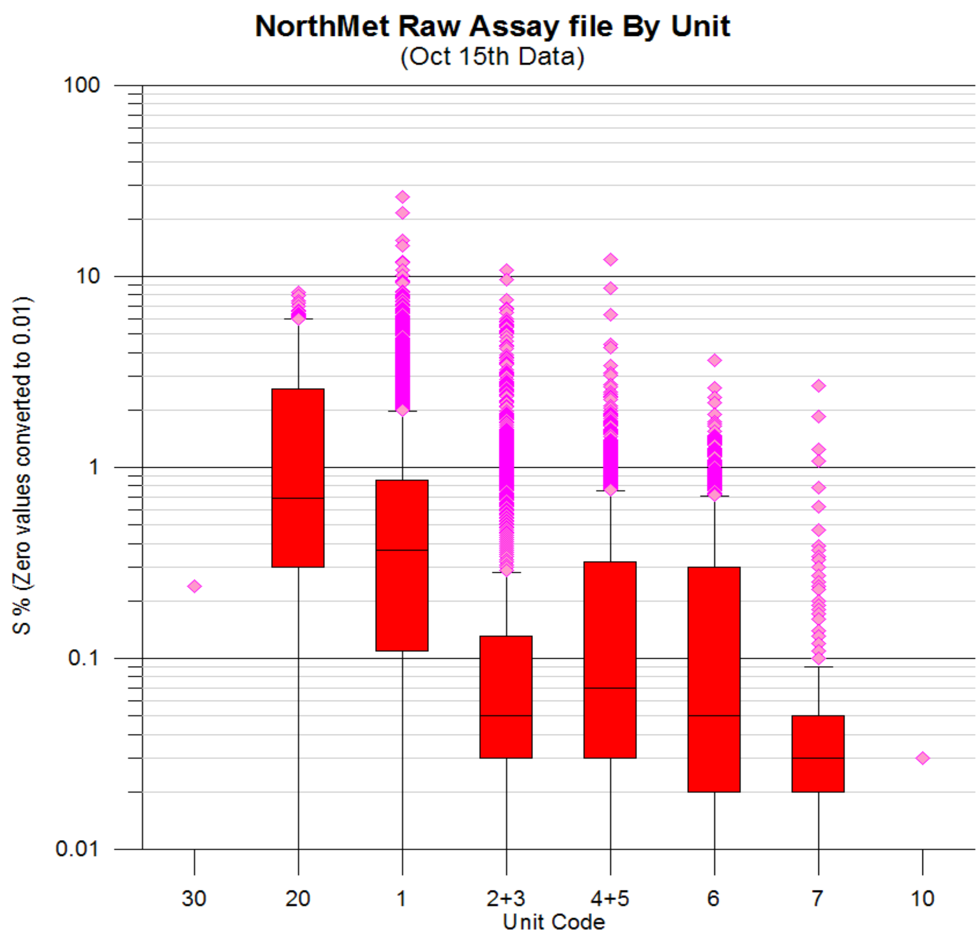
Co (ppm) -- NorthMet - Raw Assay file by Unit (Oct 15th data)	30	20	1	2+3	4+5	6	7	10
Number of values	76	1370	19819	8164	3351	1596	462	365
Number of missing values	35,127	33,833	15,384	27,039	31,852	33,607	34,741	34,838
Sum	16	31,756	1,325,092	431,266	179,325	101,543	29,822	82
Minimum	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Maximum	5.000	188.000	713.000	367.000	421.000	156.000	160.000	46.000
Range	4.900	187.900	712.900	366.900	420.900	155.900	159.900	45.900
Mean	0.220	23.180	66.860	52.830	53.510	63.620	64.550	0.226
Median	0.100	24.000	61.000	48.000	49.000	62.000	58.000	0.100
First quartile	0.100	19.000	48.000	40.000	44.000	54.000	47.000	0.100
Third quartile	0.100	28.000	81.000	64.000	62.000	74.000	86.000	0.100
Standard error	0.082	0.331	0.235	0.261	0.380	0.510	1.622	0.126
95% confidence interval	0.160	0.649	0.461	0.512	0.744	0.998	3.189	0.248
99% confidence interval	0.220	0.852	0.606	0.673	0.977	1.311	4.195	0.326
Variance	0.510	150.400	1,098.000	556.900	483.000	414.500	1,215.000	5.770
Average deviation	0.230	7.818	22.900	16.520	14.090	14.330	26.810	0.251
Standard deviation	0.710	12.260	33.130	23.600	21.980	20.360	34.850	2.400
Coefficient of variation	3.307	0.529	0.496	0.447	0.411	0.320	0.540	10.642
Skew	6.162	2.121	2.603	2.331	2.867	(0.242)	0.339	19.105

After Oct 26th corrections



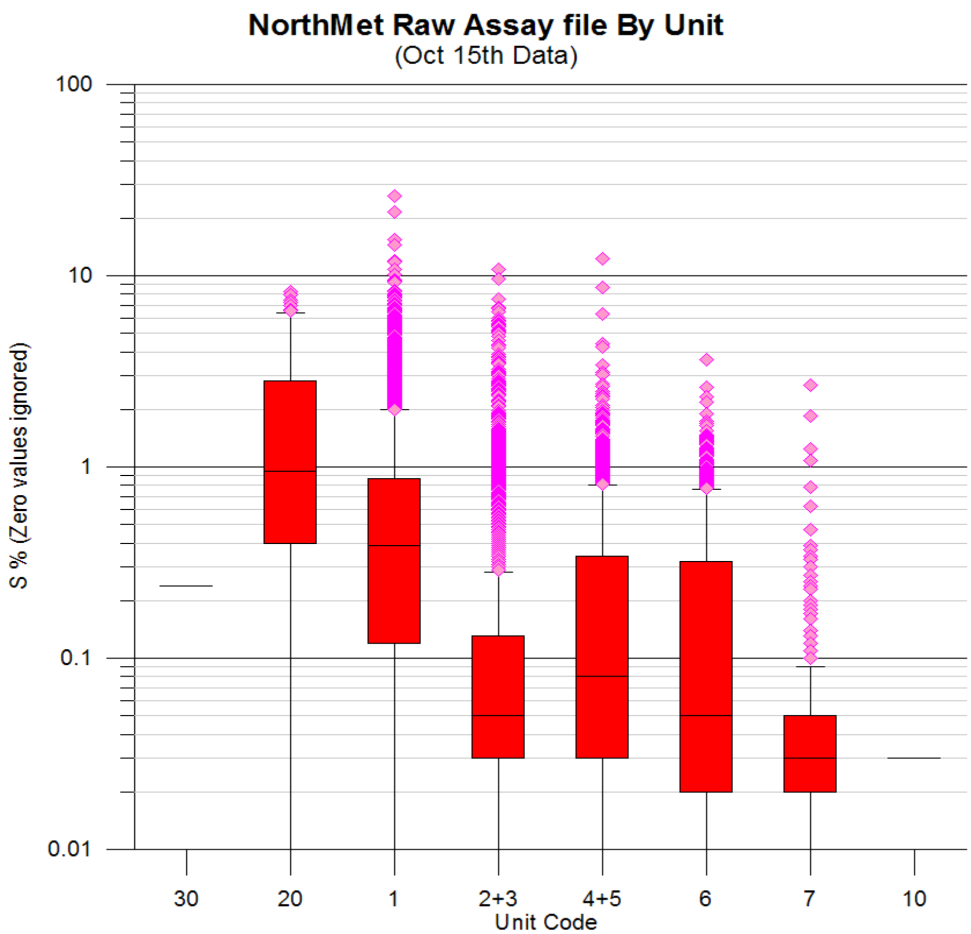
S% -- NorthMet - Raw Assay file by Unit (Oct 15th data - zero values converted to 0.01)								
	30	20	1	2+3	4+5	6	7	10
Number of values	76	1370	19819	8164	3351	1596	462	365
Number of missing values	35,127.00	33,833.00	15,384.00	27,039.00	31,852.00	33,607.00	34,741.00	34,838.00
Sum	1.220	2,112.390	12,165.680	1,390.720	832.740	352.790	28.610	3.670
Minimum	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Maximum	0.240	8.290	26.100	10.800	12.220	3.620	2.670	0.030
Range	0.230	8.280	26.090	10.790	12.210	3.610	2.660	0.020
Mean	0.016	1.542	0.614	0.170	0.249	0.221	0.062	0.010
Median	0.010	0.690	0.370	0.050	0.070	0.050	0.030	0.010
First quartile	0.010	0.300	0.110	0.030	0.030	0.020	0.020	0.010
Third quartile	0.010	2.590	0.860	0.130	0.320	0.300	0.050	0.010
Standard error	0.004	0.045	0.006	0.005	0.008	0.008	0.008	0.000
95% confidence interval	0.008	0.088	0.011	0.010	0.015	0.017	0.016	0.000
99% confidence interval	0.011	0.116	0.015	0.013	0.020	0.022	0.022	0.000
Variance	0.001	2.771	0.665	0.212	0.208	0.115	0.032	0.000
Average deviation	0.012	1.381	0.509	0.192	0.259	0.245	0.058	0.000
Standard deviation	0.037	1.665	0.815	0.461	0.456	0.339	0.180	0.001
Coefficient of variation	2.309	1.080	1.328	2.704	1.837	1.531	2.901	0.104
Skew	6.038	1.189	6.153	9.275	9.647	2.633	10.107	19.105

After Oct 26th corrections

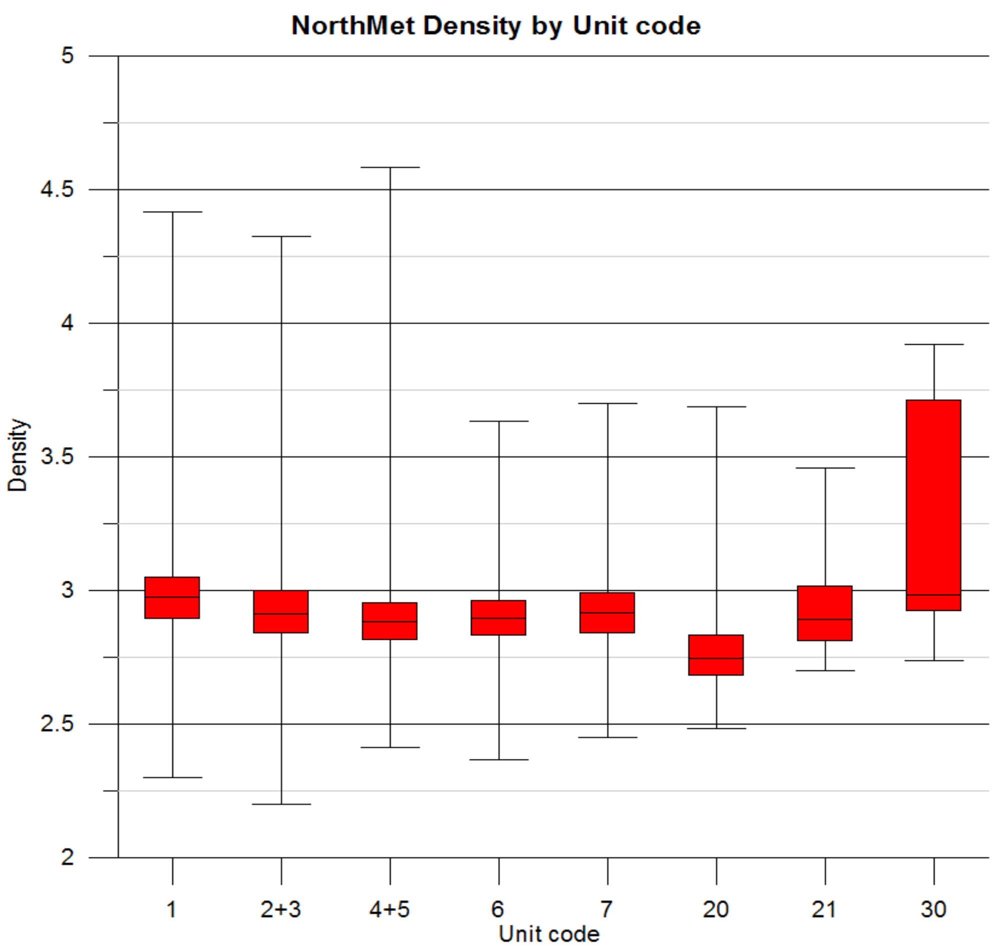


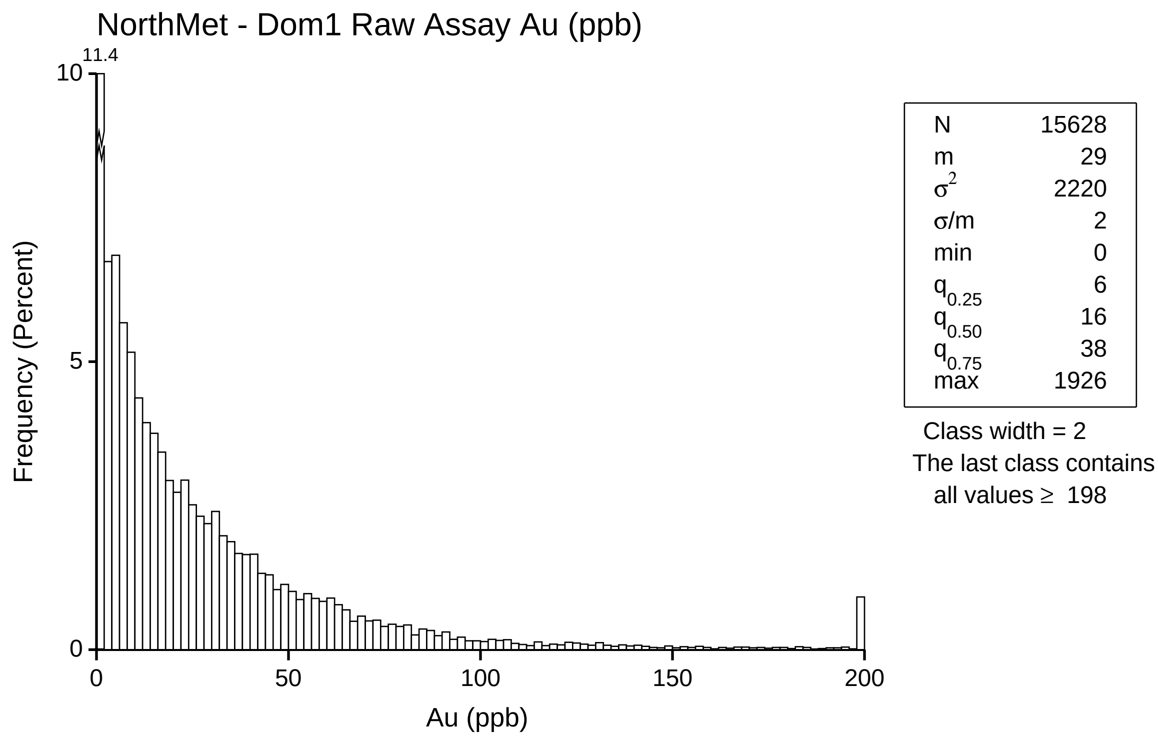
S% -- NorthMet - Raw Assay file by Unit (Oct 15th data - zero values ignored)	30	20	1	2+3	4+5	6	7	10
Number of values	2	1215	19315	7889	3241	1554	429	1
Number of missing values	33,644.00	32,431.00	14,331.00	25,757.00	30,405.00	32,092.00	33,217.00	33,645.00
Sum	0.480	2,110.840	12,160.640	1,387.970	831.640	352.370	28.280	0.030
Minimum	0.240	0.010	0.010	0.010	0.010	0.010	0.010	0.030
Maximum	0.240	8.290	26.100	10.800	12.220	3.620	2.670	0.030
Range	-	8.280	26.090	10.790	12.210	3.610	2.660	-
Mean	0.240	1.737	0.630	0.176	0.257	0.227	0.066	0.030
Median	0.240	0.950	0.390	0.050	0.080	0.050	0.030	#N/A
First quartile	#N/A	0.400	0.120	0.030	0.030	0.020	0.020	#N/A
Third quartile	#N/A	2.810	0.870	0.130	0.340	0.320	0.050	#N/A
Standard error	-	0.048	0.006	0.005	0.008	0.009	0.009	#N/A
95% confidence interval	-	0.094	0.012	0.010	0.016	0.017	0.018	#N/A
99% confidence interval	-	0.123	0.015	0.014	0.021	0.022	0.023	#N/A
Variance	-	2.787	0.672	0.219	0.213	0.116	0.035	#N/A
Average deviation	-	1.401	0.511	0.196	0.263	0.249	0.062	#N/A
Standard deviation	-	1.669	0.820	0.468	0.462	0.341	0.186	#N/A
Coefficient of variation	-	0.961	1.302	2.658	1.800	1.505	2.820	#N/A
Skew	#N/A	1.075	6.160	9.141	9.573	2.595	9.774	#N/A

After Oct 26th corrections

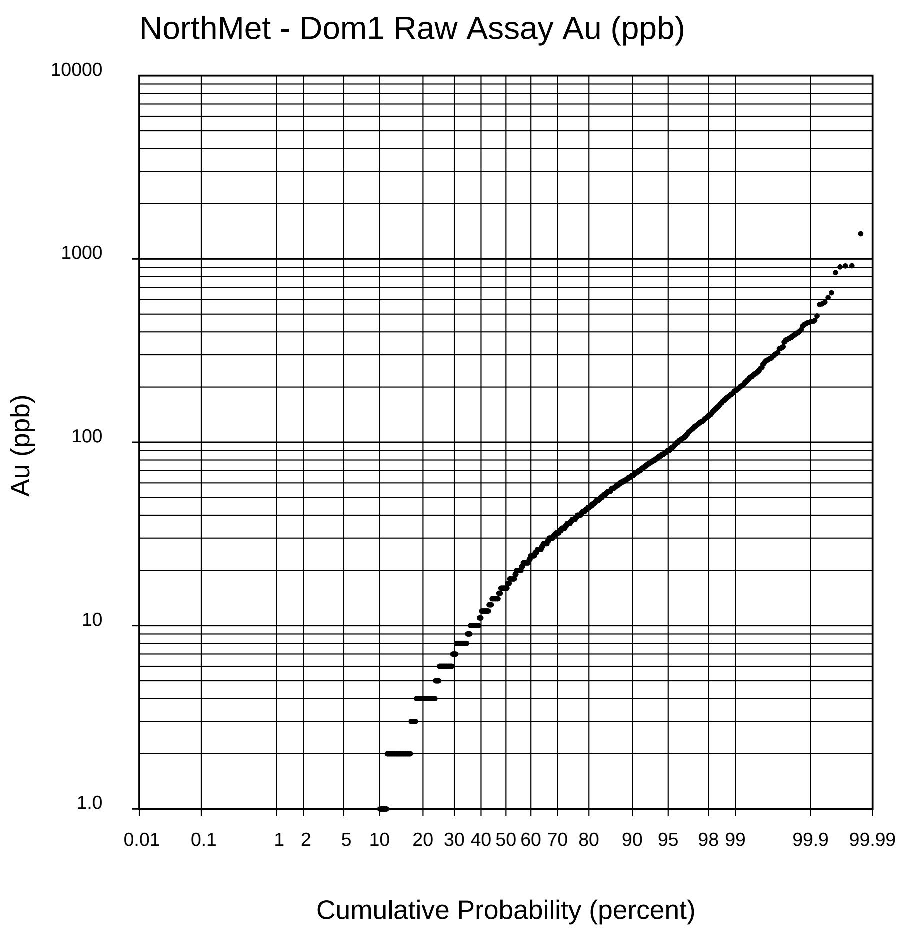


NorthMet project - Density by Units October 2007 dataset	1	3	5	6	7	20	21	30	Total (less 21)
Number of values	2381	1818	1266	902	326	273	20	9	6975
Sum	7,091.24	5,311.63	3,666.18	2,614.92	953.14	756.48	58.41	28.51	
Minimum	2.30	2.20	2.41	2.37	2.45	2.48	2.70	2.74	
Maximum	4.42	4.32	4.58	3.63	3.70	3.69	3.46	3.92	
Range	2.12	2.12	2.17	1.27	1.25	1.20	0.76	1.18	
Mean	2.98	2.92	2.90	2.90	2.92	2.77	2.92	3.17	
Median	2.97	2.91	2.88	2.90	2.92	2.75	2.89	2.98	
First quartile	2.90	2.84	2.82	2.83	2.84	2.68	2.82	2.89	
Third quartile	3.05	3.00	2.95	2.96	2.99	2.83	3.01	3.54	
Standard error	0.00	0.00	0.00	0.00	0.01	0.01	0.04	0.14	
95% confidence interval	0.01	0.01	0.01	0.01	0.02	0.02	0.08	0.33	
99% confidence interval	0.01	0.01	0.01	0.01	0.02	0.02	0.11	0.48	
Variance	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.18	
Average deviation	0.10	0.10	0.10	0.09	0.11	0.10	0.12	0.36	
Standard deviation	0.15	0.14	0.15	0.12	0.15	0.14	0.18	0.43	
Coefficient of variation	0.05	0.05	0.05	0.04	0.05	0.05	0.06	0.14	
Skew	1.66	0.97	2.90	0.29	0.76	1.73	1.43	0.93	
Kurtosis	13.17	8.34	25.49	3.90	3.29	7.27	3.76	(0.70)	



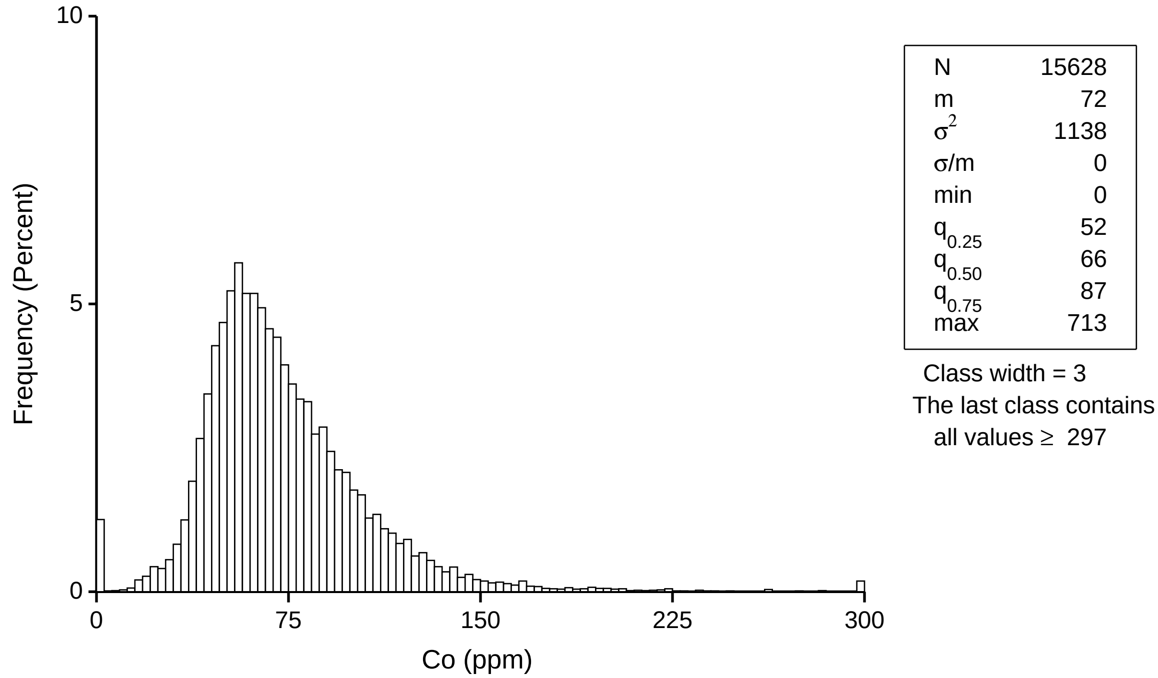


NorthMet - Dom1 Raw Assay Au (ppb)
11.4
10
5
0
Frequency (Percent)
0
50
100
150
200
Au (ppb)
N 15628
m 29
σ2 2220
σ/m 2
min 0
q0.25 6
q0.50 16
q0.75 38
max 1926
Class width = 2
The last class contains
all values ≥ 198

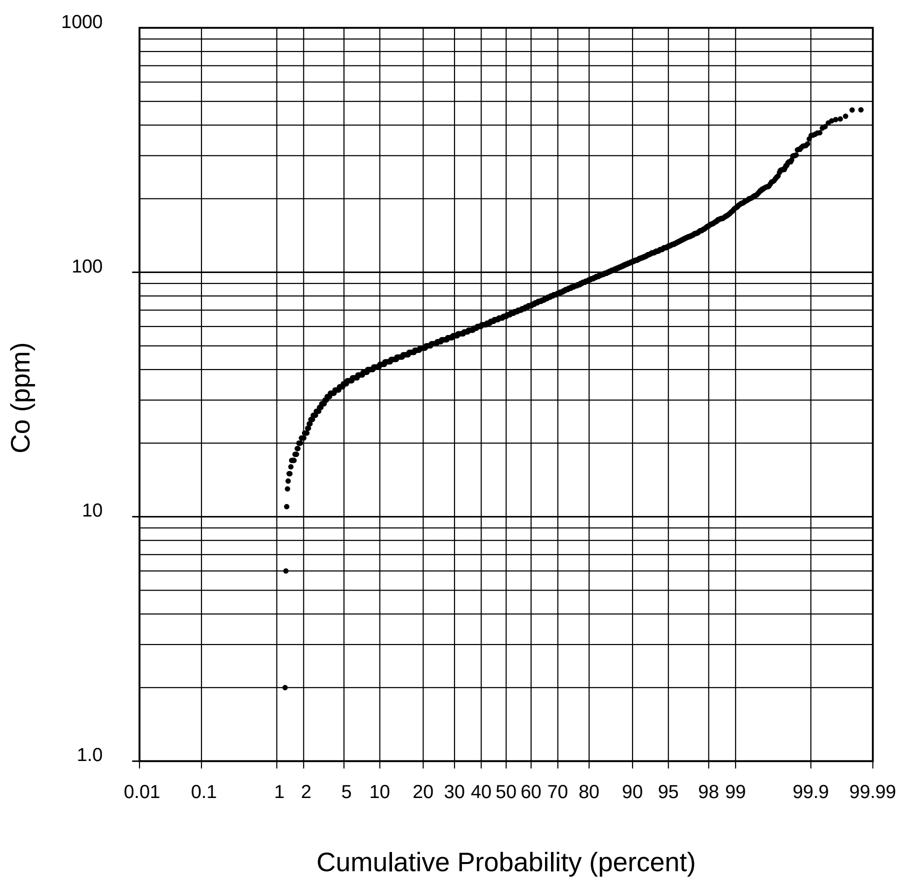


NorthMet - Dom1 Raw Assay Au (ppb)
10000
1000
100
10
1.0
Au (ppb)
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

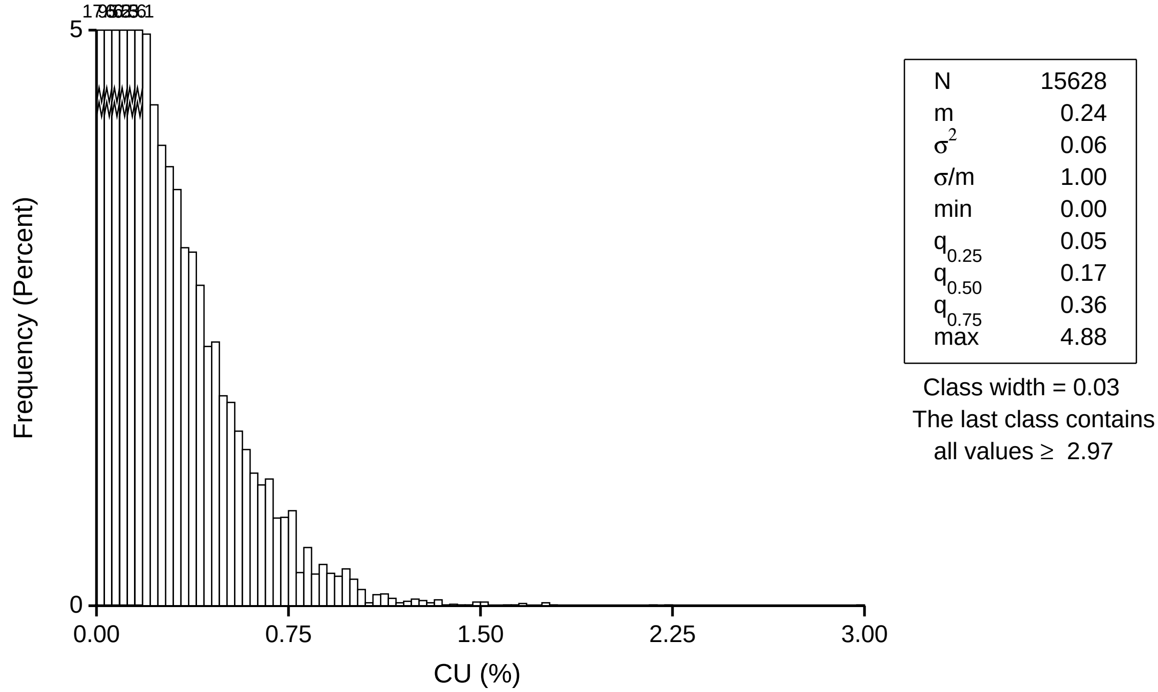
NorthMet - Dom1 Raw Assay Co (ppm)



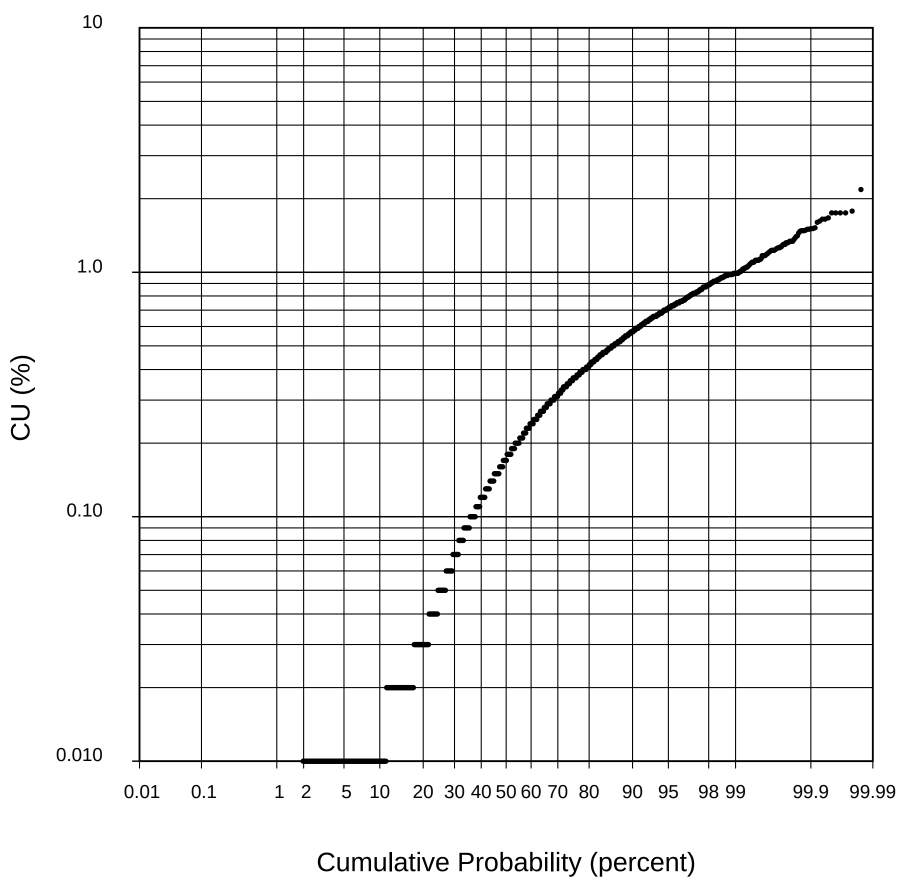
NorthMet - Dom1 Raw Assay Co (ppm)



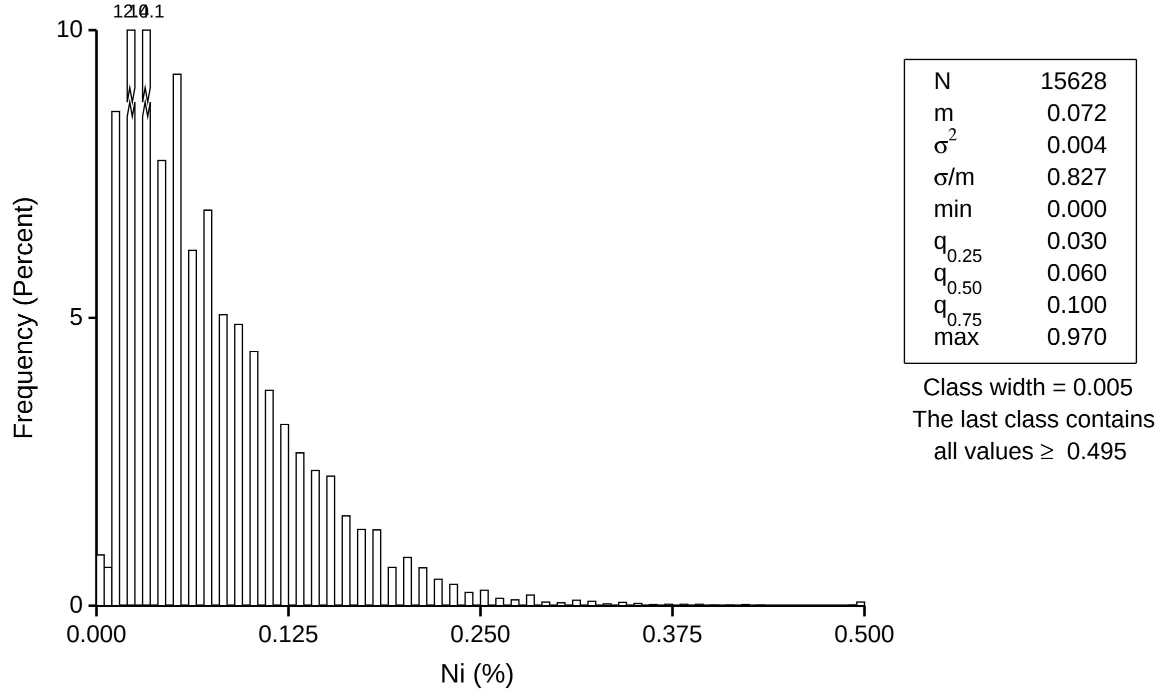
NorthMet - Dom1 Raw Assay Cu (%)



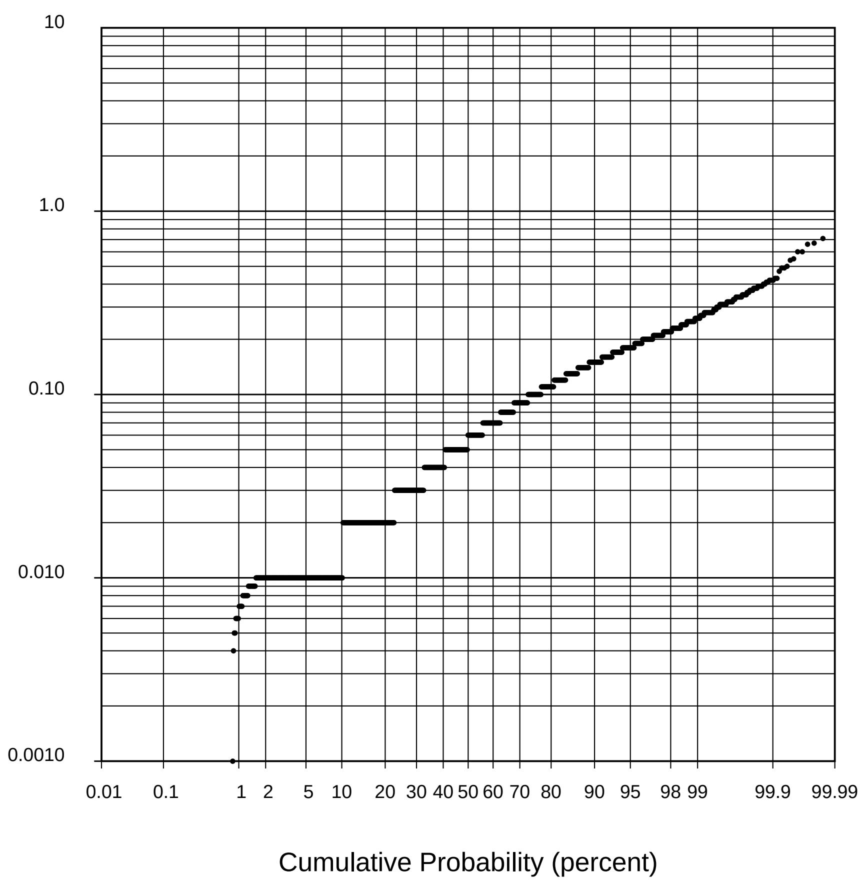
NorthMet - Dom1 Raw Assay Cu (%)

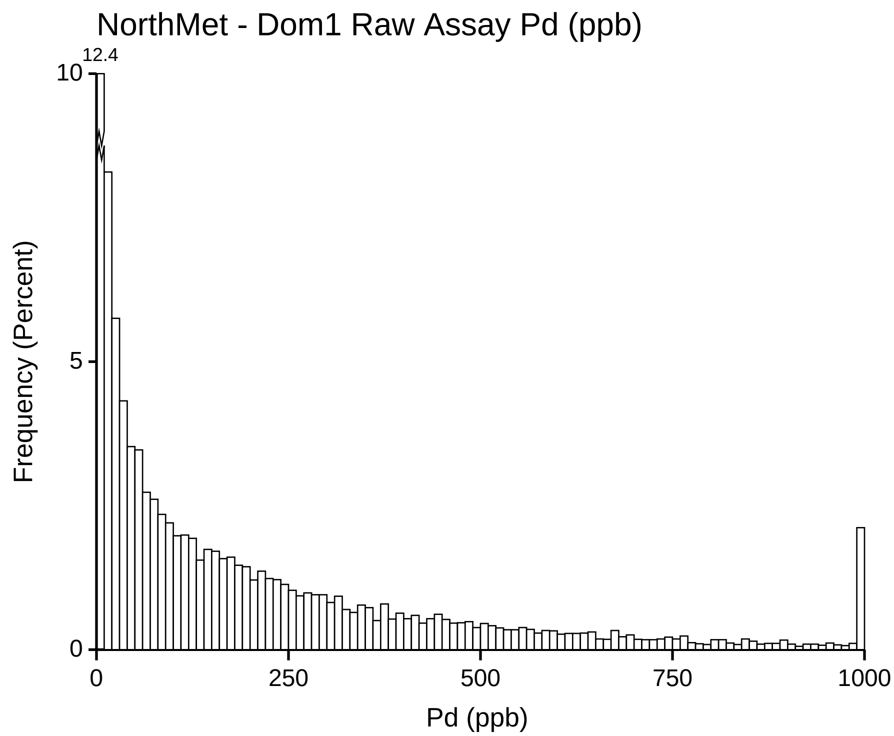


NorthMet - Dom1 Raw Assay Ni (%)



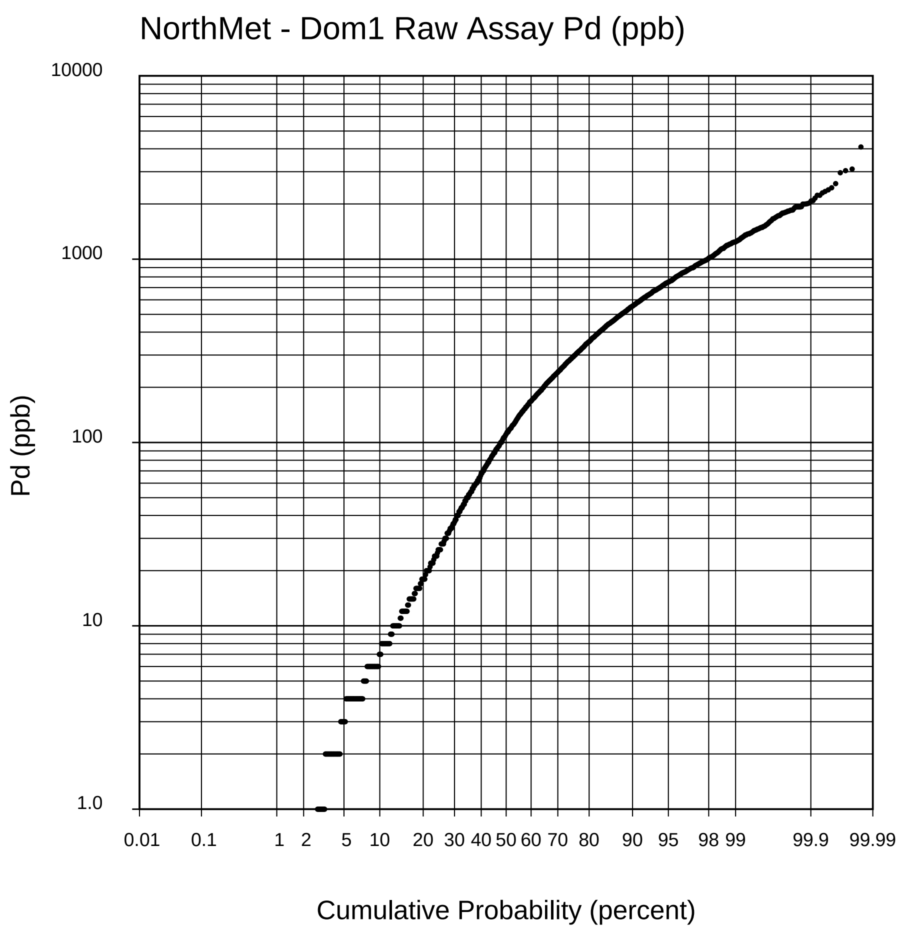
NorthMet - Dom1 Raw Assay Ni (%)



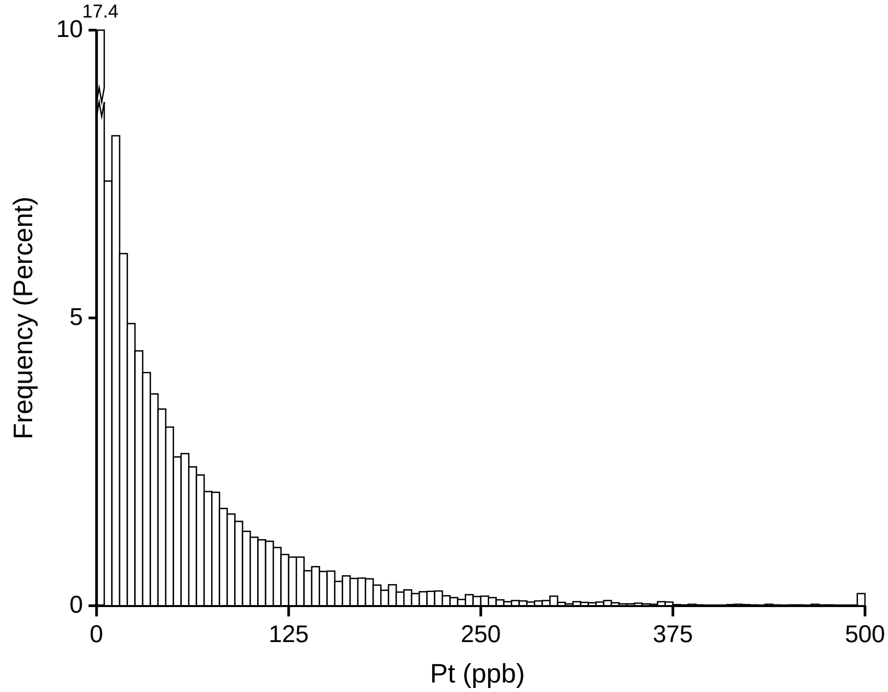


N	15628
m	212
σ^2	84859
σ/m	1
min	0
$q_{0.25}$	26
$q_{0.50}$	111
$q_{0.75}$	292
max	10386

Class width = 10
The last class contains
all values ≥ 990



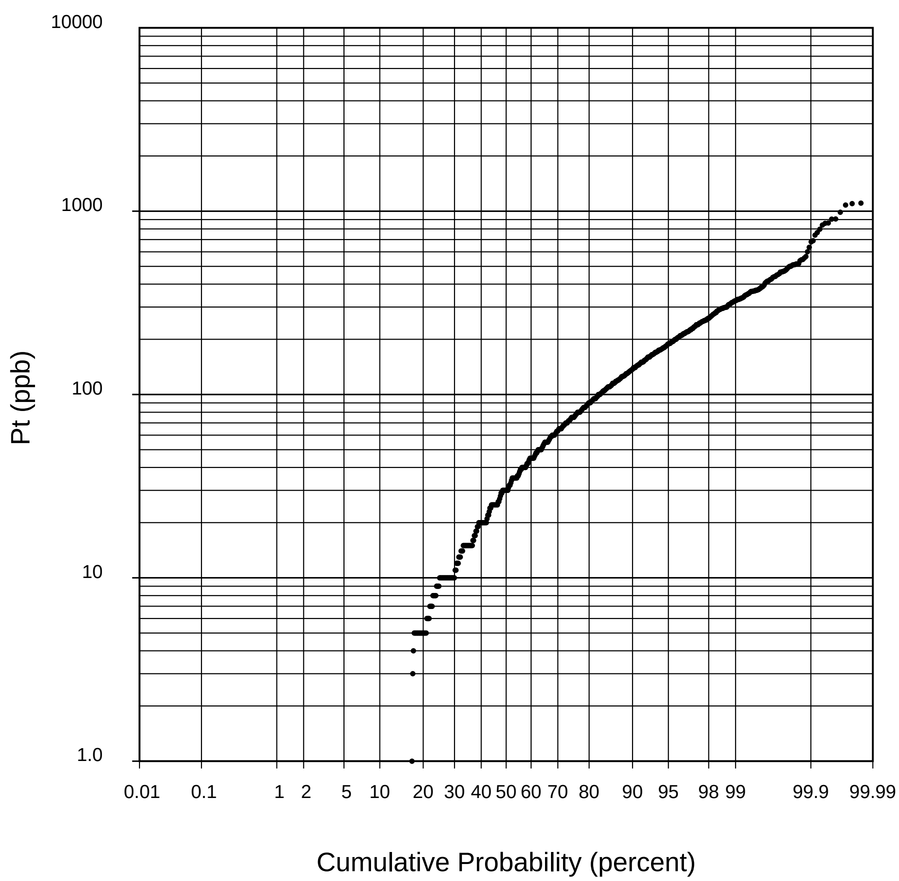
NorthMet - Dom1 Raw Assay Pt (ppb)



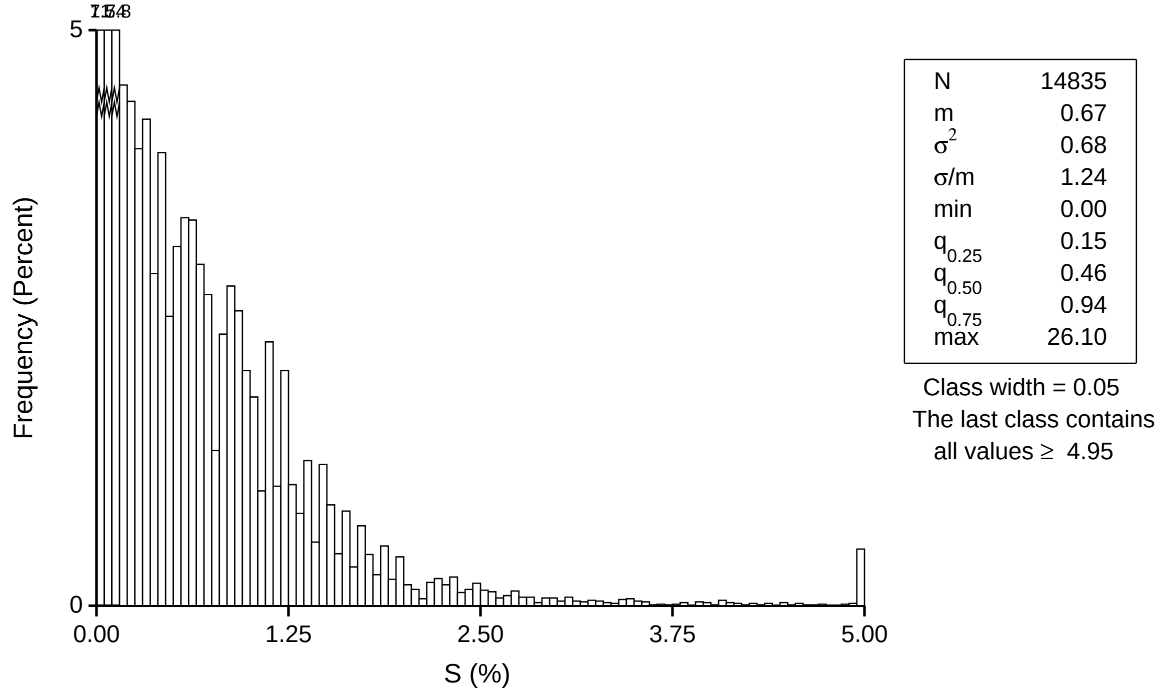
N	15628
m	55
σ^2	5339
σ/m	1
min	0
$q_{0.25}$	10
$q_{0.50}$	30
$q_{0.75}$	75
max	1535

Class width = 5
The last class contains all values ≥ 495

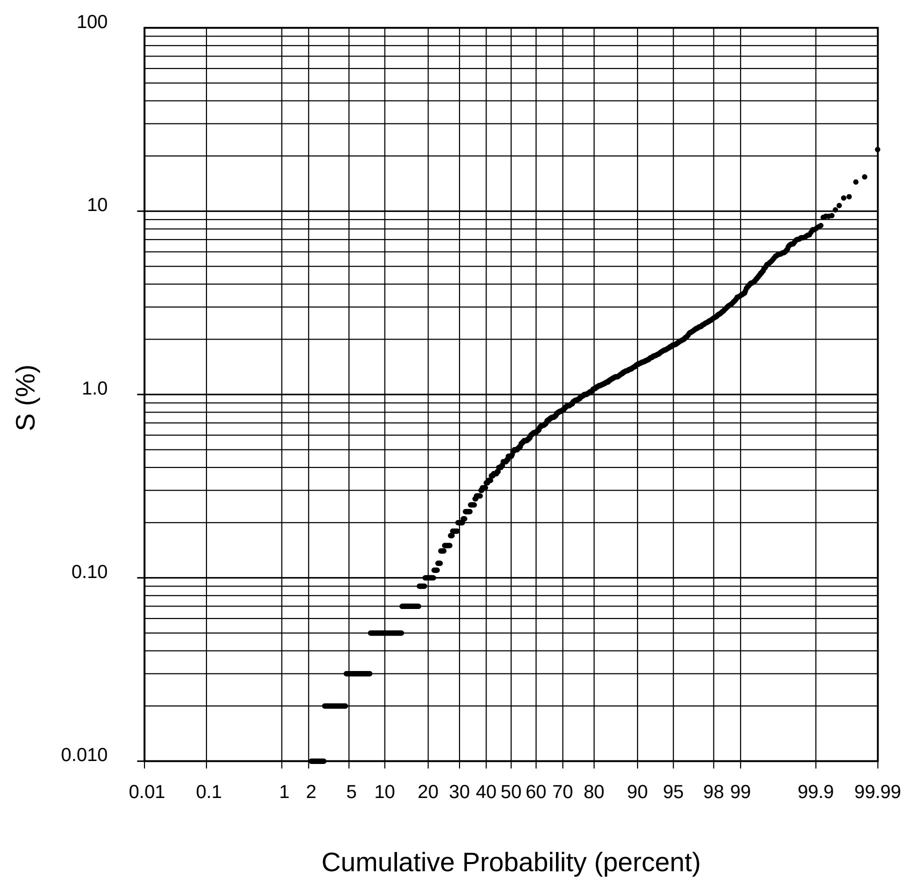
NorthMet - Dom1 Raw Assay Pt (ppb)

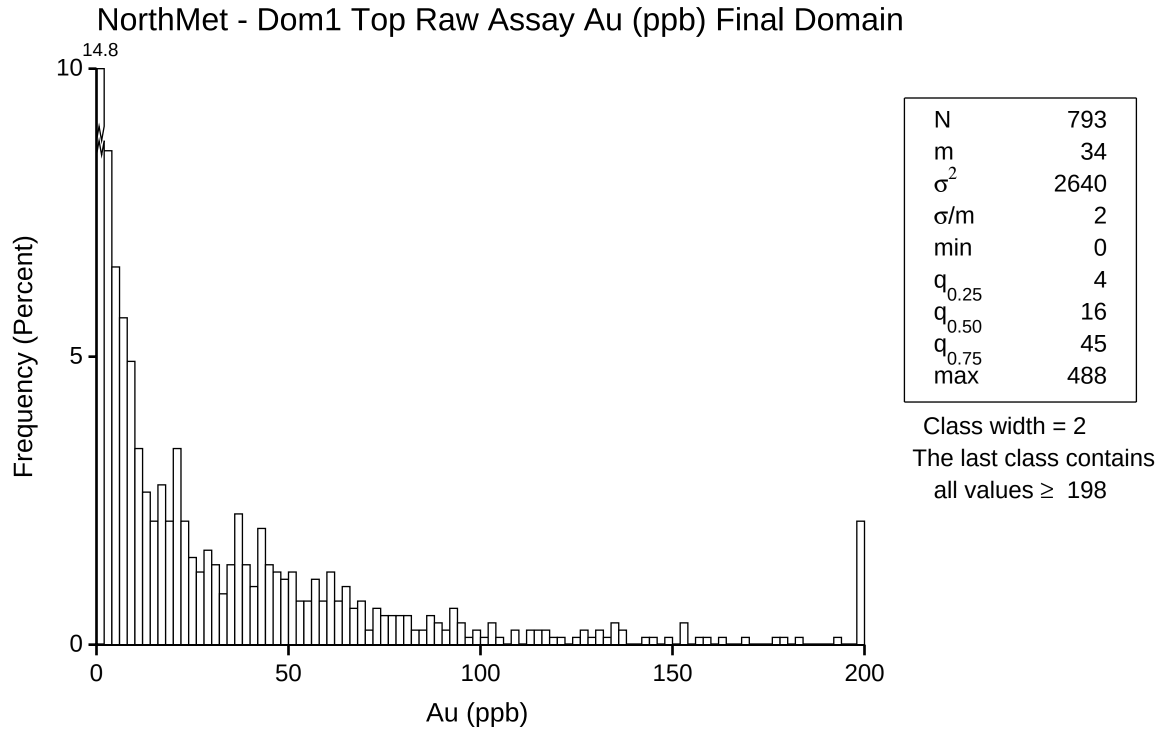


NorthMet - Dom 1 bot Raw Assay S (%) Final Domain

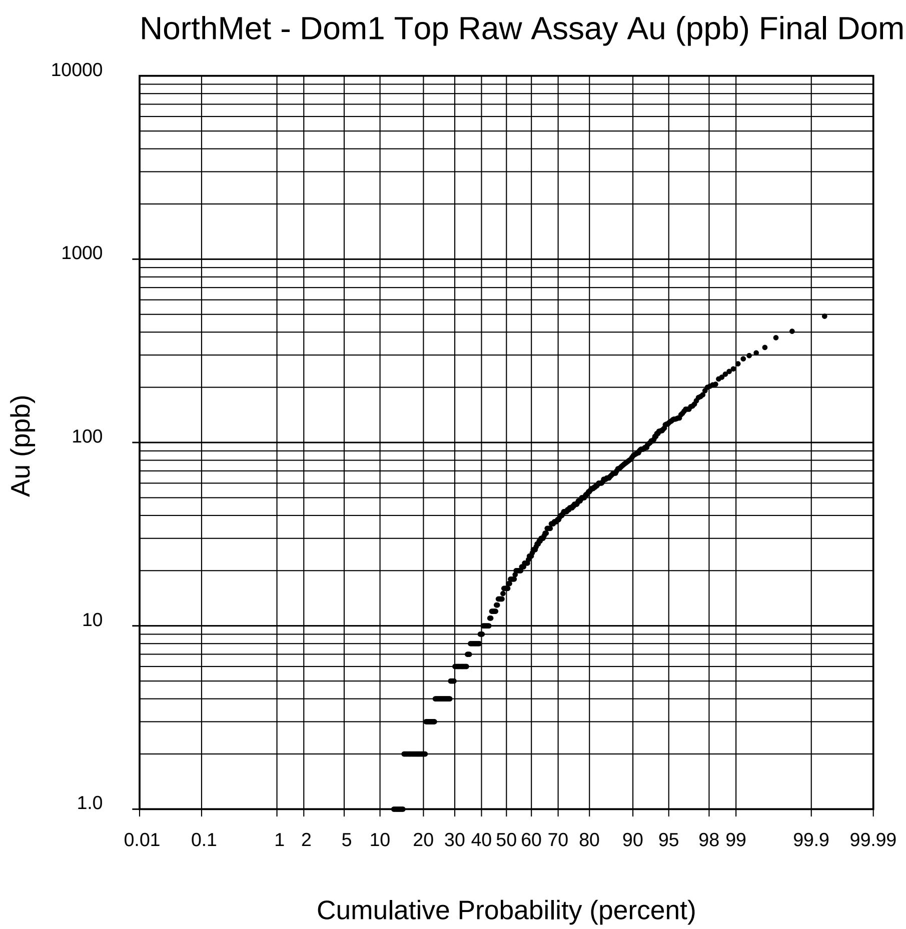


NorthMet - Dom 1 bot Raw Assay S (%) Final Domain

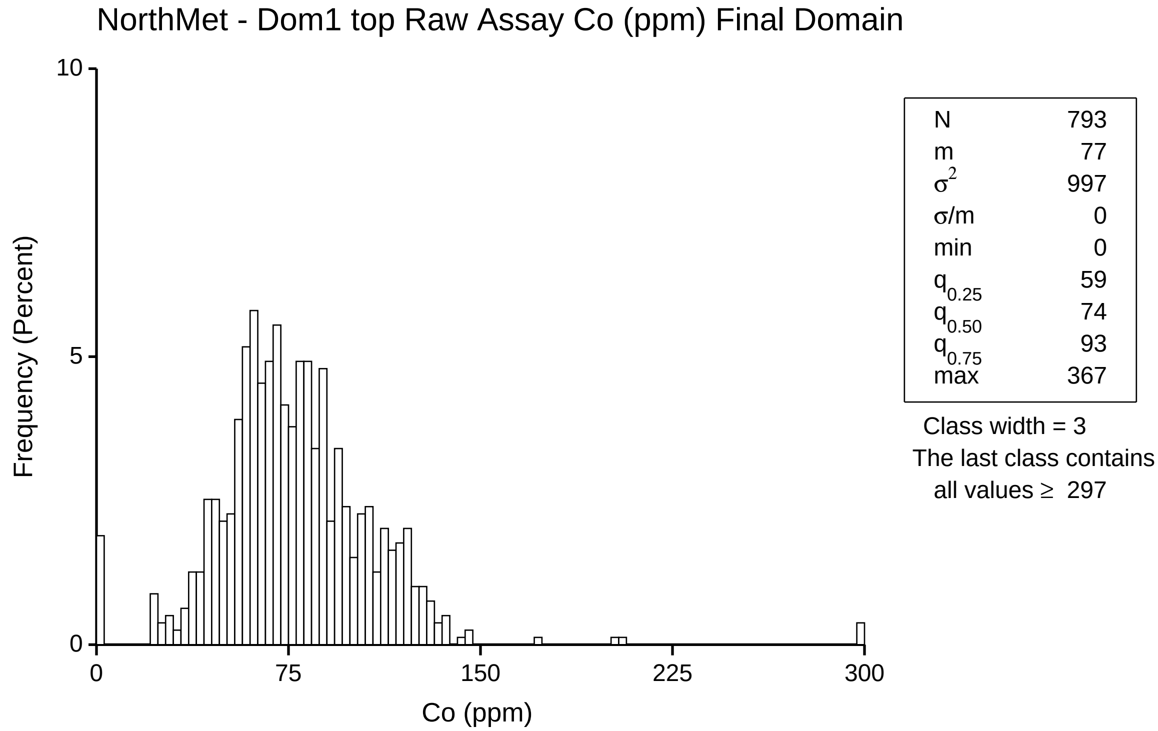


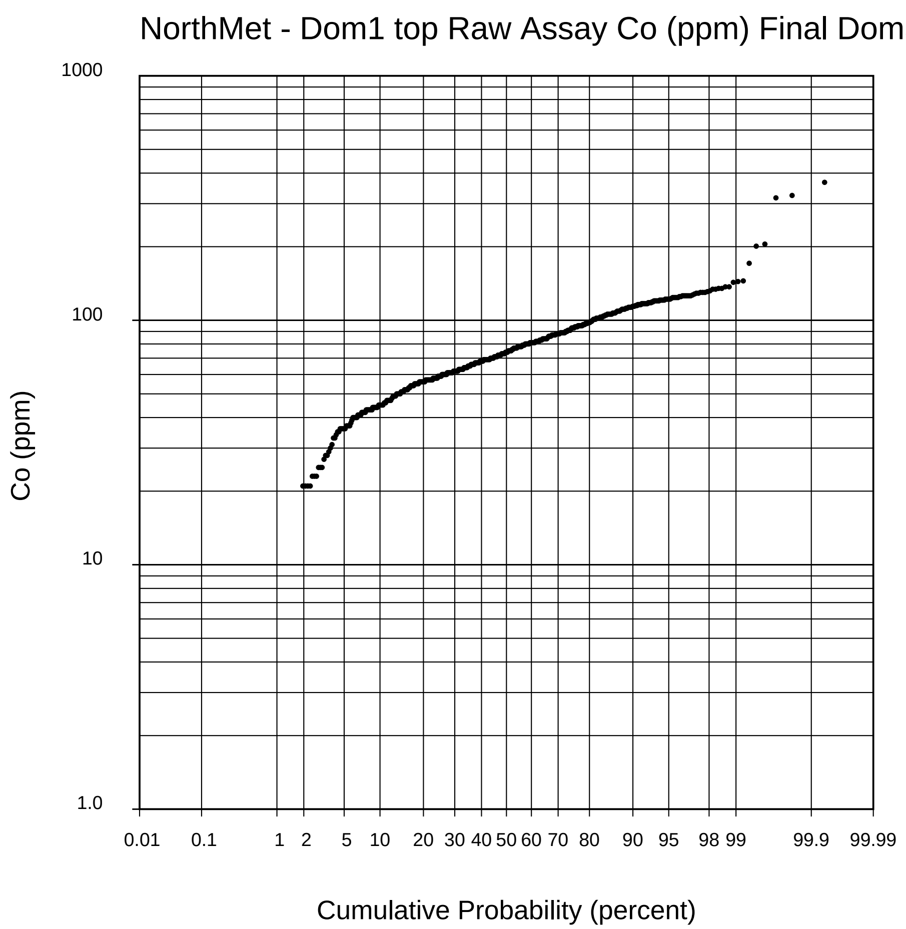


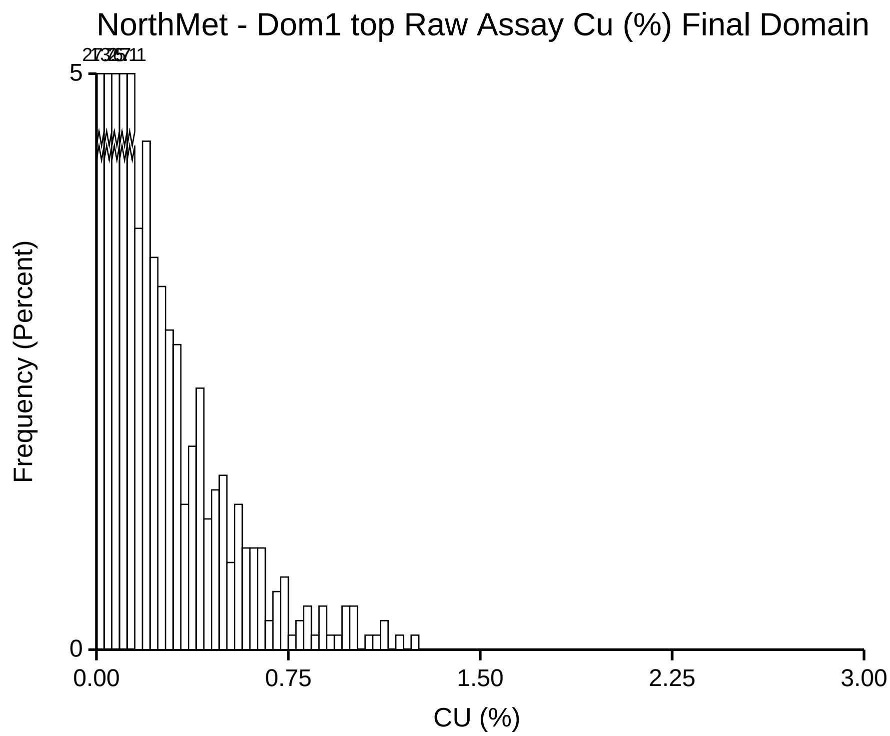
NorthMet - Dom1 Top Raw Assay Au (ppb) Final Domain
14.8
10
5
0
Frequency (Percent)
0
50
100
150
200
Au (ppb)
N 793
m 34
σ2 2640
σ/m 2
min 0
q0.25 4
q0.50 16
q0.75 45
max 488
Class width = 2
The last class contains
all values ≥ 198



NorthMet - Dom1 Top Raw Assay Au (ppb) Final Domain
10000
1000
100
10
1.0
Au (ppb)
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

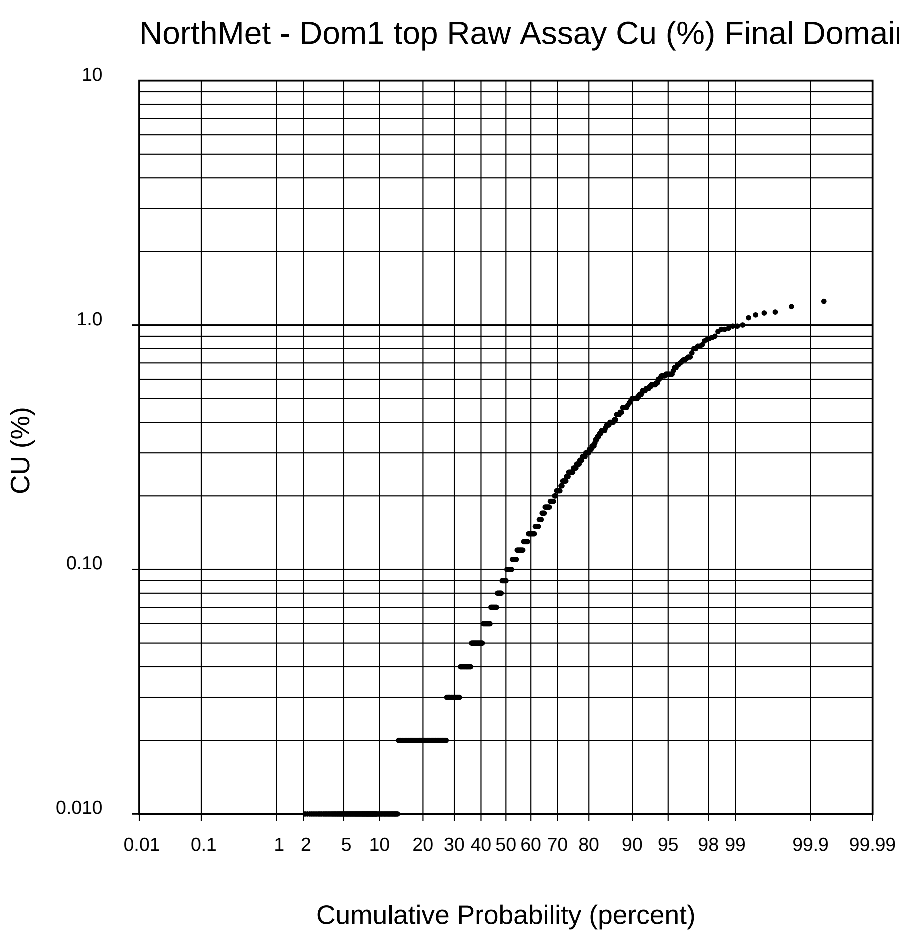

NorthMet - Dom1 top Raw Assay Co (ppm) Final Domain
Frequency (Percent)
10
5
0
0
75
150
225
300
Co (ppm)
N 793
m 77
σ2 997
σ/m 0
min 0
q0.25 59
q0.50 74
q0.75 93
max 367
Class width = 3
The last class contains
all values ≥ 297

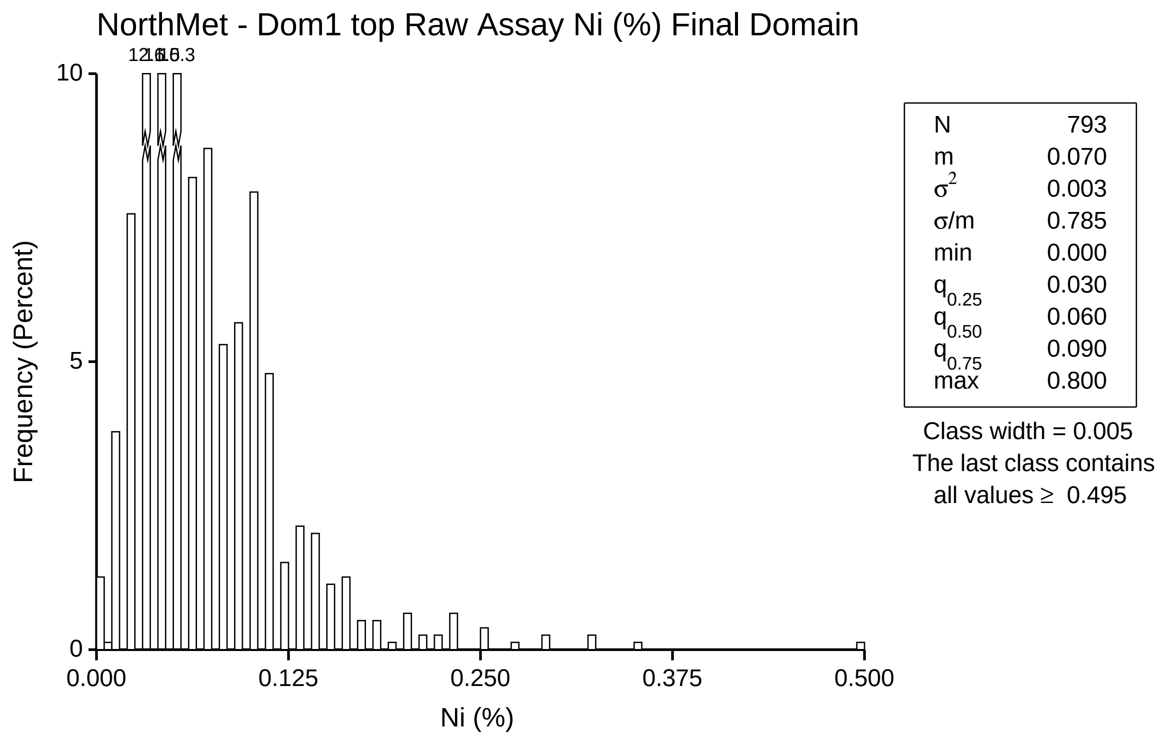

NorthMet - Dom1 top Raw Assay Co (ppm) Final Domain
Co (ppm)
1000
100
10
1.0
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

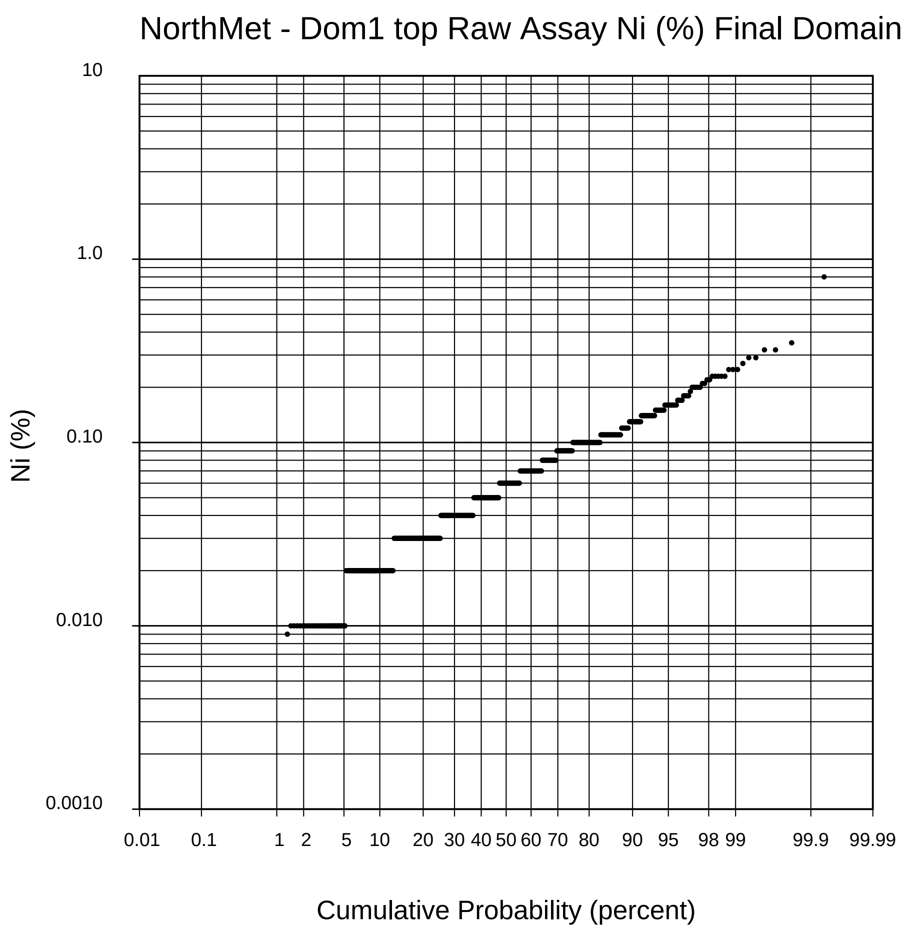


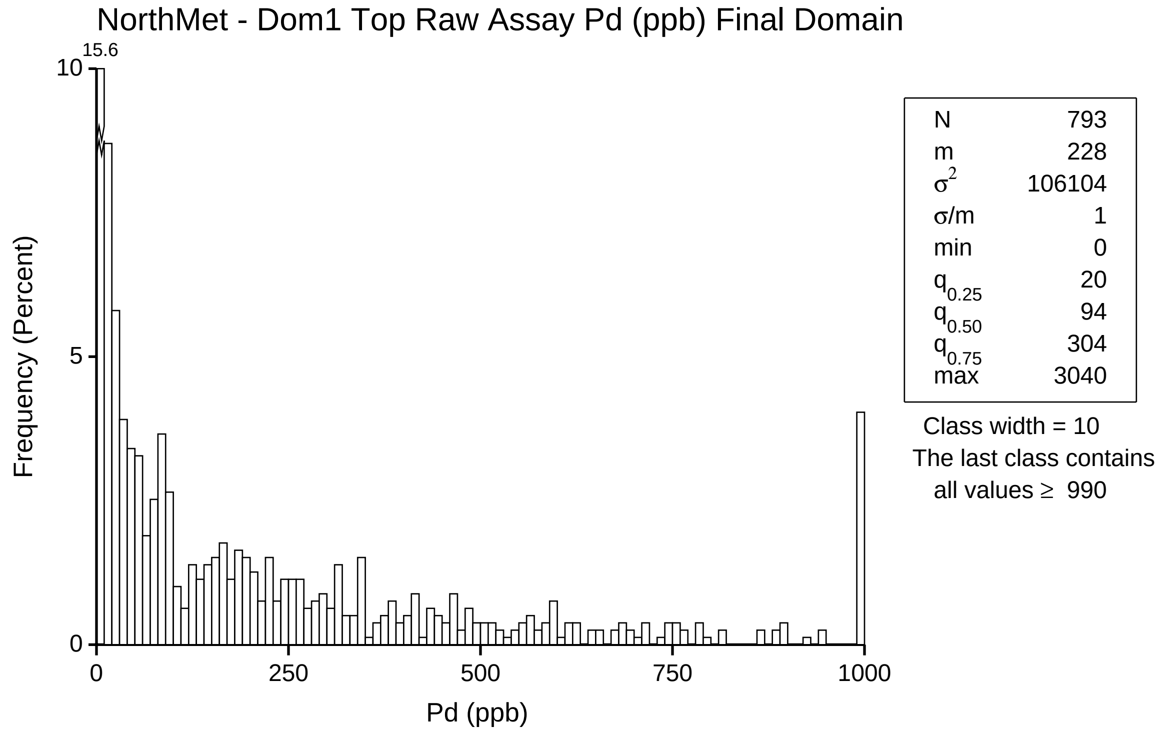
N	793
m	0.18
σ^2	0.05
σ/m	1.22
min	0.00
$q_{0.25}$	0.02
$q_{0.50}$	0.09
$q_{0.75}$	0.25
max	1.25

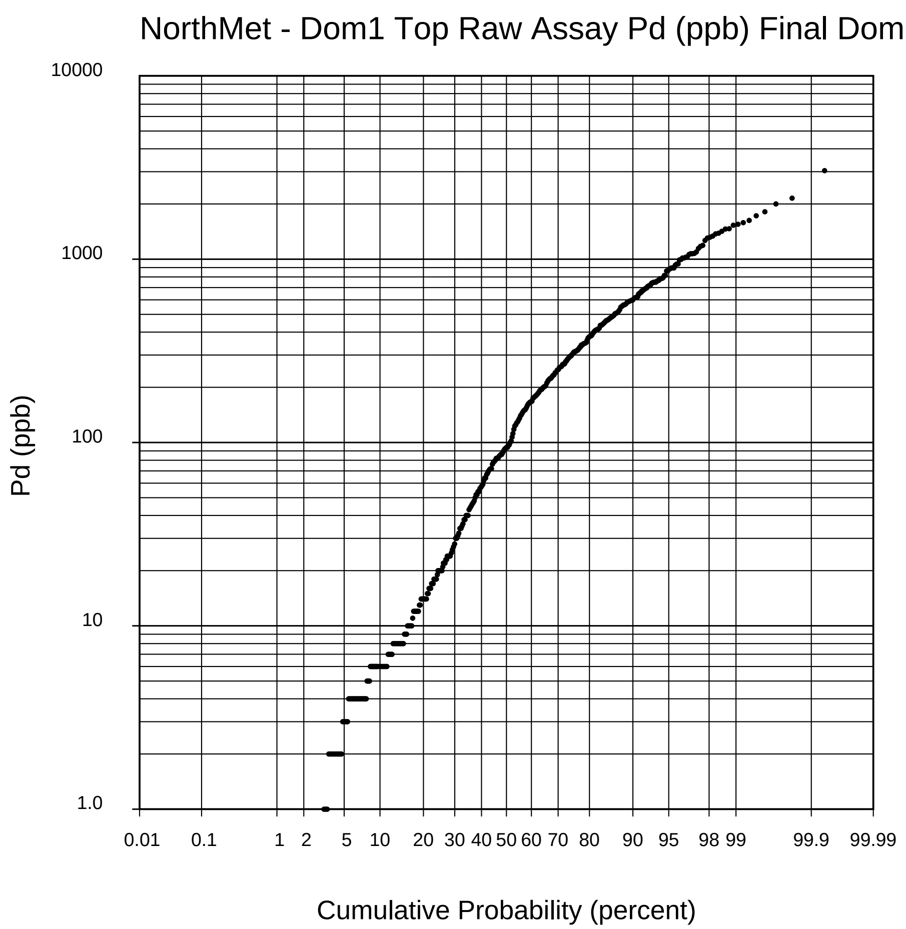
Class width = 0.03
The last class contains all values ≥ 2.97



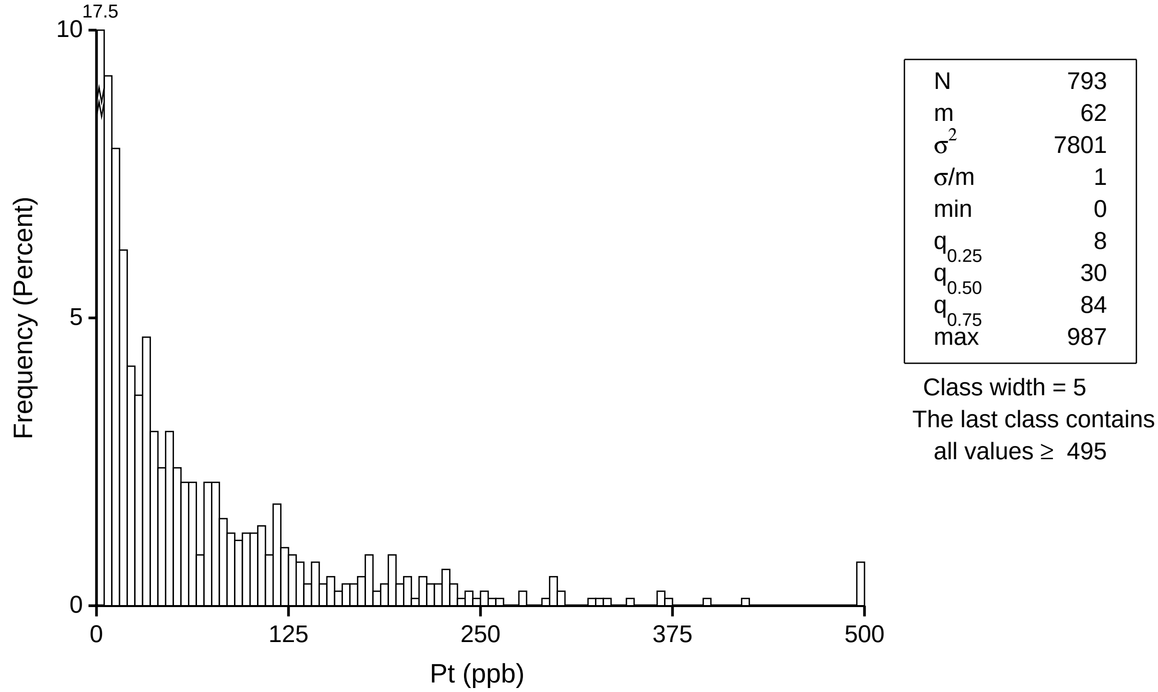

NorthMet - Dom1 top Raw Assay Ni (%) Final Domain
Frequency (Percent)
Ni (%)
N 793
m 0.070
σ2 0.003
σ/m 0.785
min 0.000
q0.25 0.030
q0.50 0.060
q0.75 0.090
max 0.800
Class width = 0.005
The last class contains
all values ≥ 0.495


NorthMet - Dom1 top Raw Assay Ni (%) Final Domain
Ni (%)
Cumulative Probability (percent)

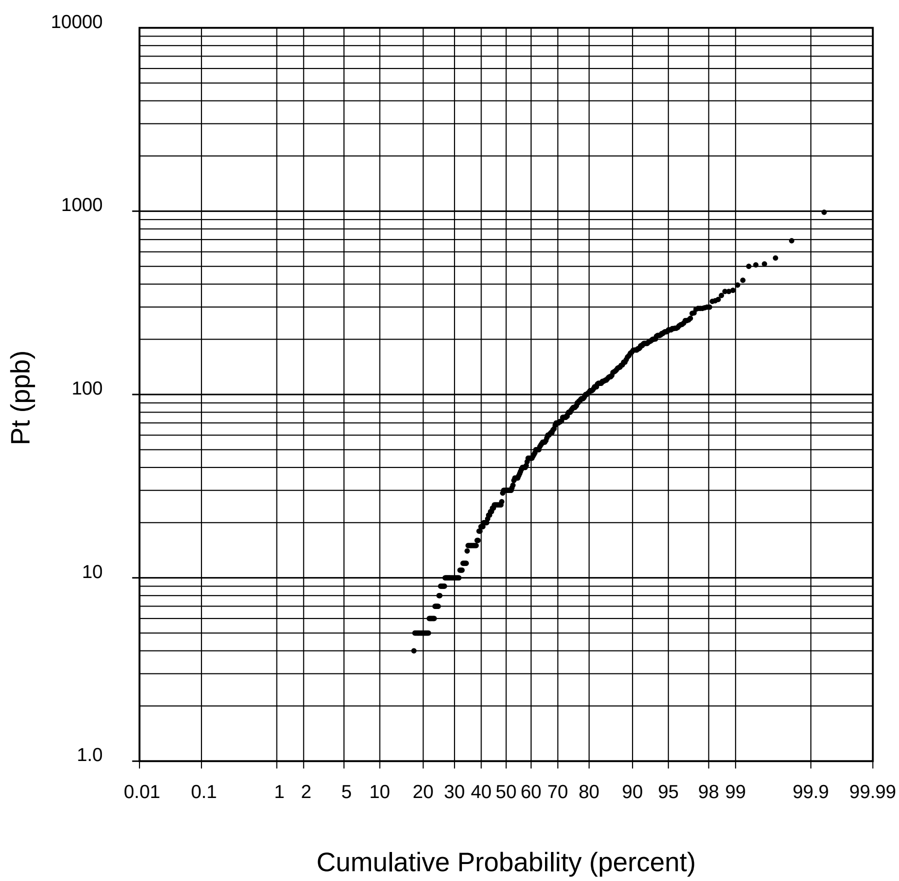

NorthMet - Dom1 Top Raw Assay Pd (ppb) Final Domain
Frequency (Percent)
Pd (ppb)
15.6
10
5
0
0
250
500
750
1000
N 793
m 228
σ2 106104
σ/m 1
min 0
q0.25 20
q0.50 94
q0.75 304
max 3040
Class width = 10
The last class contains
all values ≥ 990


NorthMet - Dom1 Top Raw Assay Pd (ppb) Final Domain
Pd (ppb)
10000
1000
100
10
1.0
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

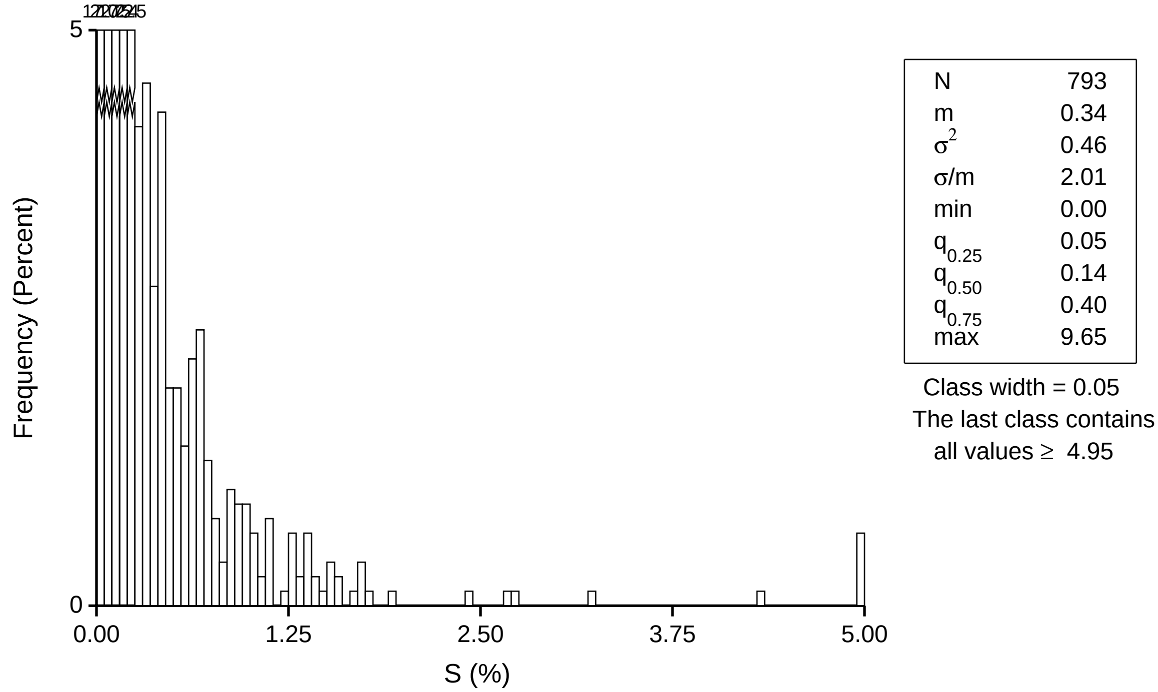
NorthMet - Dom1 Top Raw Assay Pt (ppb) Final Domain



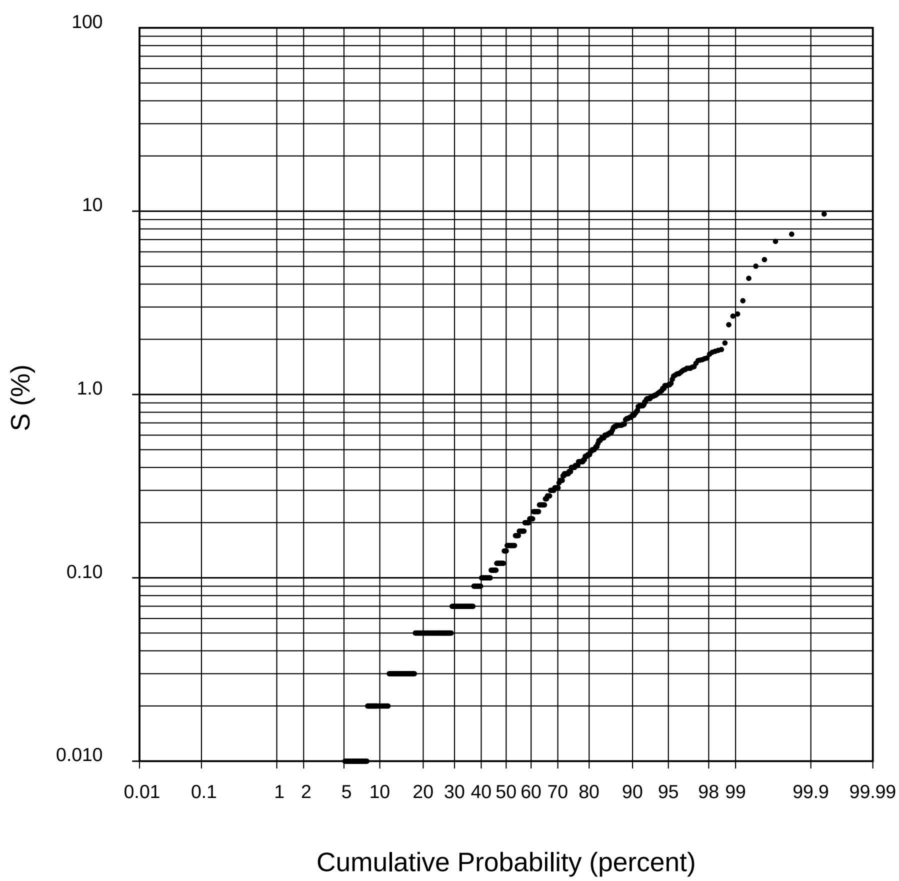
NorthMet - Dom1 Top Raw Assay Pt (ppb) Final Domain

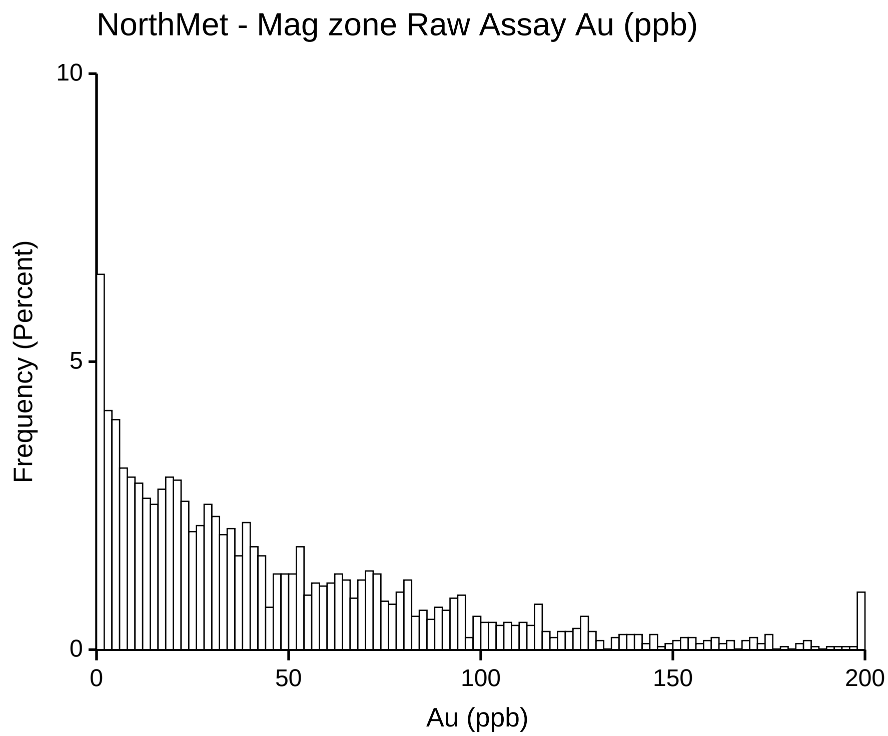


NorthMet - Dom 1 Top Raw Assay S (%) Final Domain



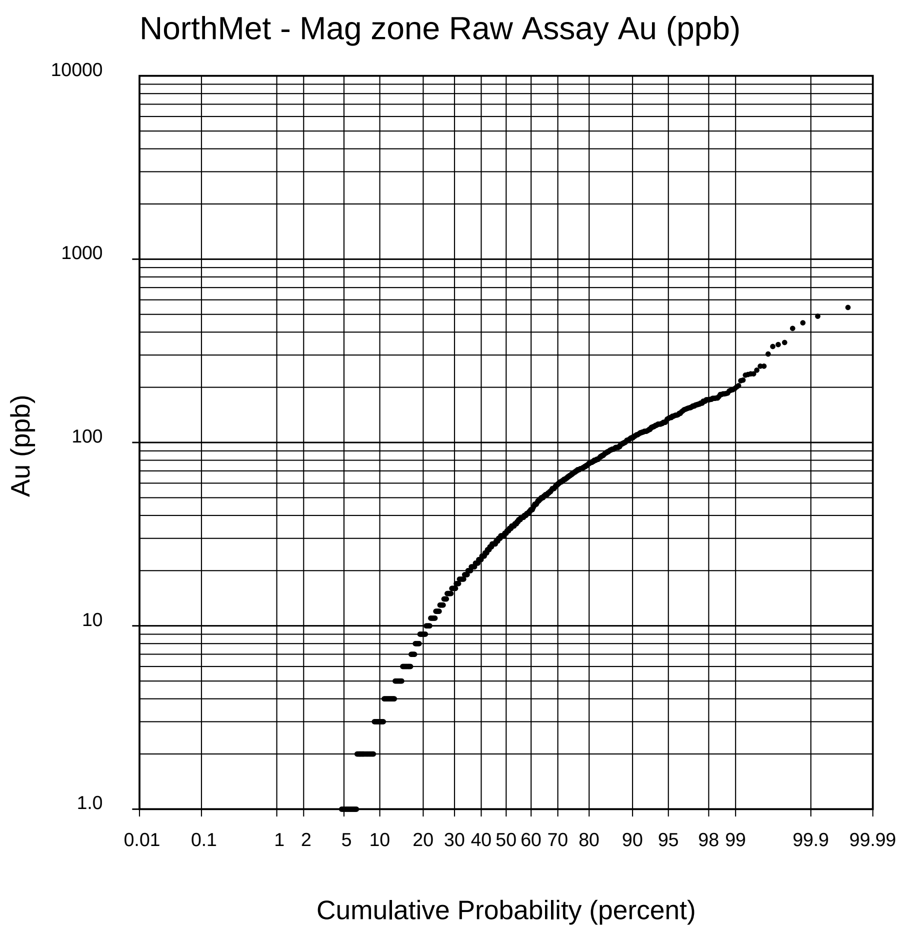
NorthMet - Dom 1 Top Raw Assay S (%) Final Domain



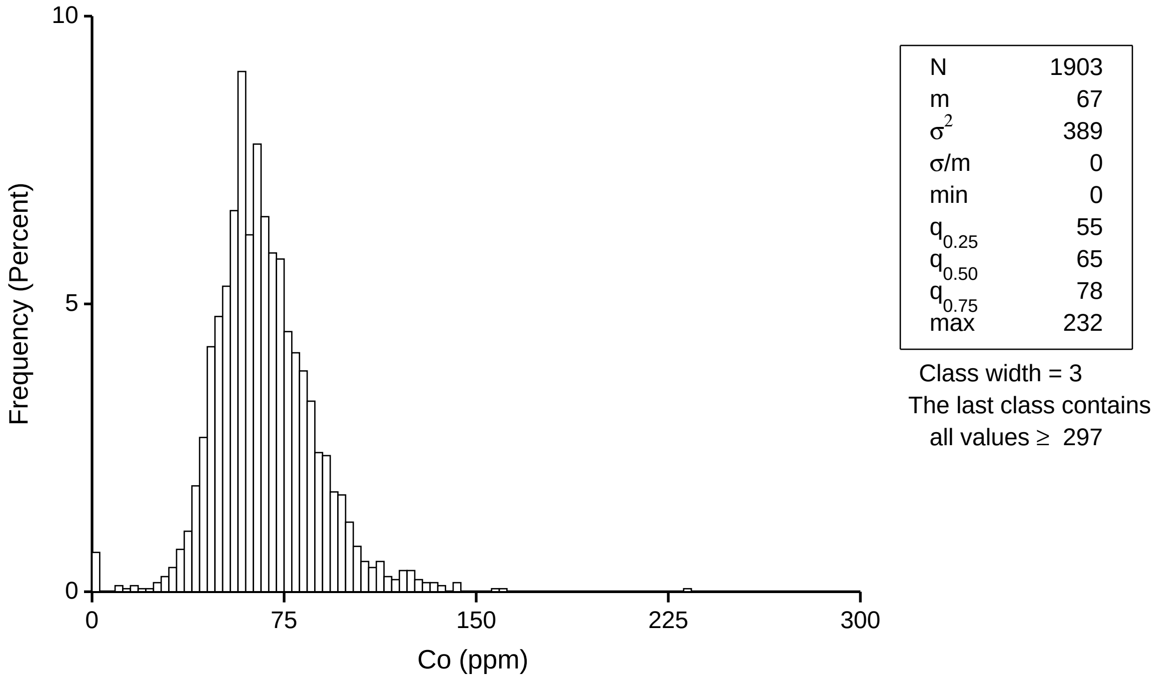


N	1903
m	47
σ^2	2390
σ/m	1
min	0
$q_{0.25}$	12
$q_{0.50}$	32
$q_{0.75}$	68
max	545

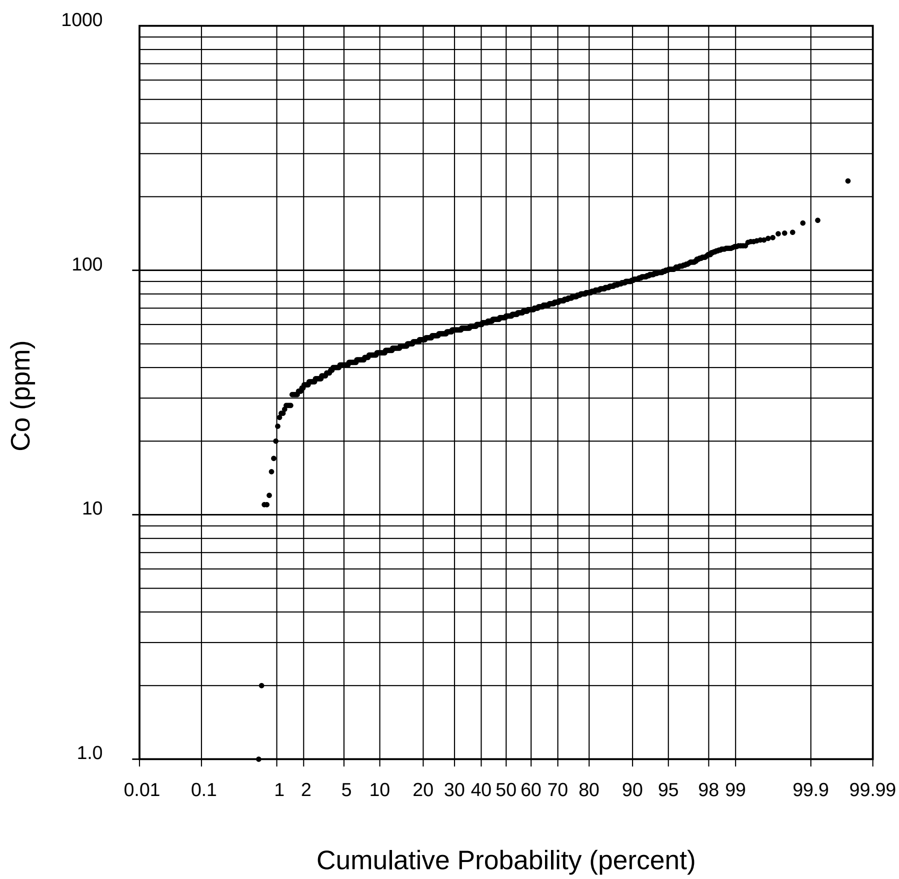
Class width = 2
The last class contains
all values ≥ 198

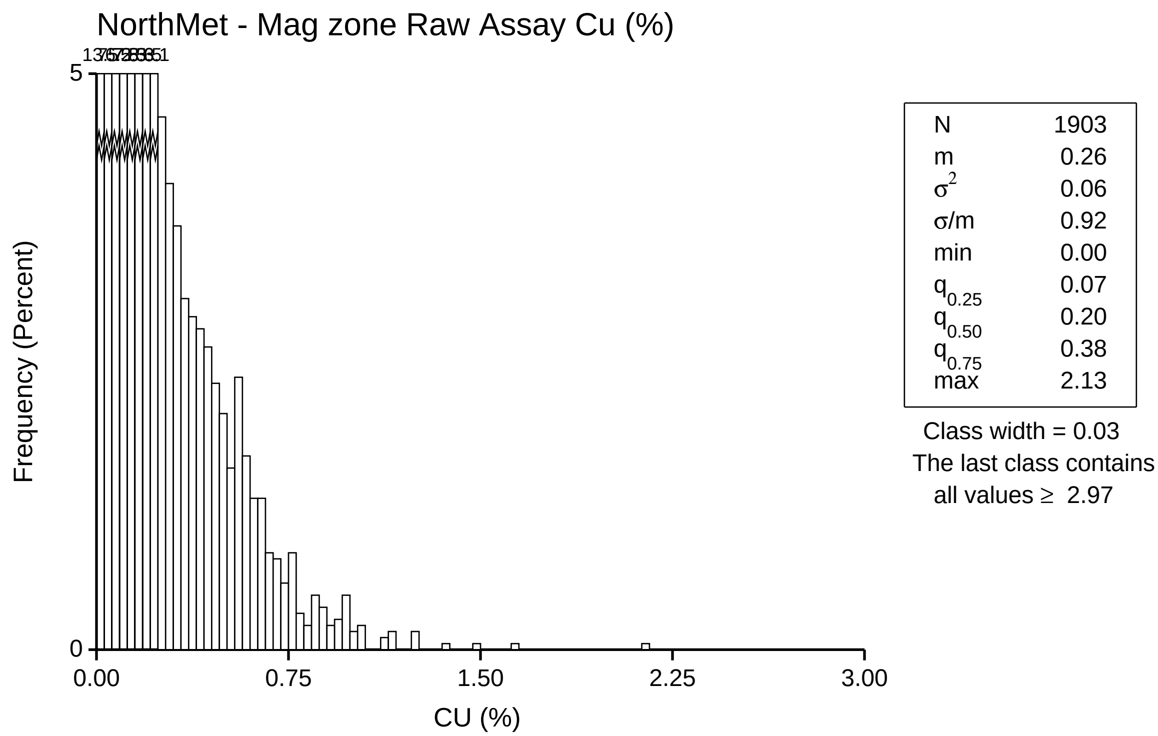


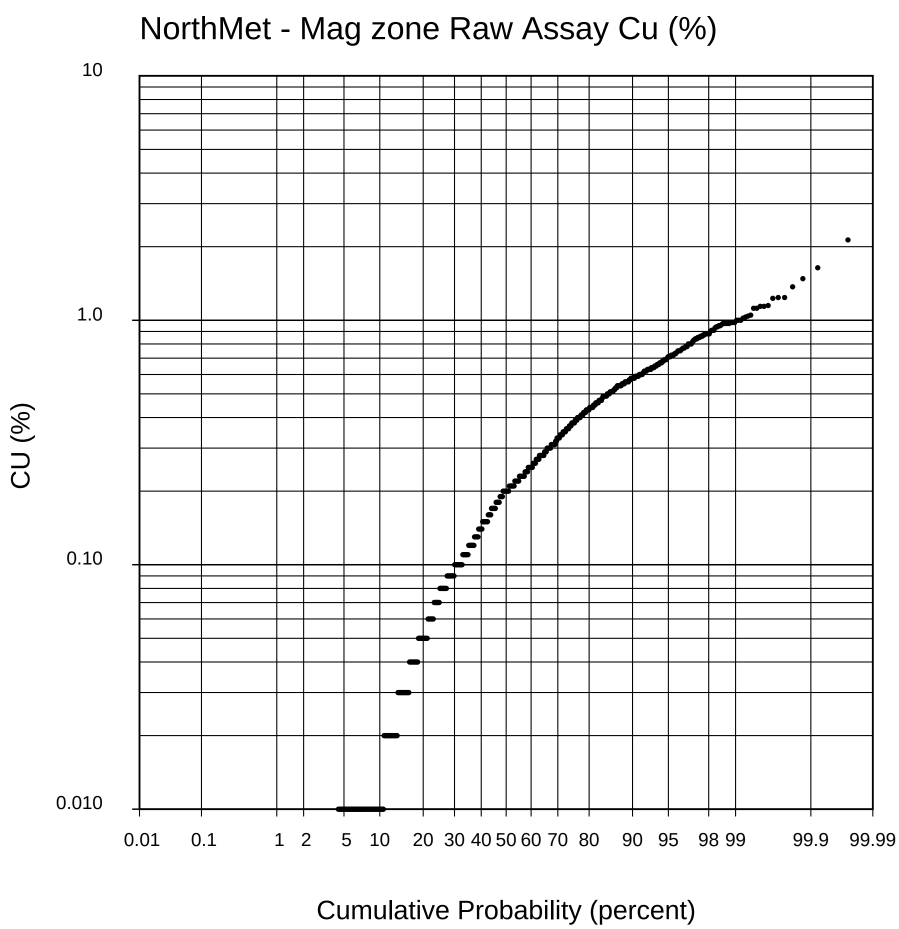
NorthMet - Mag zone Raw Assay Co (ppm)

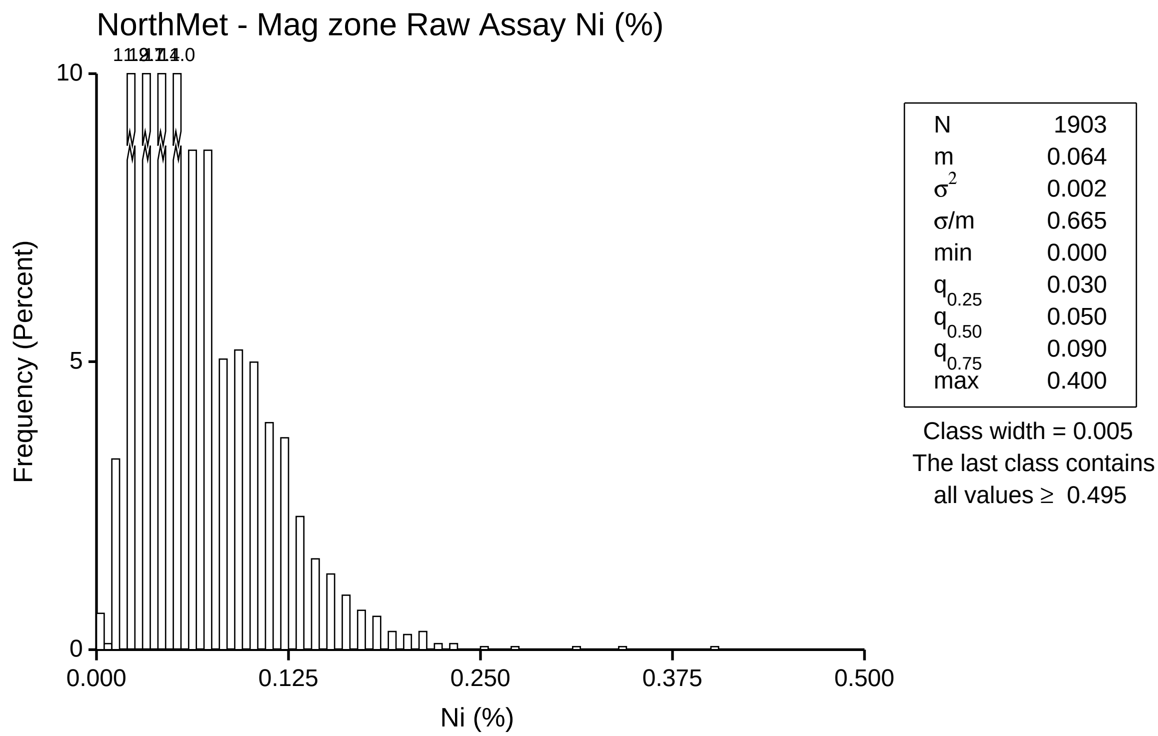


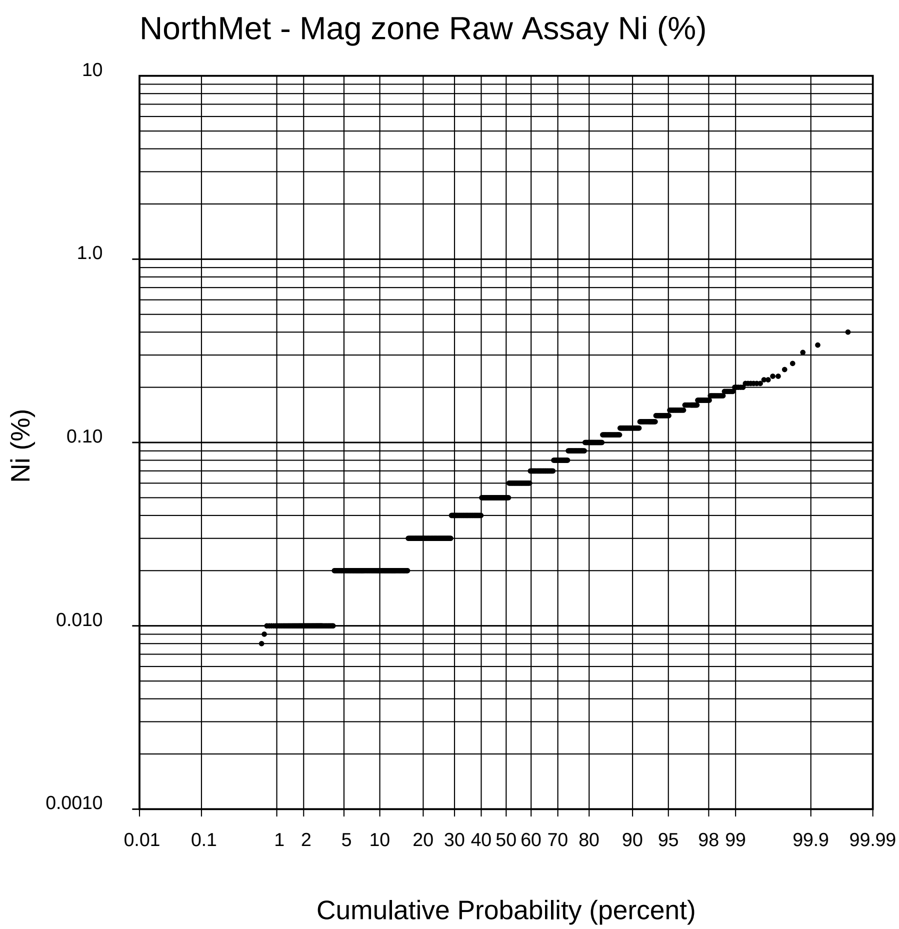
NorthMet - Mag zone Raw Assay Co (ppm)

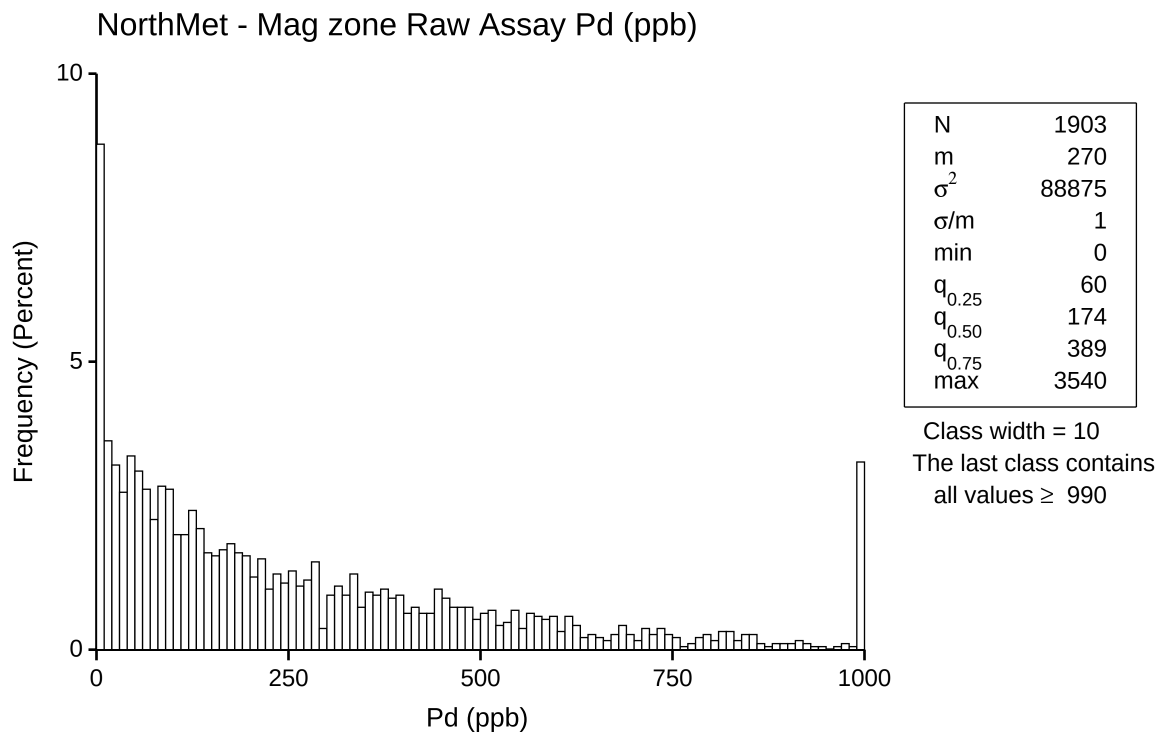


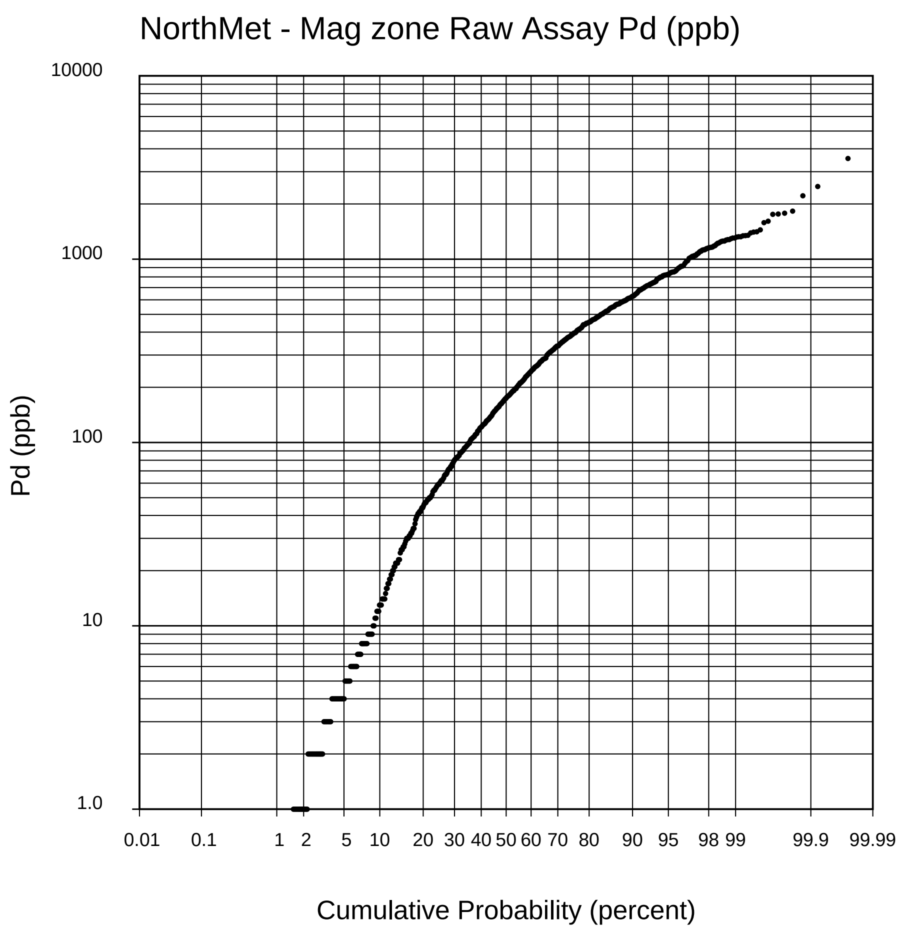

NorthMet - Mag zone Raw Assay Cu (%)
Frequency (Percent)
CU (%)
0.00
0.75
1.50
2.25
3.00
N 1903
m 0.26
σ2 0.06
σ/m 0.92
min 0.00
q0.25 0.07
q0.50 0.20
q0.75 0.38
max 2.13
Class width = 0.03
The last class contains
all values ≥ 2.97

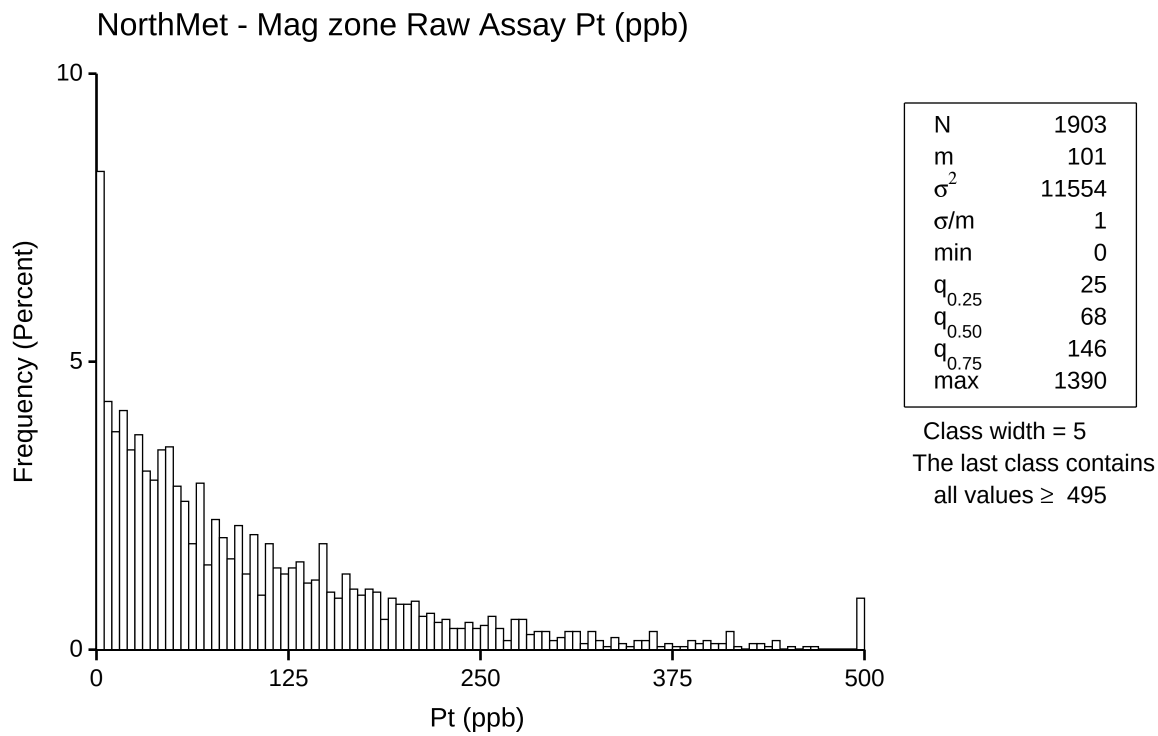

NorthMet - Mag zone Raw Assay Cu (%)
CU (%)
10
1.0
0.10
0.010
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

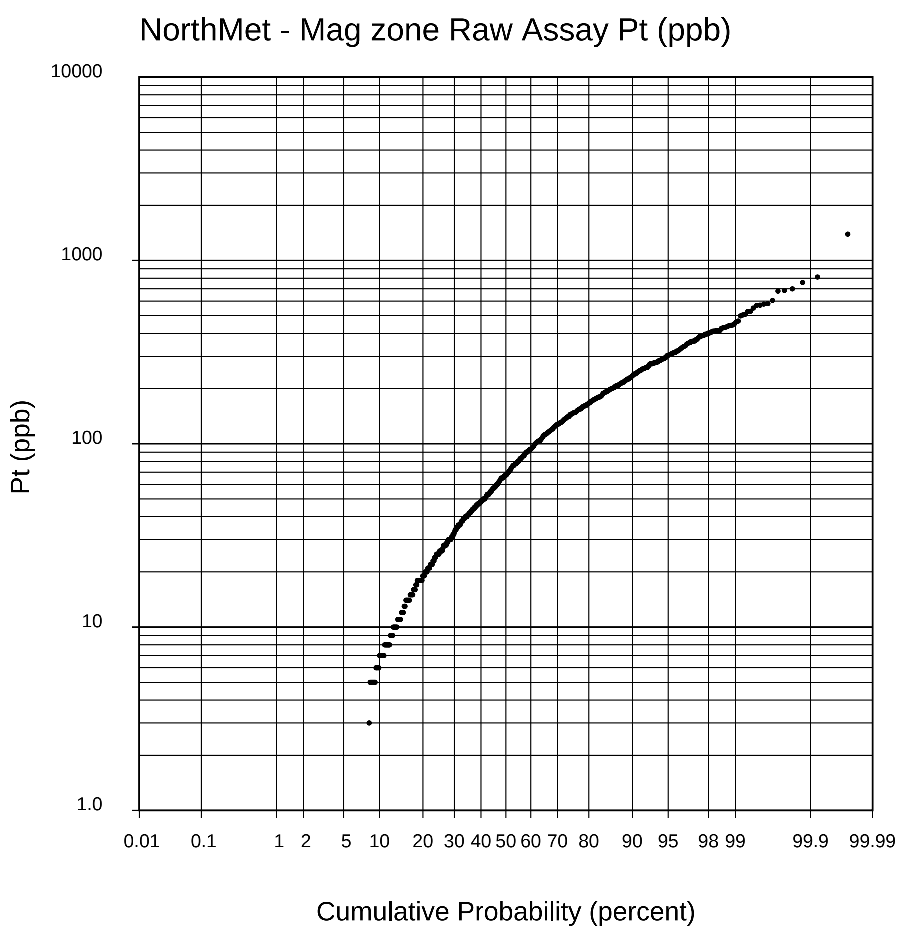

NorthMet - Mag zone Raw Assay Ni (%)
Frequency (Percent)
Ni (%)
0.000
0.125
0.250
0.375
0.500
N 1903
m 0.064
σ2 0.002
σ/m 0.665
min 0.000
q0.25 0.030
q0.50 0.050
q0.75 0.090
max 0.400
Class width = 0.005
The last class contains
all values ≥ 0.495


NorthMet - Mag zone Raw Assay Ni (%)
Ni (%)
10
1.0
0.10
0.010
0.0010
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

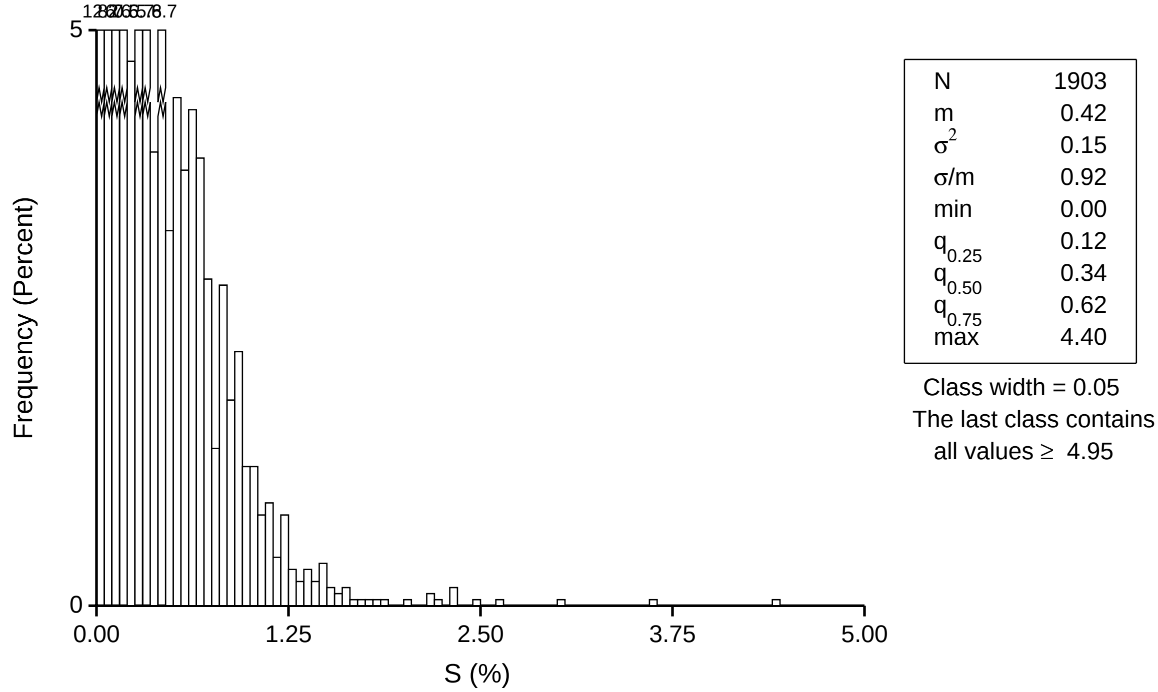

NorthMet - Mag zone Raw Assay Pd (ppb)
Frequency (Percent)
Pd (ppb)
N 1903
m 270
σ2 88875
σ/m 1
min 0
q0.25 60
q0.50 174
q0.75 389
max 3540
Class width = 10
The last class contains
all values ≥ 990


NorthMet - Mag zone Raw Assay Pd (ppb)
Pd (ppb)
Cumulative Probability (percent)

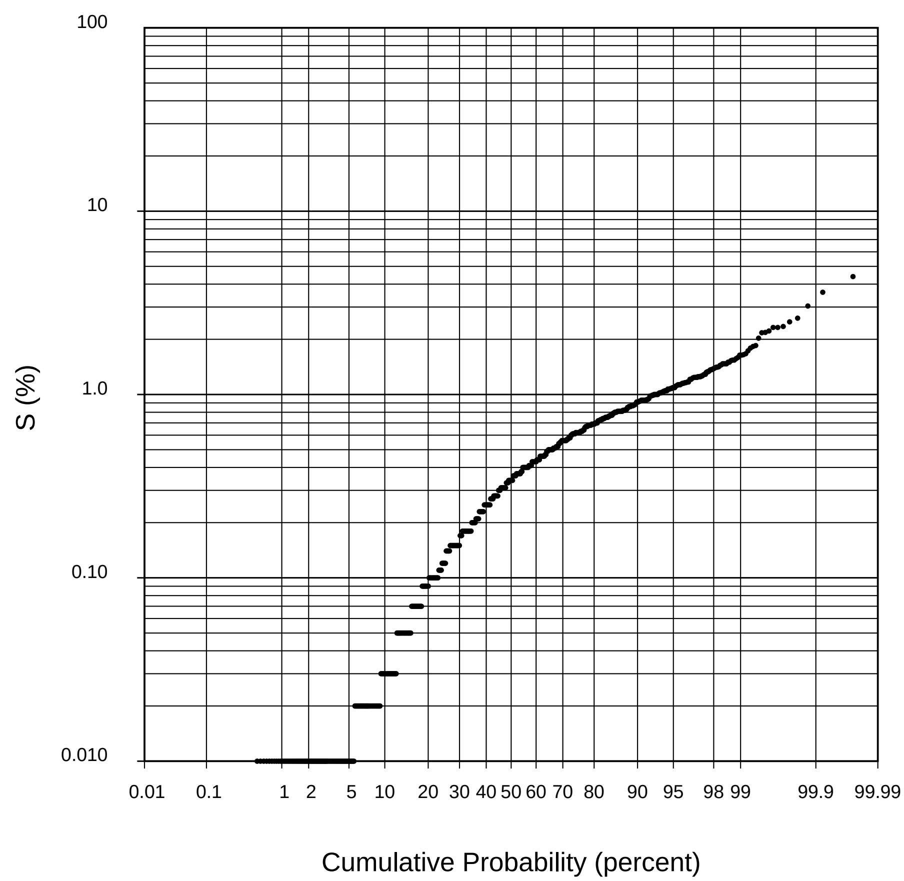

NorthMet - Mag zone Raw Assay Pt (ppb)
Frequency (Percent)
Pt (ppb)
N 1903
m 101
σ2 11554
σ/m 1
min 0
q0.25 25
q0.50 68
q0.75 146
max 1390
Class width = 5
The last class contains all values ≥ 495

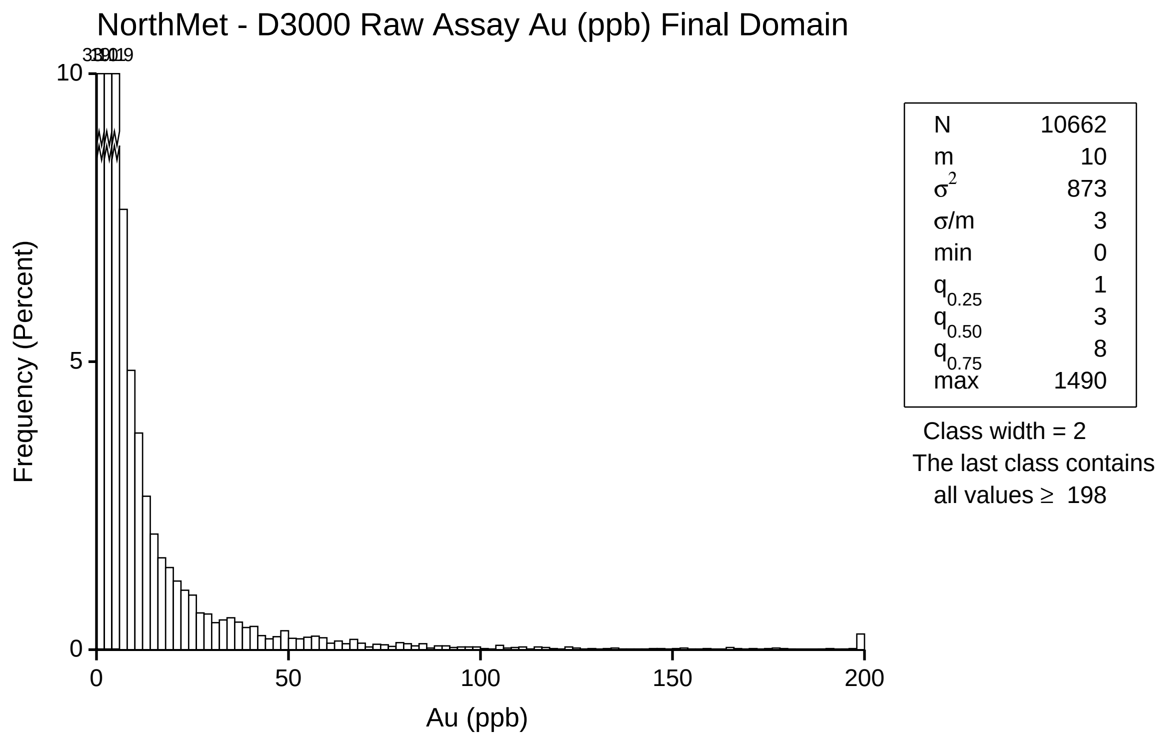

NorthMet - Mag zone Raw Assay Pt (ppb)
Pt (ppb)
Cumulative Probability (percent)

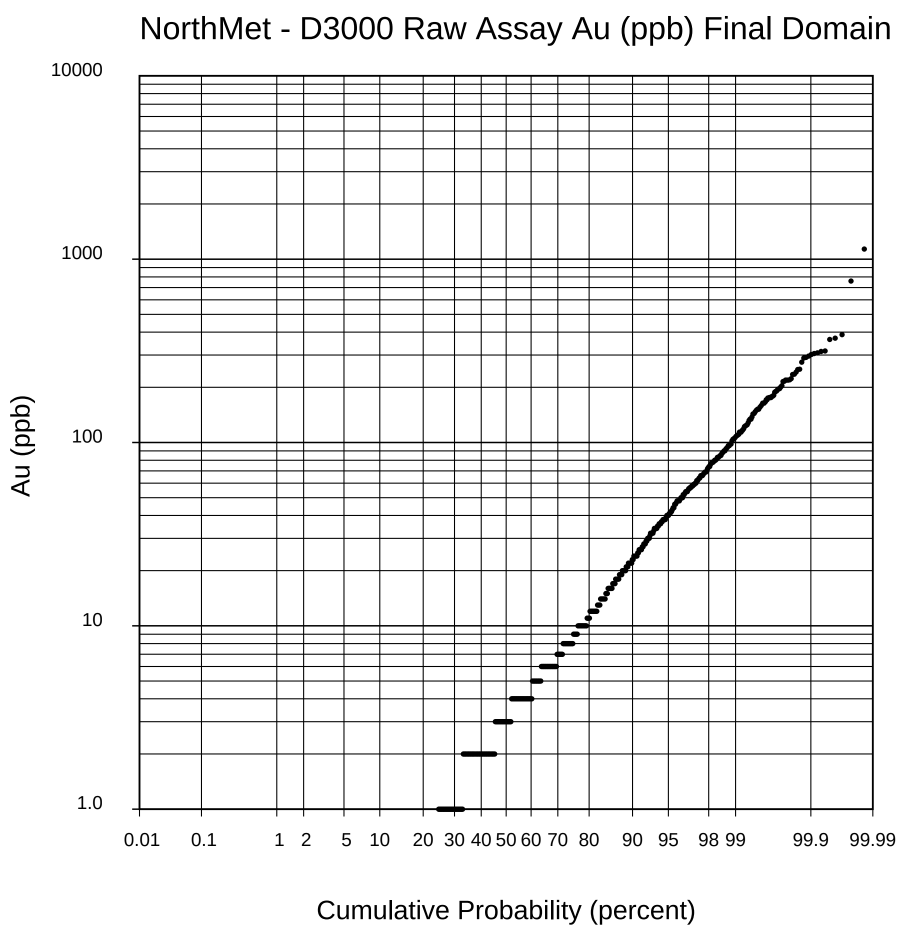
NorthMet - Mag zone Raw Assay S (%)



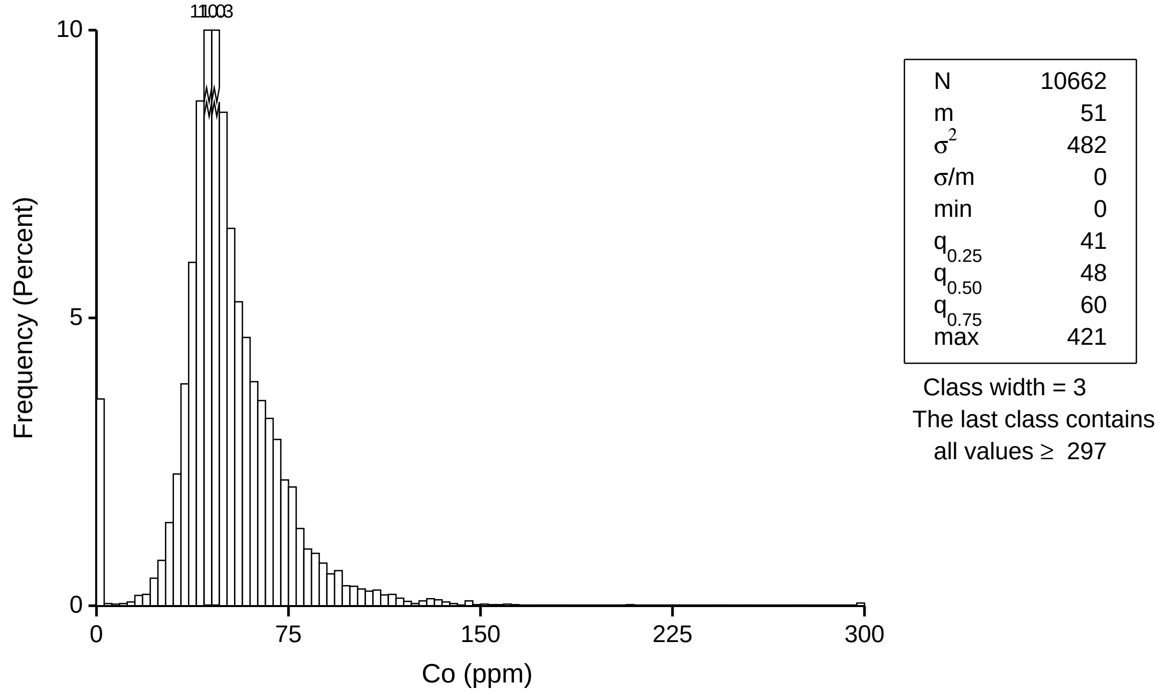
NorthMet - Mag zone Raw Assay S (%)



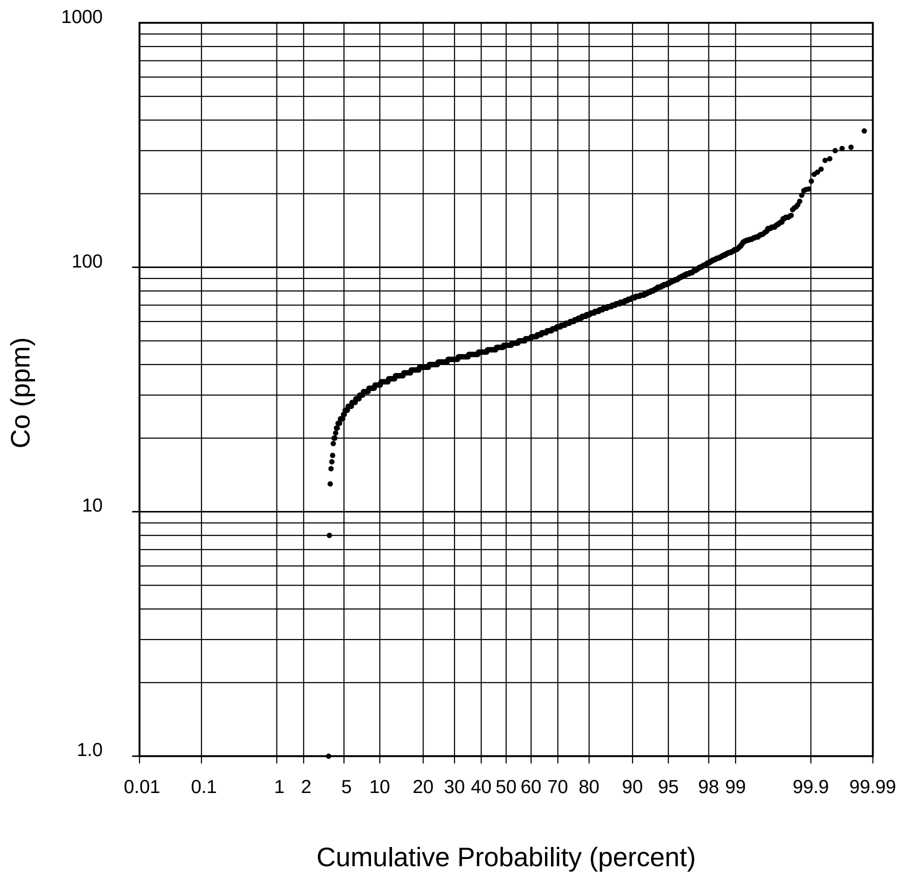

NorthMet - D3000 Raw Assay Au (ppb) Final Domain
10
5
0
0
50
100
150
200
Au (ppb)
Frequency (Percent)
N 10662
m 10
σ2 873
σ/m 3
min 0
q0.25 1
q0.50 3
q0.75 8
max 1490
Class width = 2
The last class contains
all values ≥ 198

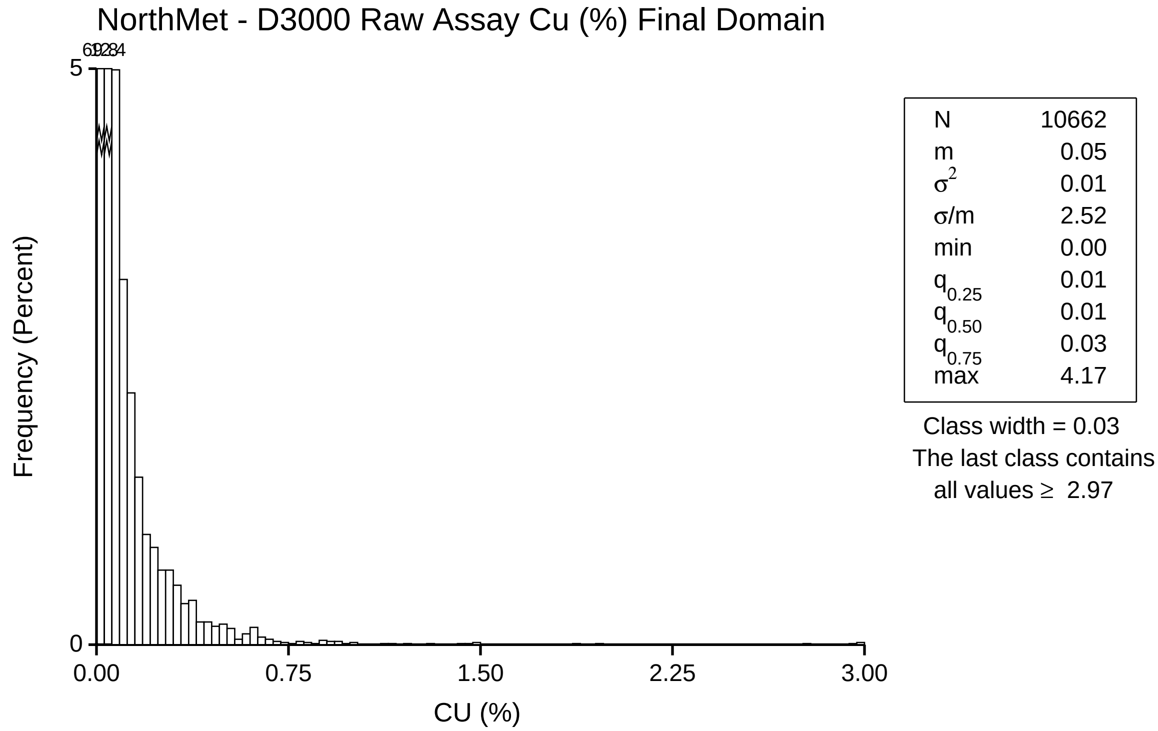

NorthMet - D3000 Raw Assay Au (ppb) Final Domain
10000
1000
100
10
1.0
Au (ppb)
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

NorthMet - D3000 Raw Assay Co (ppm) - Final Domain

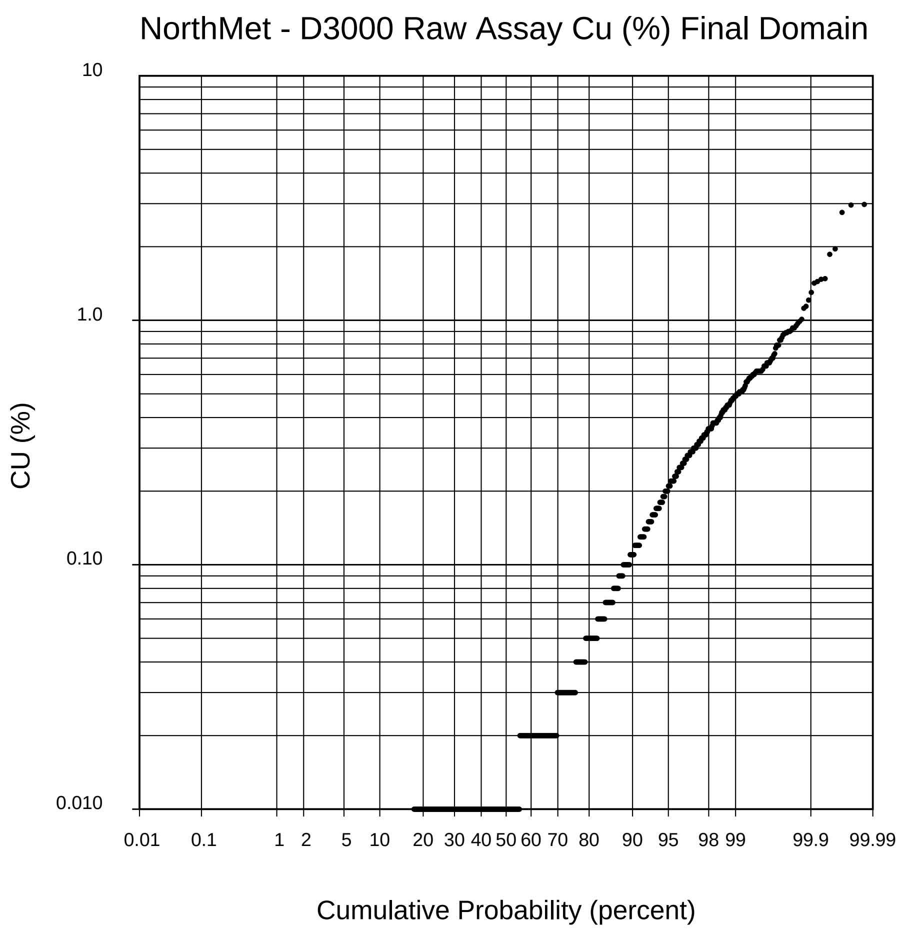


NorthMet - D3000 Raw Assay Co (ppm) - Final Domain



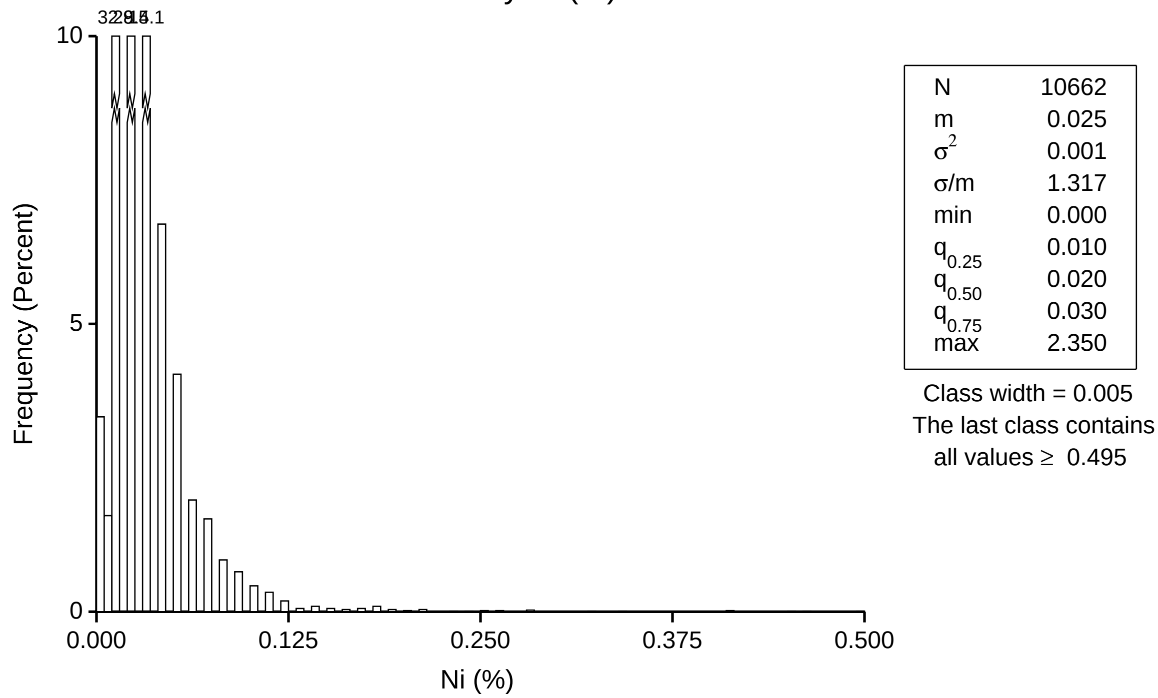


NorthMet - D3000 Raw Assay Cu (%) Final Domain
Frequency (Percent)
CU (%)
0.00
0.75
1.50
2.25
3.00
0
5
N 10662
m 0.05
σ2 0.01
σ/m 2.52
min 0.00
q0.25 0.01
q0.50 0.01
q0.75 0.03
max 4.17
Class width = 0.03
The last class contains
all values ≥ 2.97

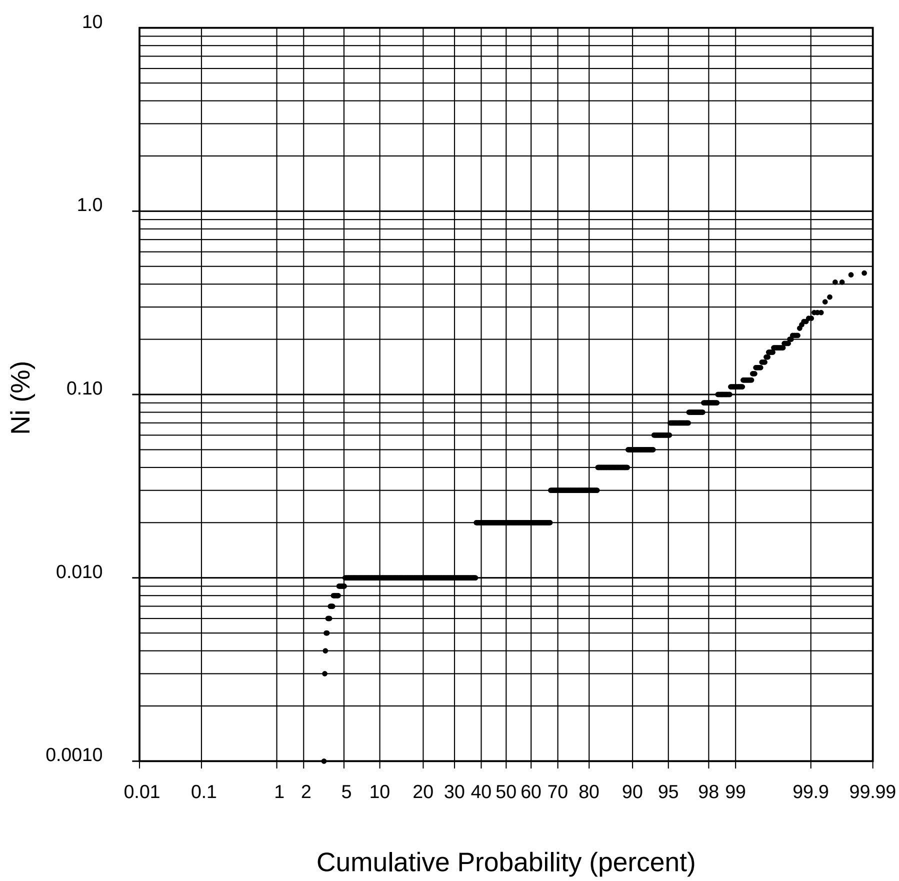


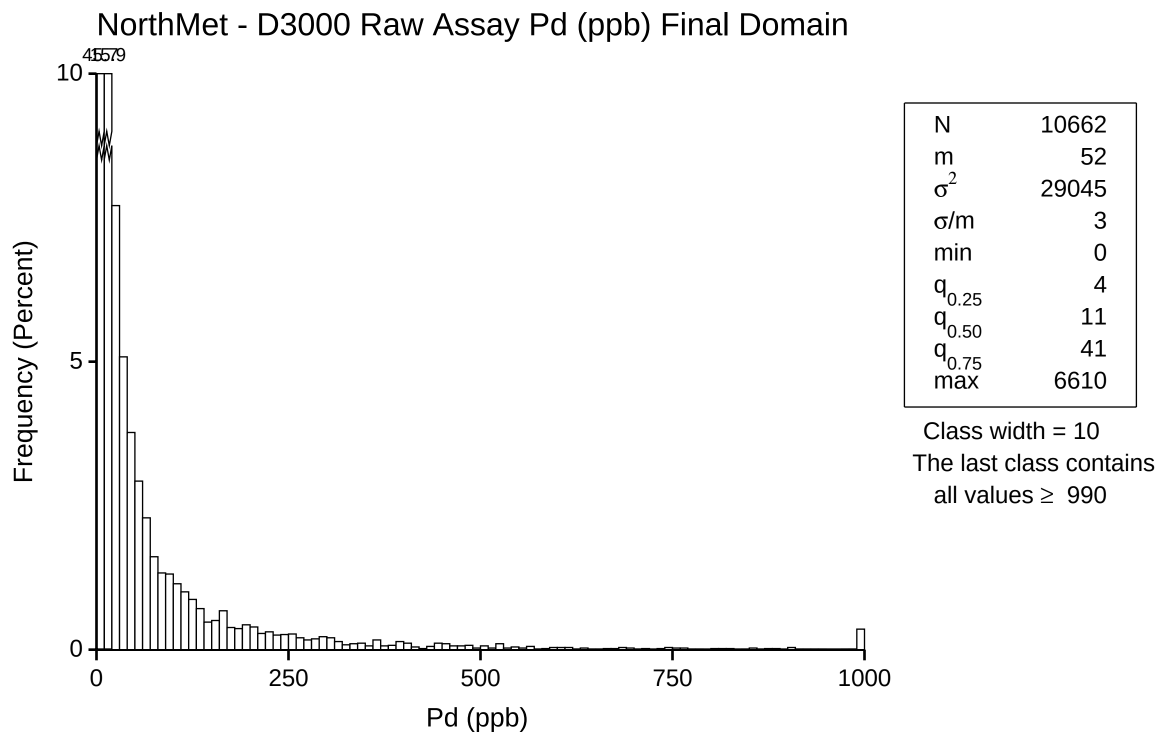
NorthMet - D3000 Raw Assay Cu (%) Final Domain
CU (%)
10
1.0
0.10
0.010
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

NorthMet - D3000 Raw Assay Ni (%) Final Domain.

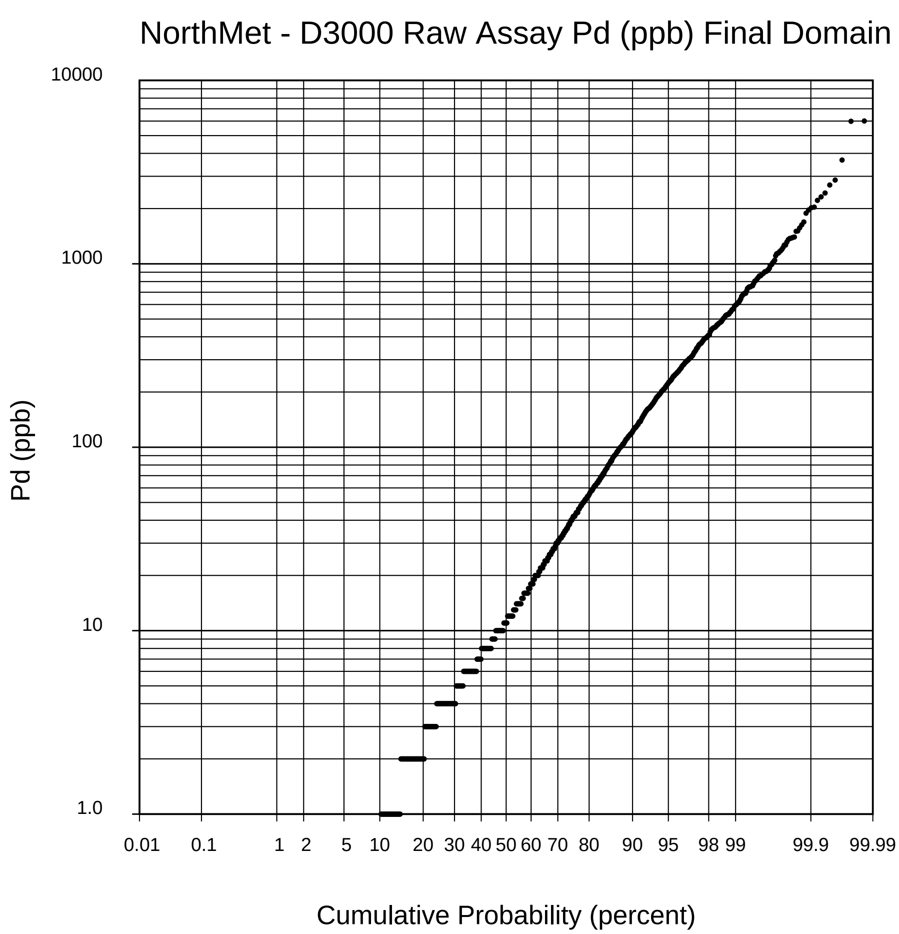


NorthMet - D3000 Raw Assay Ni (%) Final Domain.

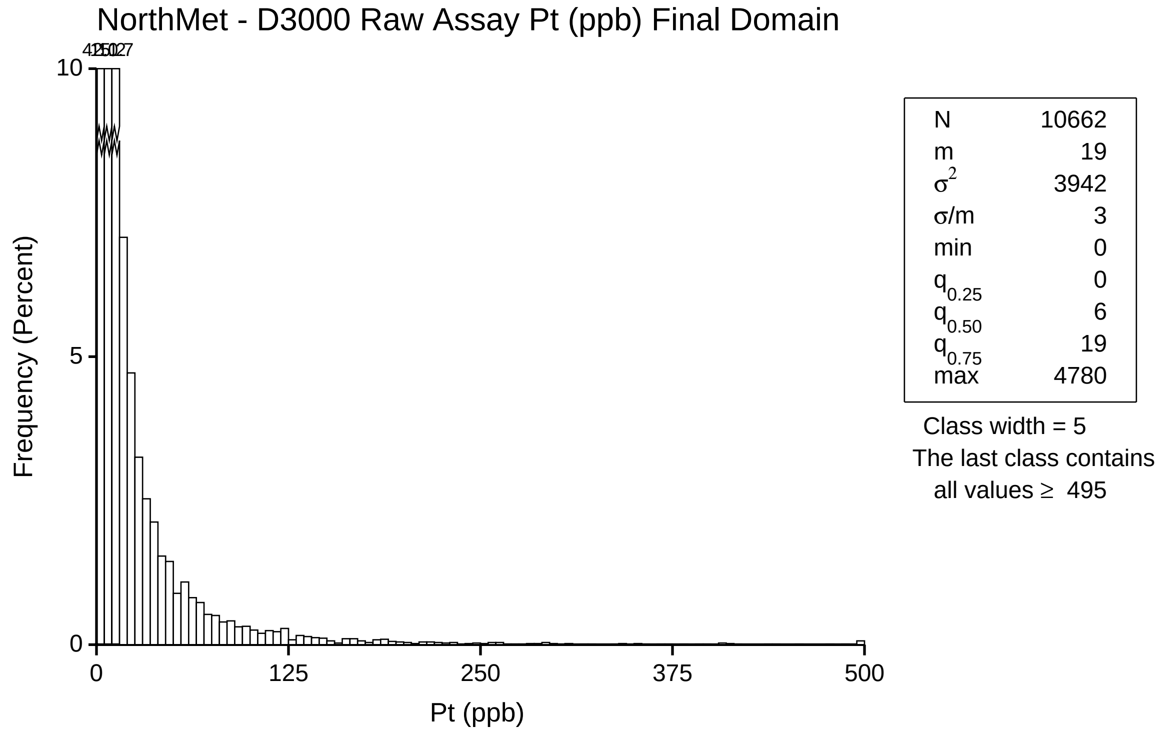


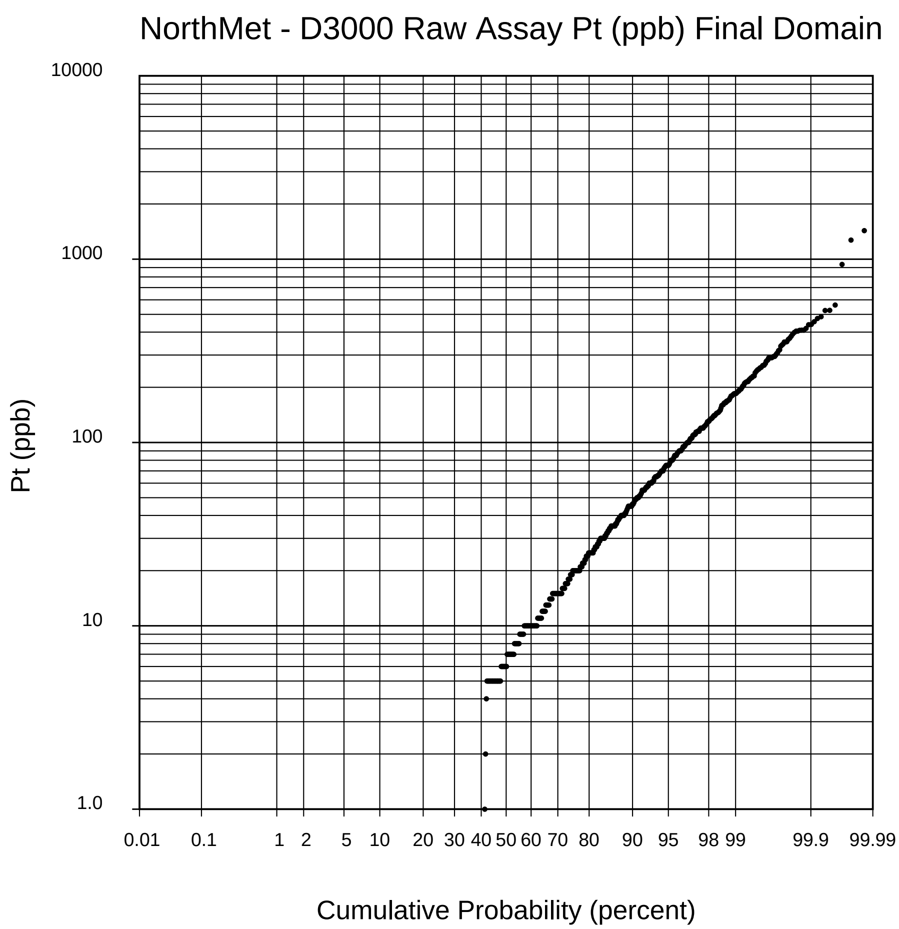


NorthMet - D3000 Raw Assay Pd (ppb) Final Domain
Frequency (Percent)
Pd (ppb)
N 10662
m 52
σ² 29045
σ/m 3
min 0
q0.25 4
q0.50 11
q0.75 41
max 6610
Class width = 10
The last class contains
all values ≥ 990

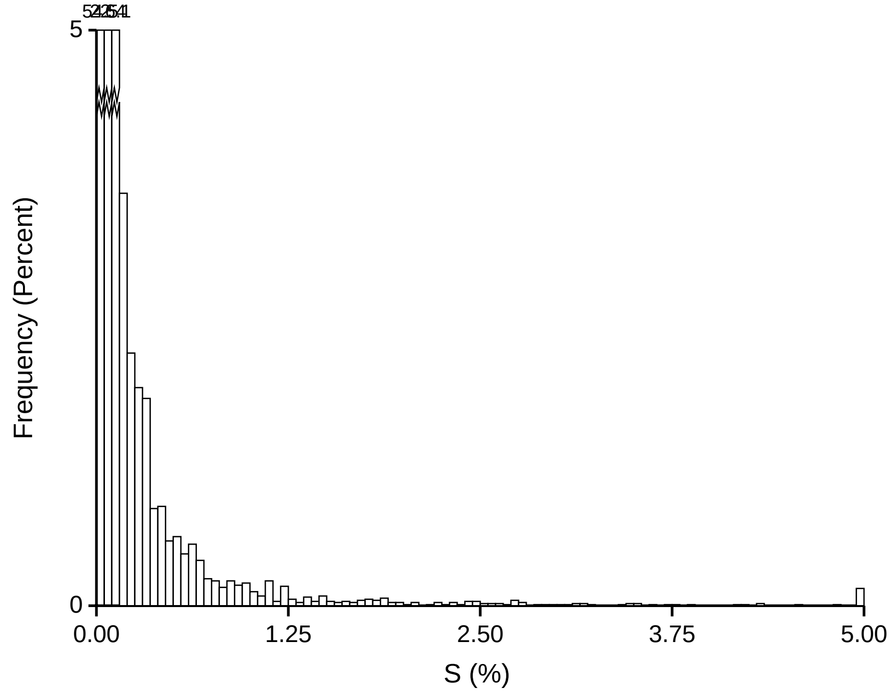


NorthMet - D3000 Raw Assay Pd (ppb) Final Domain
Pd (ppb)
Cumulative Probability (percent)


NorthMet - D3000 Raw Assay Pt (ppb) Final Domain
Frequency (Percent)
Pt (ppb)
N 10662
m 19
σ2 3942
σ/m 3
min 0
q0.25 0
q0.50 6
q0.75 19
max 4780
Class width = 5
The last class contains
all values ≥ 495


NorthMet - D3000 Raw Assay Pt (ppb) Final Domain
Pt (ppb)
Cumulative Probability (percent)

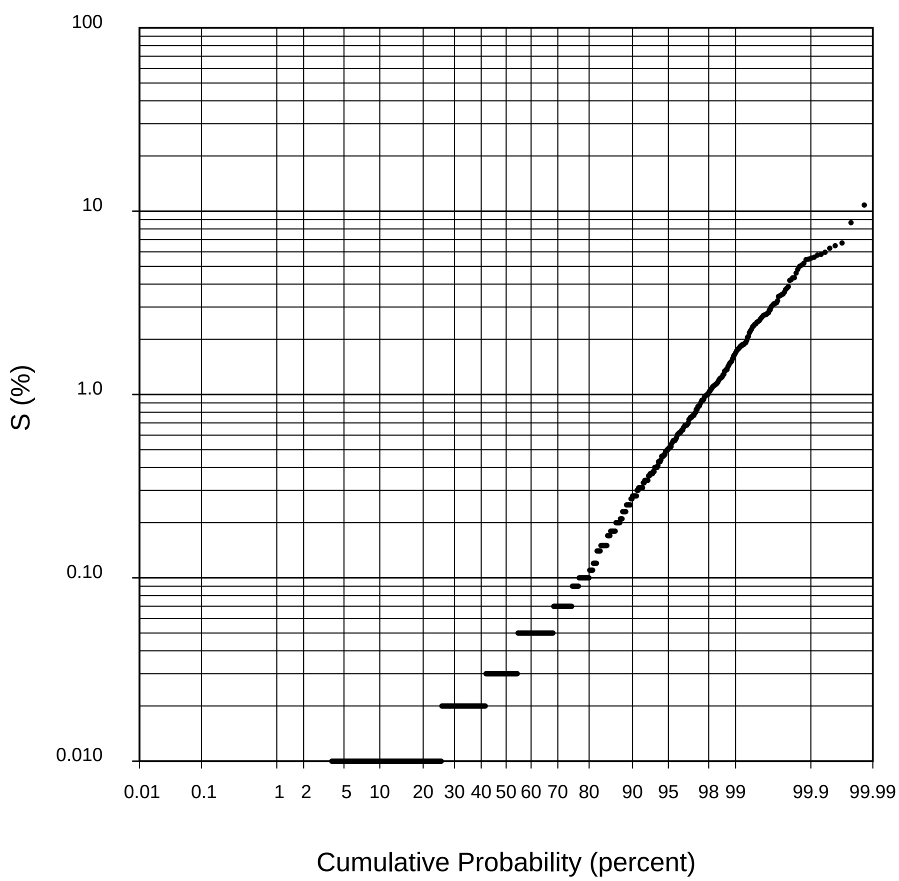
NorthMet - D-3000 Raw Assay S (%) Final Domain

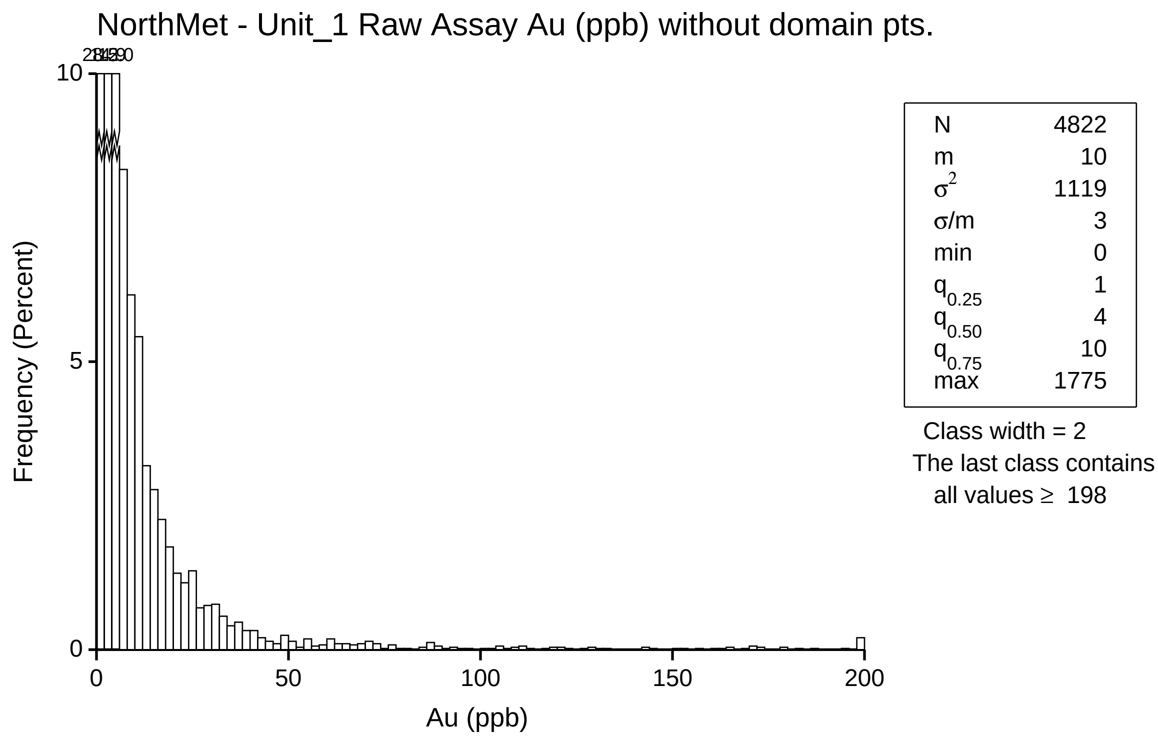


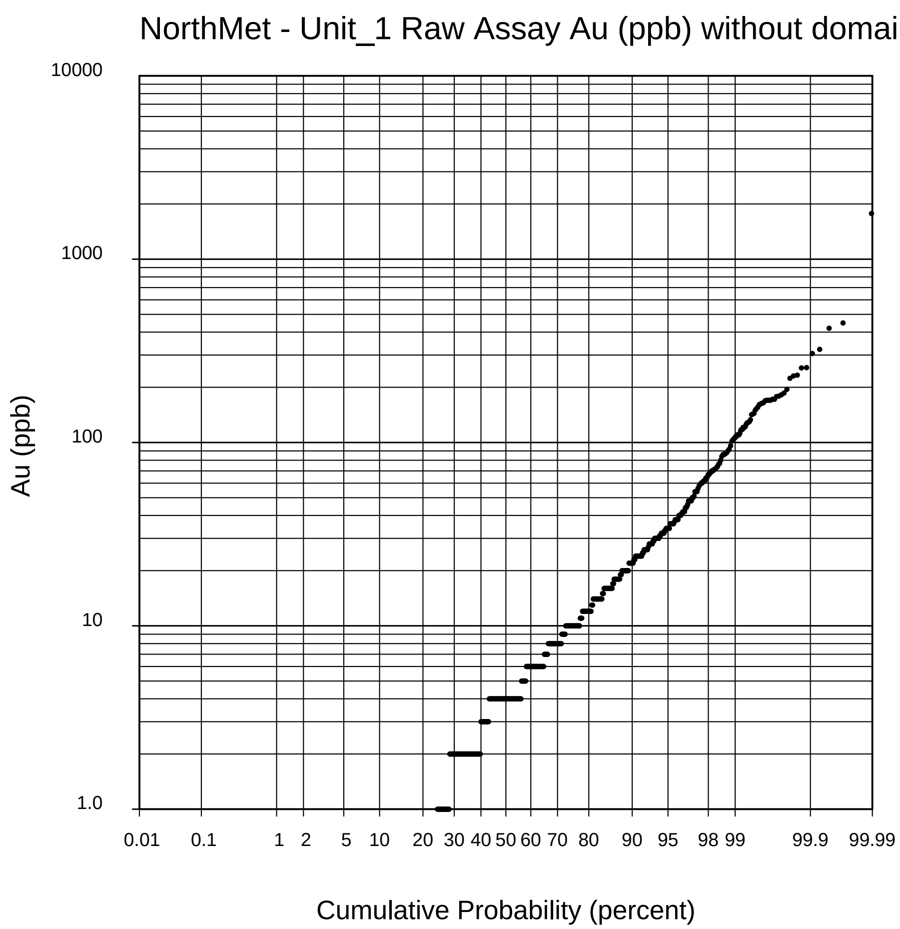
N	10662
m	0.13
σ^2	0.16
σ/m	3.16
min	0.00
$q_{0.25}$	0.01
$q_{0.50}$	0.03
$q_{0.75}$	0.09
max	12.22

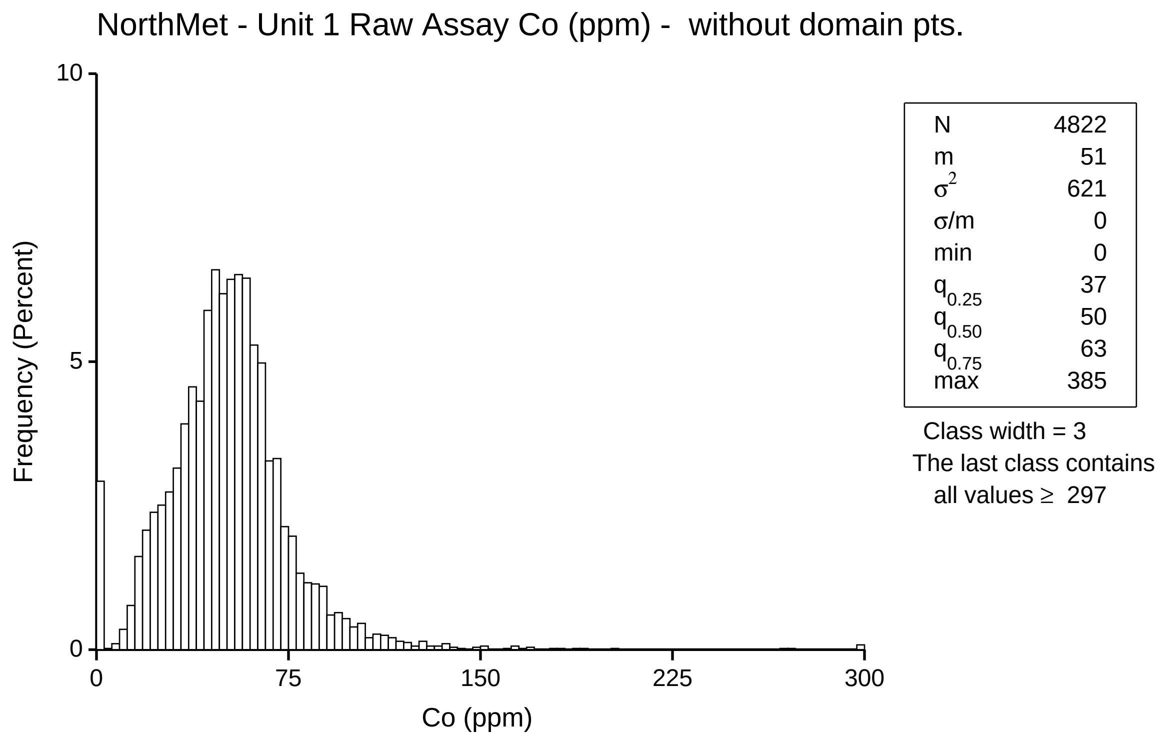
Class width = 0.05
The last class contains all values ≥ 4.95

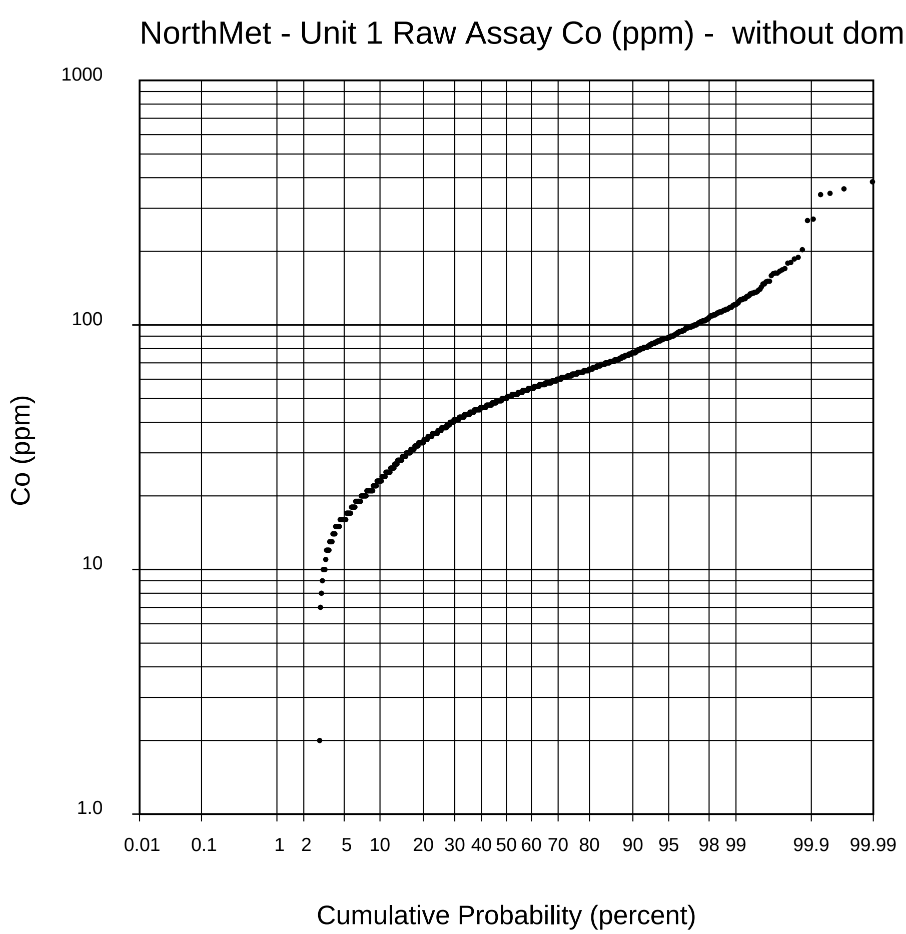
NorthMet - D-3000 Raw Assay S (%) Final Domain



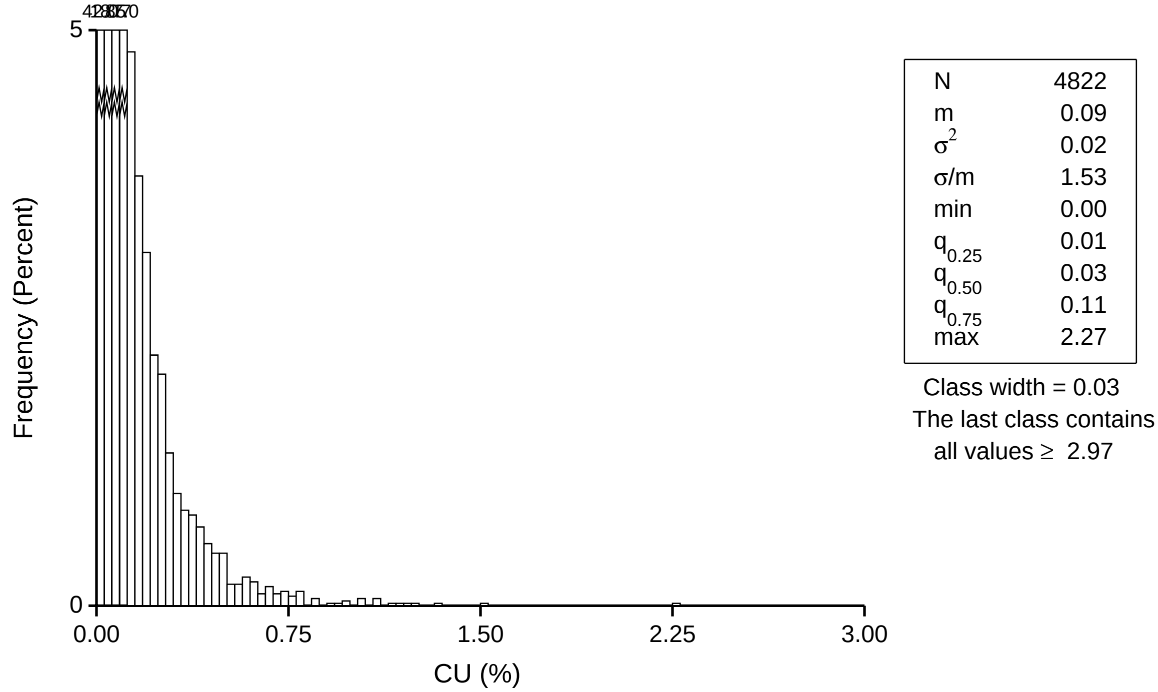

NorthMet - Unit_1 Raw Assay Au (ppb) without domain pts.
Frequency (Percent)
Au (ppb)
0
50
100
150
200
5
10
N 4822
m 10
σ2 1119
σ/m 3
min 0
q0.25 1
q0.50 4
q0.75 10
max 1775
Class width = 2
The last class contains
all values ≥ 198


NorthMet - Unit_1 Raw Assay Au (ppb) without domain pts.
Au (ppb)
10000
1000
100
10
1.0
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

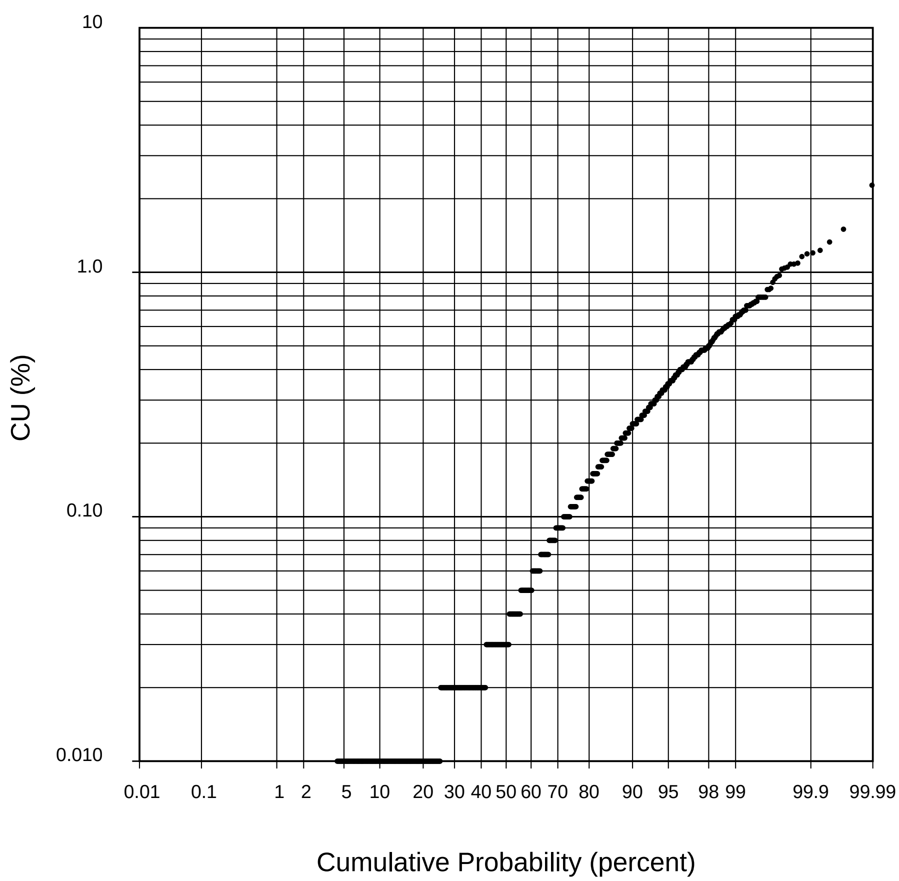

NorthMet - Unit 1 Raw Assay Co (ppm) - without domain pts.
Frequency (Percent)
10
5
0
0
75
150
225
300
Co (ppm)
N 4822
m 51
σ2 621
σ/m 0
min 0
q0.25 37
q0.50 50
q0.75 63
max 385
Class width = 3
The last class contains
all values ≥ 297

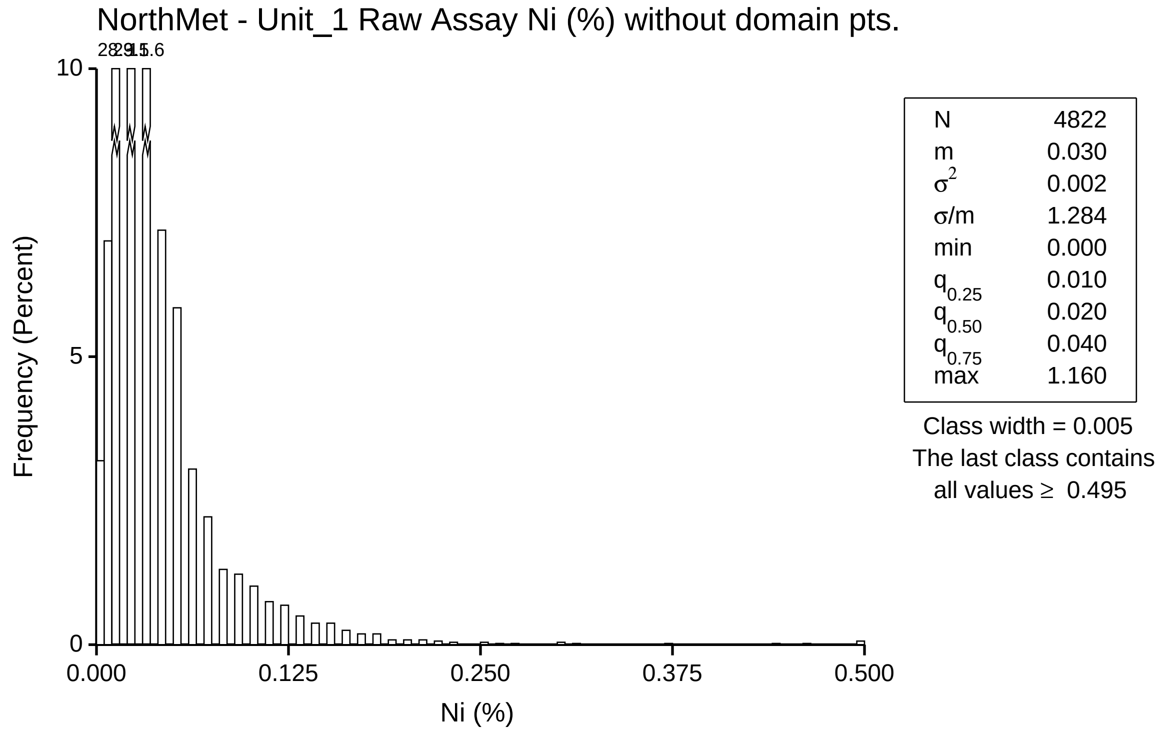

NorthMet - Unit 1 Raw Assay Co (ppm) - without domain pts.
Co (ppm)
1000
100
10
1.0
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

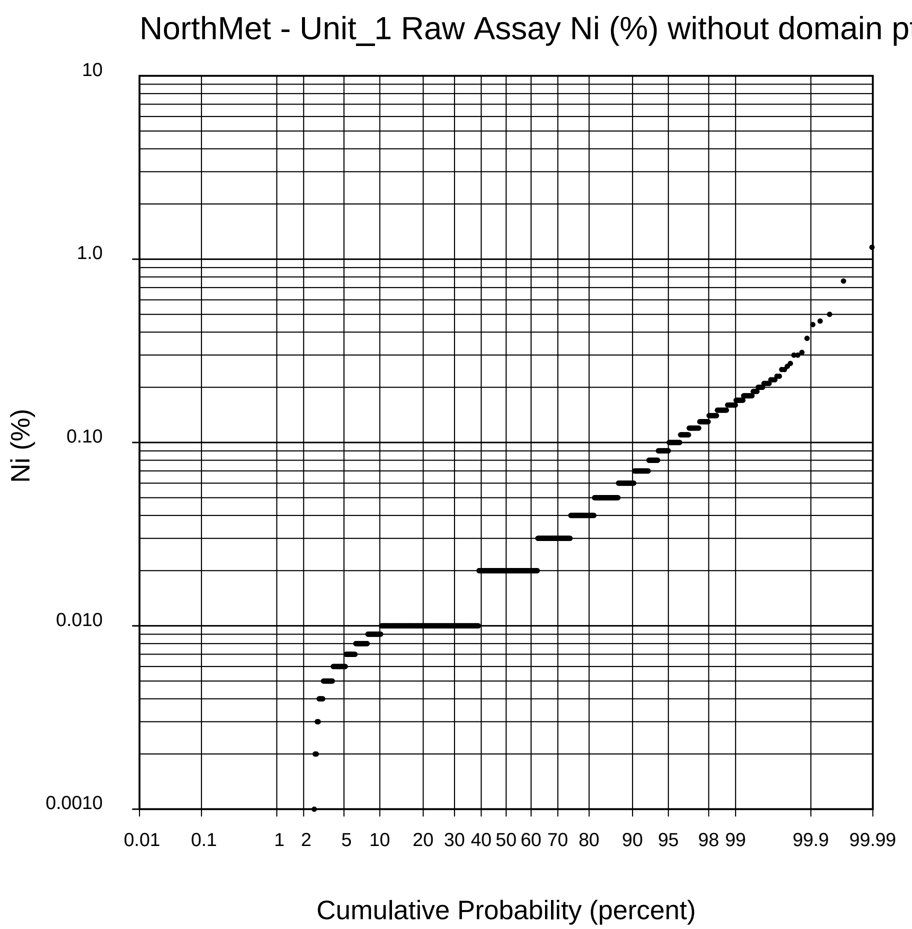
NorthMet - Unit_1 Raw Assay Cu (%) without domain pts.



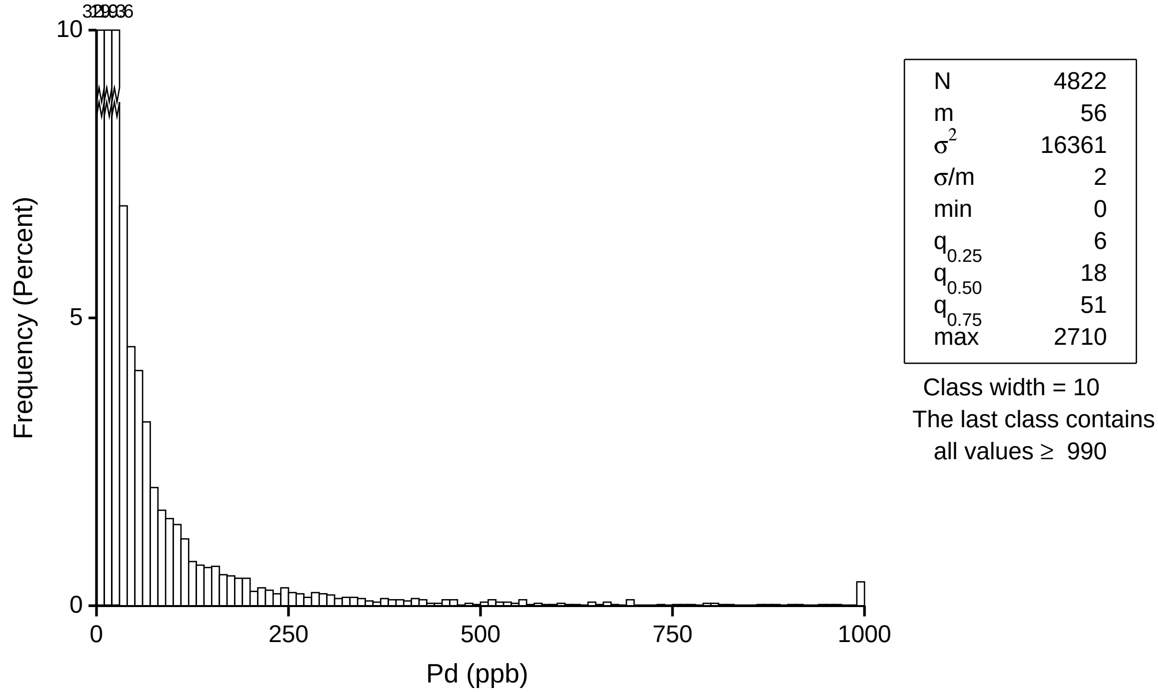
NorthMet - Unit_1 Raw Assay Cu (%) without domain pts.



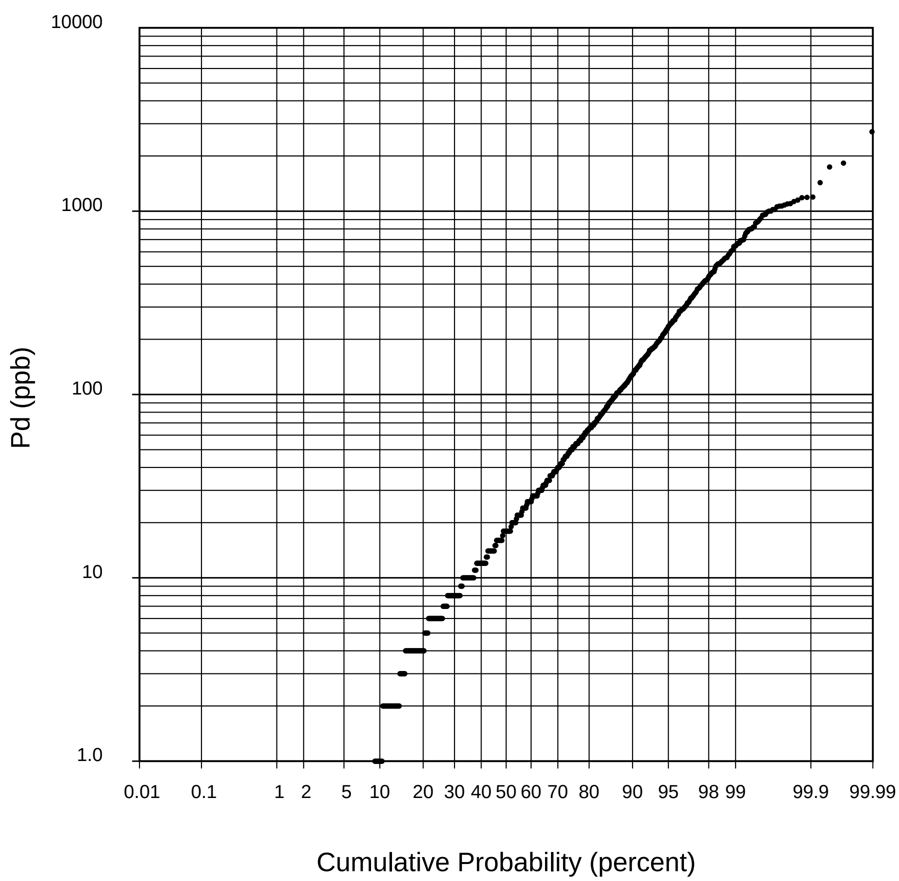

NorthMet - Unit_1 Raw Assay Ni (%) without domain pts.
28.9
29.1
15.6
10
5
0
Frequency (Percent)
0.000
0.125
0.250
0.375
0.500
Ni (%)
N 4822
m 0.030
σ2 0.002
σ/m 1.284
min 0.000
q0.25 0.010
q0.50 0.020
q0.75 0.040
max 1.160
Class width = 0.005
The last class contains
all values ≥ 0.495

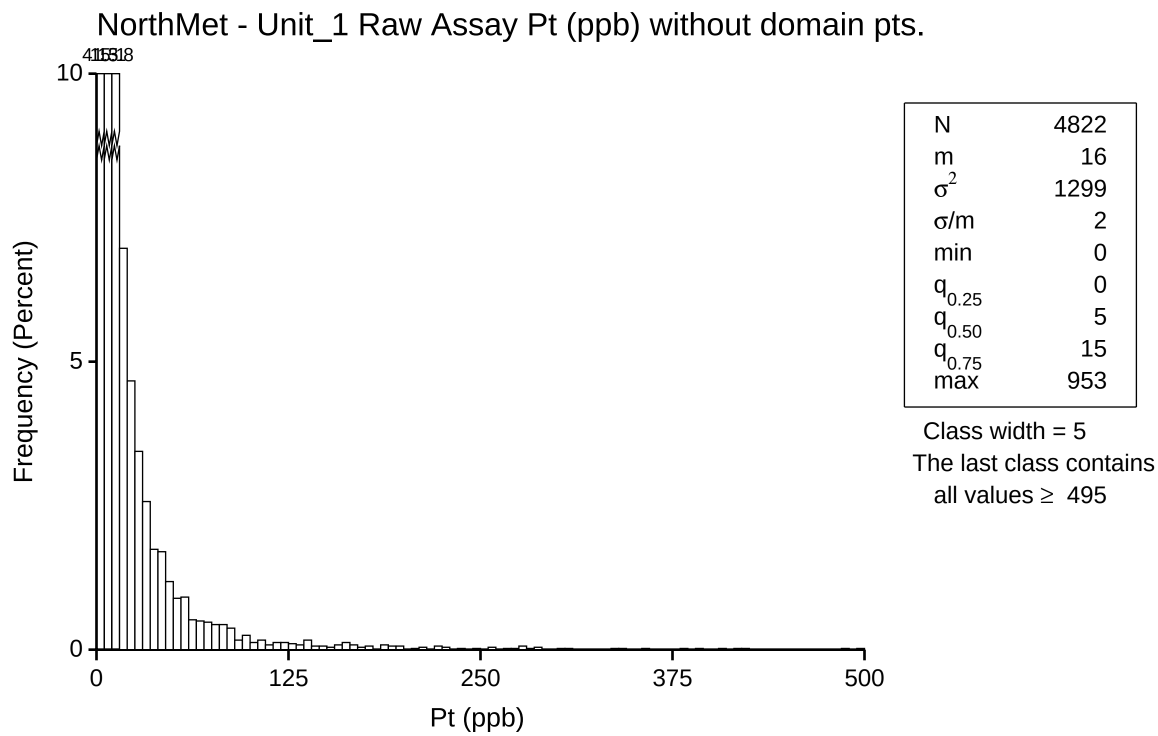

NorthMet - Unit_1 Raw Assay Ni (%) without domain pts.
10
1.0
0.10
0.010
0.0010
Ni (%)
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

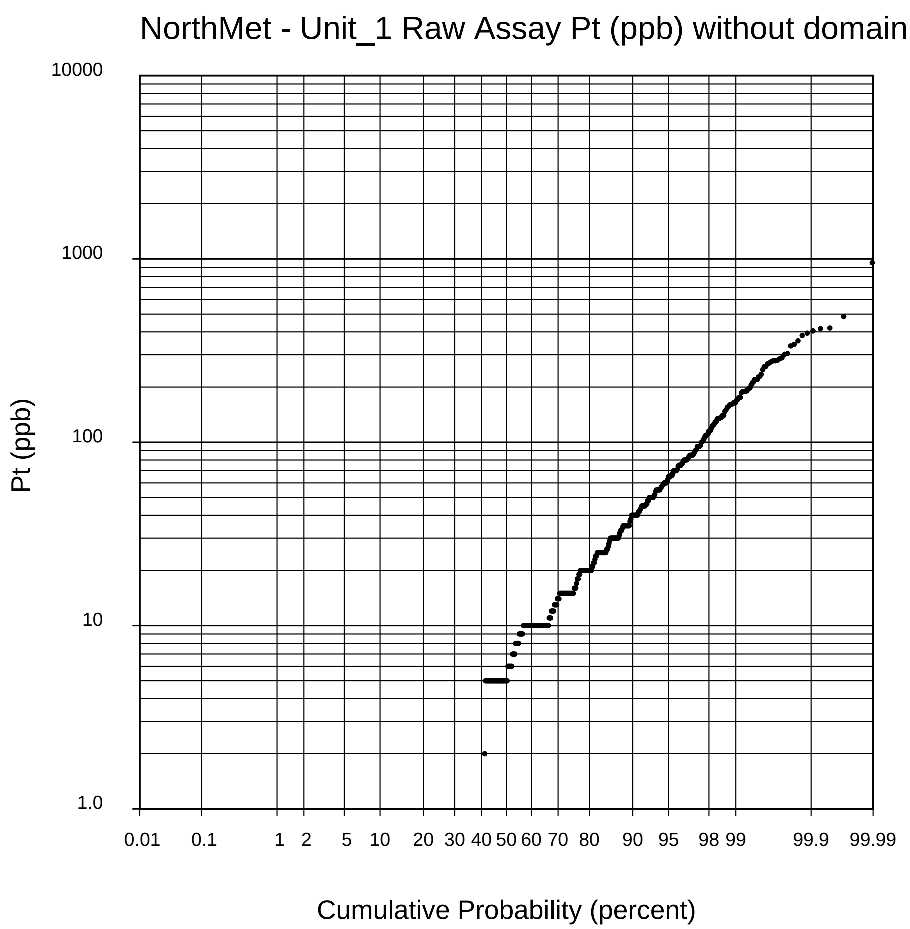
NorthMet - Unit_1 Raw Assay Pd (ppb) without domain pts.



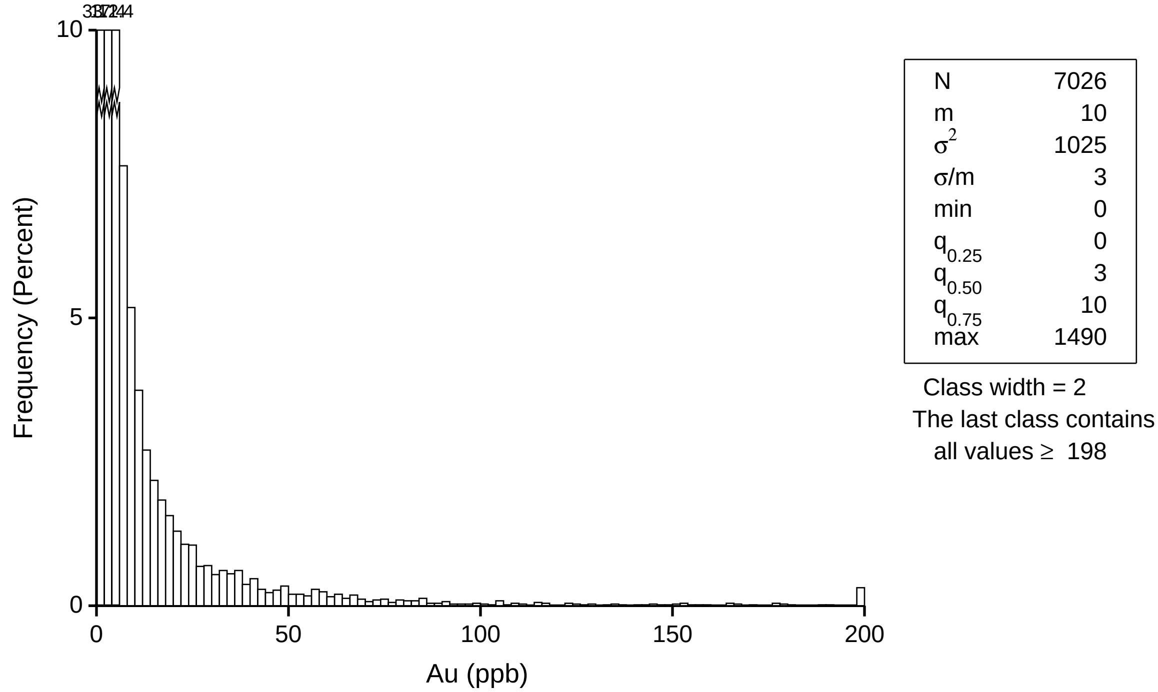
NorthMet - Unit_1 Raw Assay Pd (ppb) without domain pts.



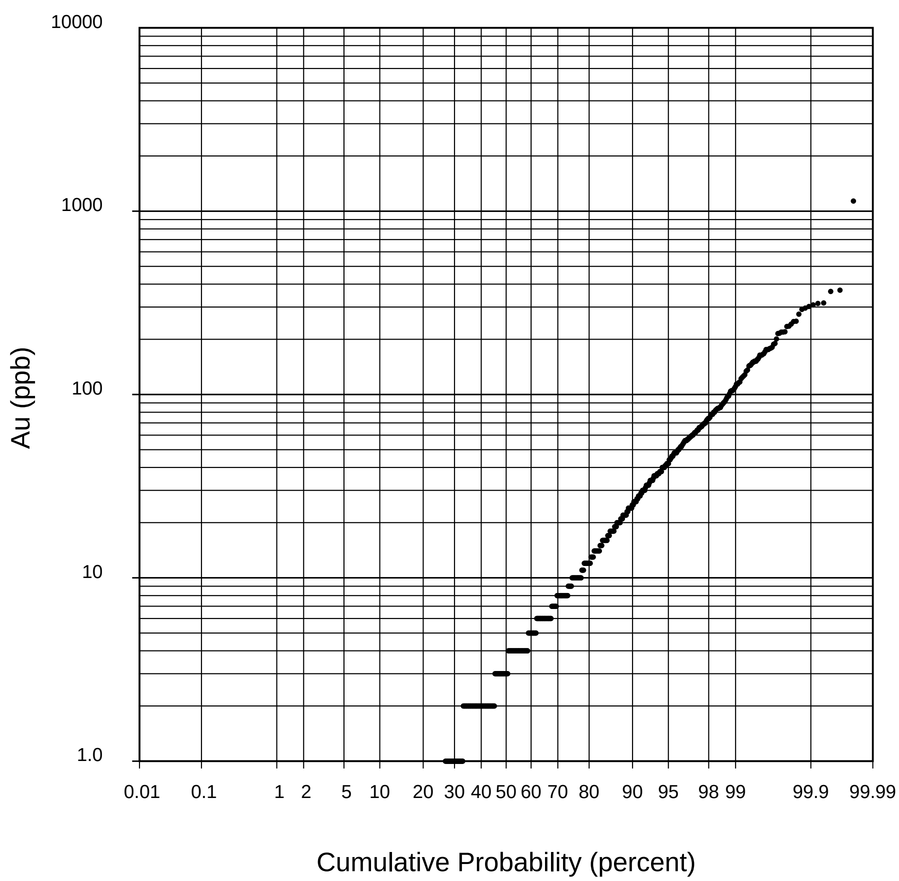

NorthMet - Unit_1 Raw Assay Pt (ppb) without domain pts.
Frequency (Percent)
Pt (ppb)
0
125
250
375
500
0
5
10
N 4822
m 16
σ2 1299
σ/m 2
min 0
q0.25 0
q0.50 5
q0.75 15
max 953
Class width = 5
The last class contains
all values ≥ 495


NorthMet - Unit_1 Raw Assay Pt (ppb) without domain pts.
Pt (ppb)
10000
1000
100
10
1.0
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

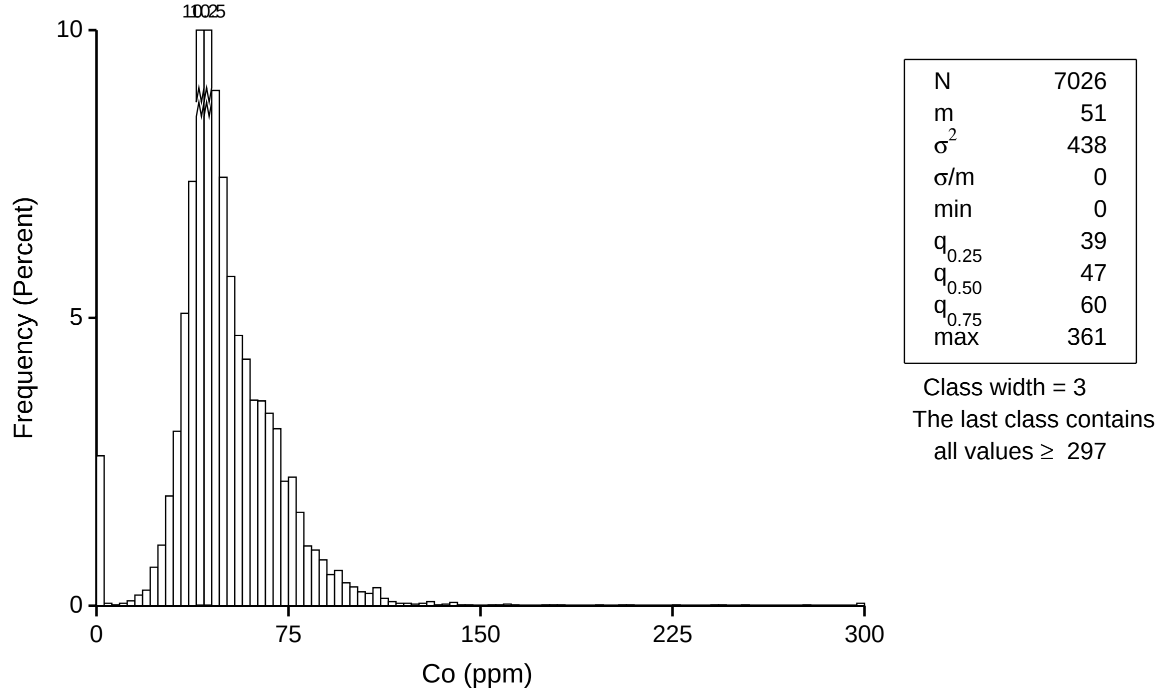
NorthMet - Unit_3 Raw Assay Au (ppb) without domain pts.



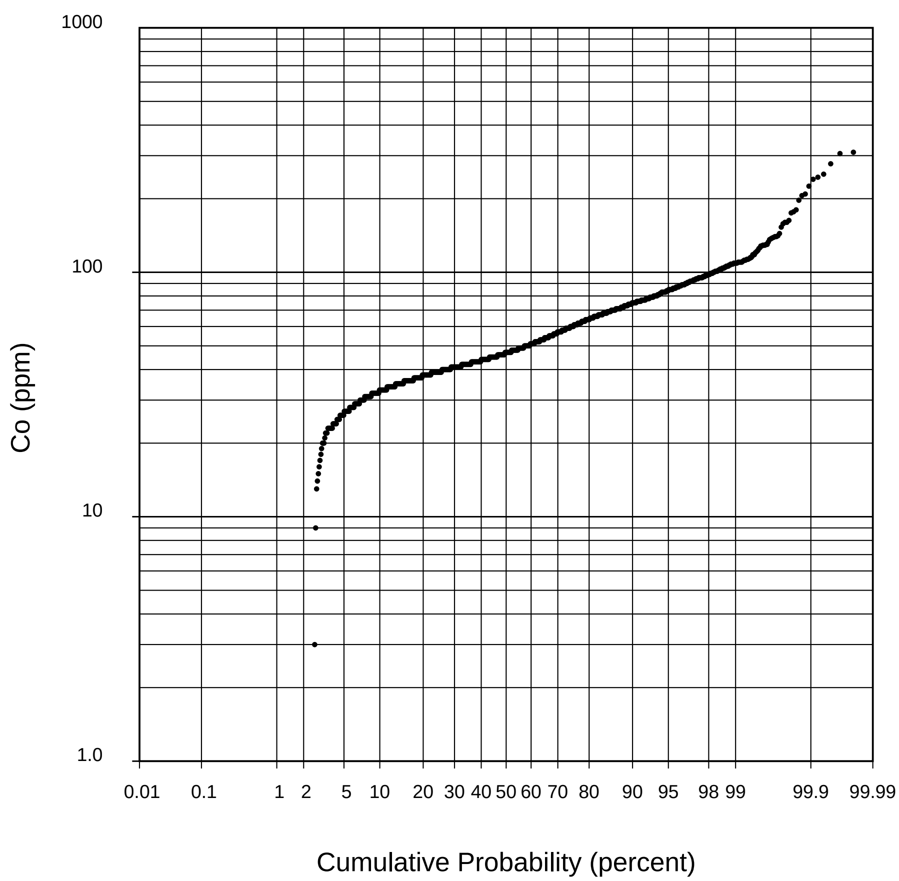
NorthMet - Unit_3 Raw Assay Au (ppb) without domain pts.



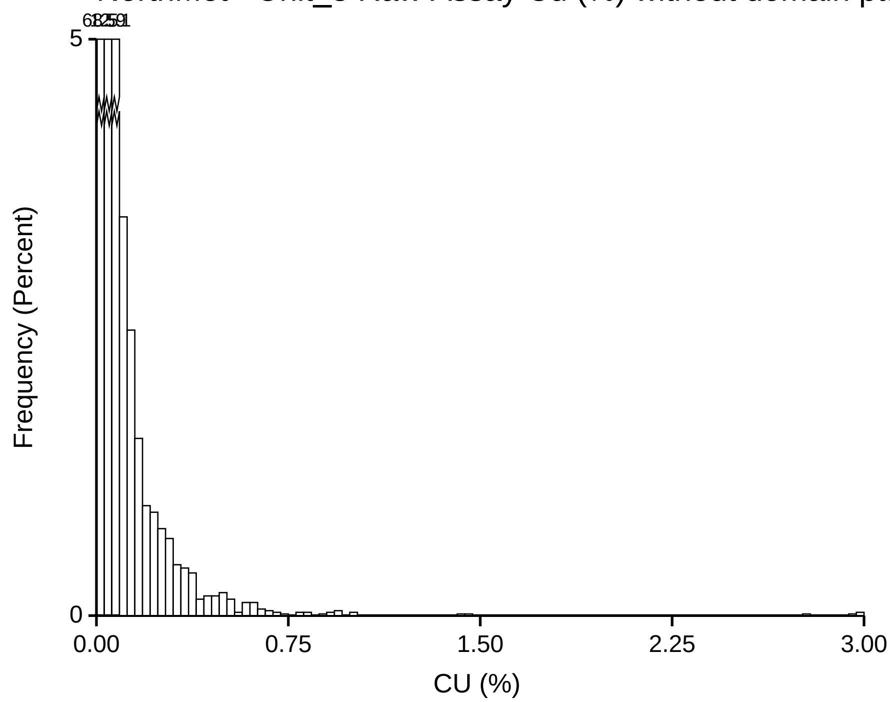
NorthMet - Unit_3 Raw Assay Co (ppm) without domain pts.



NorthMet - Unit_3 Raw Assay Co (ppm) without domain pts.



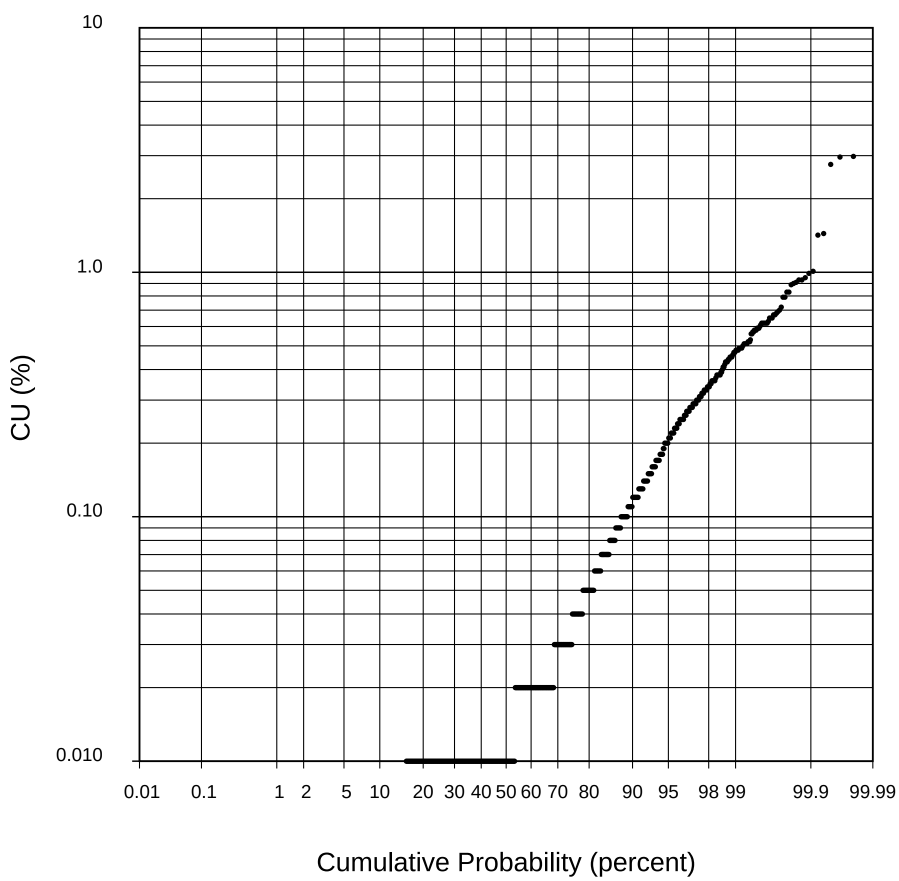
NorthMet - Unit_3 Raw Assay Cu (%) without domain pts.



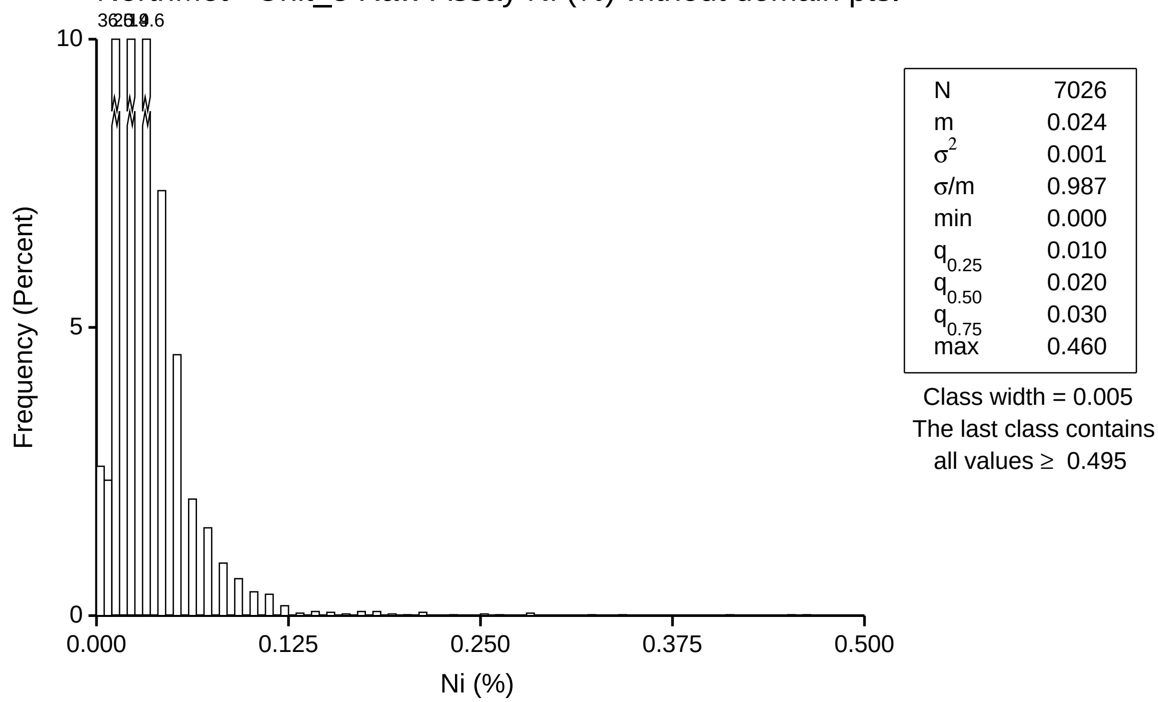
N	7026
m	0.05
σ^2	0.01
σ/m	2.53
min	0.00
$q_{0.25}$	0.01
$q_{0.50}$	0.01
$q_{0.75}$	0.04
max	4.17

Class width = 0.03
The last class contains
all values ≥ 2.97

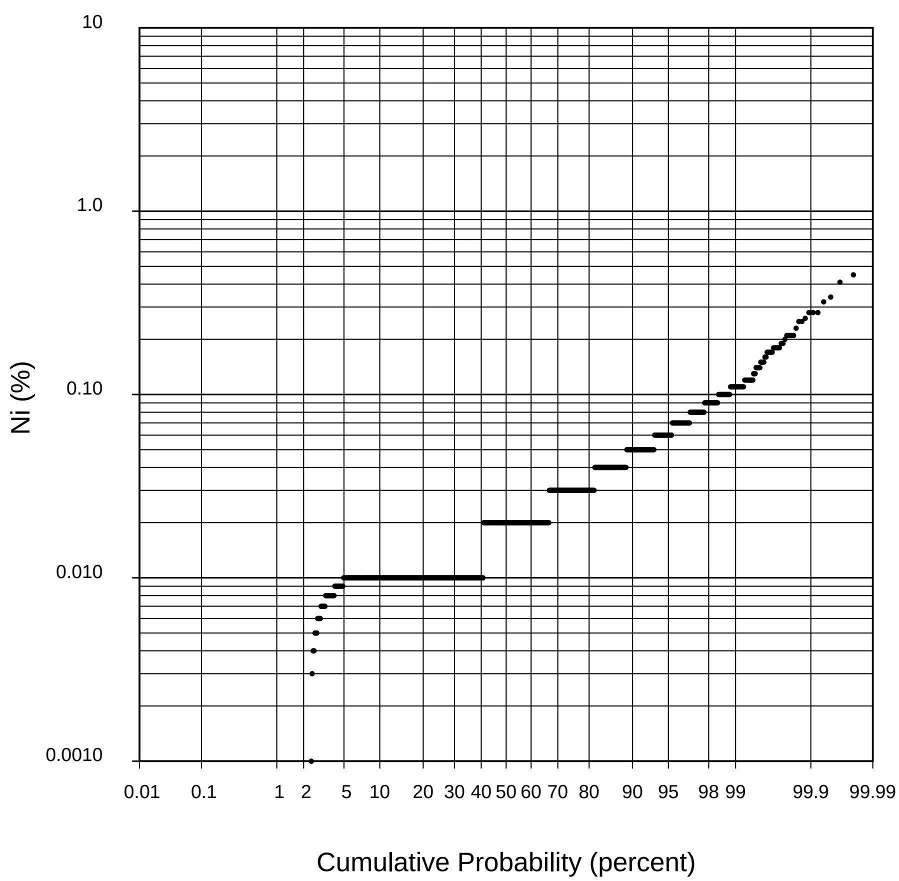
NorthMet - Unit_3 Raw Assay Cu (%) without domain pts.

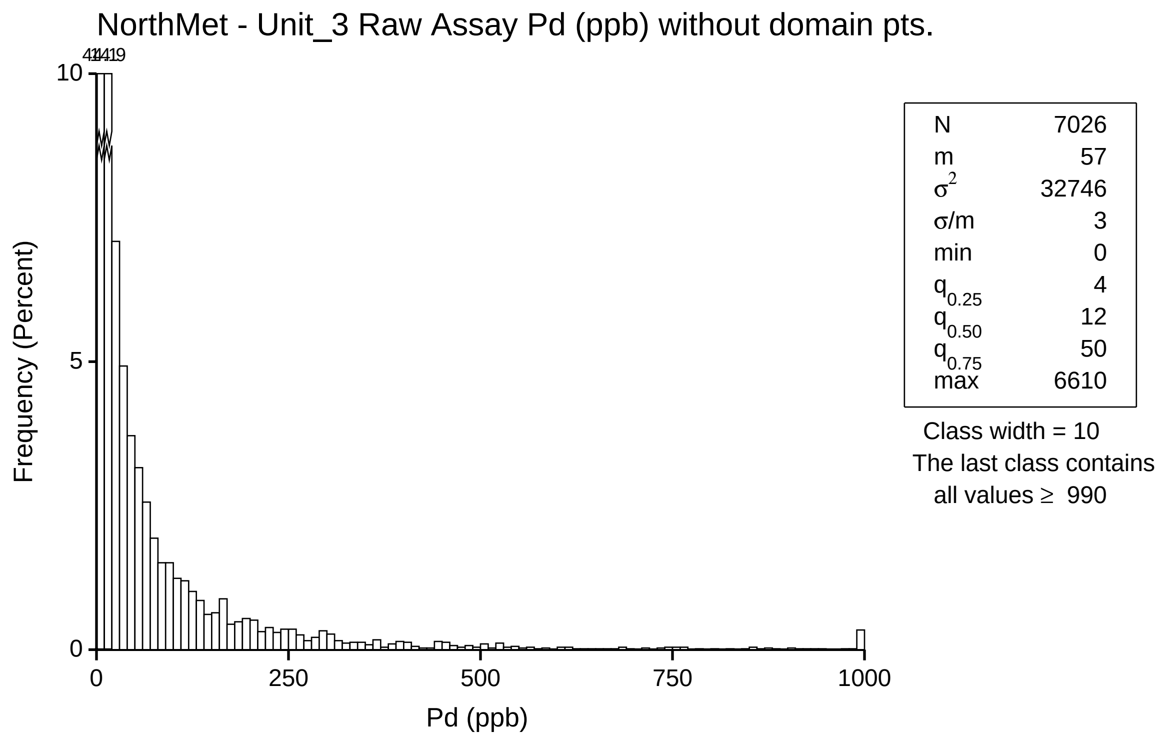


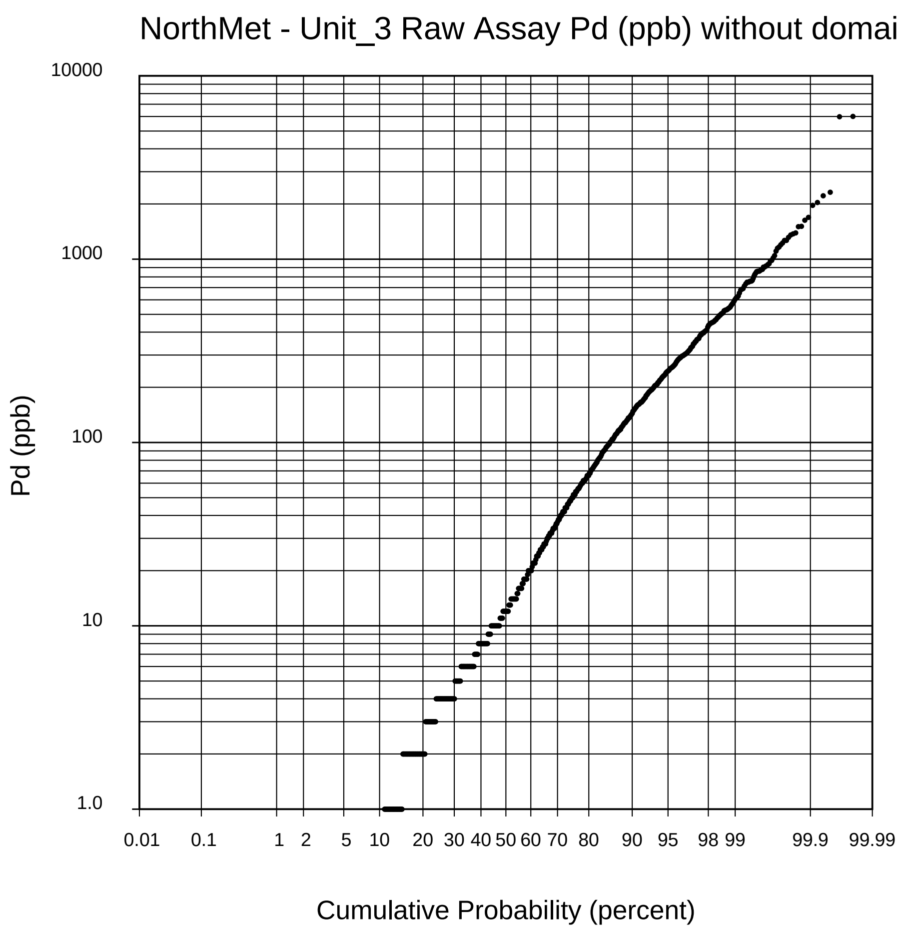
NorthMet - Unit_3 Raw Assay Ni (%) without domain pts.



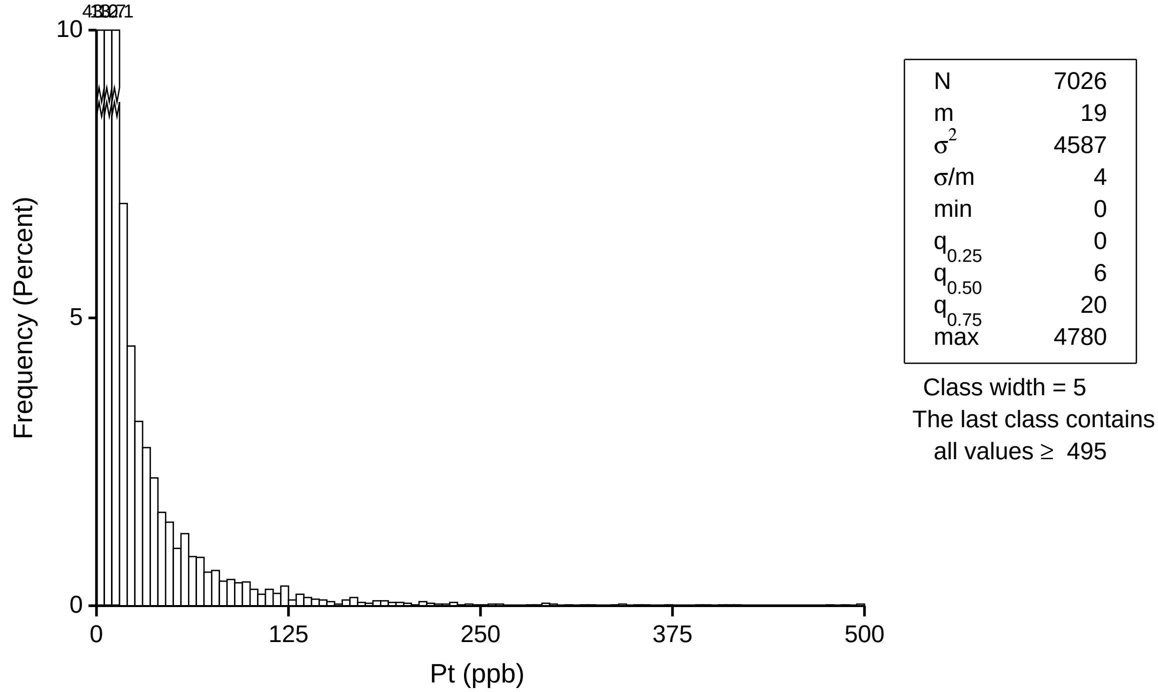
NorthMet - Unit_3 Raw Assay Ni (%) without domain pts.



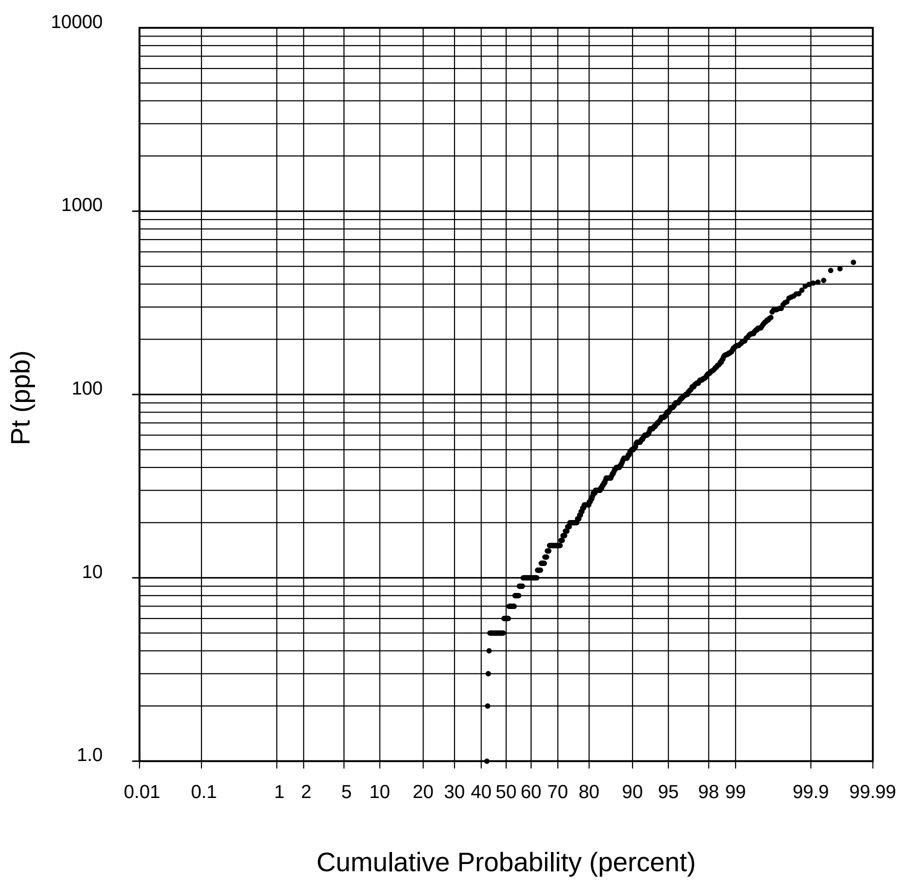

NorthMet - Unit_3 Raw Assay Pd (ppb) without domain pts.
Frequency (Percent)
Pd (ppb)
N 7026
m 57
σ2 32746
σ/m 3
min 0
q0.25 4
q0.50 12
q0.75 50
max 6610
Class width = 10
The last class contains
all values ≥ 990

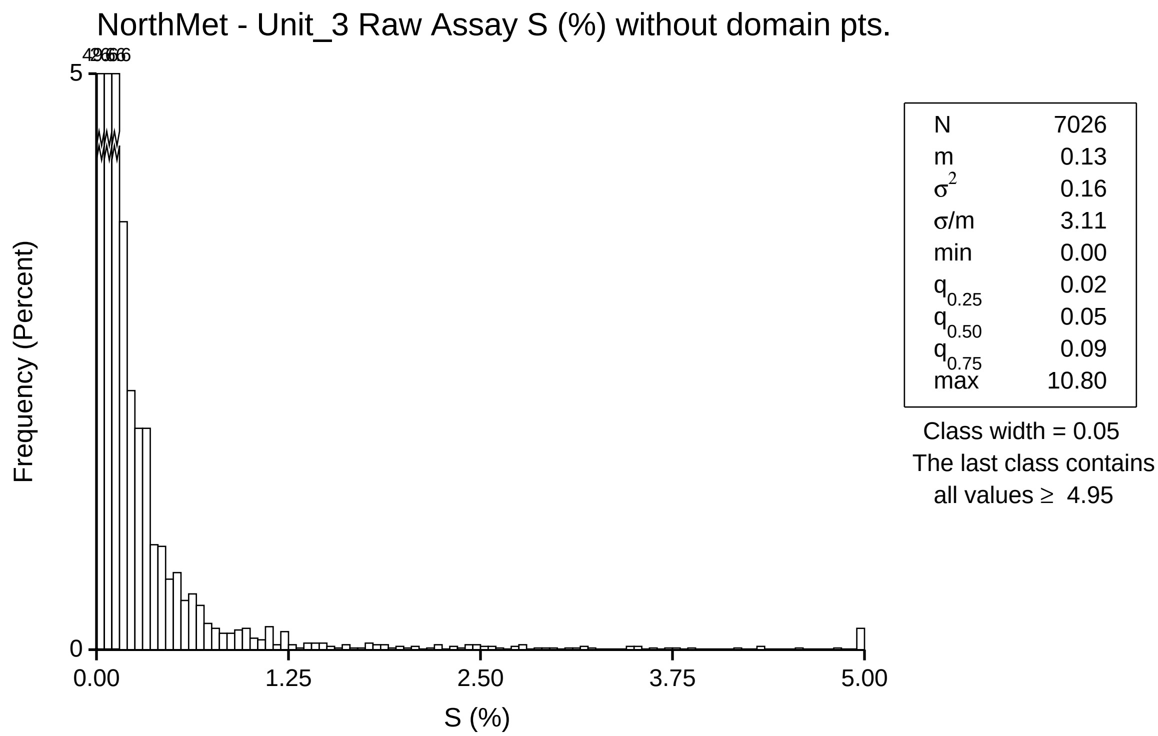

NorthMet - Unit_3 Raw Assay Pd (ppb) without domain pts.
Pd (ppb)
Cumulative Probability (percent)

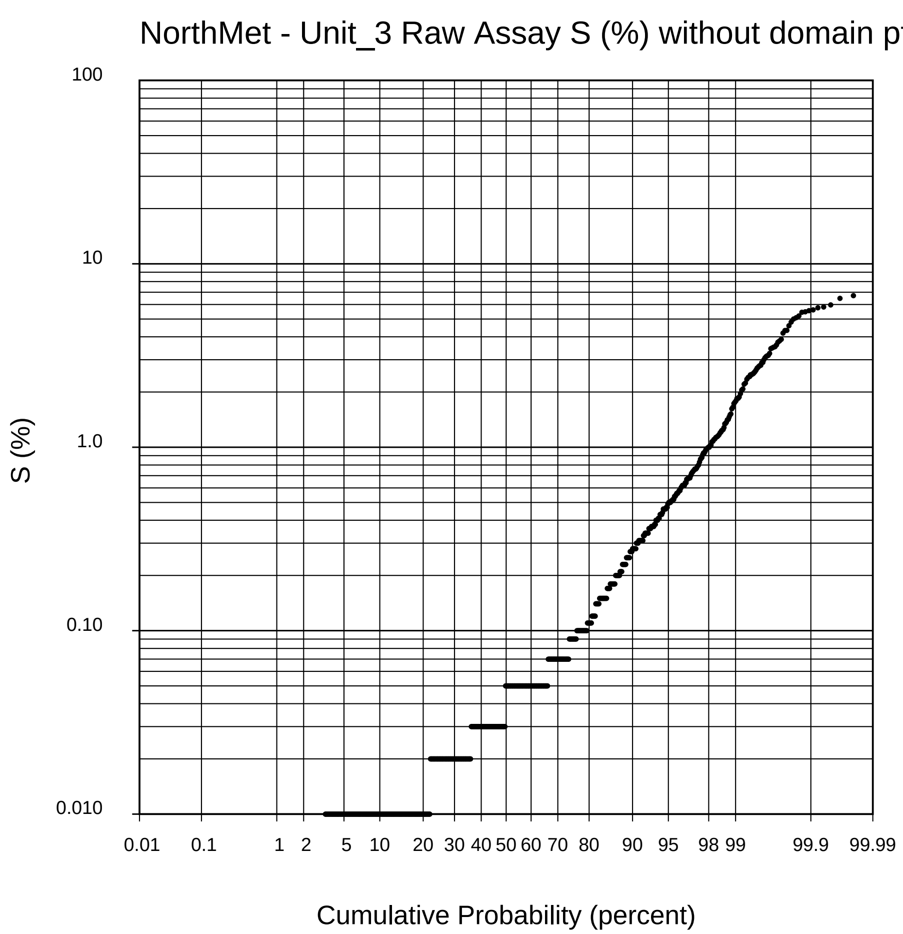
NorthMet - Unit_3 Raw Assay Pt (ppb) without domain pts.

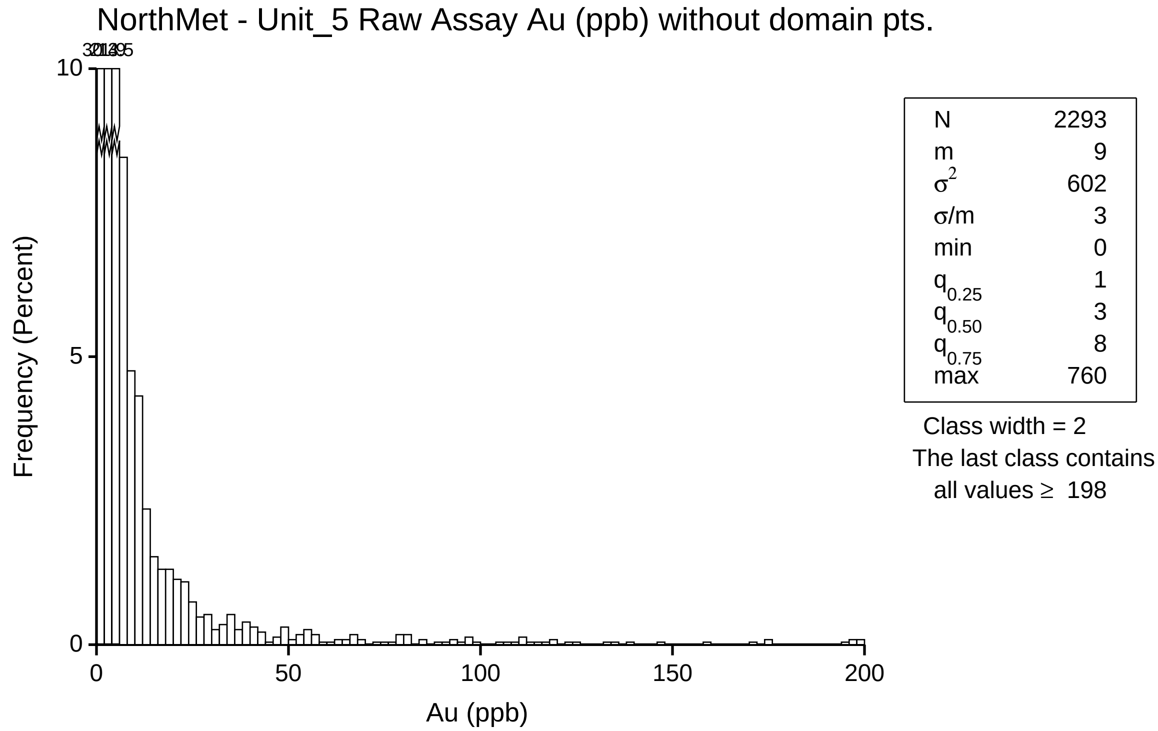


NorthMet - Unit_3 Raw Assay Pt (ppb) without domain pts.

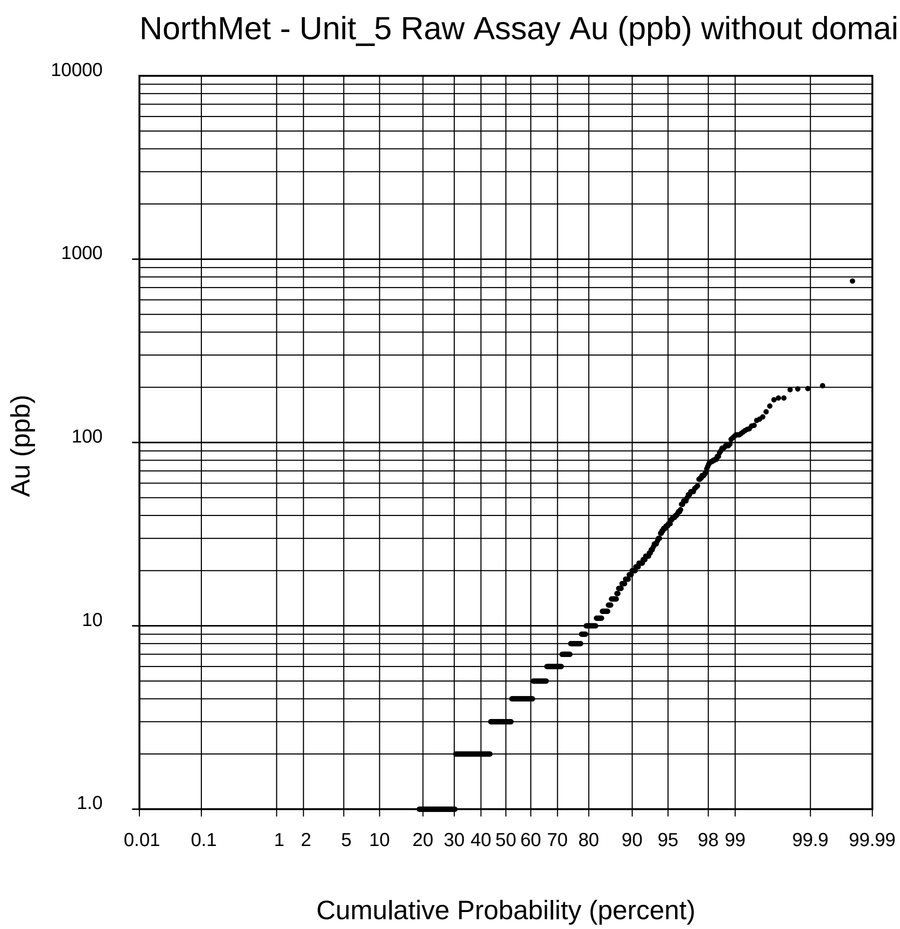



NorthMet - Unit_3 Raw Assay S (%) without domain pts.
Frequency (Percent)
S (%)
0.00
1.25
2.50
3.75
5.00
N 7026
m 0.13
σ2 0.16
σ/m 3.11
min 0.00
q0.25 0.02
q0.50 0.05
q0.75 0.09
max 10.80
Class width = 0.05
The last class contains
all values ≥ 4.95


NorthMet - Unit_3 Raw Assay S (%) without domain pts.
S (%)
100
10
1.0
0.10
0.010
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

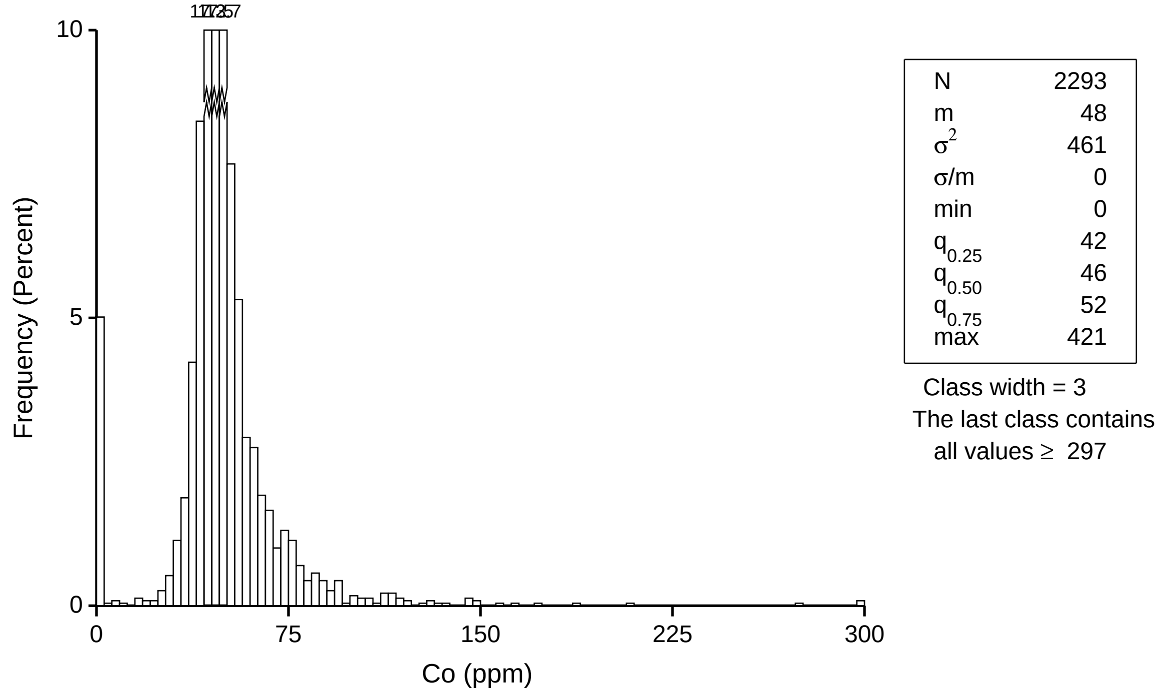


NorthMet - Unit_5 Raw Assay Au (ppb) without domain pts.
Frequency (Percent)
Au (ppb)
N 2293
m 9
σ2 602
σ/m 3
min 0
q0.25 1
q0.50 3
q0.75 8
max 760
Class width = 2
The last class contains
all values ≥ 198

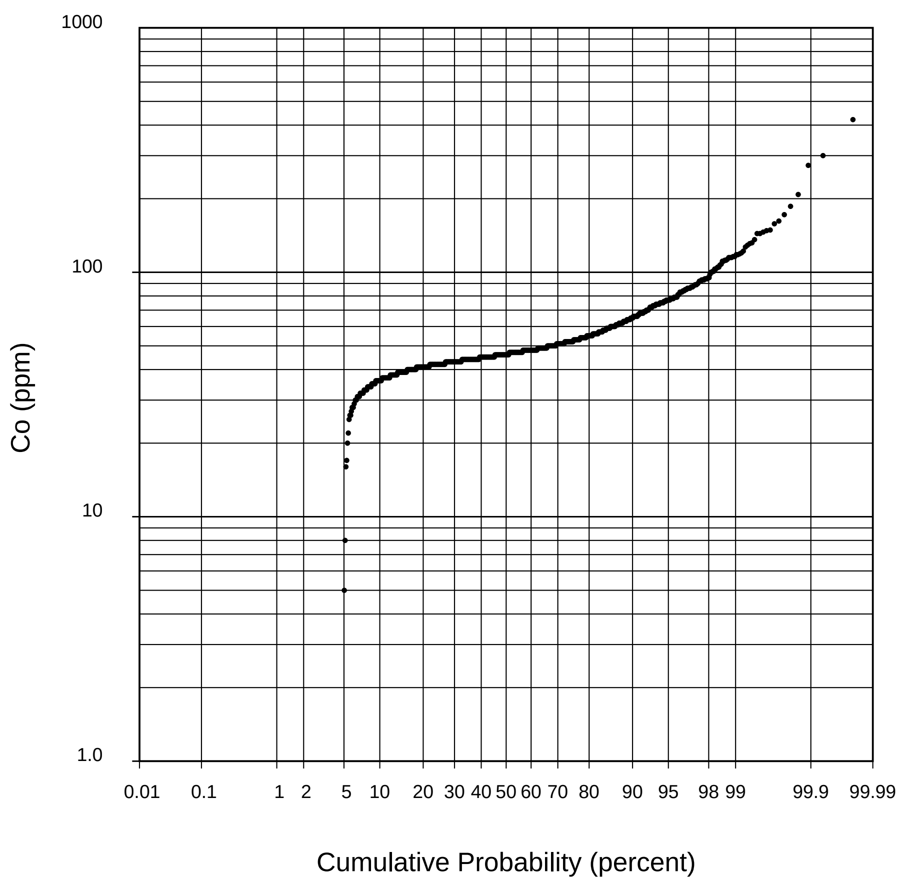


NorthMet - Unit_5 Raw Assay Au (ppb) without domain pts.
Au (ppb)
Cumulative Probability (percent)

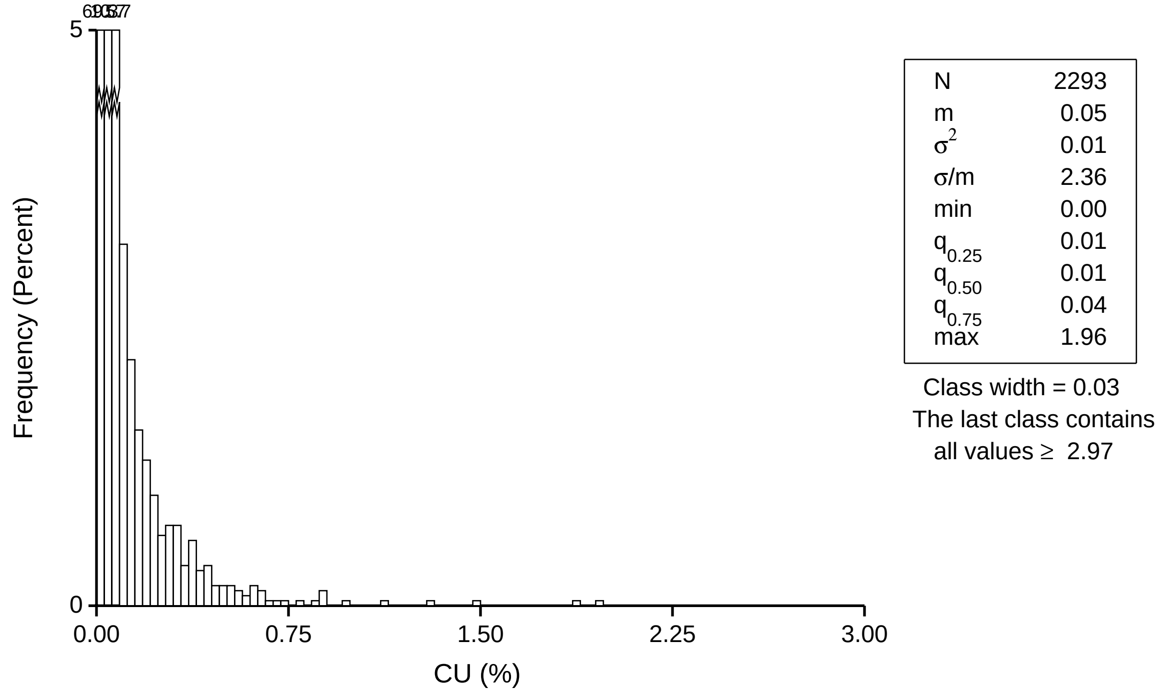
NorthMet - Unit_5 Raw Assay Co (ppm) without domain pts.



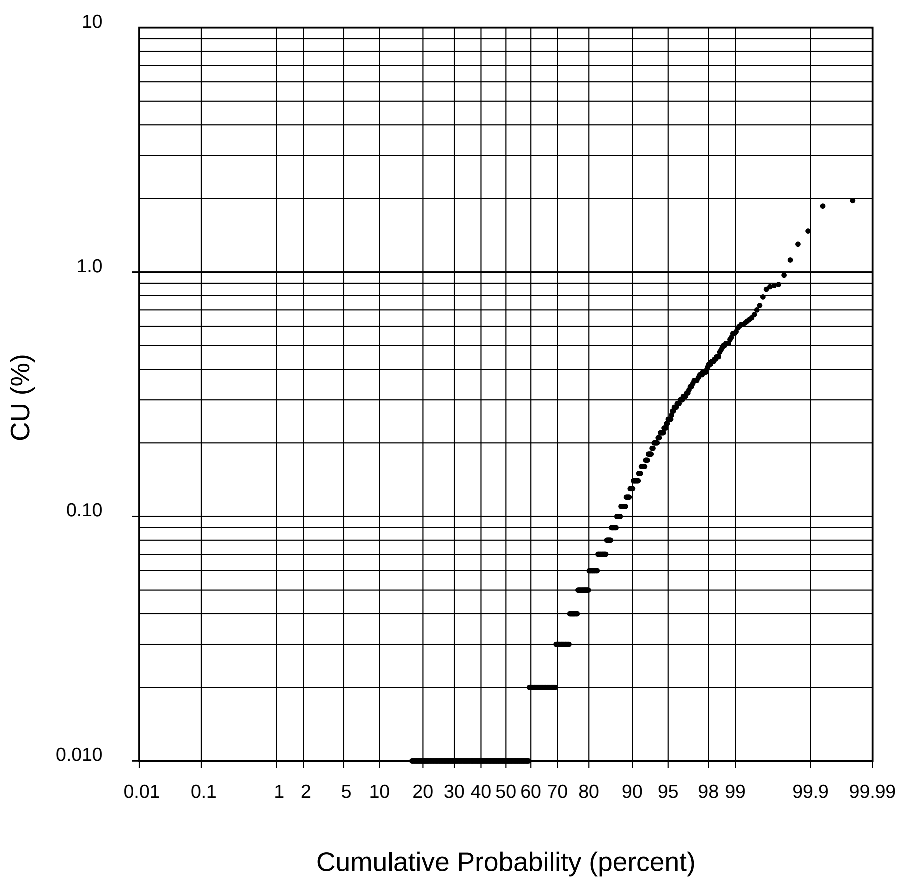
NorthMet - Unit_5 Raw Assay Co (ppm) without domain pts.



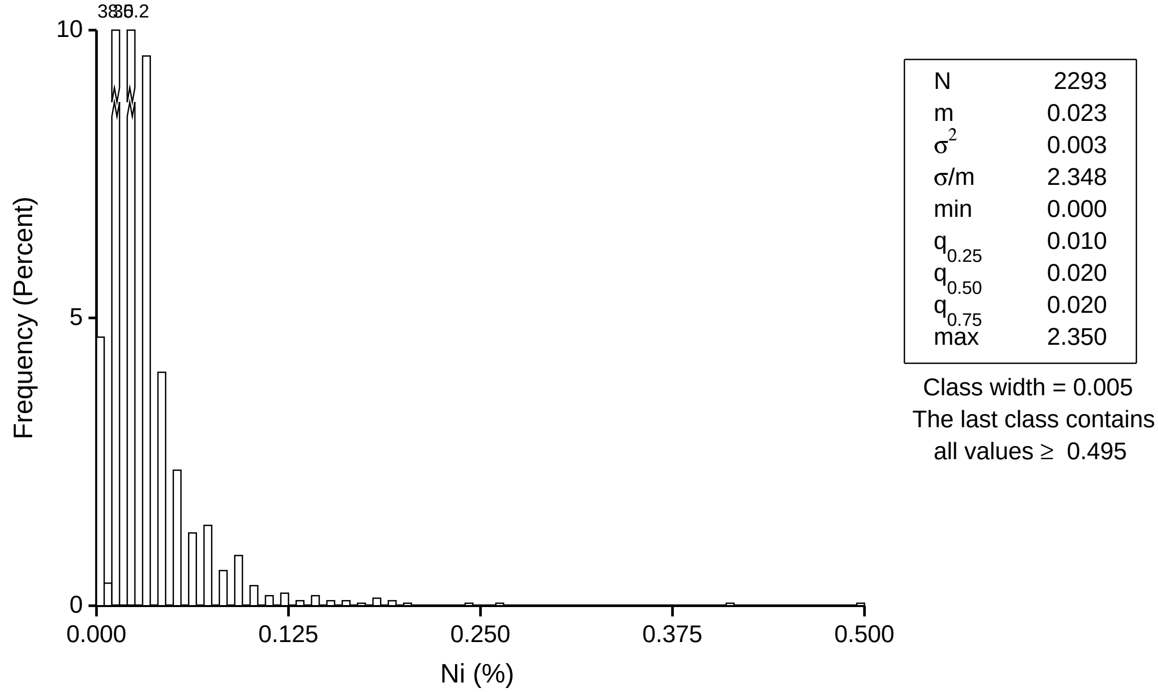
NorthMet - Unit_5 Raw Assay Cu (%) without domain pts.



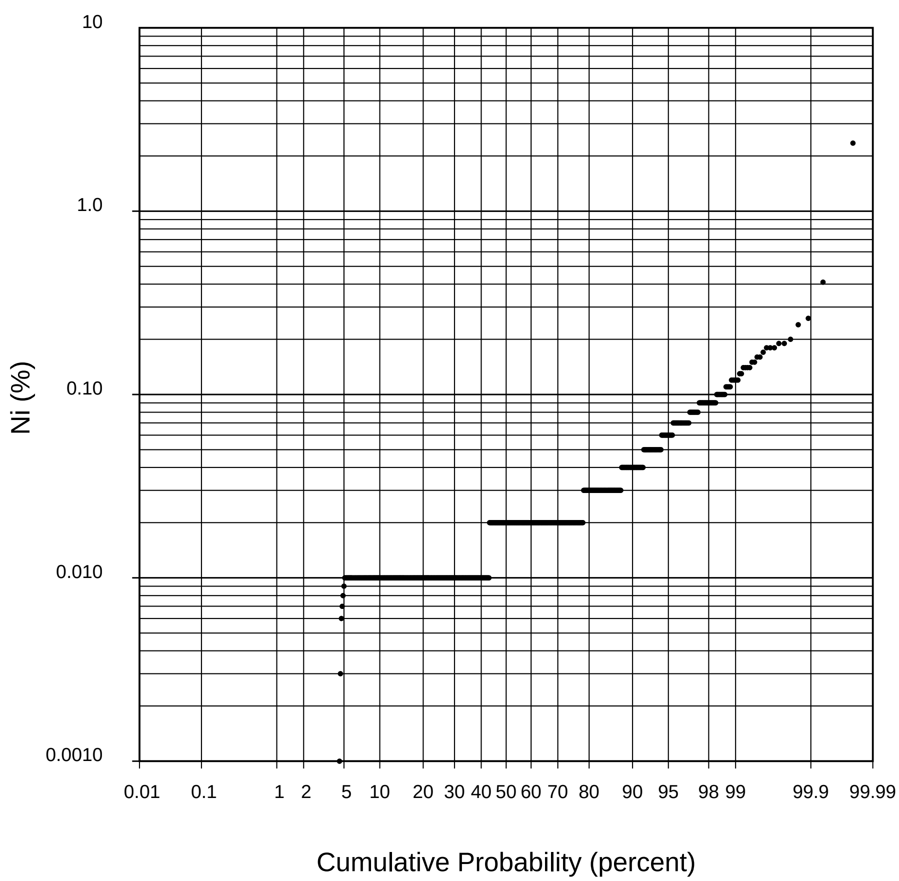
NorthMet - Unit_5 Raw Assay Cu (%) without domain pts.

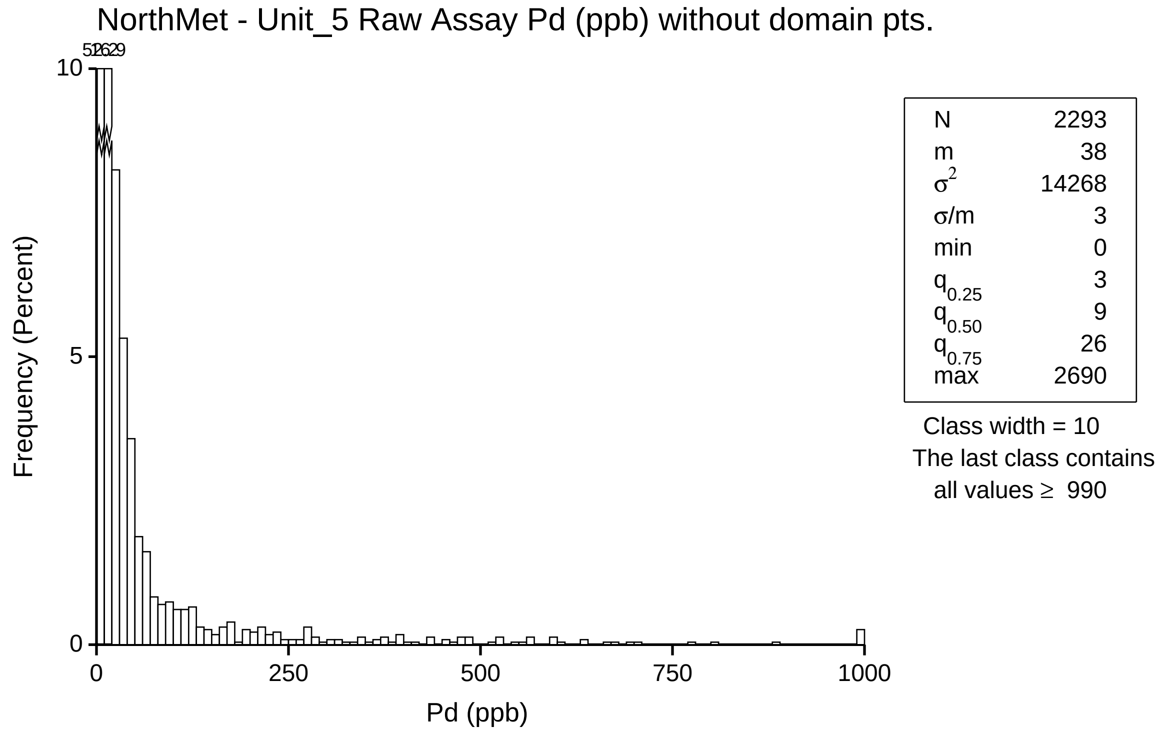


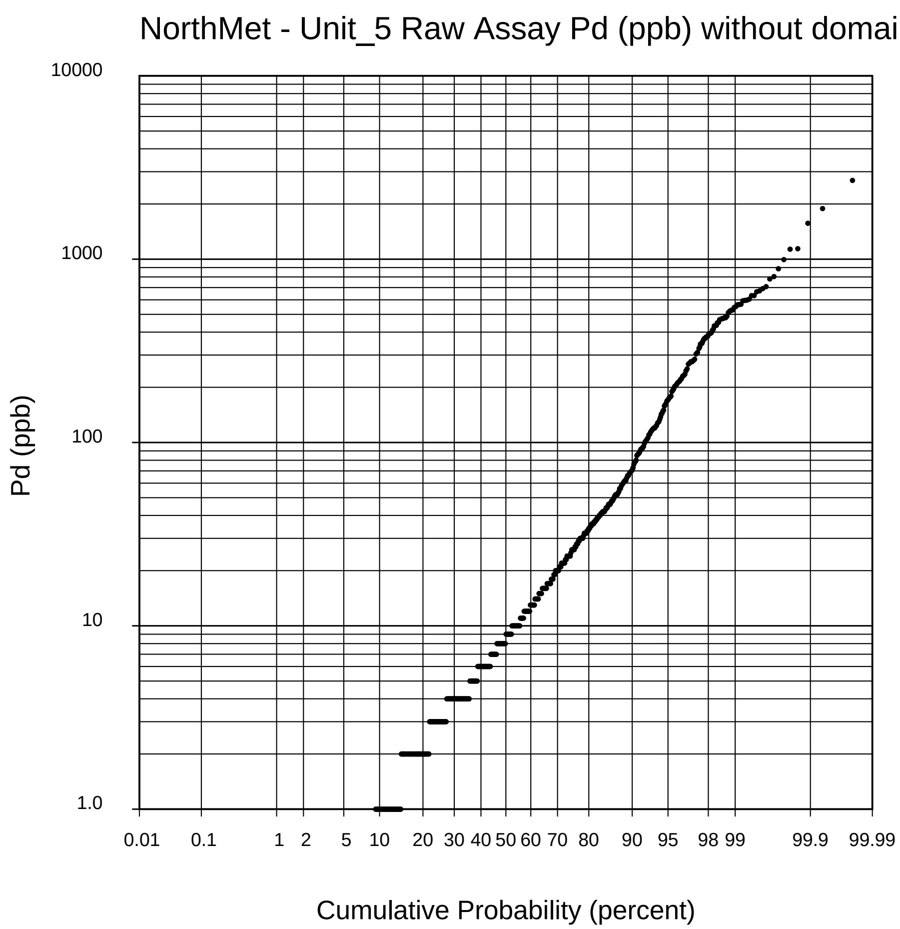
NorthMet - Unit_5 Raw Assay Ni (%) without domain pts.



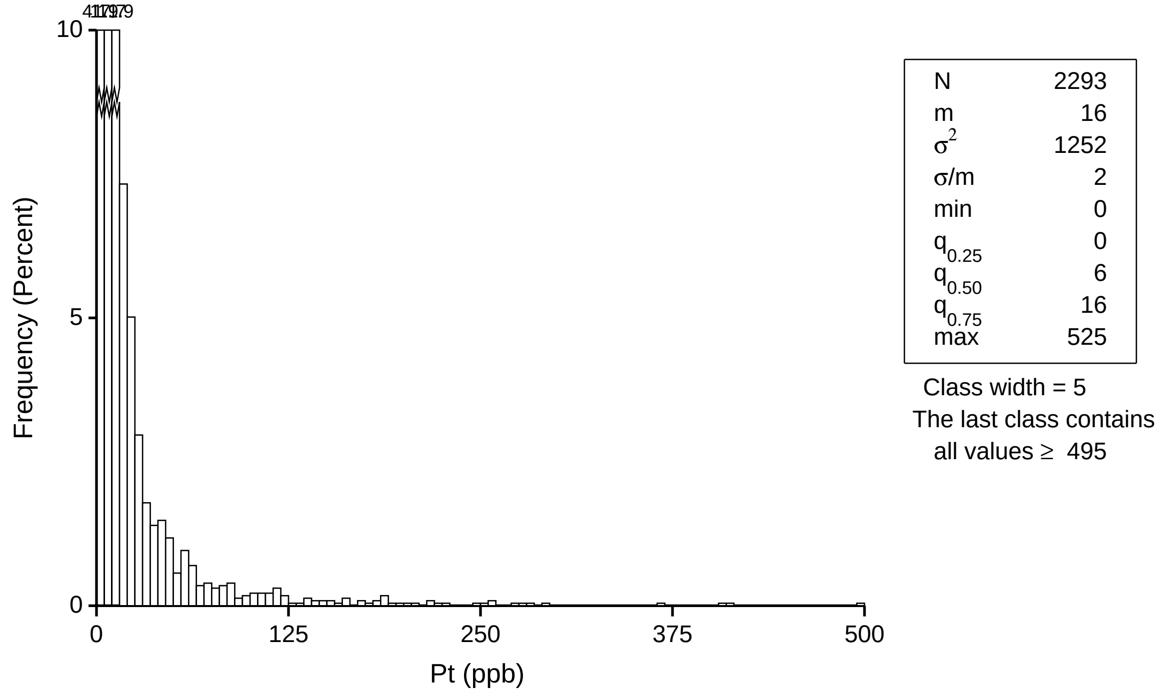
NorthMet - Unit_5 Raw Assay Ni (%) without domain pts.



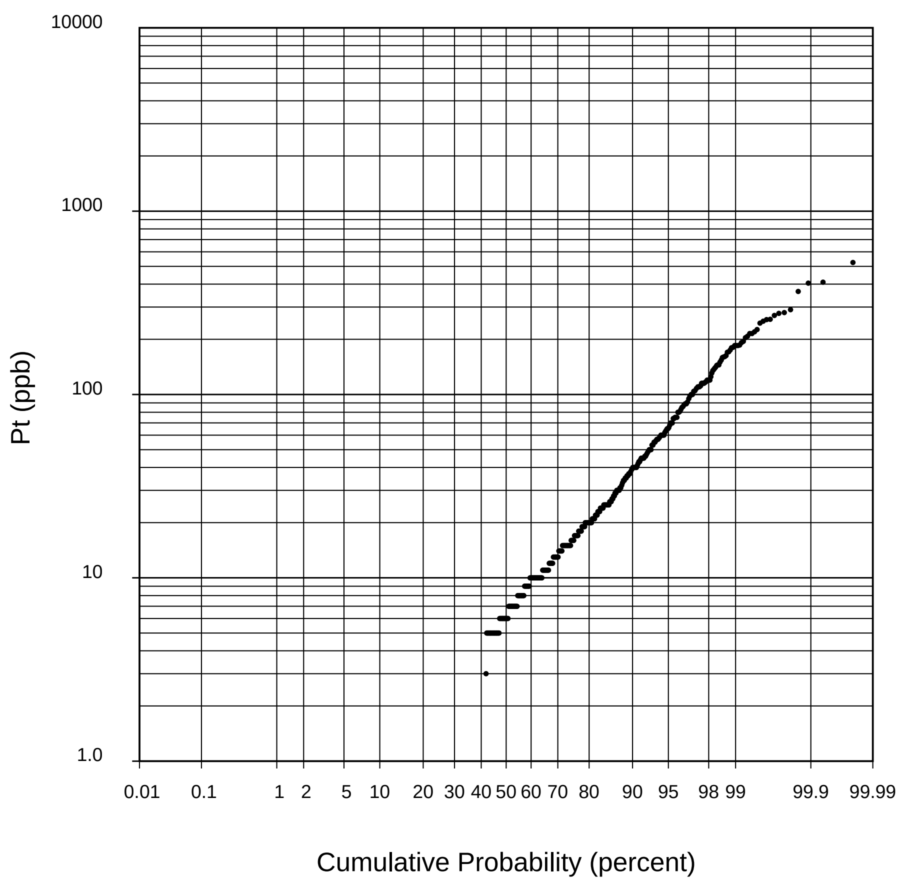

NorthMet - Unit_5 Raw Assay Pd (ppb) without domain pts.
Frequency (Percent)
Pd (ppb)
0
250
500
750
1000
0
5
10
N 2293
m 38
σ2 14268
σ/m 3
min 0
q0.25 3
q0.50 9
q0.75 26
max 2690
Class width = 10
The last class contains
all values ≥ 990


NorthMet - Unit_5 Raw Assay Pd (ppb) without domain pts.
Pd (ppb)
10000
1000
100
10
1.0
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

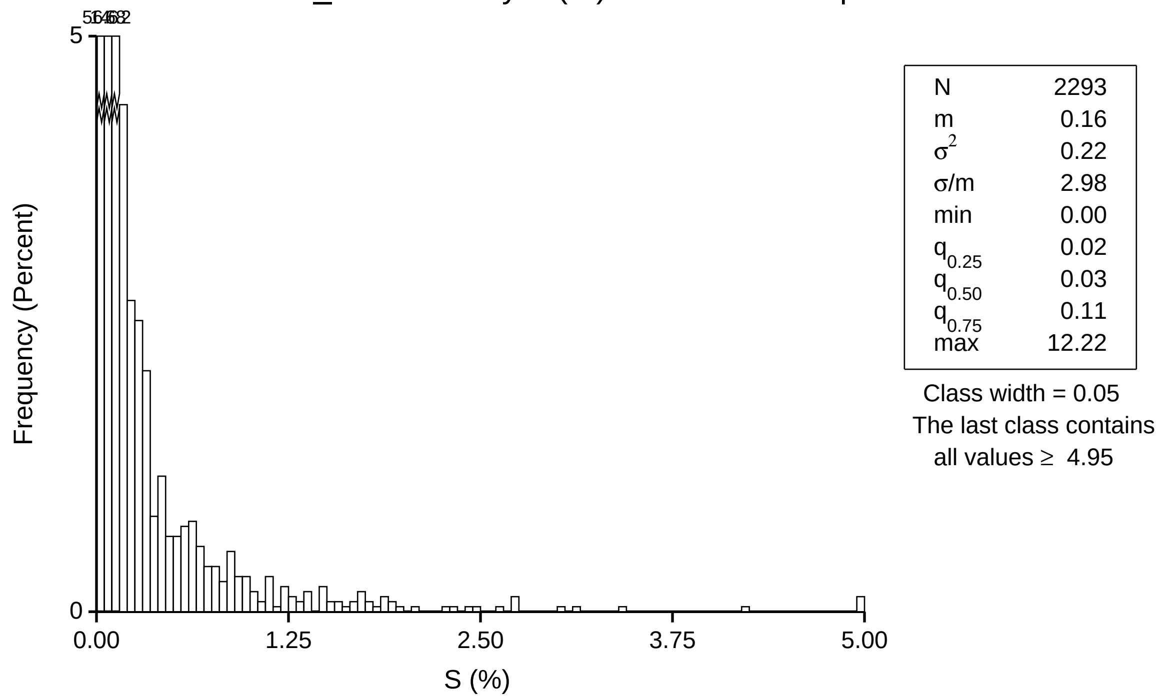
NorthMet - Unit_5 Raw Assay Pt (ppb) without domain pts.



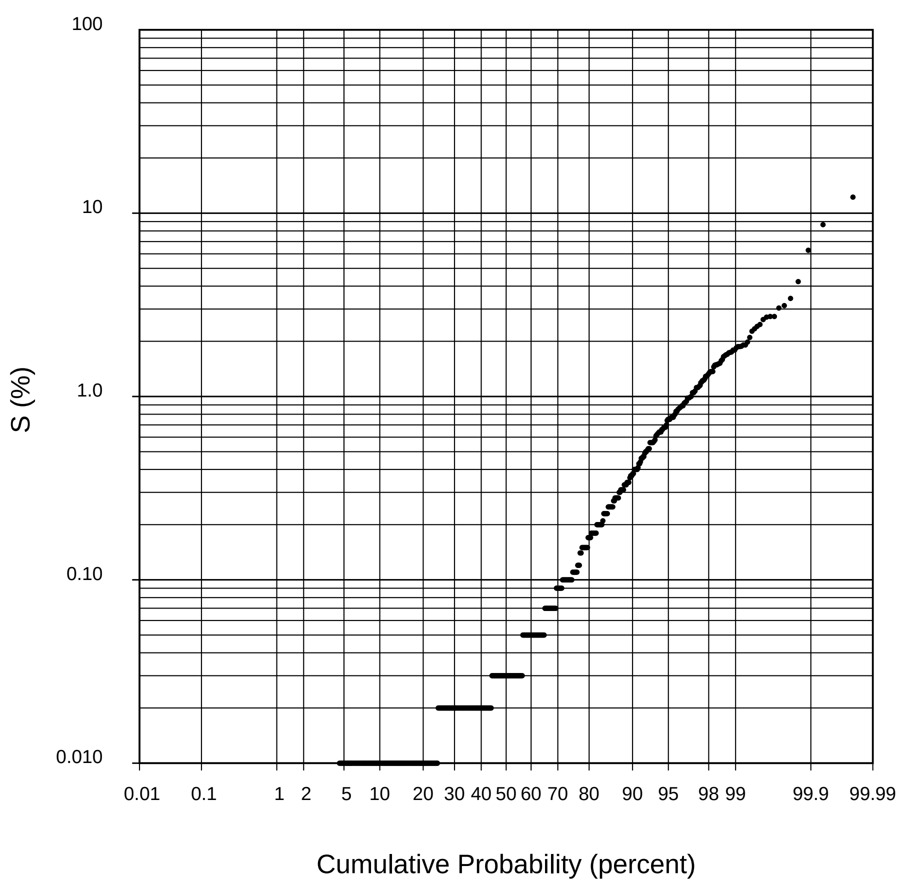
NorthMet - Unit_5 Raw Assay Pt (ppb) without domain pts.



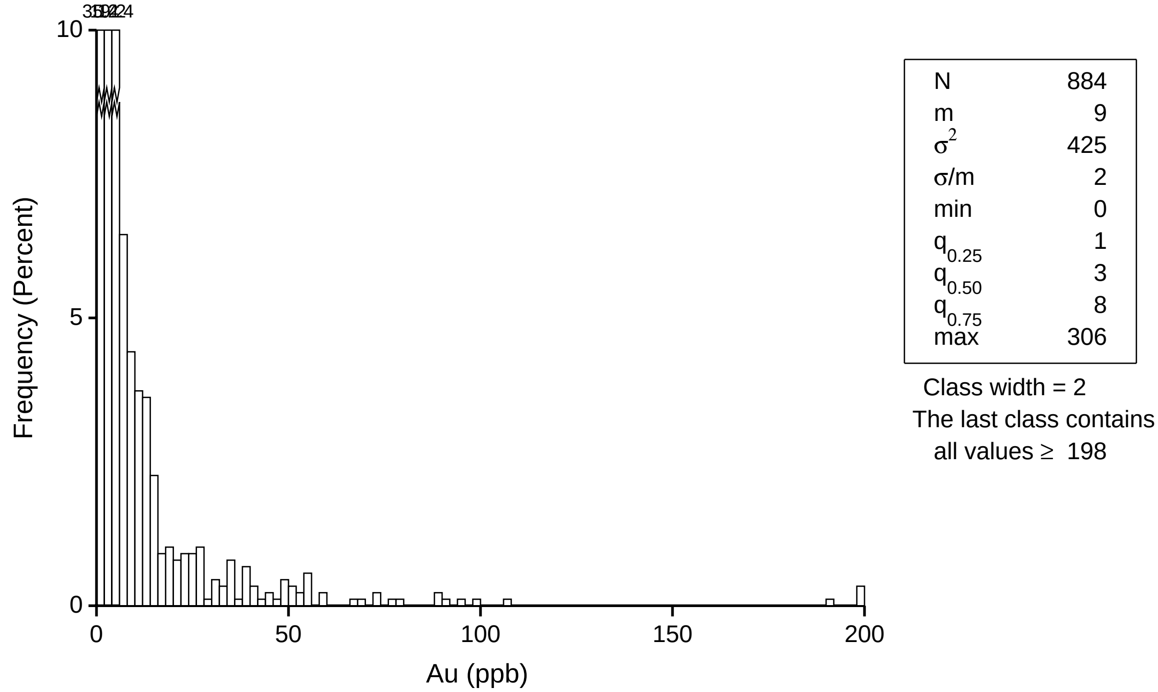
NorthMet - Unit_5 Raw Assay S (%) without domain pts.



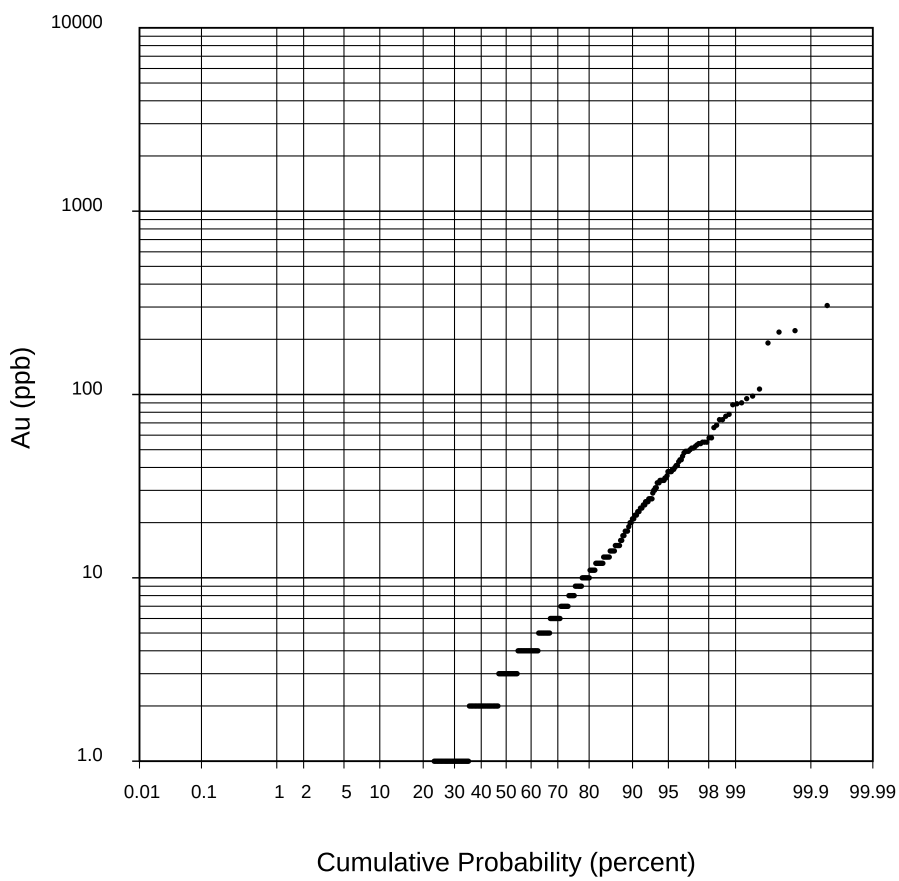
NorthMet - Unit_5 Raw Assay S (%) without domain pts.



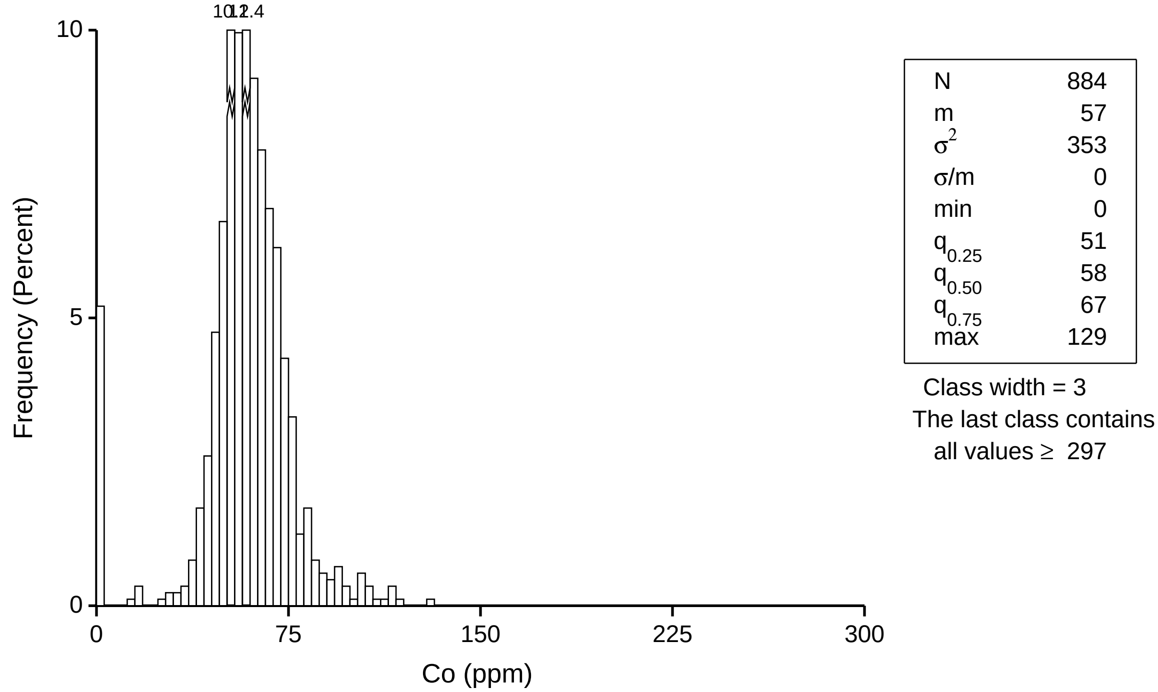
NorthMet - Unit_6 Raw Assay Au (ppb) without domain pts.



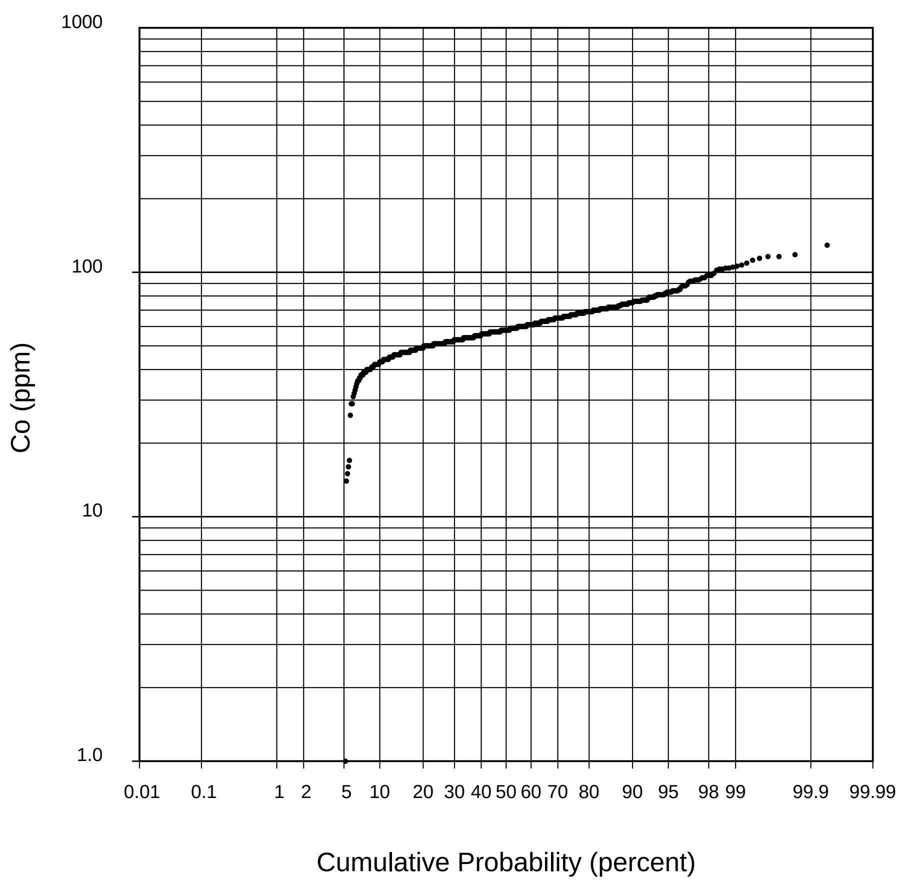
NorthMet - Unit_6 Raw Assay Au (ppb) without domain pts.

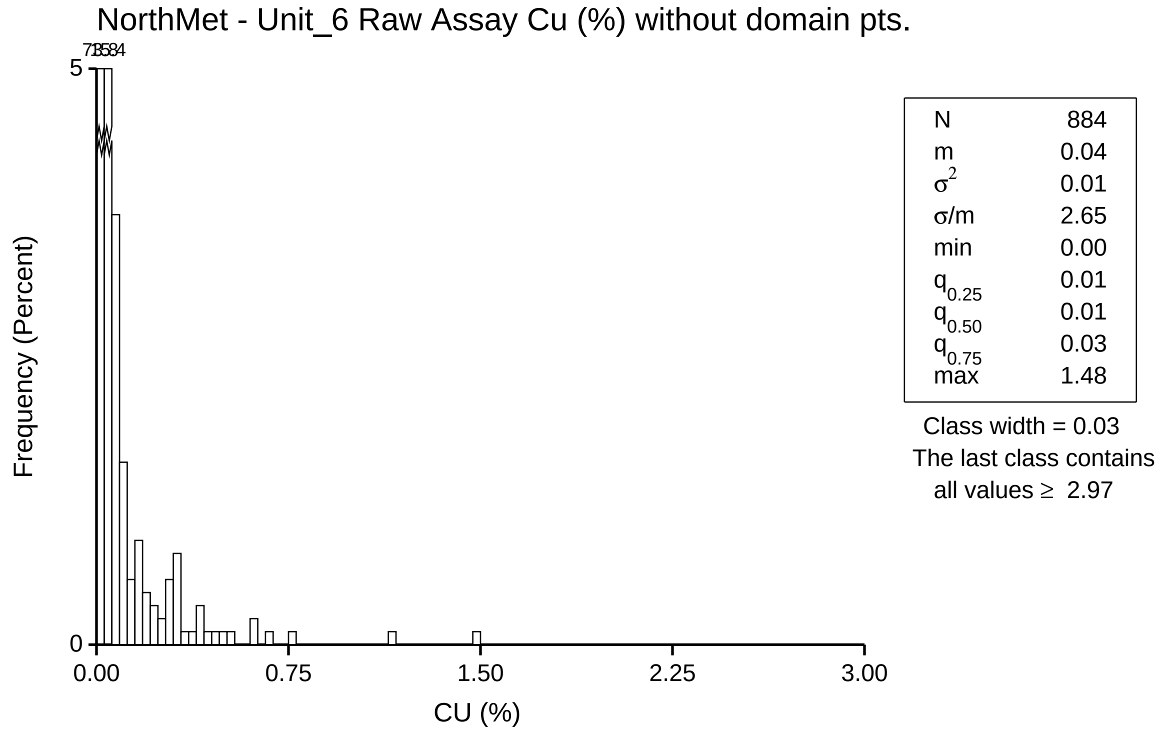


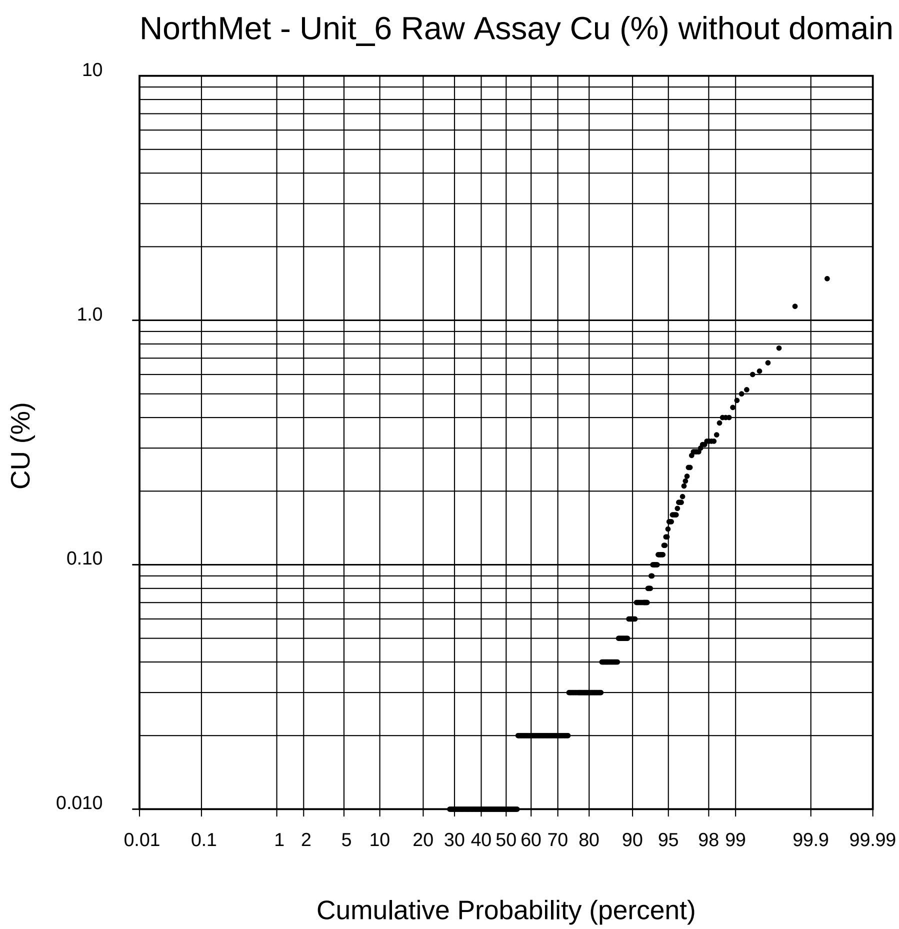
NorthMet - Unit_6 Raw Assay Co (ppm) without domain pts.



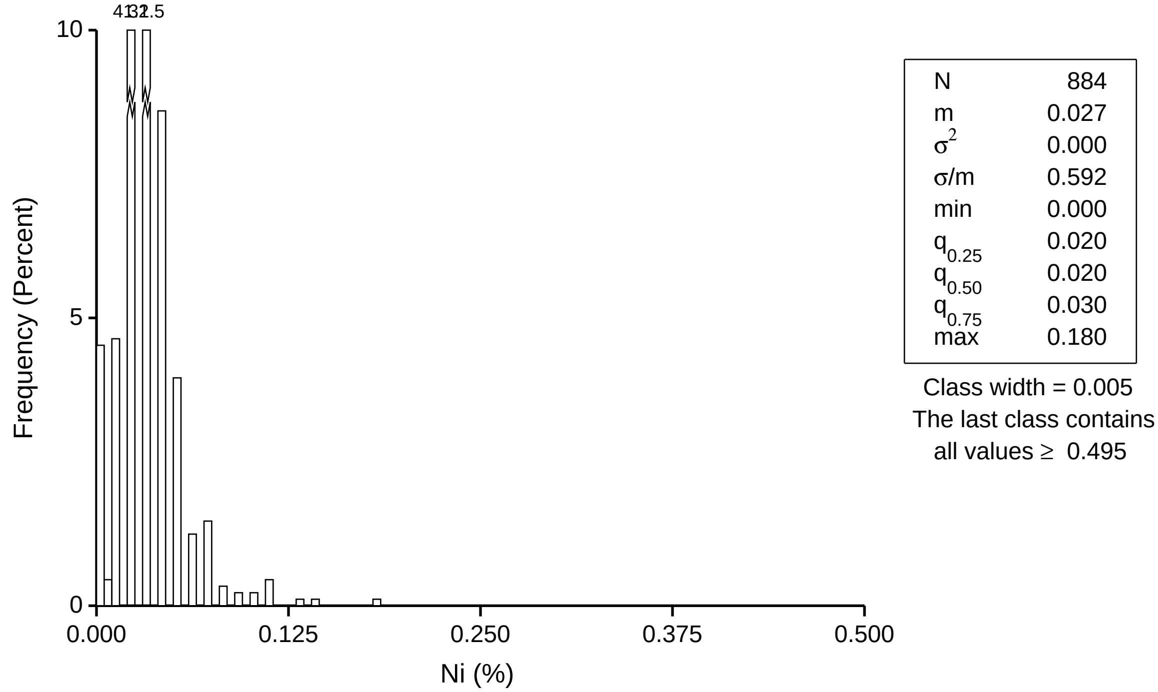
NorthMet - Unit_6 Raw Assay Co (ppm) without domain pts.



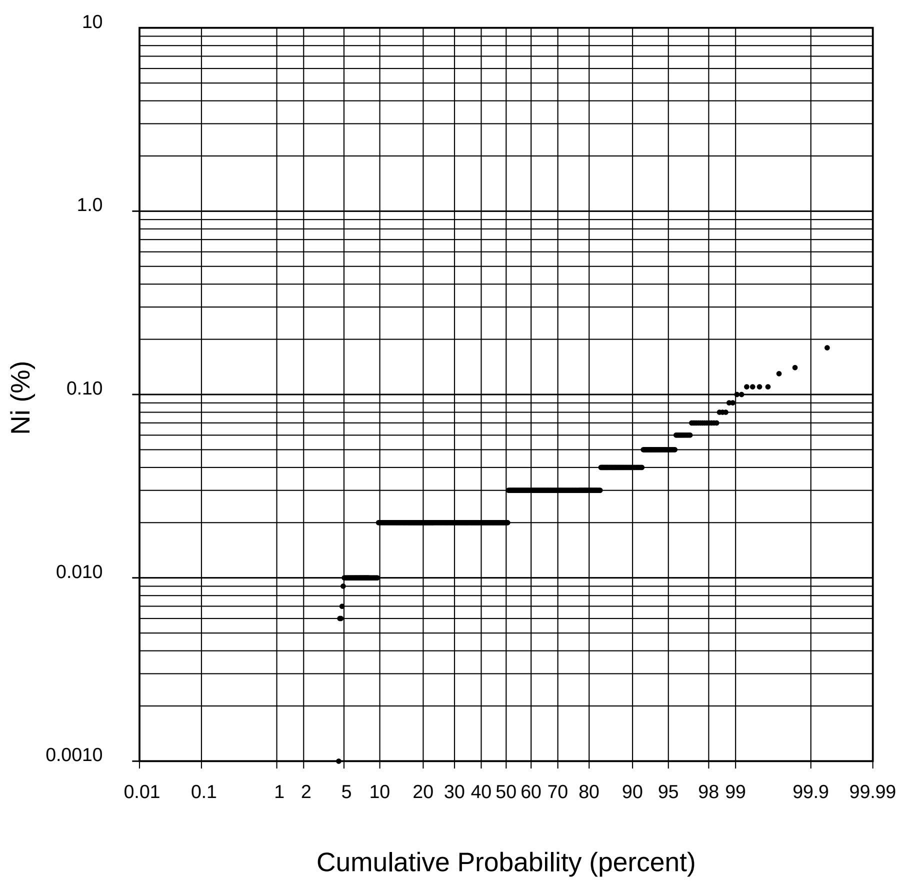

NorthMet - Unit_6 Raw Assay Cu (%) without domain pts.
Frequency (Percent)
CU (%)
0.00
0.75
1.50
2.25
3.00
N 884
m 0.04
σ2 0.01
σ/m 2.65
min 0.00
q0.25 0.01
q0.50 0.01
q0.75 0.03
max 1.48
Class width = 0.03
The last class contains
all values ≥ 2.97


NorthMet - Unit_6 Raw Assay Cu (%) without domain pts.
CU (%)
10
1.0
0.10
0.010
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

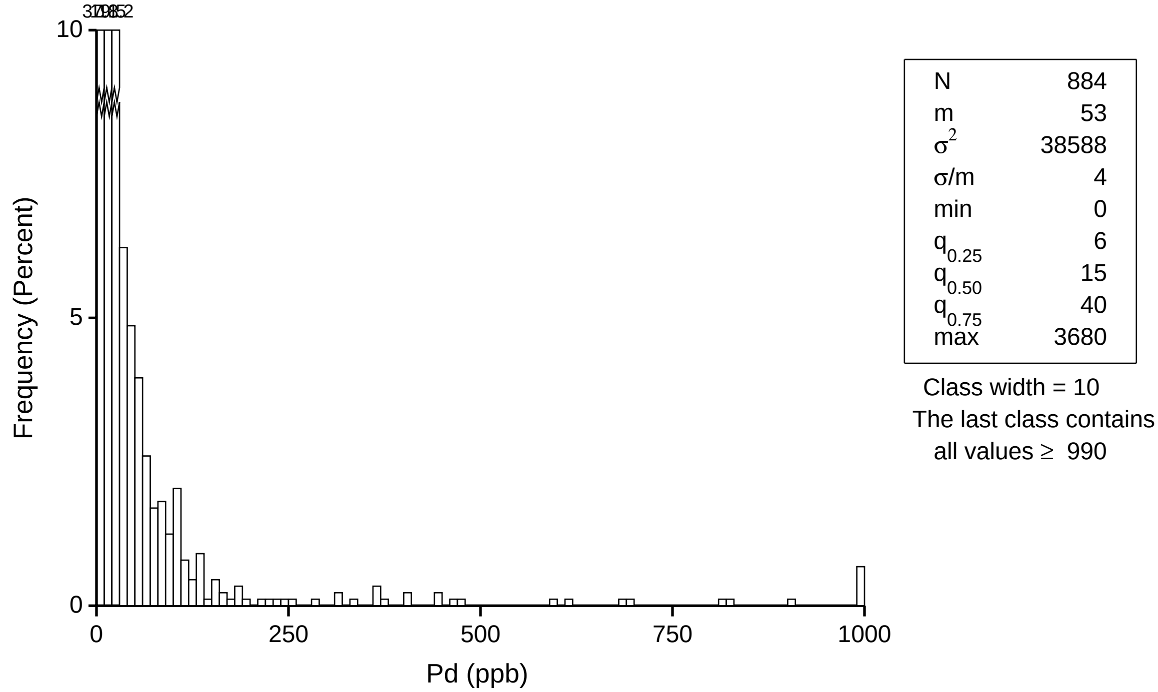
NorthMet - Unit_6 Raw Assay Ni (%) without domain pts.



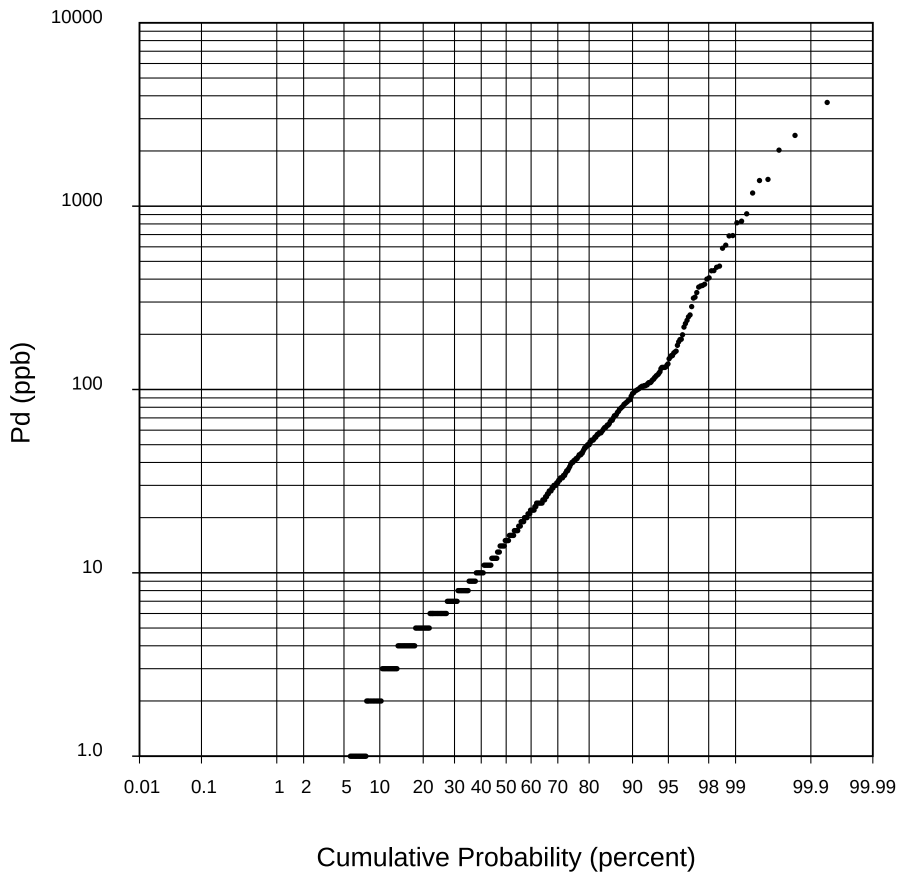
NorthMet - Unit_6 Raw Assay Ni (%) without domain pts.



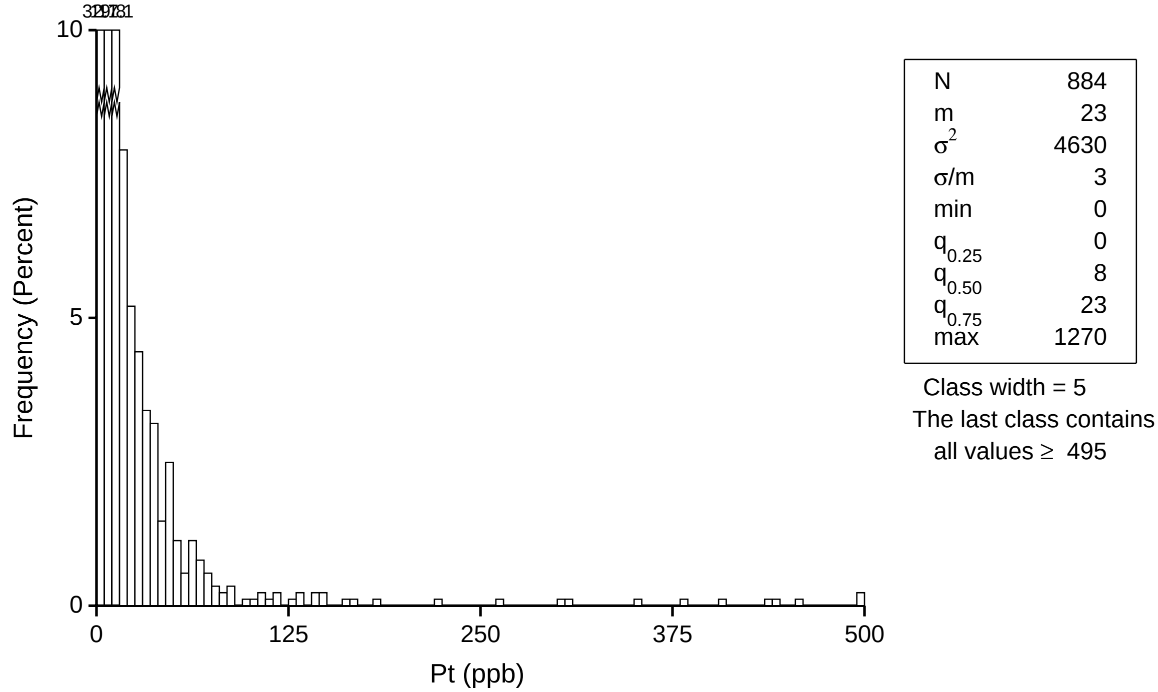
NorthMet - Unit_6 Raw Assay Pd (ppb) without domain pts.



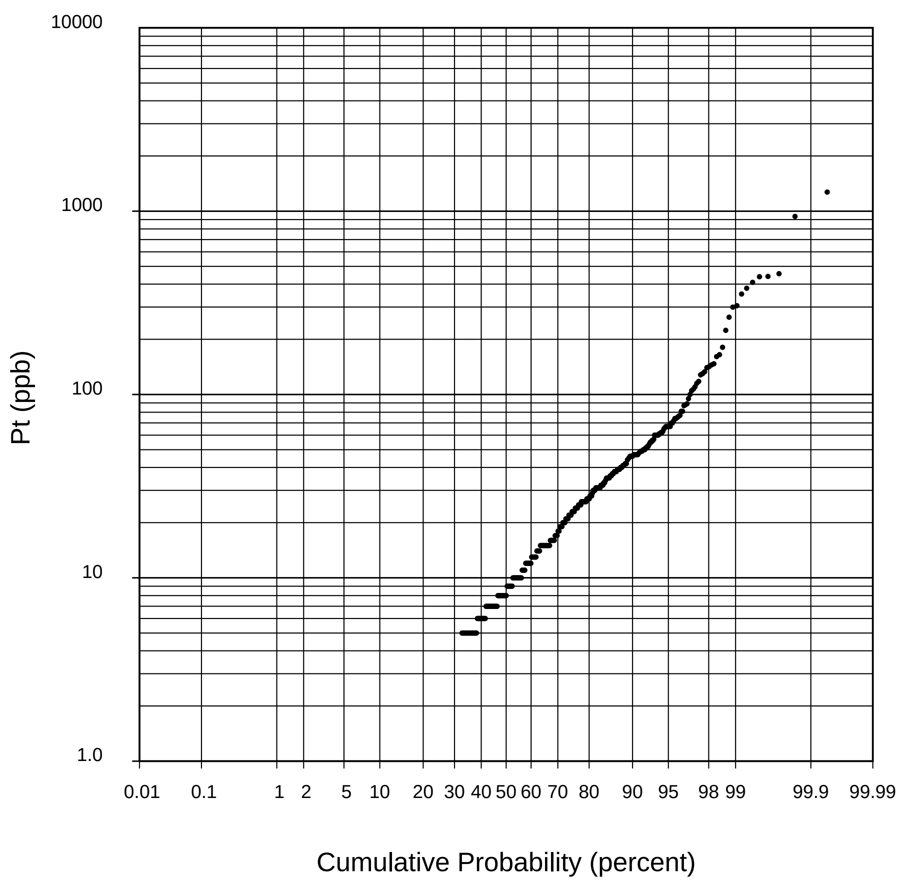
NorthMet - Unit_6 Raw Assay Pd (ppb) without domain pts.

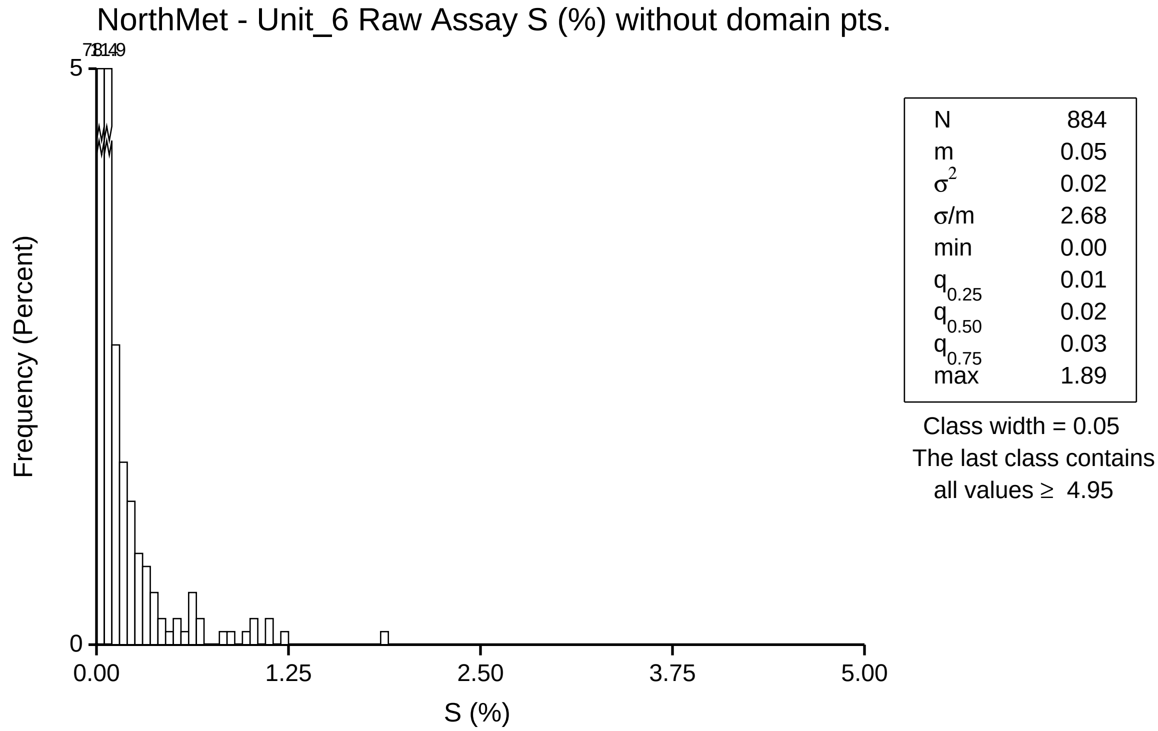


NorthMet - Unit_6 Raw Assay Pt (ppb) without domain pts.

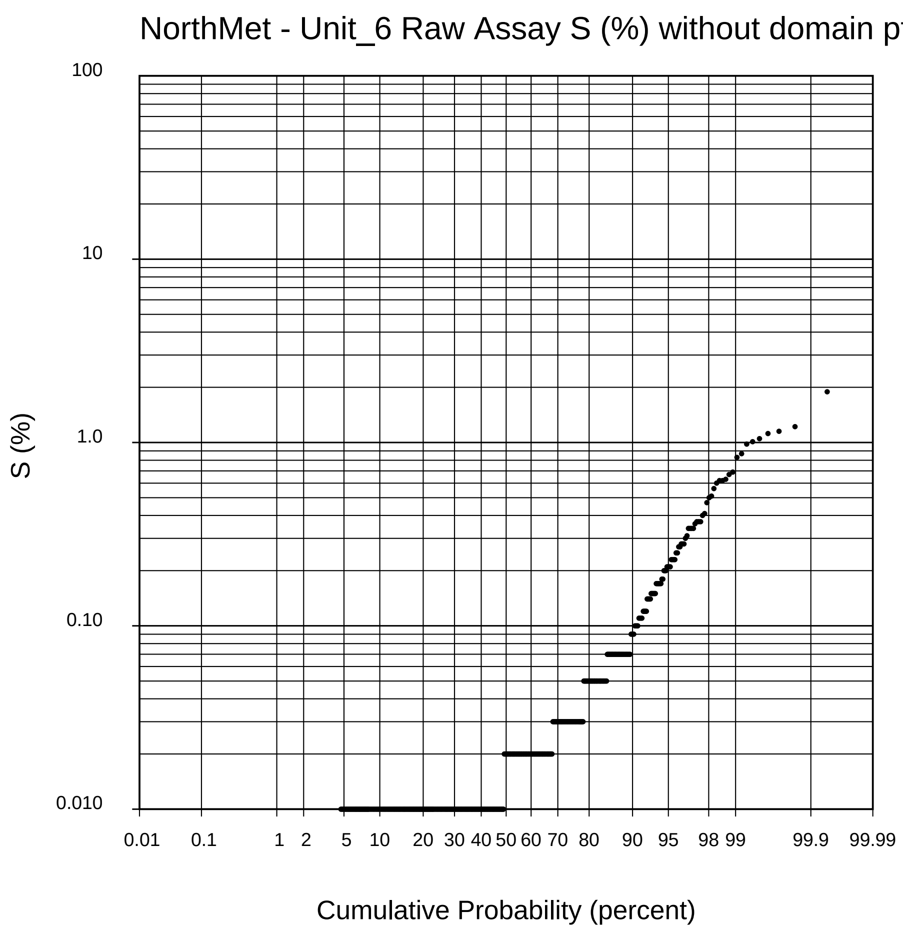


NorthMet - Unit_6 Raw Assay Pt (ppb) without domain pts.



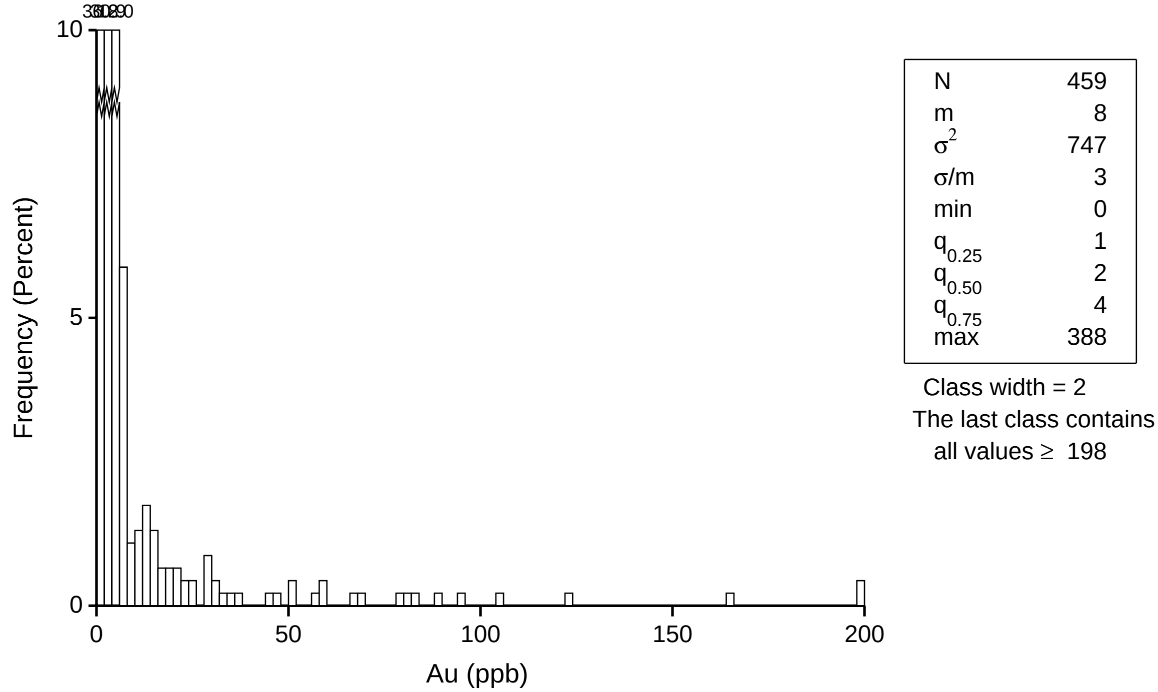


NorthMet - Unit_6 Raw Assay S (%) without domain pts.
Frequency (Percent)
S (%)
0.00
1.25
2.50
3.75
5.00
0
5
N 884
m 0.05
σ2 0.02
σ/m 2.68
min 0.00
q0.25 0.01
q0.50 0.02
q0.75 0.03
max 1.89
Class width = 0.05
The last class contains
all values ≥ 4.95

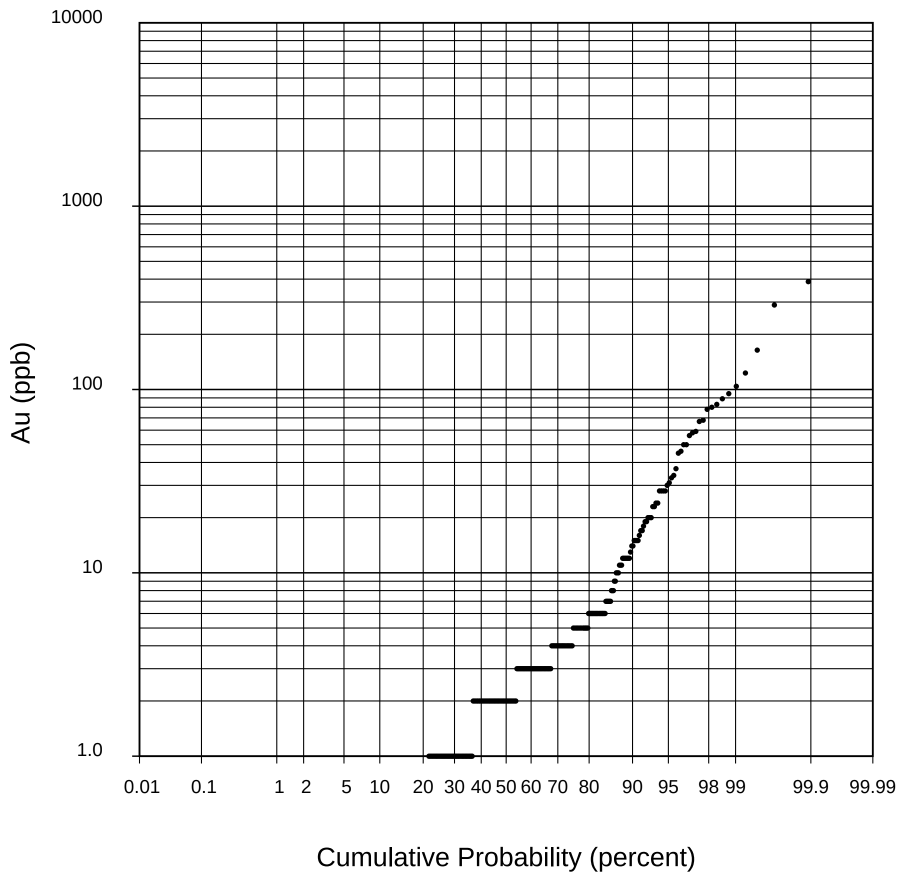


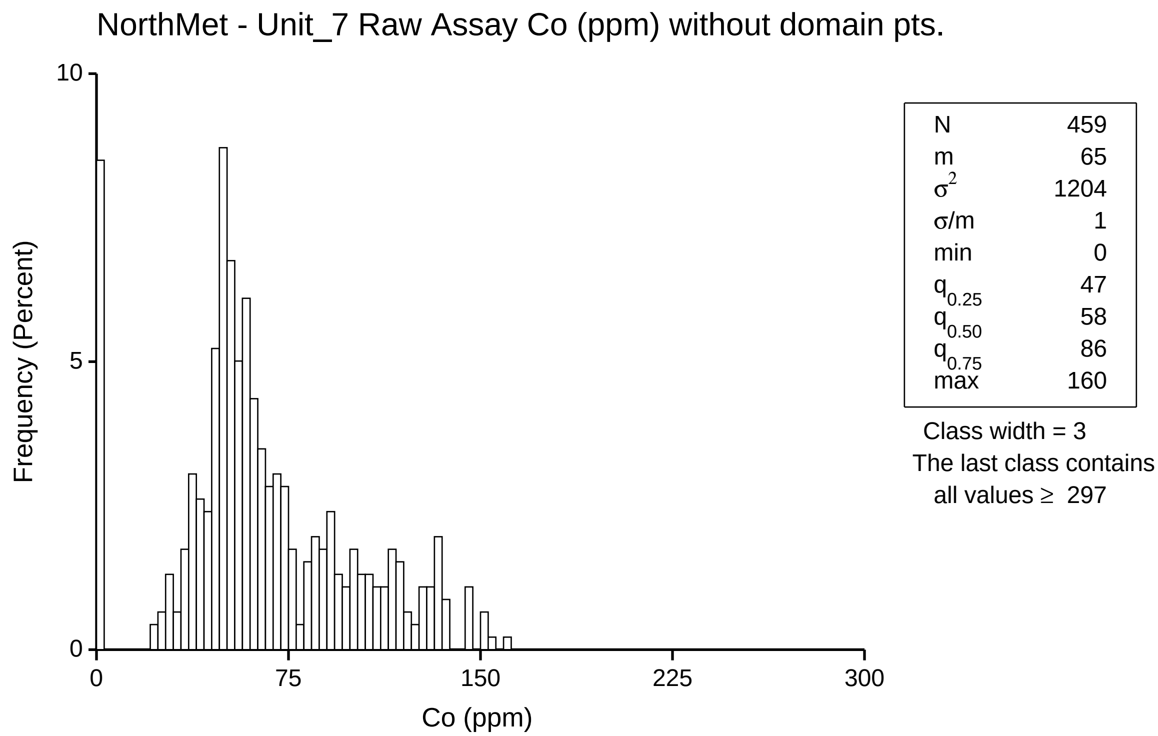
NorthMet - Unit_6 Raw Assay S (%) without domain pts.
S (%)
100
10
1.0
0.10
0.010
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

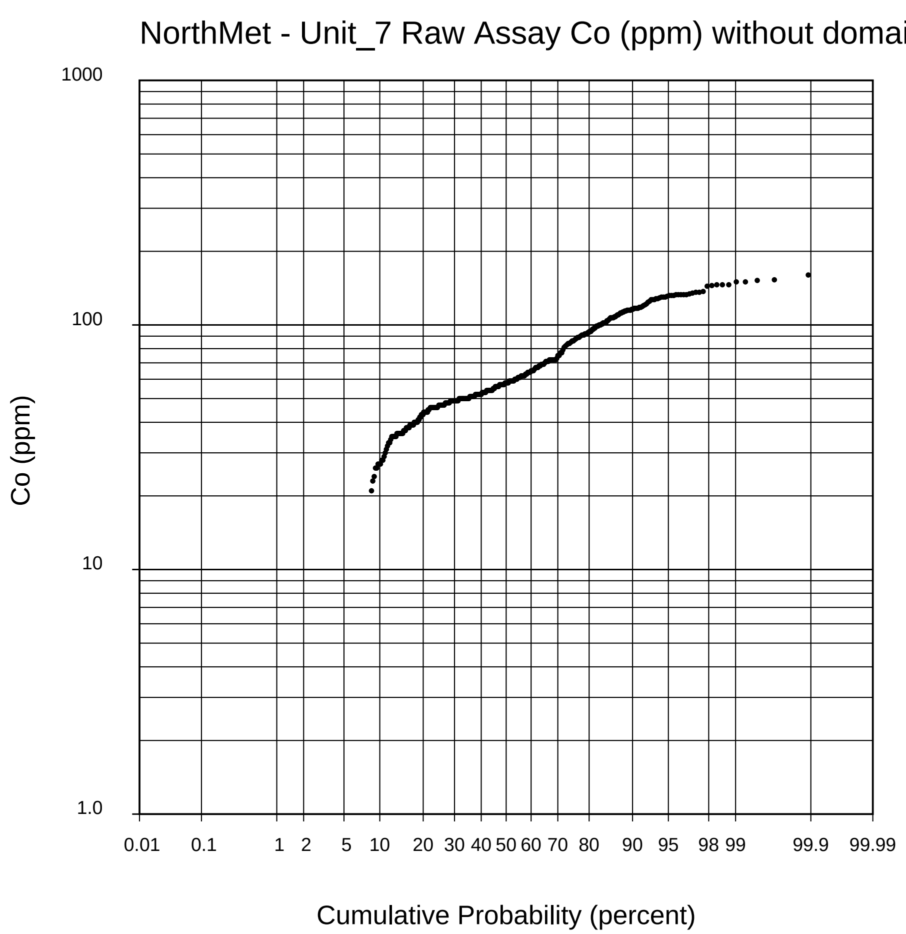
NorthMet - Unit_7 Raw Assay Au (ppb) without domain pts.



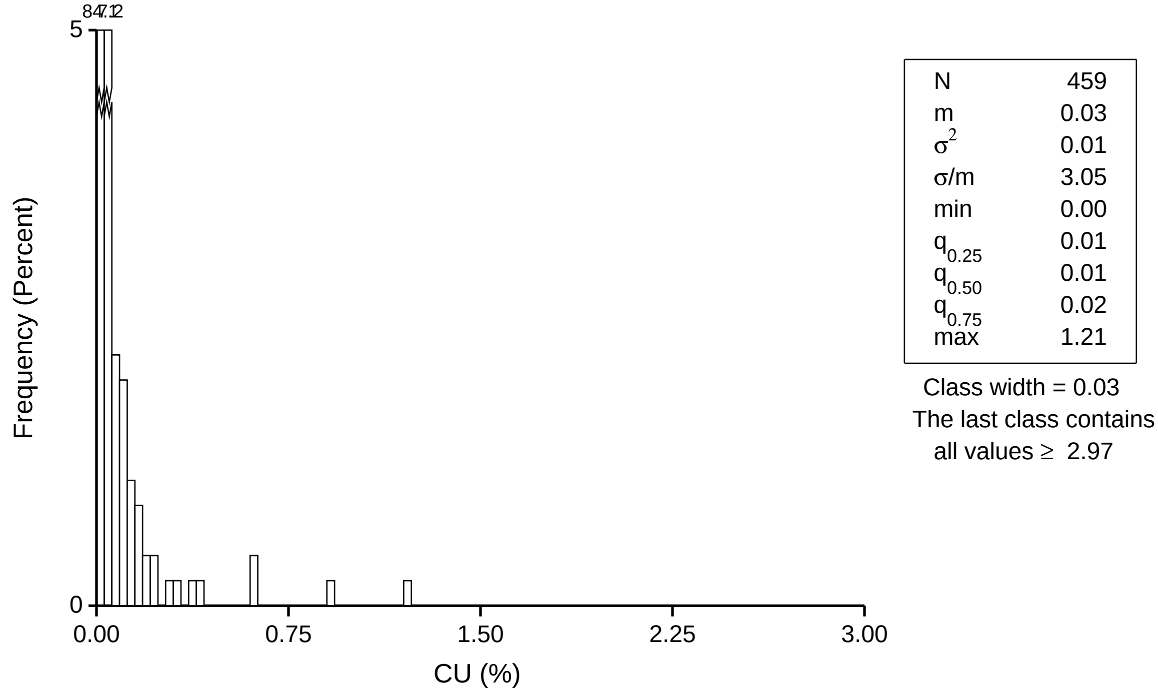
NorthMet - Unit_7 Raw Assay Au (ppb) without domain pts.



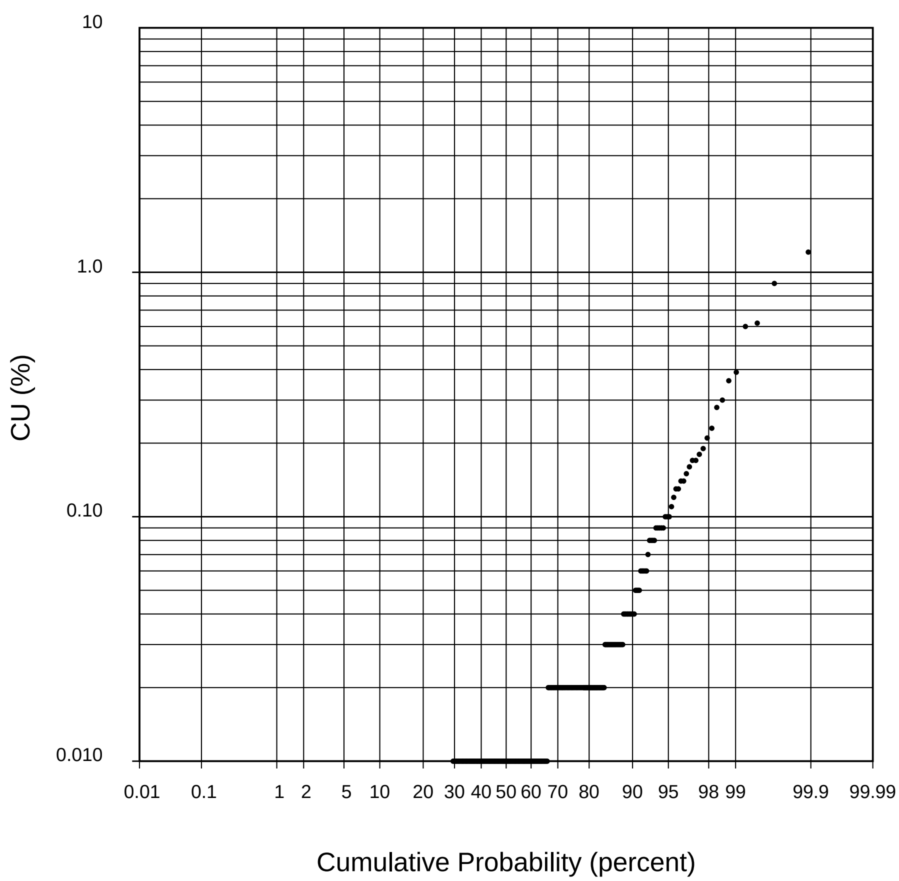

NorthMet - Unit_7 Raw Assay Co (ppm) without domain pts.
Frequency (Percent)
Co (ppm)
0
5
10
0
75
150
225
300
N 459
m 65
σ2 1204
σ/m 1
min 0
q0.25 47
q0.50 58
q0.75 86
max 160
Class width = 3
The last class contains
all values ≥ 297


NorthMet - Unit_7 Raw Assay Co (ppm) without domain pts.
Co (ppm)
1000
100
10
1.0
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

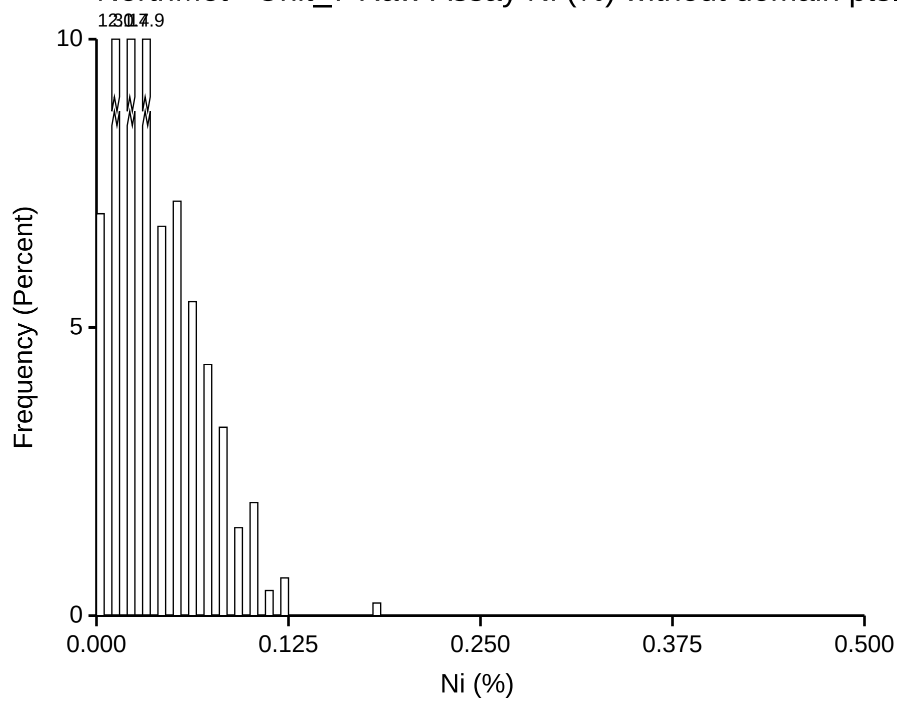
NorthMet - Unit_7 Raw Assay Cu (%) without domain pts.



NorthMet - Unit_7 Raw Assay Cu (%) without domain pts.



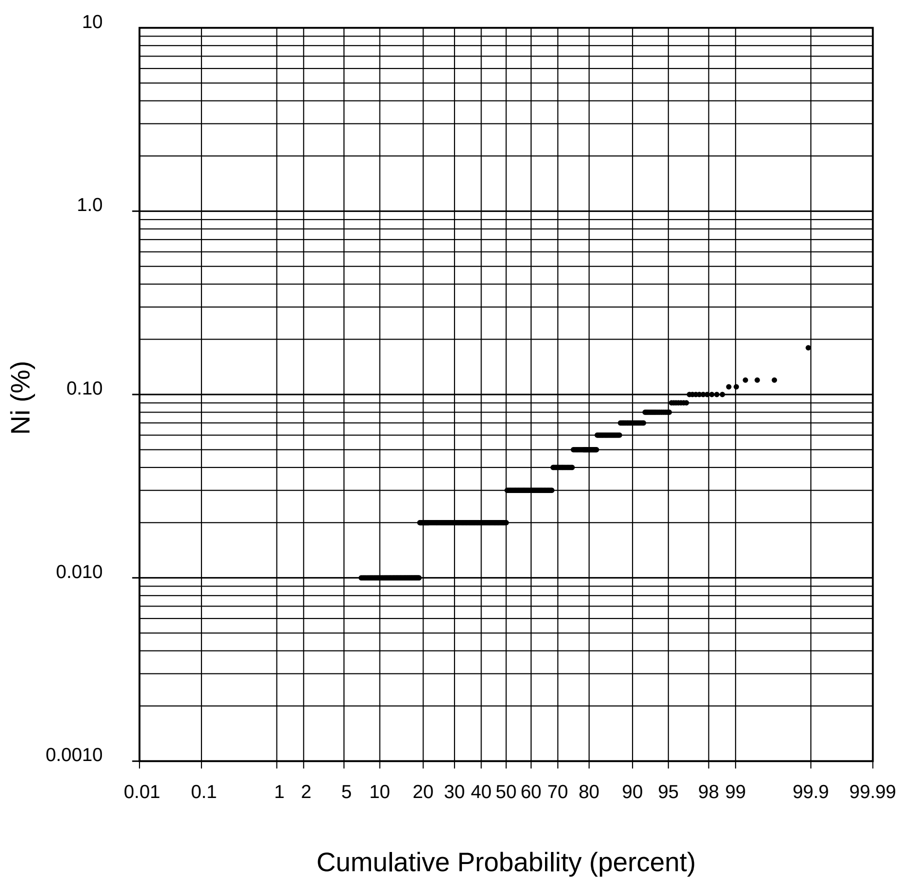
NorthMet - Unit_7 Raw Assay Ni (%) without domain pts.



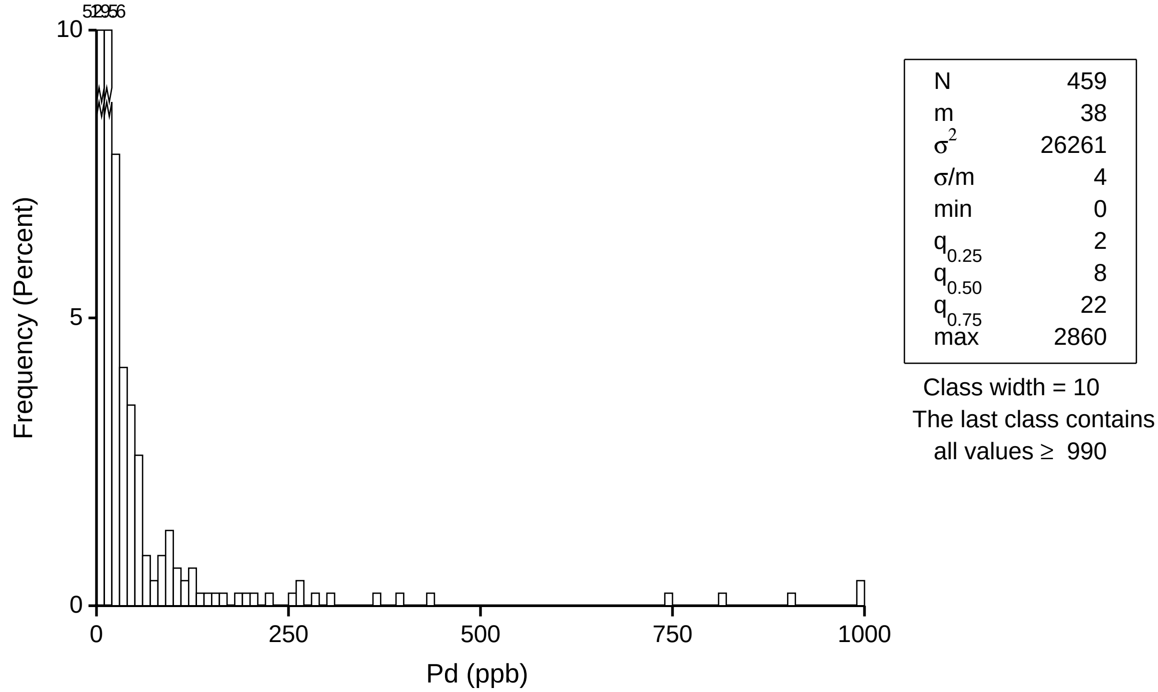
N	459
m	0.033
σ^2	0.001
σ/m	0.771
min	0.000
$q_{0.25}$	0.020
$q_{0.50}$	0.020
$q_{0.75}$	0.040
max	0.180

Class width = 0.005
The last class contains
all values ≥ 0.495

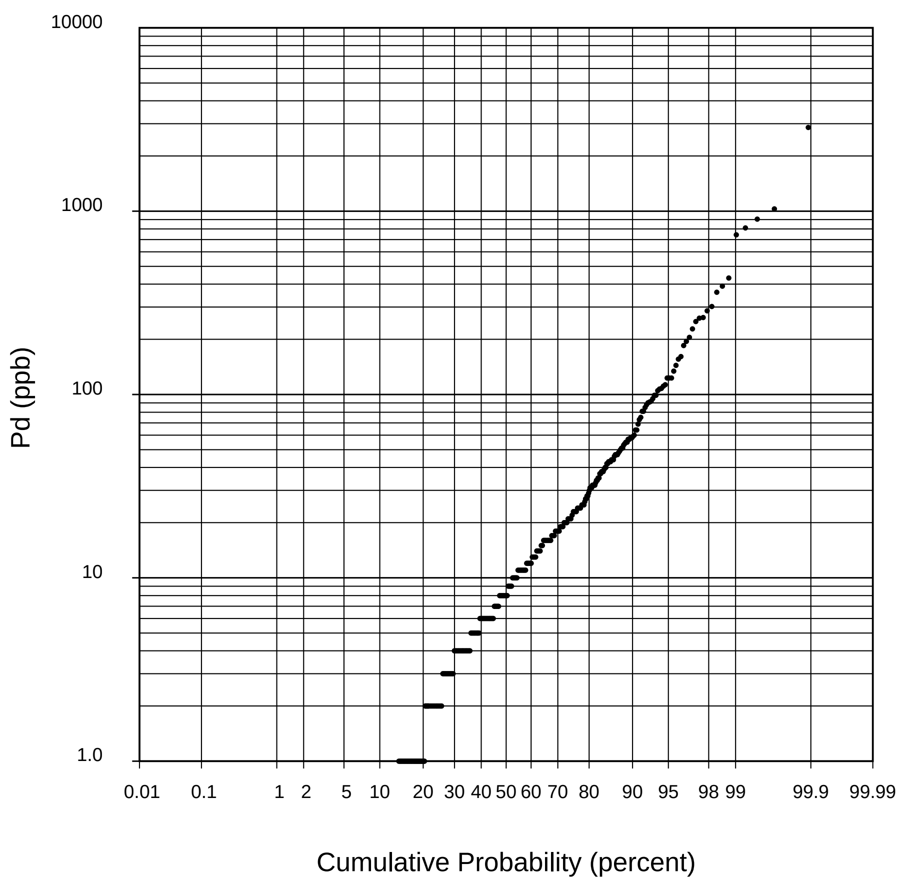
NorthMet - Unit_7 Raw Assay Ni (%) without domain pts.

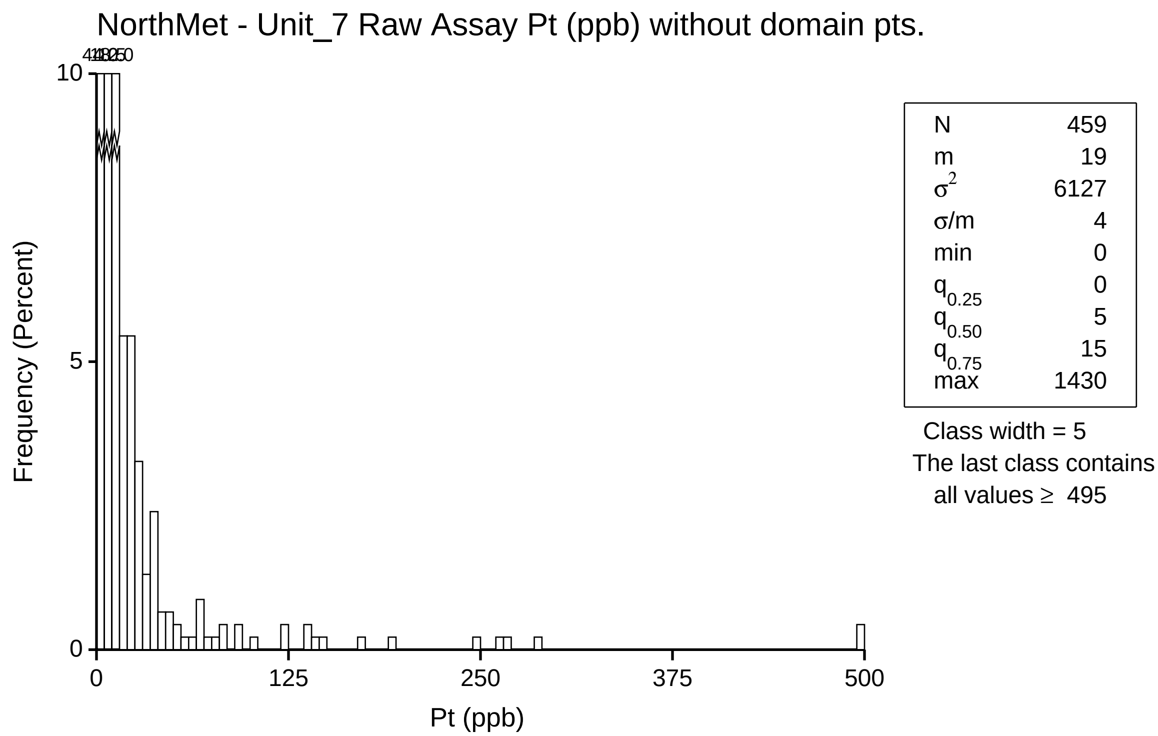


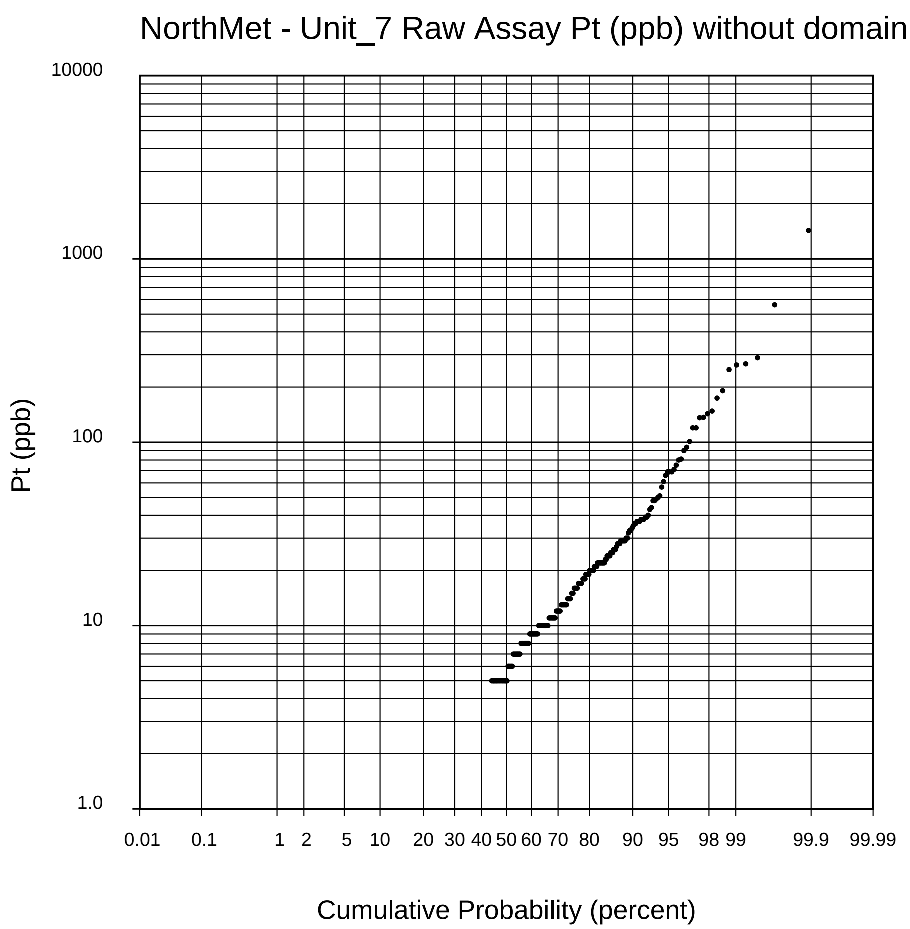
NorthMet - Unit_7 Raw Assay Pd (ppb) without domain pts.



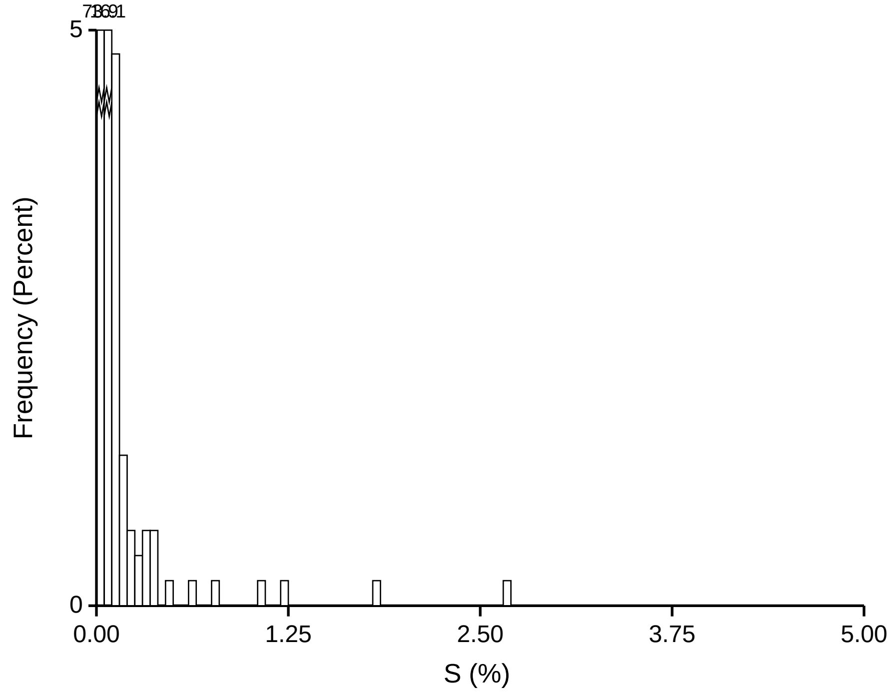
NorthMet - Unit_7 Raw Assay Pd (ppb) without domain pts.




NorthMet - Unit_7 Raw Assay Pt (ppb) without domain pts.
Frequency (Percent)
Pt (ppb)
0
125
250
375
500
0
5
10
N 459
m 19
σ2 6127
σ/m 4
min 0
q0.25 0
q0.50 5
q0.75 15
max 1430
Class width = 5
The last class contains
all values ≥ 495


NorthMet - Unit_7 Raw Assay Pt (ppb) without domain pts.
Pt (ppb)
10000
1000
100
10
1.0
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

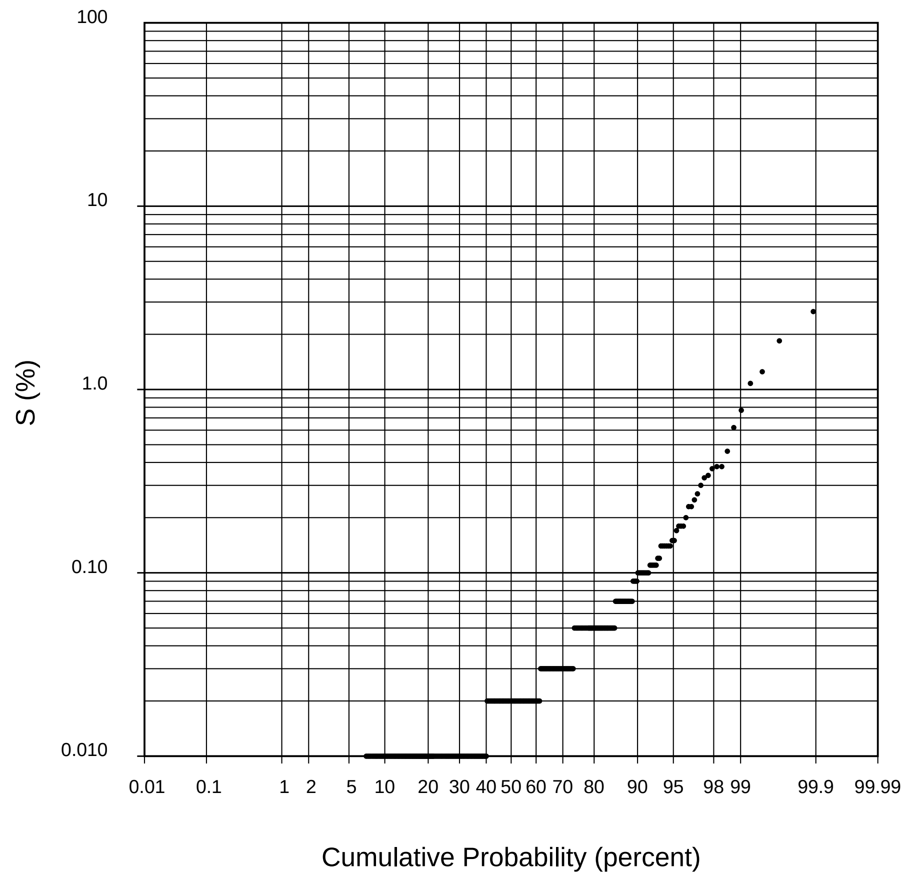
NorthMet - Unit_7 Raw Assay S (%) without domain pts.



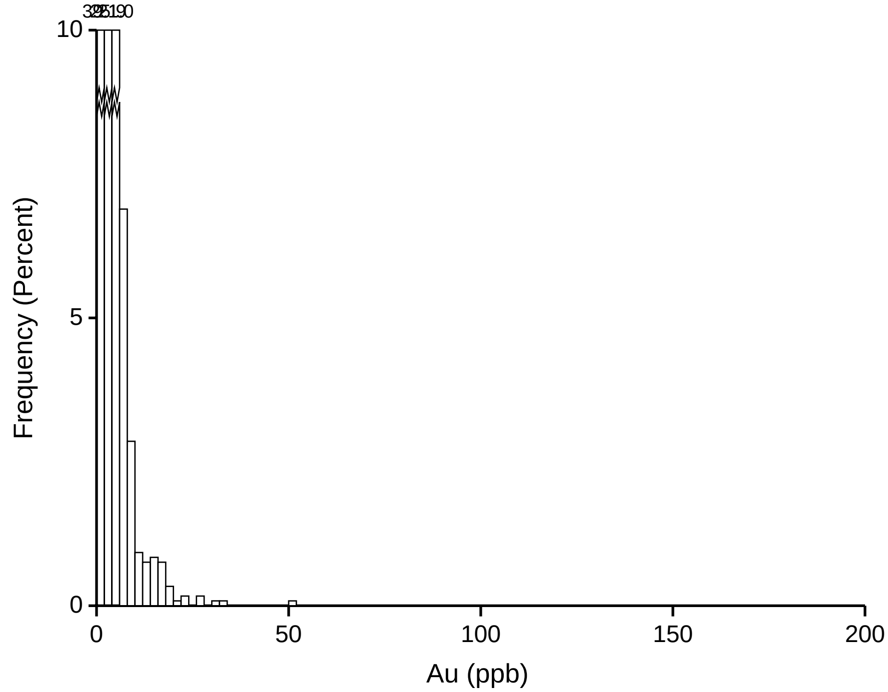
N	459
m	0.05
σ^2	0.03
σ/m	3.32
min	0.00
$q_{0.25}$	0.01
$q_{0.50}$	0.02
$q_{0.75}$	0.05
max	2.66

Class width = 0.05
The last class contains
all values ≥ 4.95

NorthMet - Unit_7 Raw Assay S (%) without domain pts.



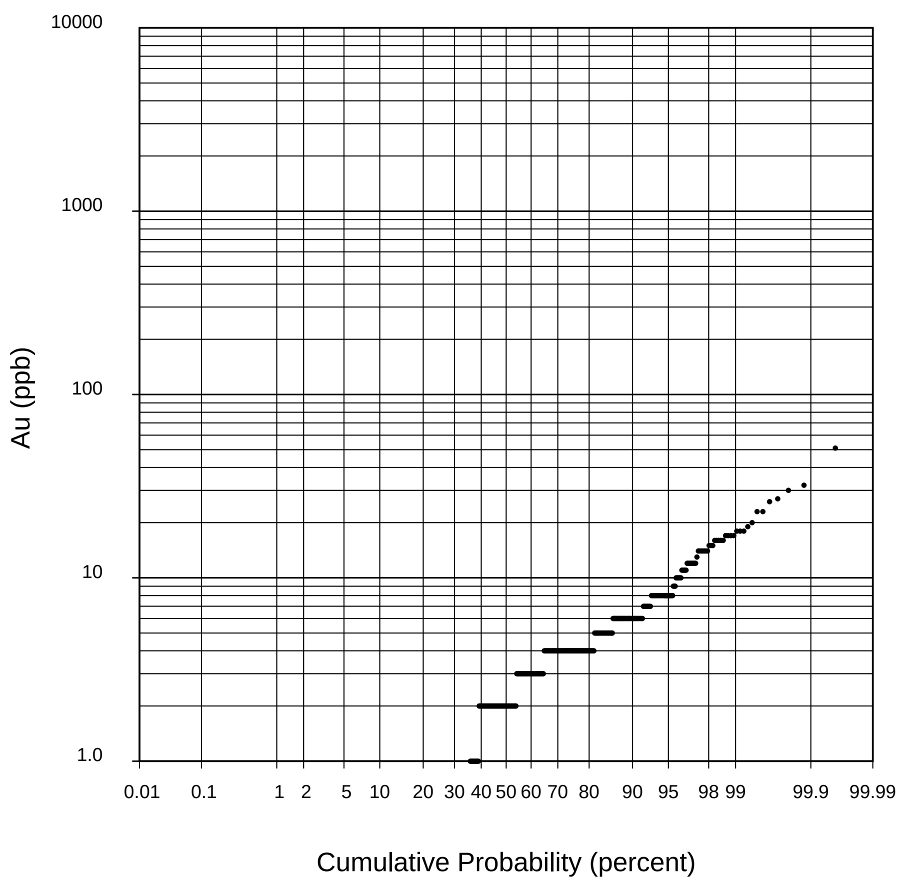
NorthMet - Unit_20 Raw Assay Au (ppb) without domain pts.



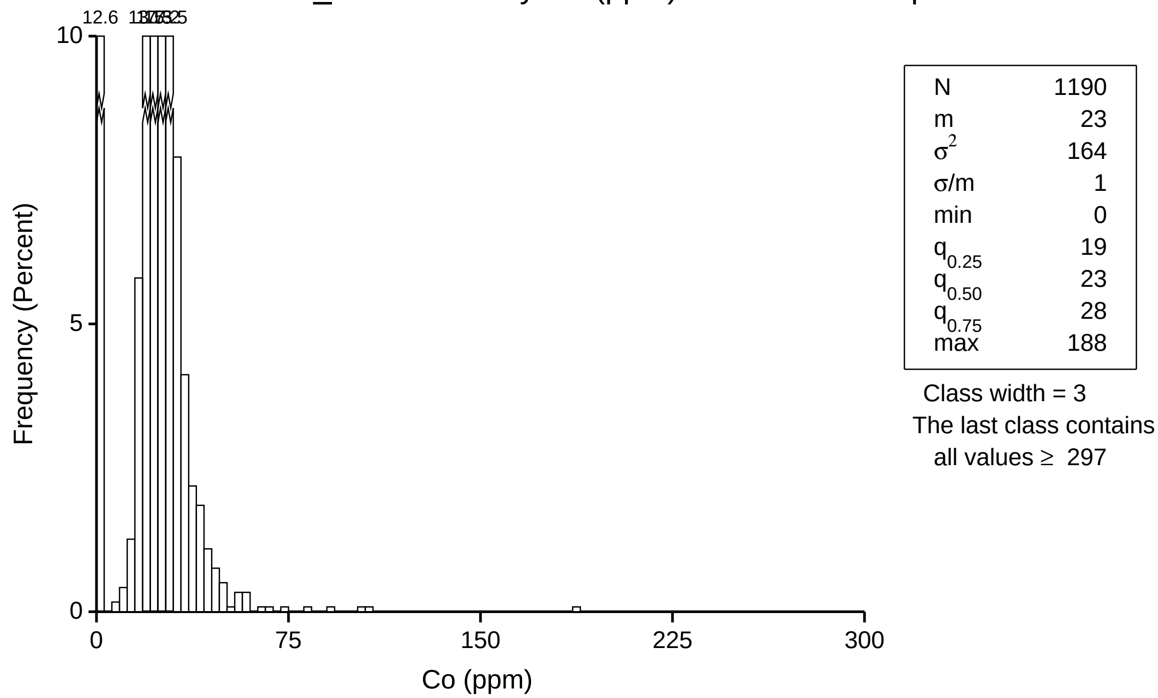
N	1190
m	3
σ^2	15
σ/m	1
min	0
$q_{0.25}$	0
$q_{0.50}$	2
$q_{0.75}$	4
max	51

Class width = 2
The last class contains all values ≥ 198

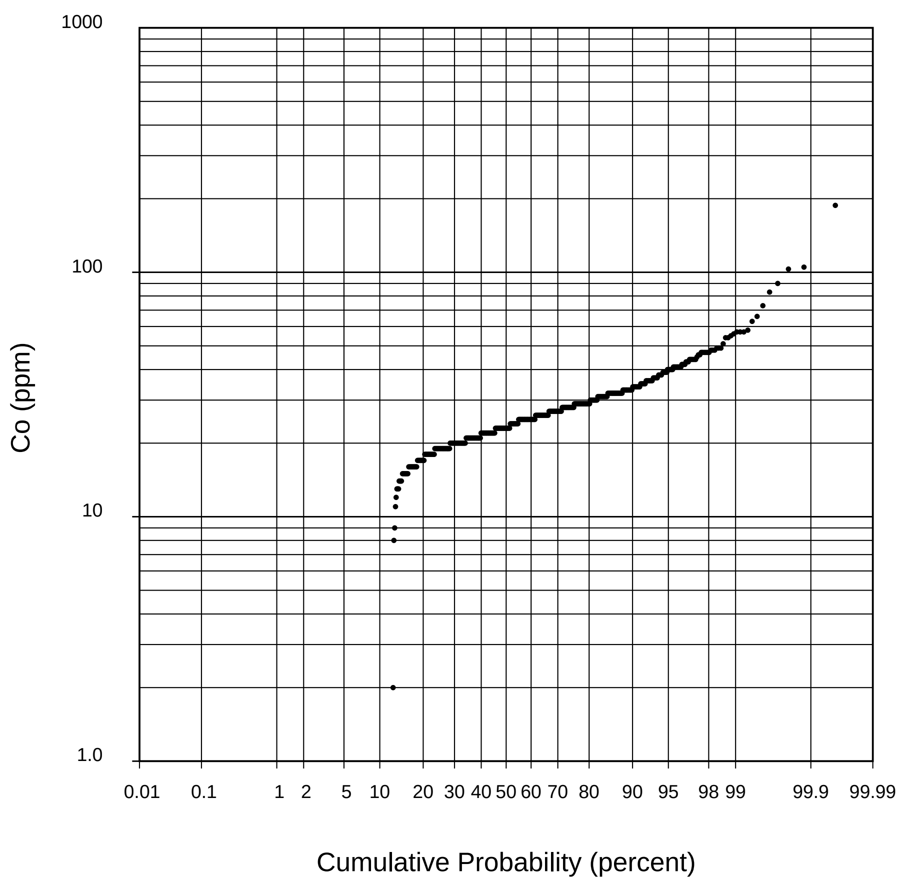
NorthMet - Unit_20 Raw Assay Au (ppb) without domain pts.



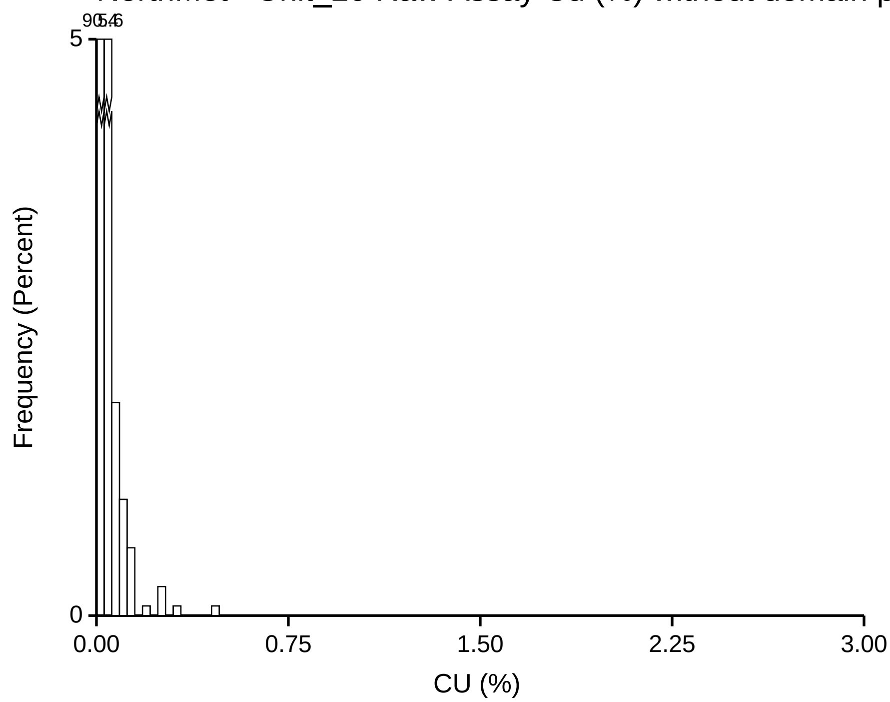
NorthMet - Unit_20 Raw Assay Co (ppm) without domain pts.



NorthMet - Unit_20 Raw Assay Co (ppm) without domain pts.



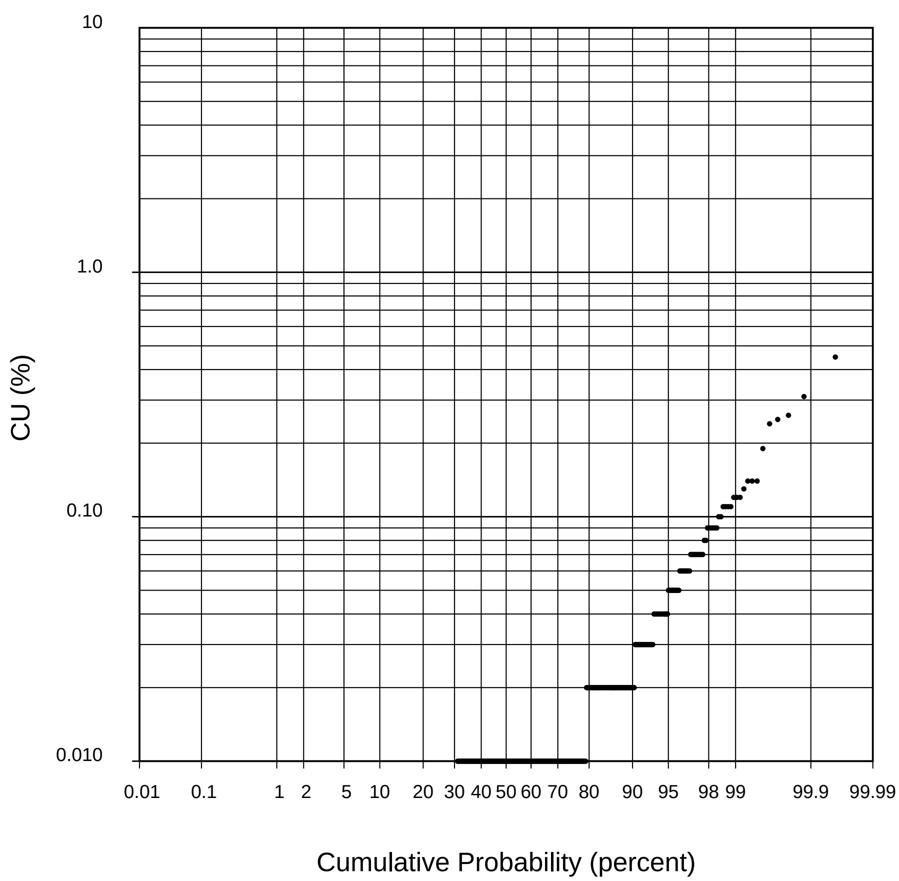
NorthMet - Unit_20 Raw Assay Cu (%) without domain pts.



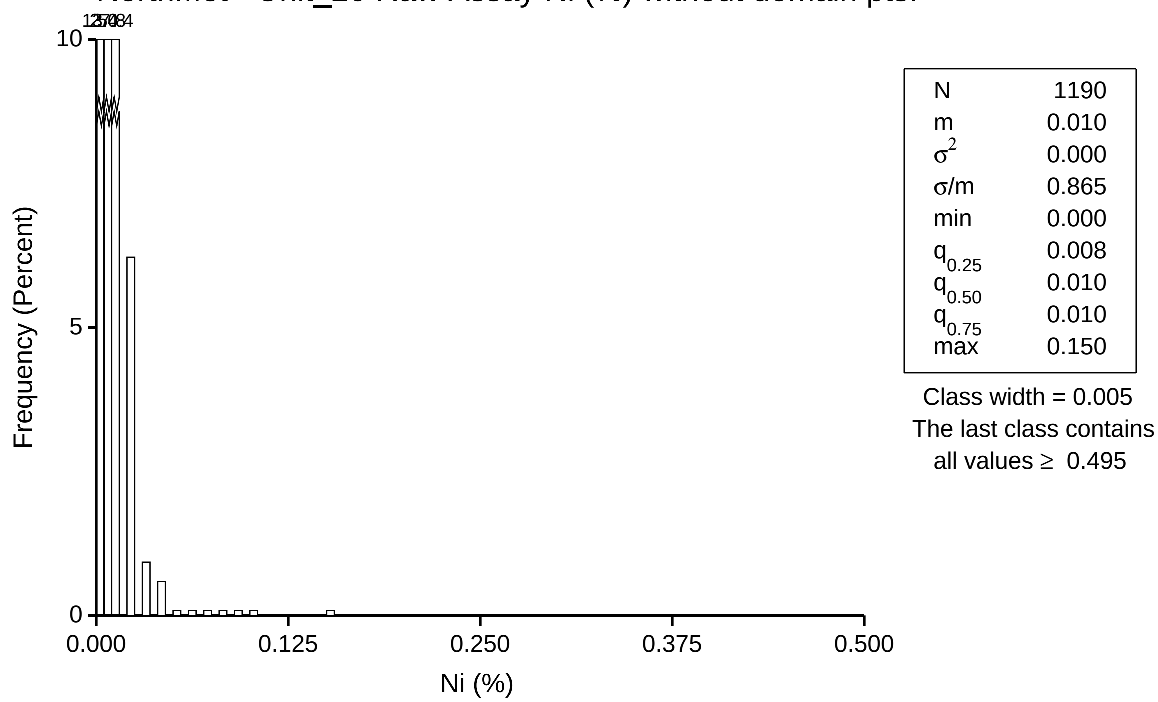
N	1190
m	0.01
σ^2	0.00
σ/m	1.75
min	0.00
$q_{0.25}$	0.01
$q_{0.50}$	0.01
$q_{0.75}$	0.01
max	0.45

Class width = 0.03
The last class contains
all values ≥ 2.97

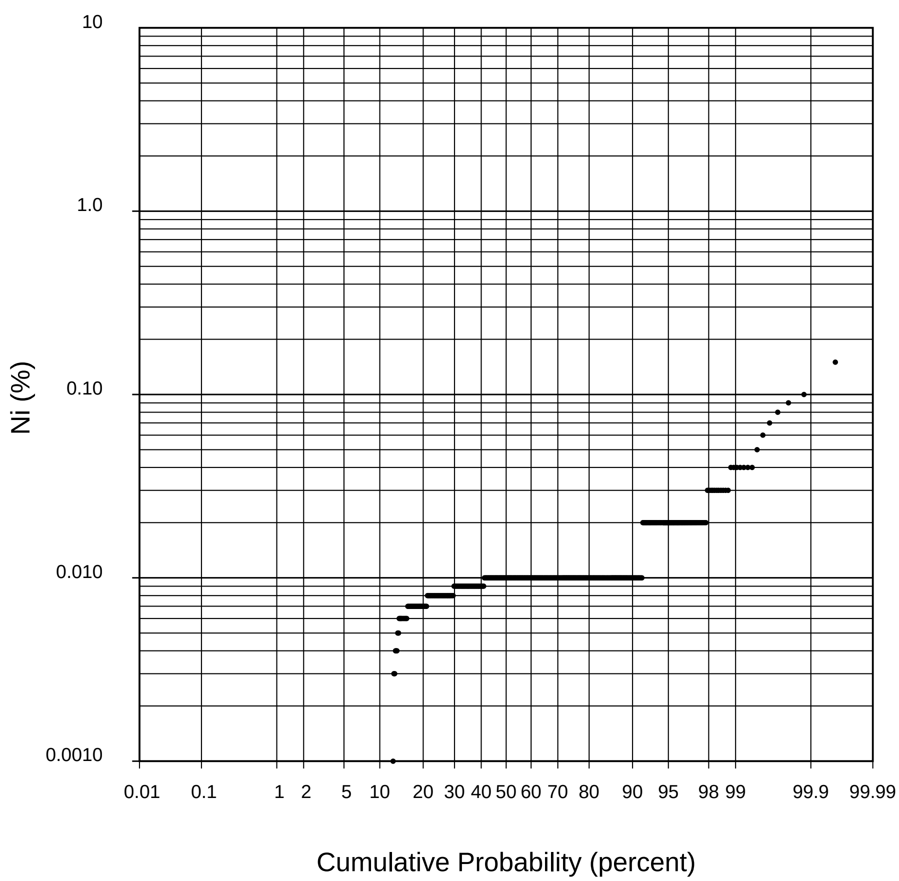
NorthMet - Unit_20 Raw Assay Cu (%) without domain pts.

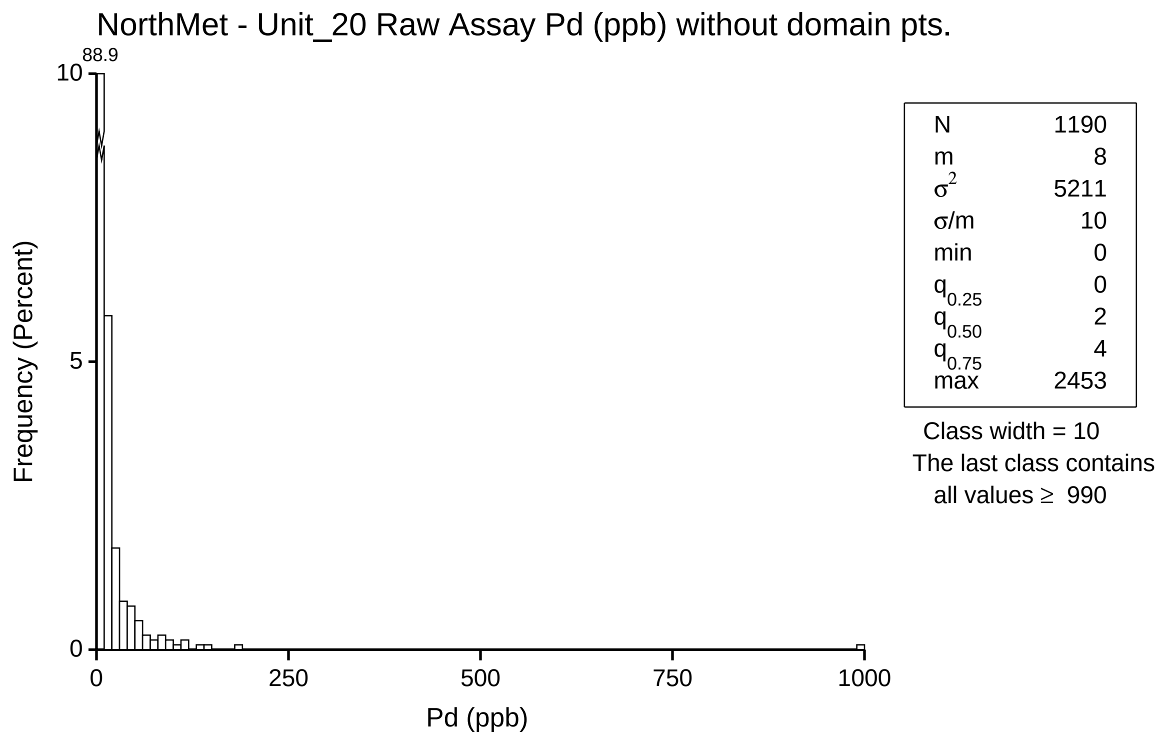


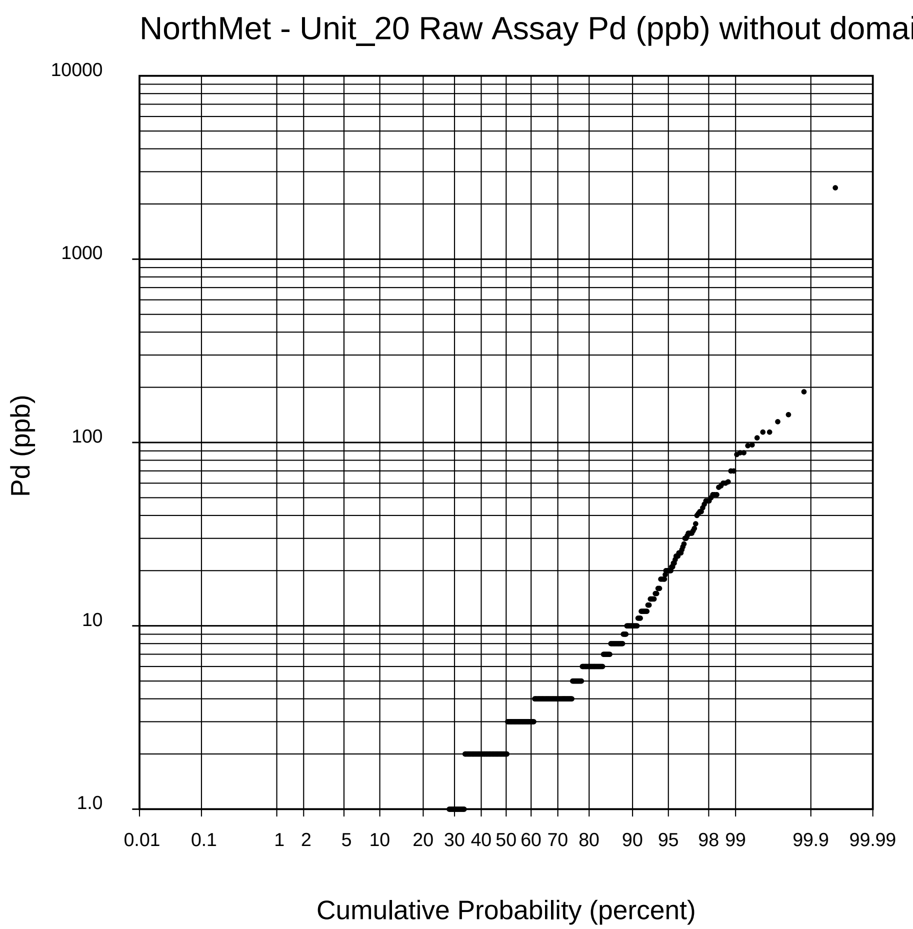
NorthMet - Unit_20 Raw Assay Ni (%) without domain pts.



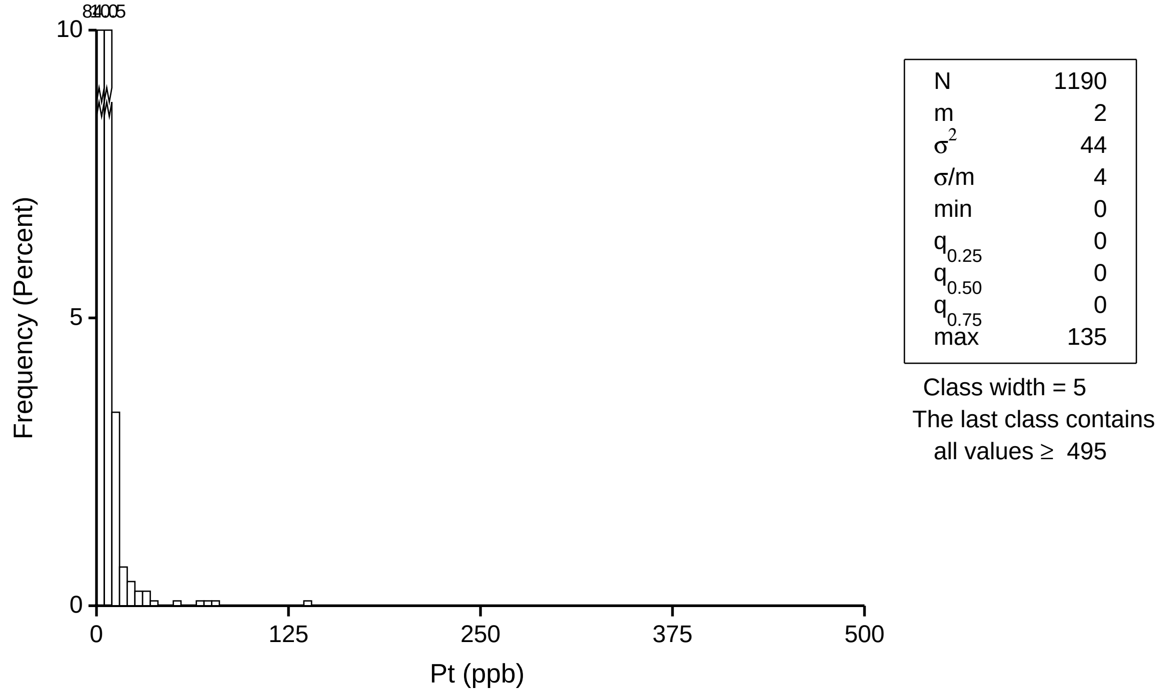
NorthMet - Unit_20 Raw Assay Ni (%) without domain pts.



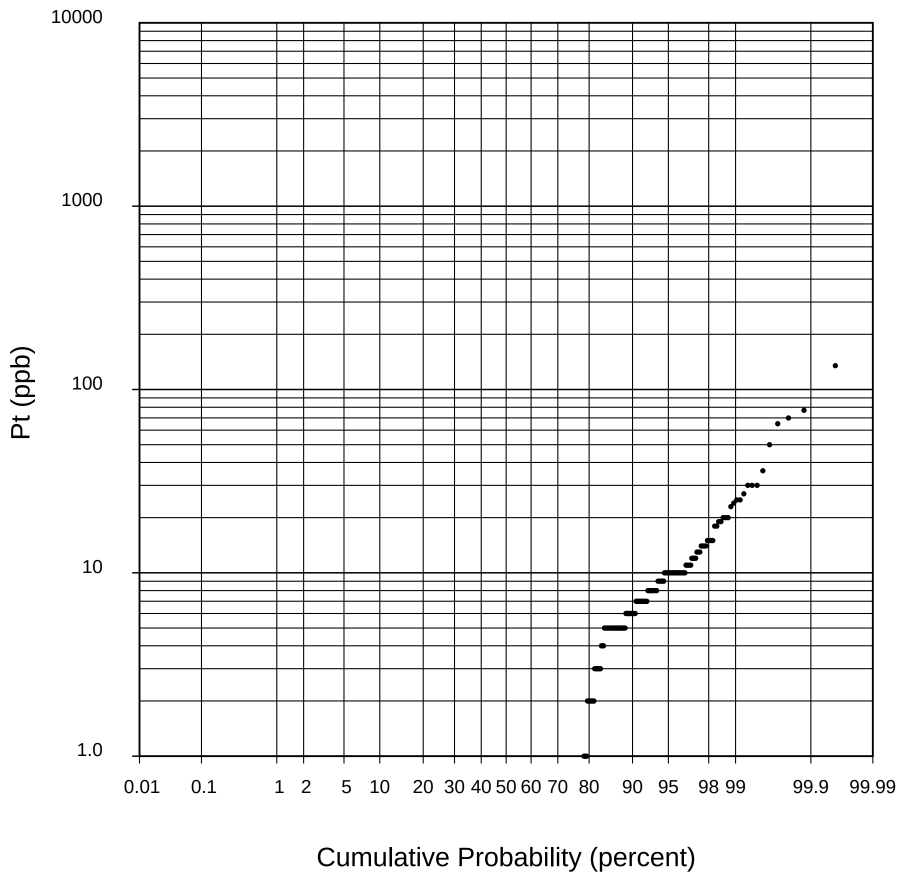

NorthMet - Unit_20 Raw Assay Pd (ppb) without domain pts.
88.9
10
5
0
Frequency (Percent)
0
250
500
750
1000
Pd (ppb)
N 1190
m 8
σ² 5211
σ/m 10
min 0
q0.25 0
q0.50 2
q0.75 4
max 2453
Class width = 10
The last class contains
all values ≥ 990

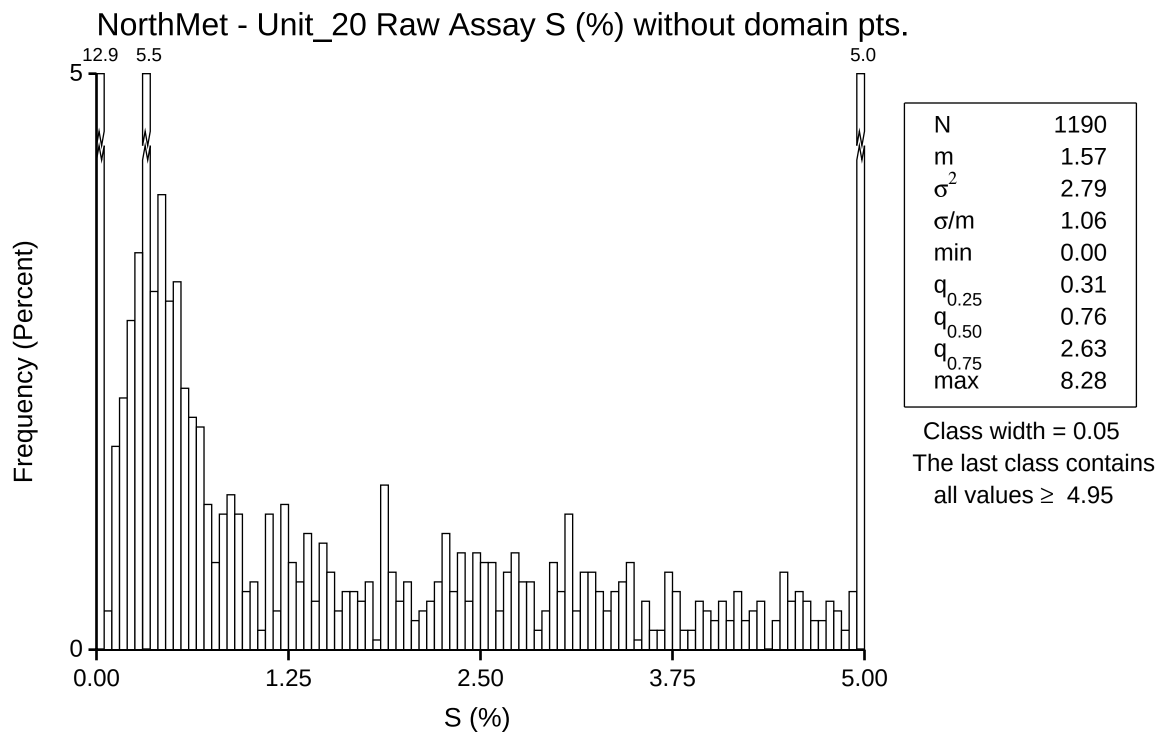

NorthMet - Unit_20 Raw Assay Pd (ppb) without domain pts.
10000
1000
100
10
1.0
Pd (ppb)
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

NorthMet - Unit_20 Raw Assay Pt (ppb) without domain pts.

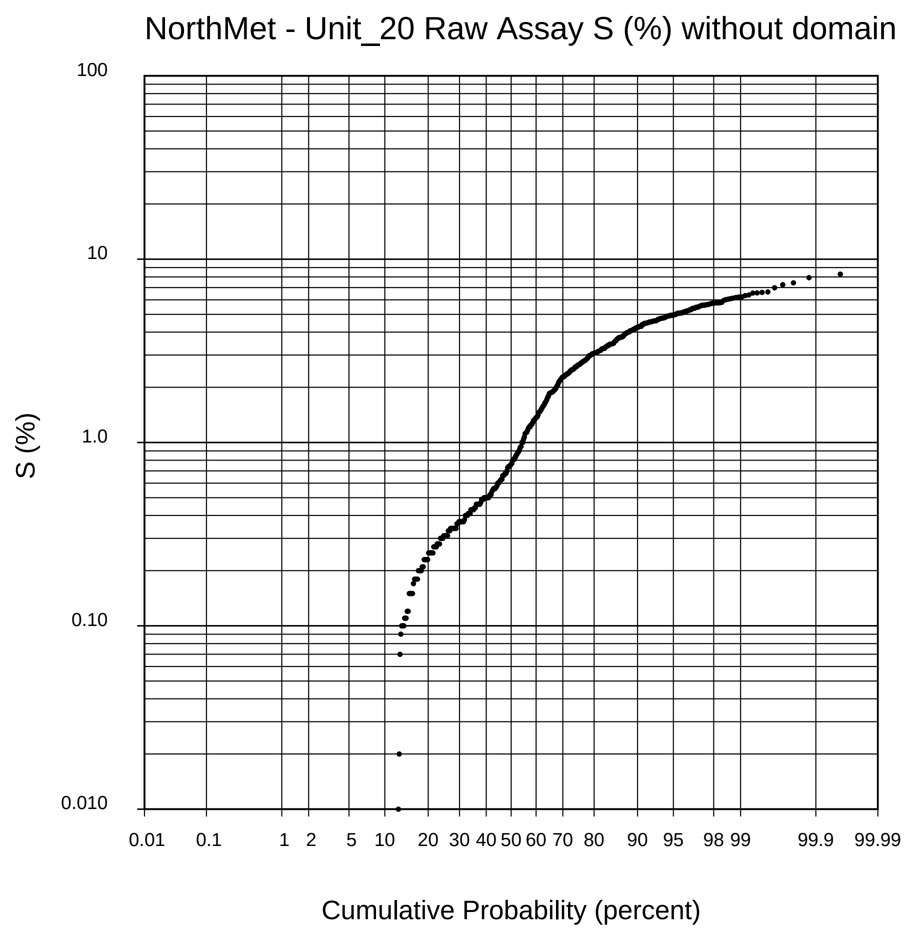


NorthMet - Unit_20 Raw Assay Pt (ppb) without domain pts.



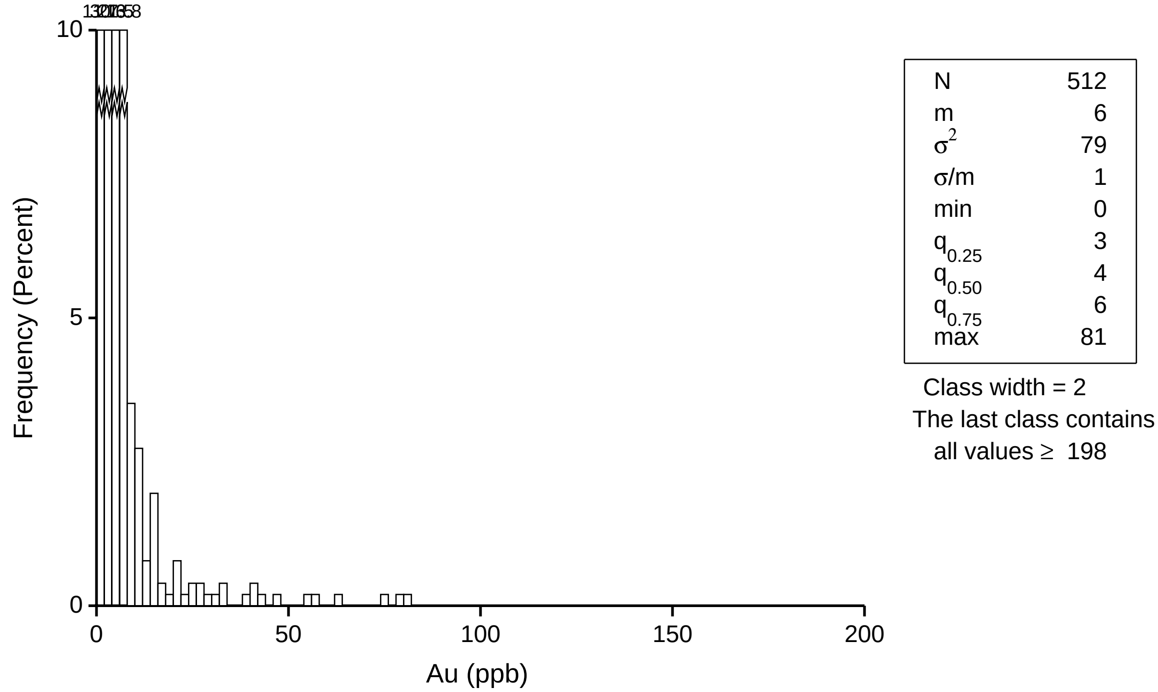


NorthMet - Unit_20 Raw Assay S (%) without domain pts.
12.9
5.5
5.0
5
0
0.00
1.25
2.50
3.75
5.00
S (%)
Frequency (Percent)
N 1190
m 1.57
σ2 2.79
σ/m 1.06
min 0.00
q0.25 0.31
q0.50 0.76
q0.75 2.63
max 8.28
Class width = 0.05
The last class contains
all values ≥ 4.95

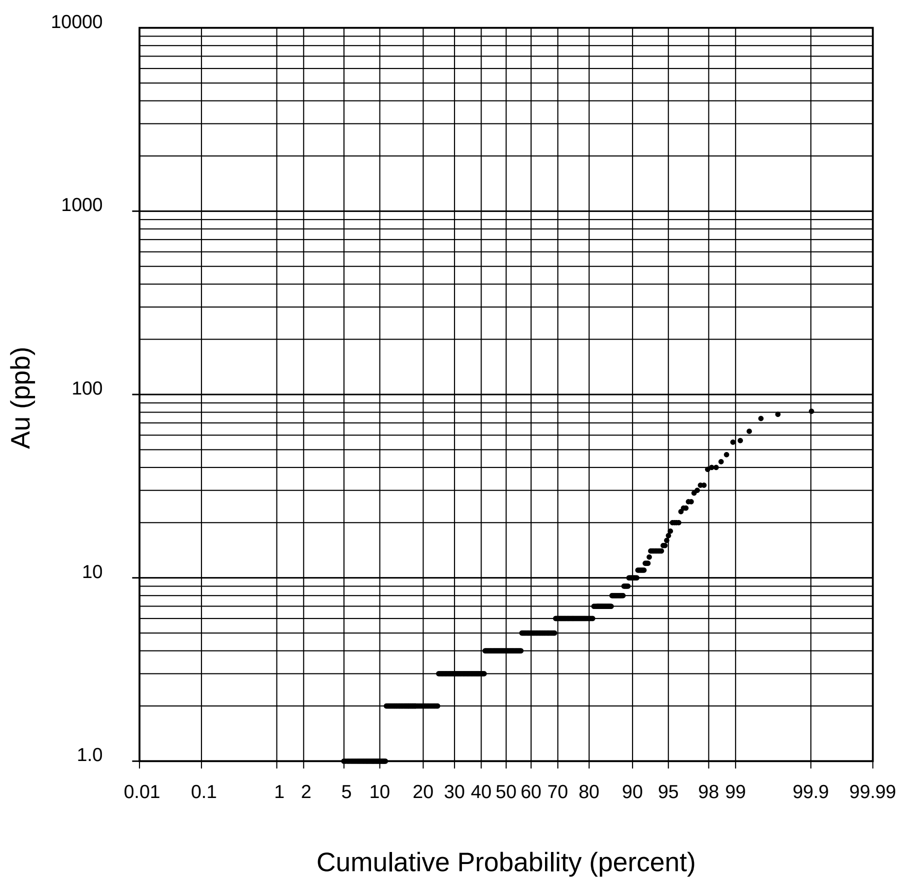


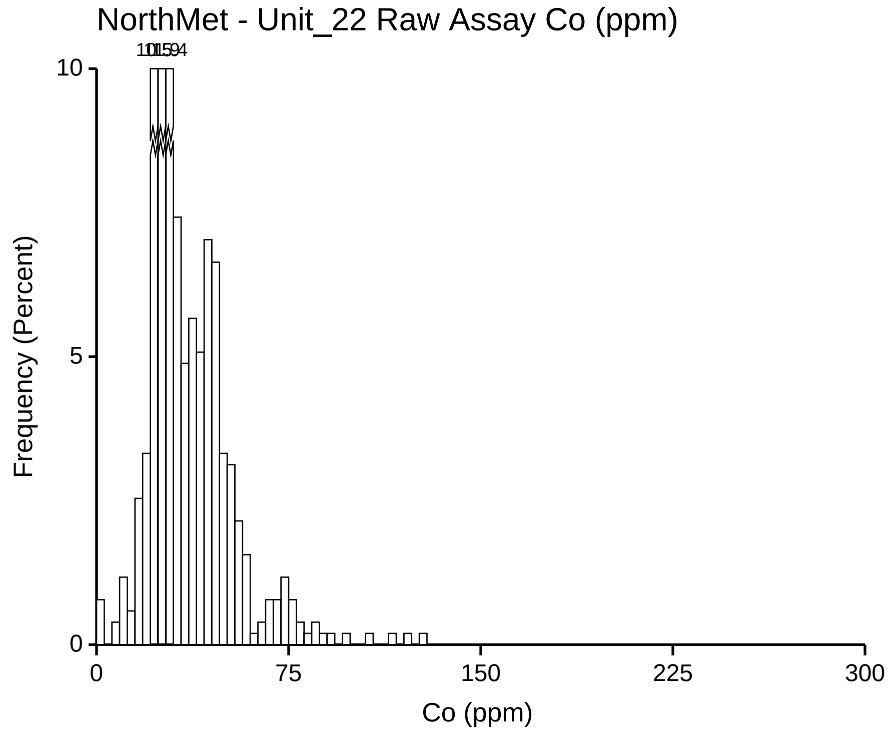
NorthMet - Unit_20 Raw Assay S (%) without domain pts.
100
10
1.0
0.10
0.010
S (%)
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

NorthMet - Unit_22 Raw Assay Au (ppb) without domain pts.



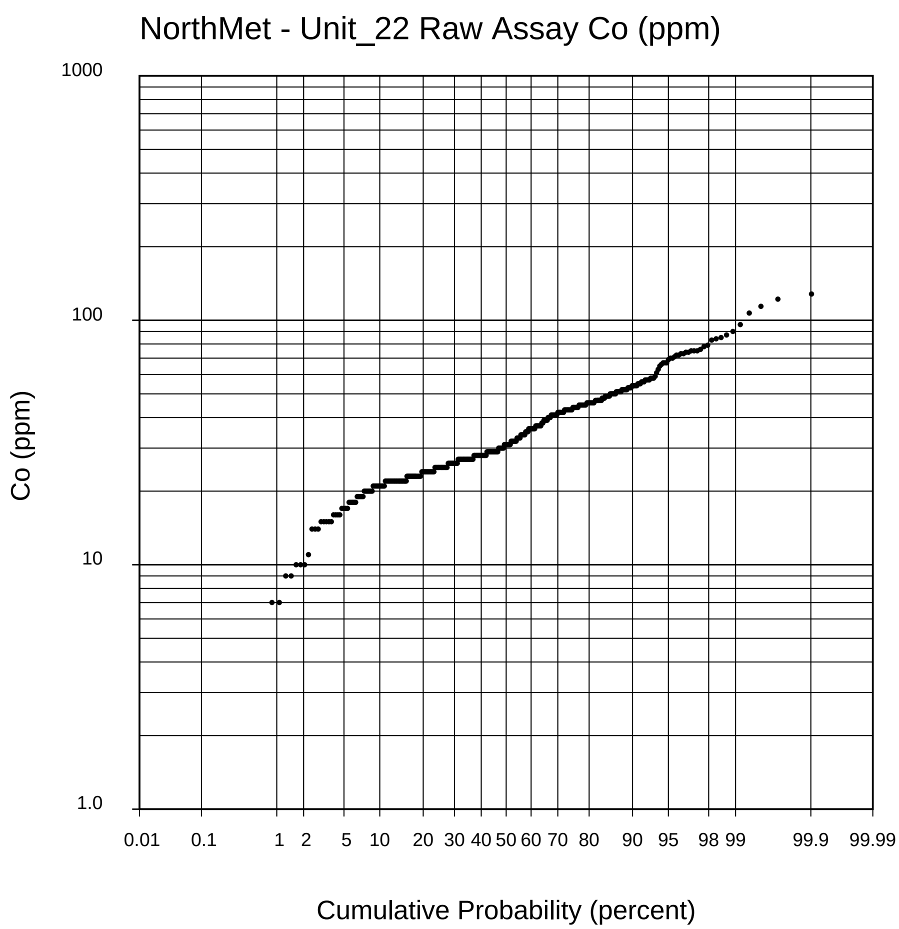
NorthMet - Unit_22 Raw Assay Au (ppb) without domain pts.



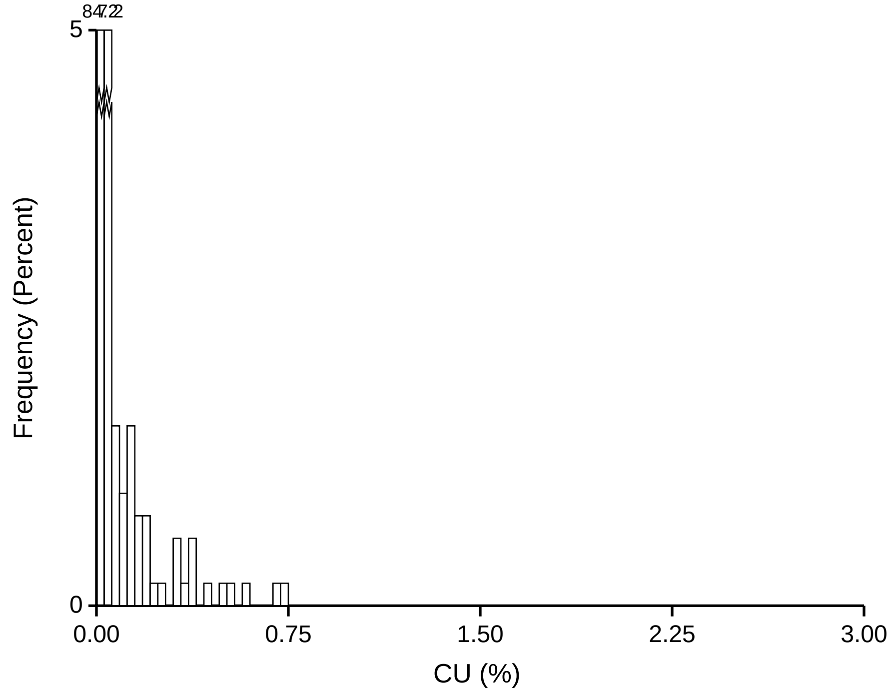


N	512
m	35
σ^2	270
σ/m	0
min	0
$q_{0.25}$	25
$q_{0.50}$	31
$q_{0.75}$	44
max	128

Class width = 3
The last class contains all values ≥ 297



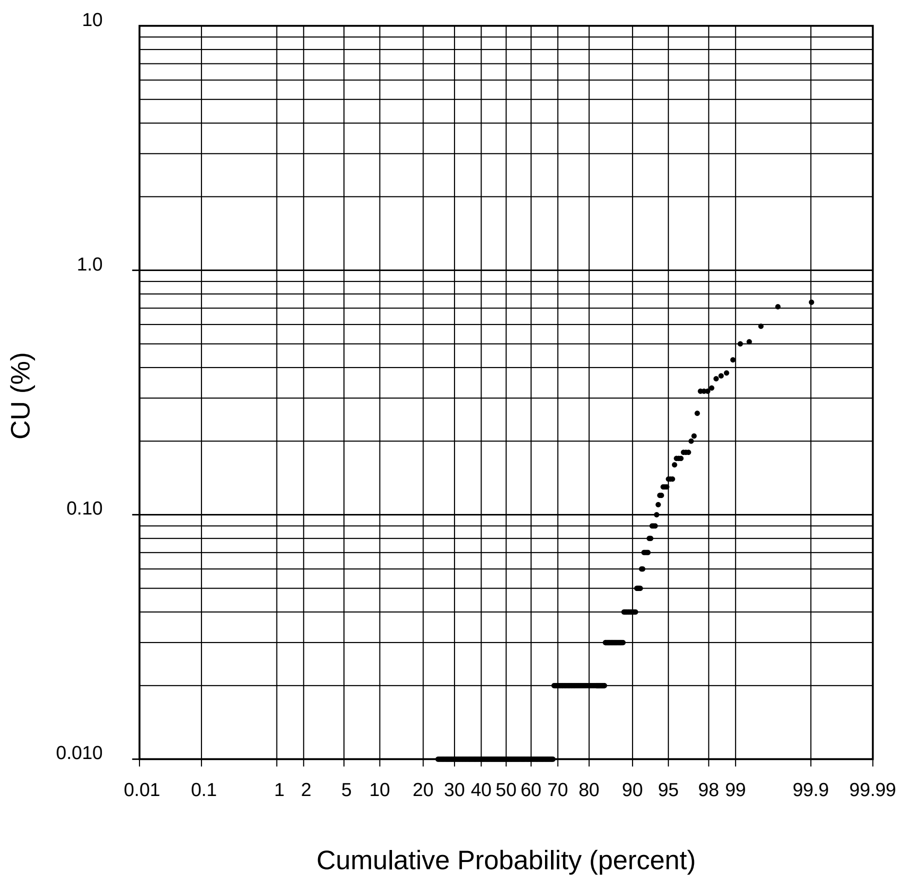
NorthMet - Unit_22 Raw Assay Cu (%)

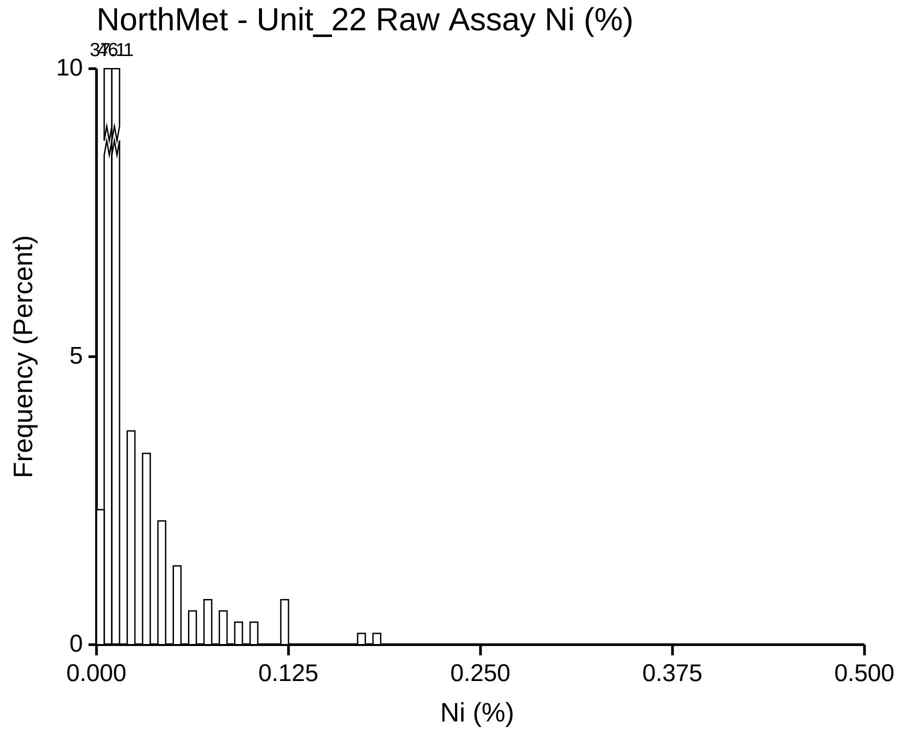


N	512
m	0.03
σ^2	0.01
σ/m	2.52
min	0.00
$q_{0.25}$	0.01
$q_{0.50}$	0.01
$q_{0.75}$	0.02
max	0.74

Class width = 0.03
The last class contains
all values ≥ 2.97

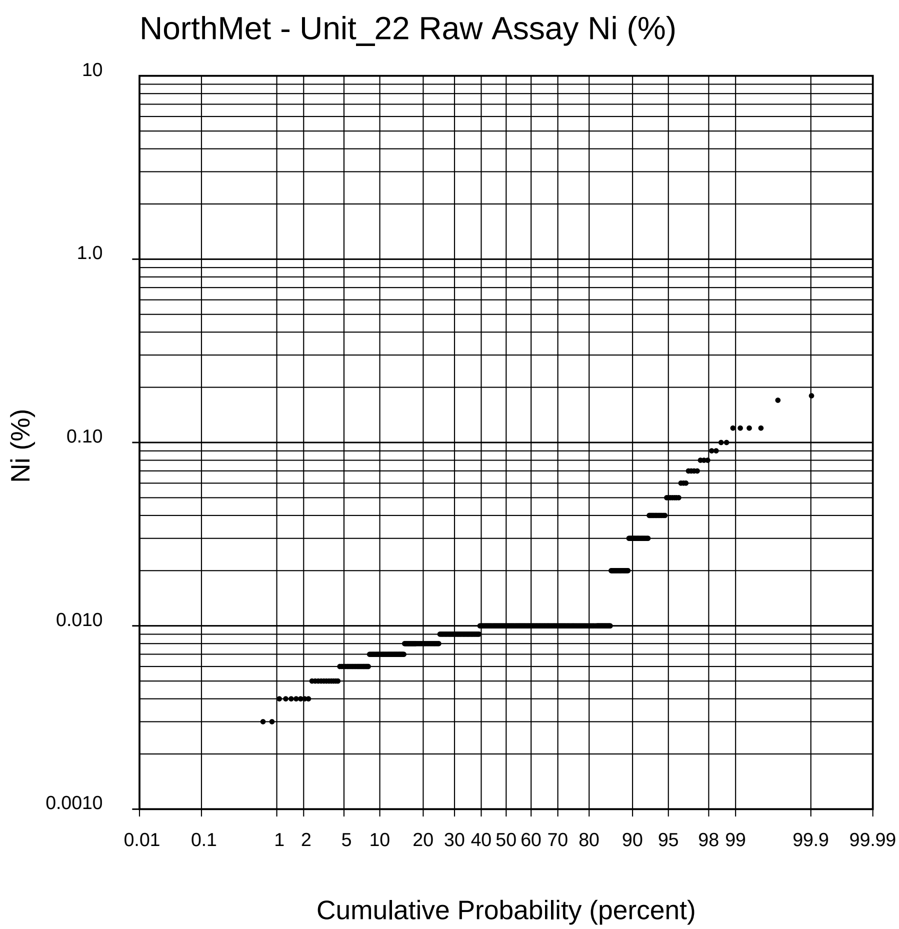
NorthMet - Unit_22 Raw Assay Cu (%)



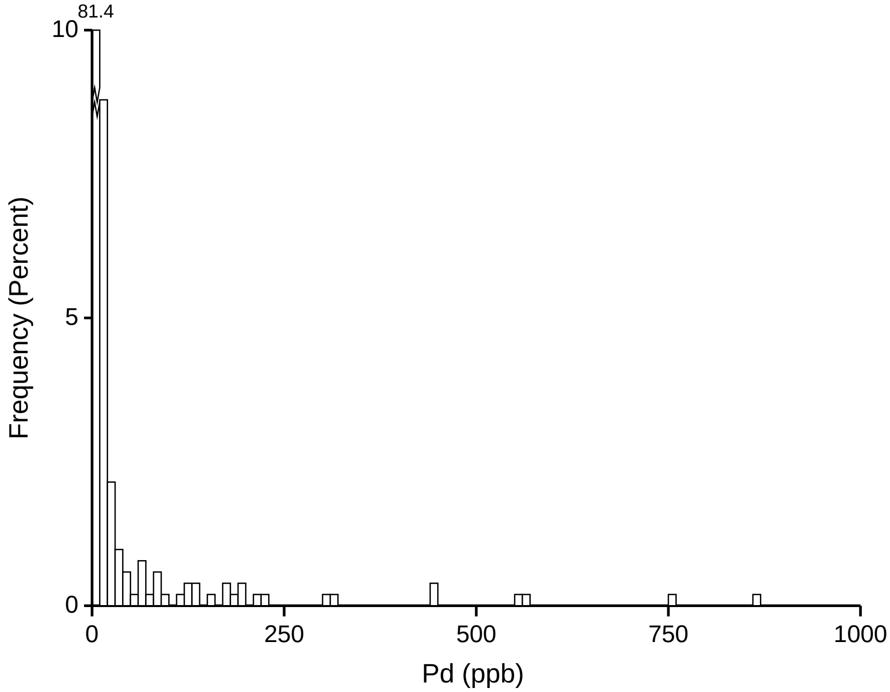


N	512
m	0.015
σ^2	0.000
σ/m	1.317
min	0.000
$q_{0.25}$	0.009
$q_{0.50}$	0.010
$q_{0.75}$	0.010
max	0.180

Class width = 0.005
The last class contains
all values ≥ 0.495



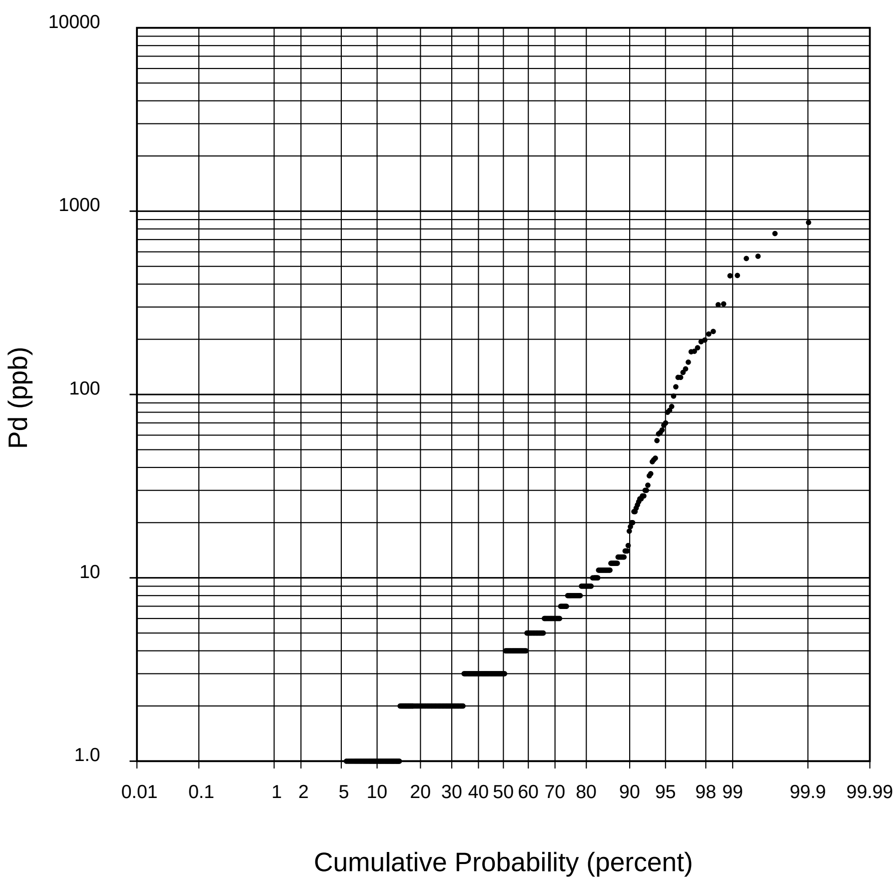
NorthMet - Unit_22 Raw Assay Pd (ppb)



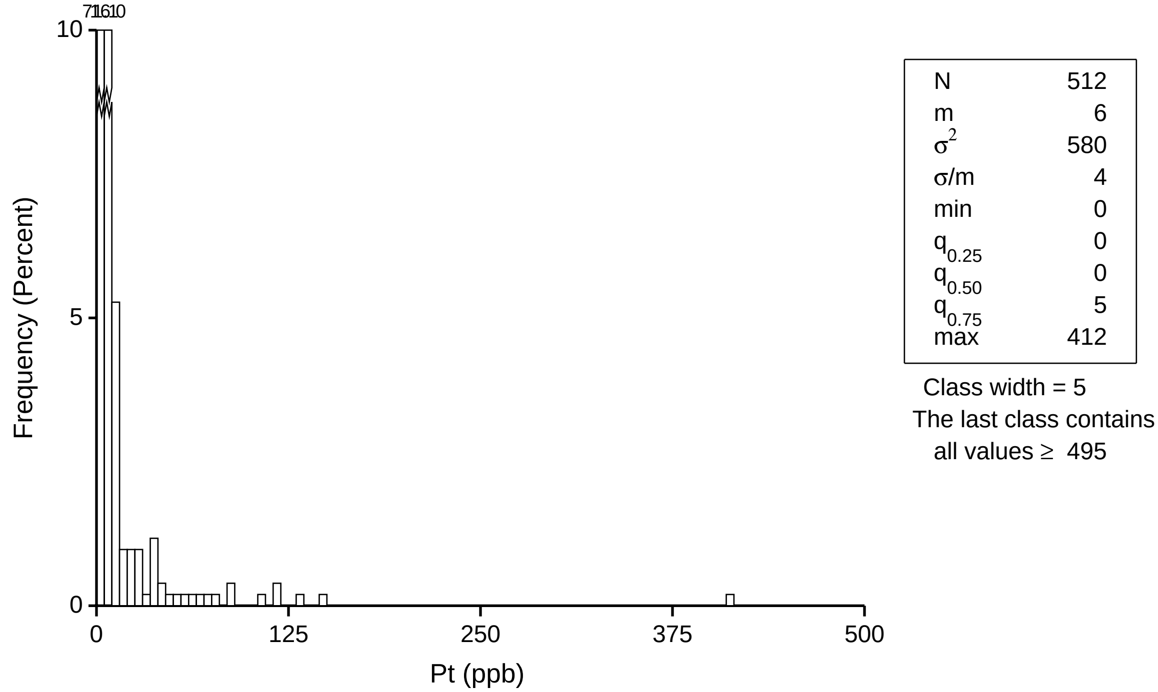
N	512
m	19
σ^2	5484
σ/m	4
min	0
$q_{0.25}$	2
$q_{0.50}$	3
$q_{0.75}$	8
max	868

Class width = 10
The last class contains
all values ≥ 990

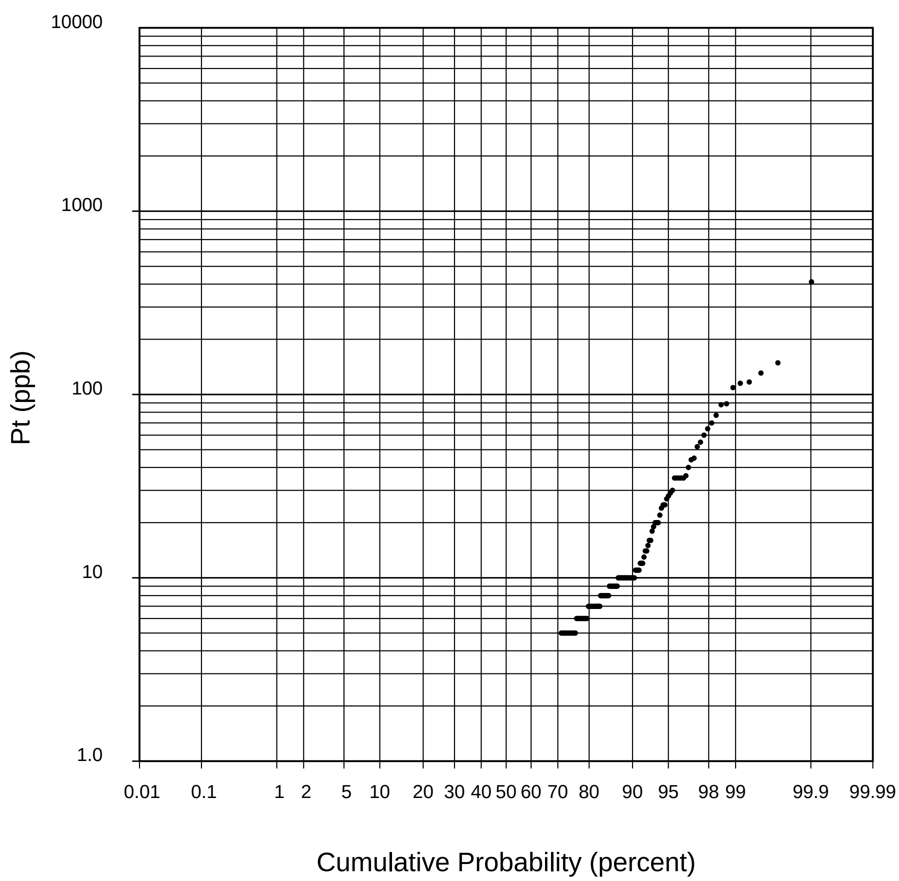
NorthMet - Unit_22 Raw Assay Pd (ppb)



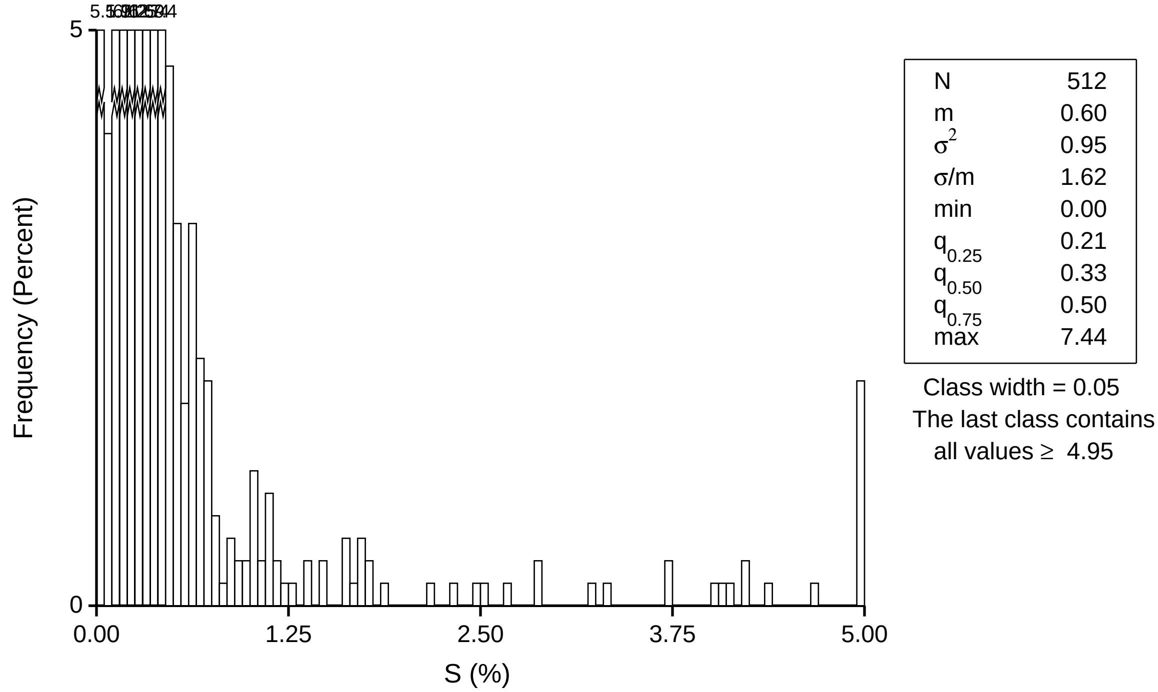
NorthMet - Unit_22 Raw Assay Pt (ppb)



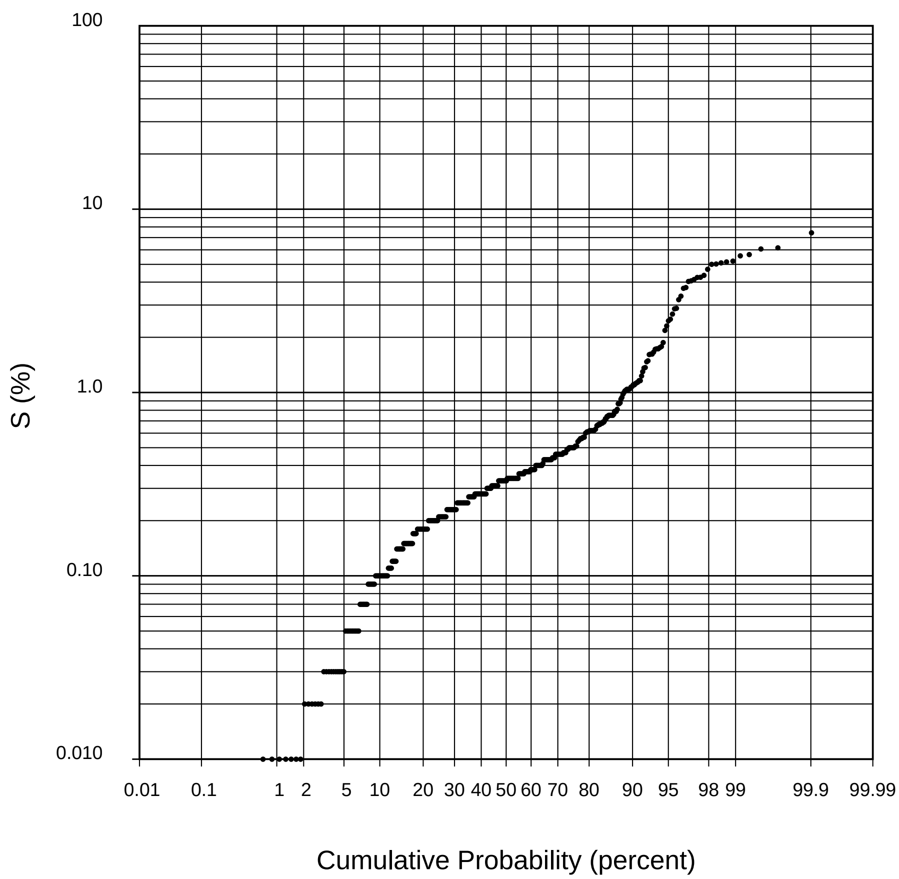
NorthMet - Unit_22 Raw Assay Pt (ppb)

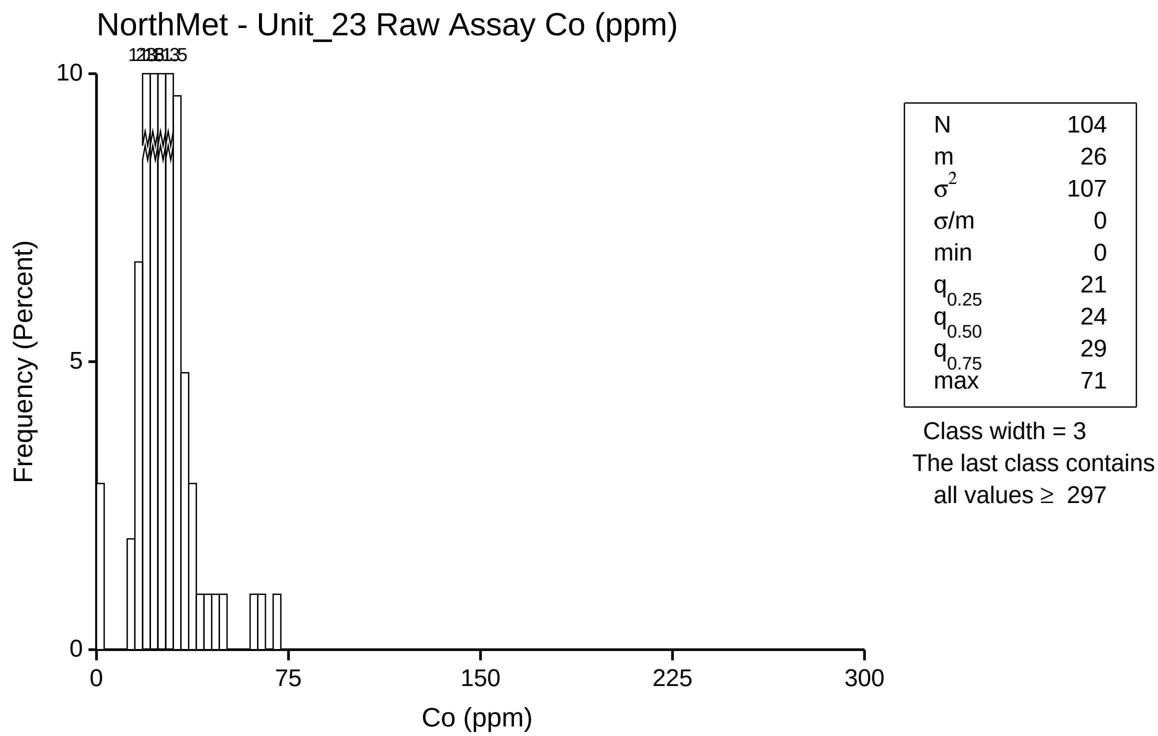


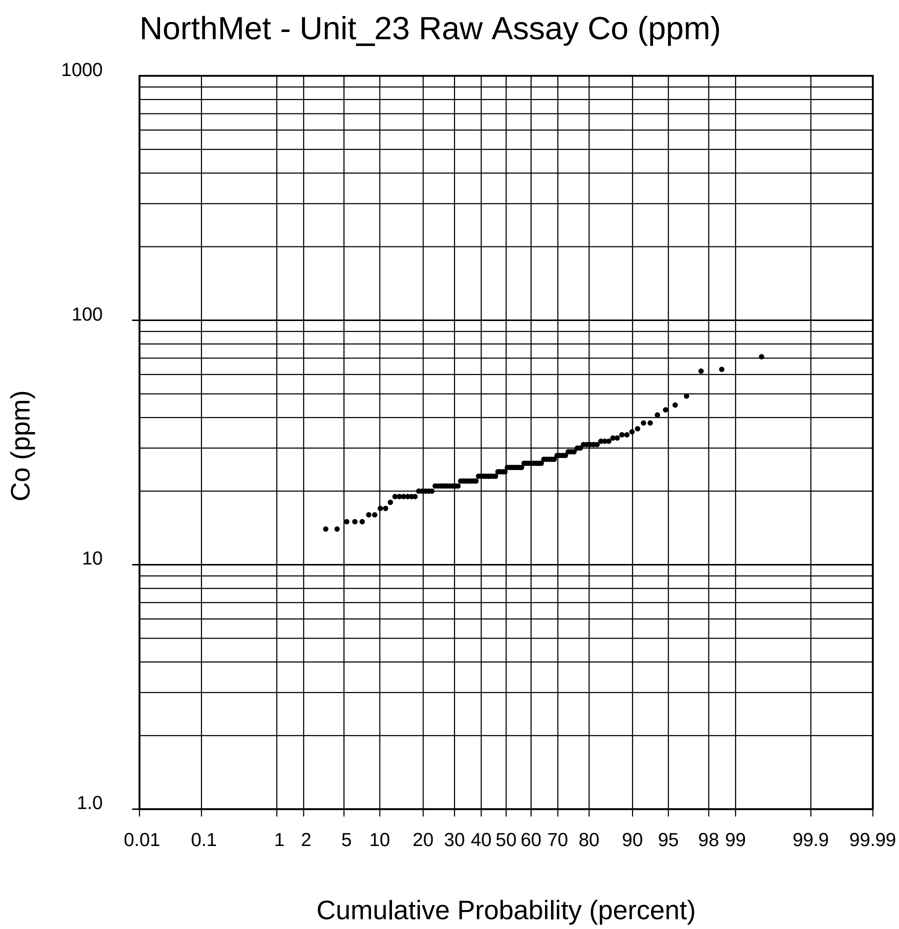
NorthMet - Unit_22 Raw Assay S (%)

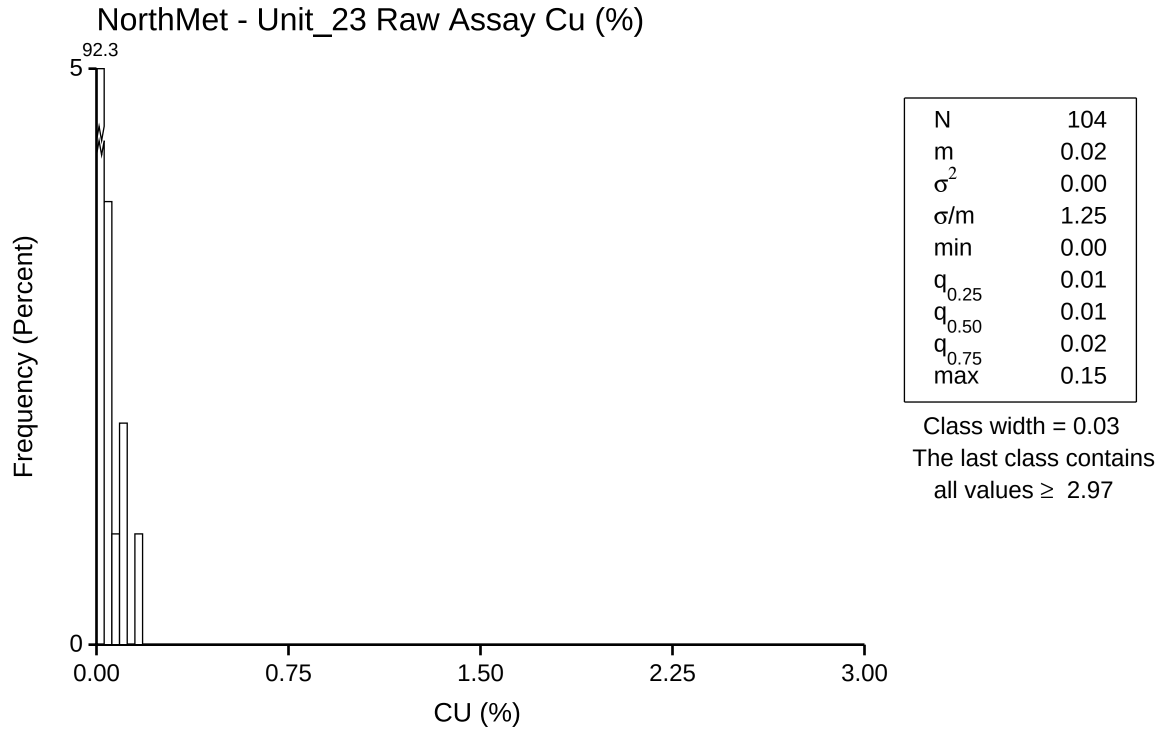


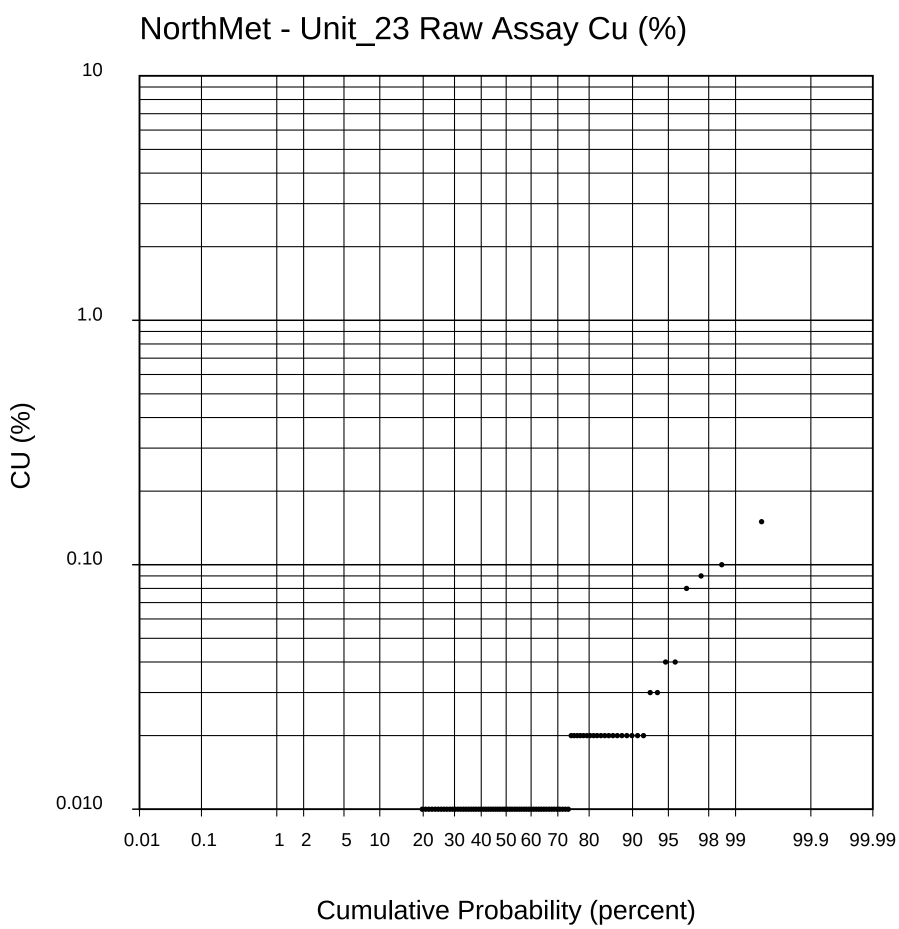
NorthMet - Unit_22 Raw Assay S (%)



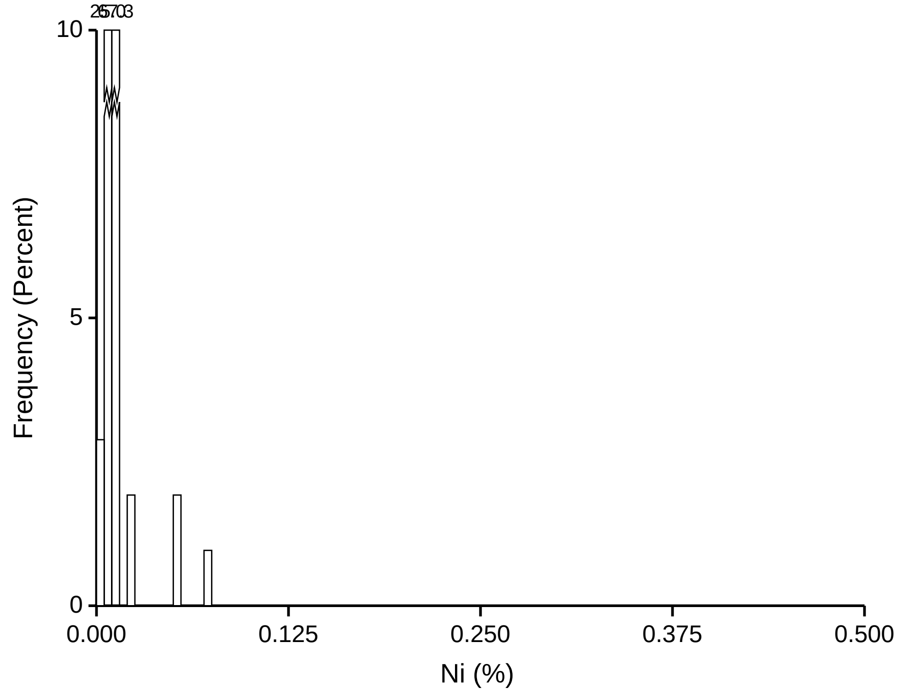

NorthMet - Unit_23 Raw Assay Co (ppm)
Frequency (Percent)
Co (ppm)
0
5
10
0
75
150
225
300
N 104
m 26
σ2 107
σ/m 0
min 0
q0.25 21
q0.50 24
q0.75 29
max 71
Class width = 3
The last class contains
all values ≥ 297


NorthMet - Unit_23 Raw Assay Co (ppm)
Co (ppm)
1000
100
10
1.0
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)


NorthMet - Unit_23 Raw Assay Cu (%)
92.3
5
0
Frequency (Percent)
0.00
0.75
1.50
2.25
3.00
CU (%)
N 104
m 0.02
σ2 0.00
σ/m 1.25
min 0.00
q0.25 0.01
q0.50 0.01
q0.75 0.02
max 0.15
Class width = 0.03
The last class contains
all values ≥ 2.97


NorthMet - Unit_23 Raw Assay Cu (%)
10
1.0
0.10
0.010
CU (%)
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

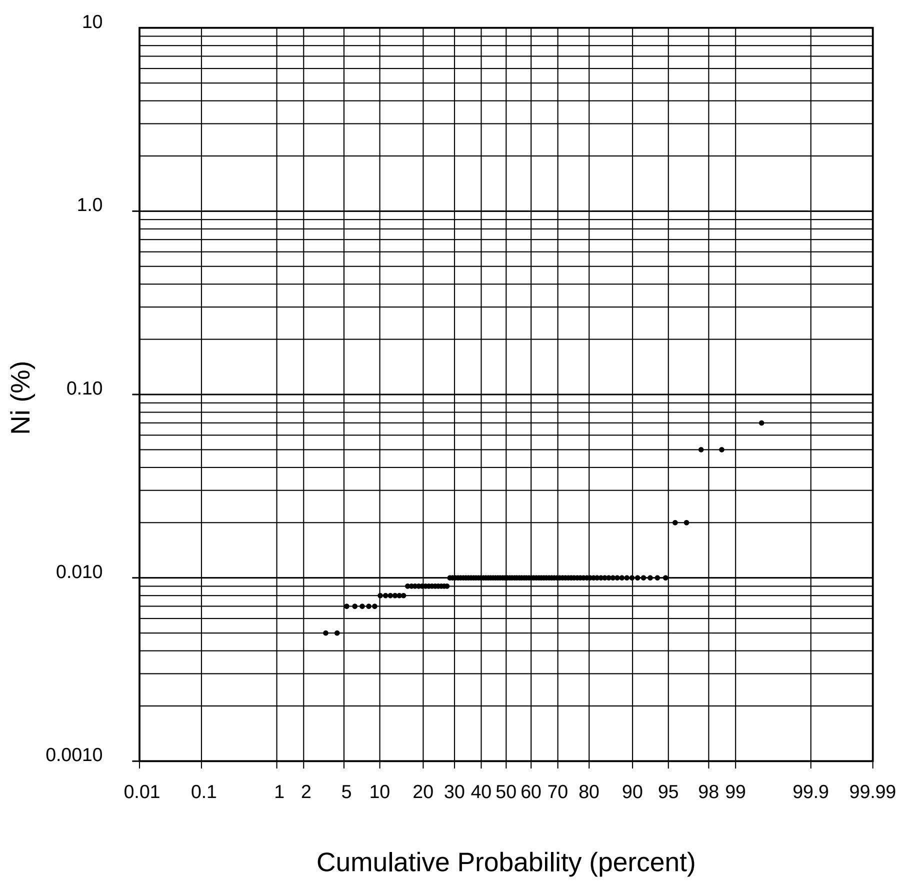
NorthMet - Unit_23 Raw Assay Ni (%)

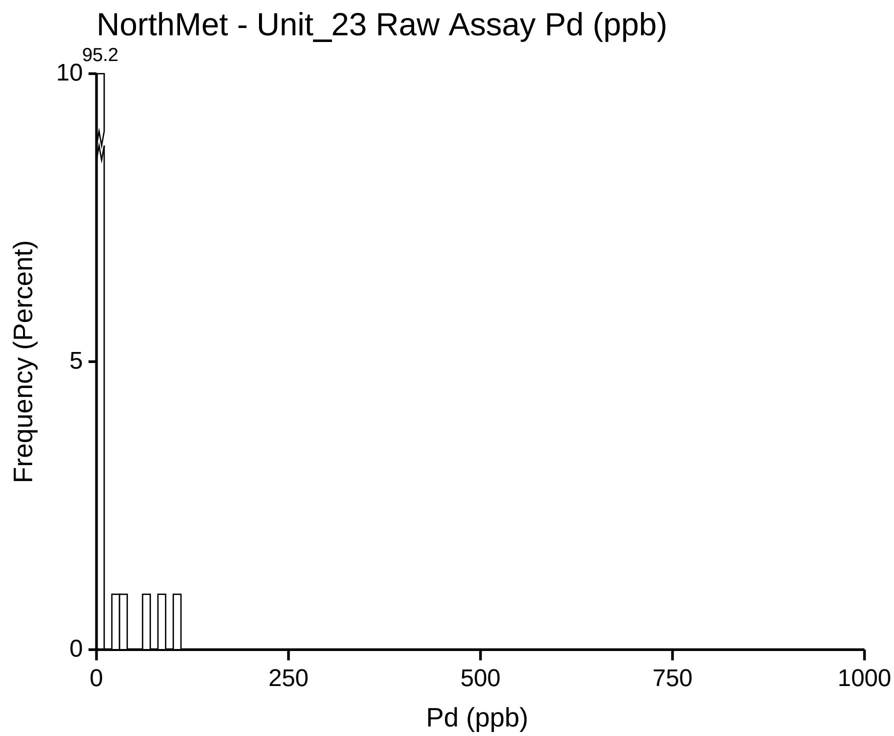


N	104
m	0.011
σ^2	0.000
σ/m	0.782
min	0.000
$q_{0.25}$	0.009
$q_{0.50}$	0.010
$q_{0.75}$	0.010
max	0.070

Class width = 0.005
The last class contains
all values ≥ 0.495

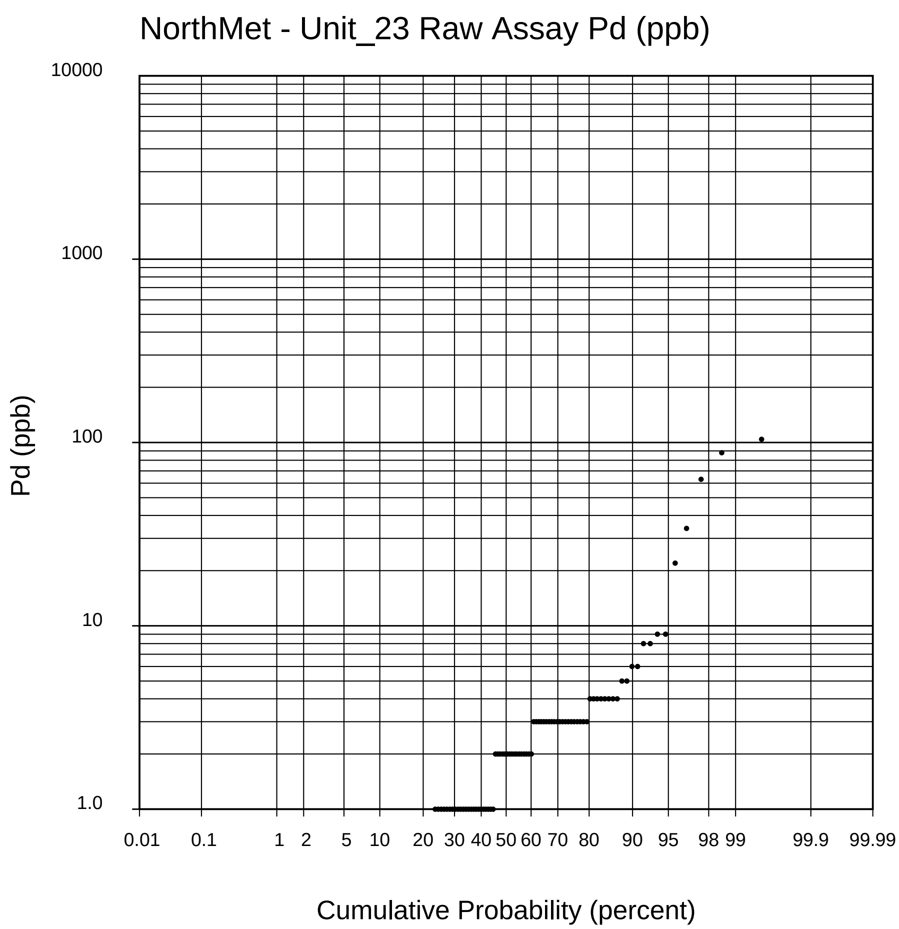
NorthMet - Unit_23 Raw Assay Ni (%)

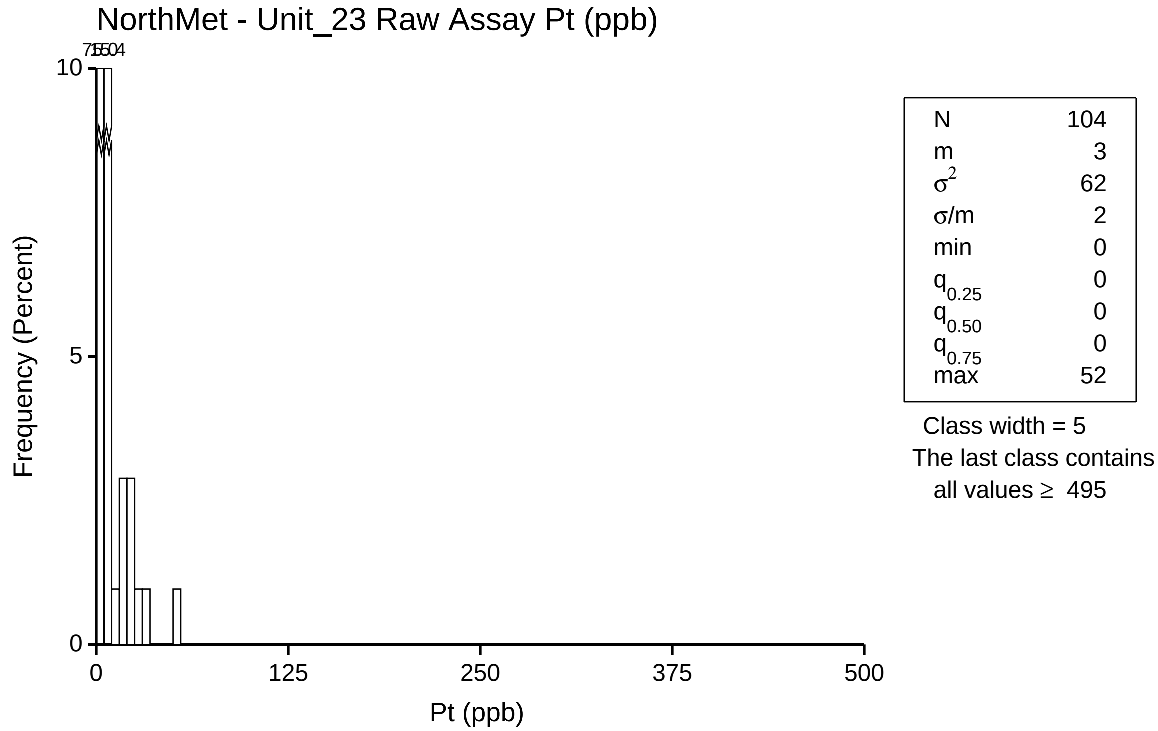


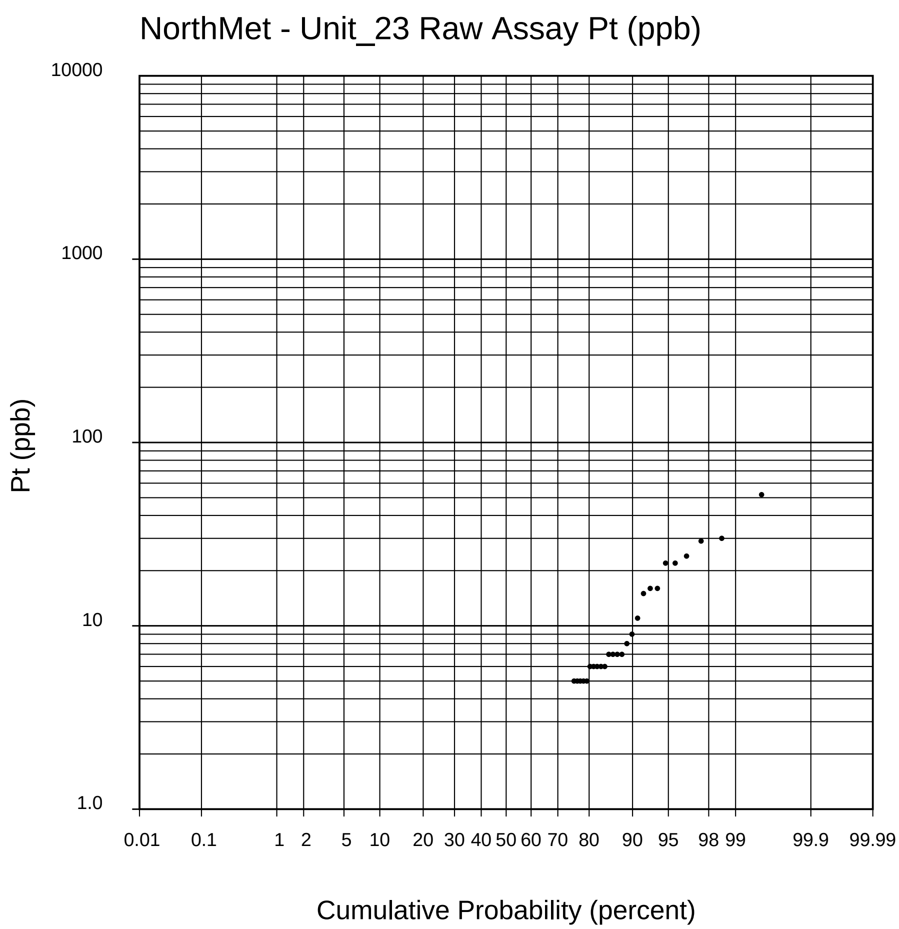


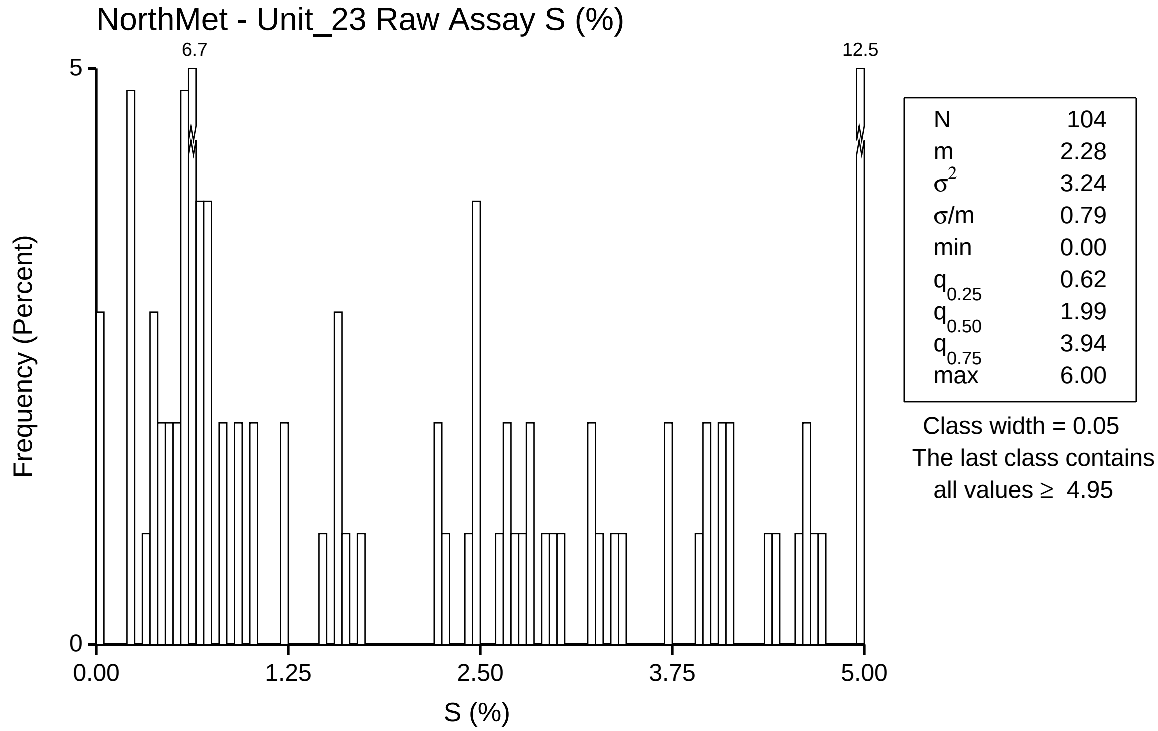
N	104
m	5
σ^2	216
σ/m	3
min	0
$q_{0.25}$	1
$q_{0.50}$	2
$q_{0.75}$	3
max	104

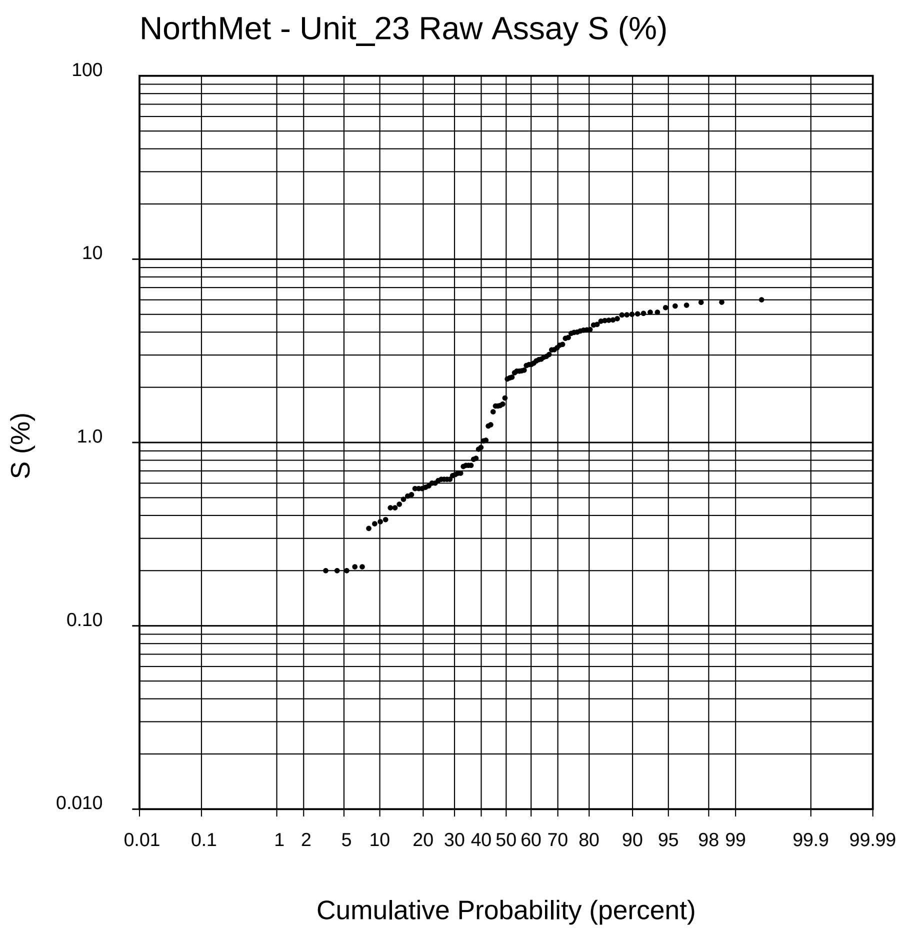
Class width = 10
The last class contains
all values ≥ 990

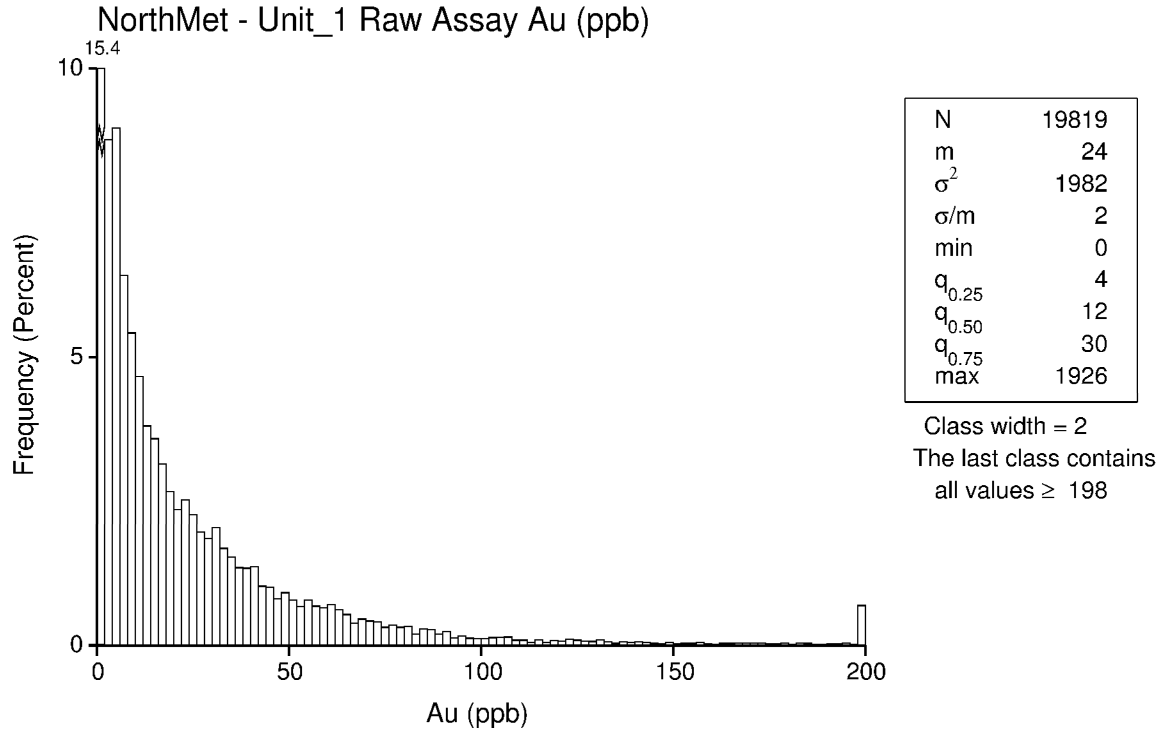


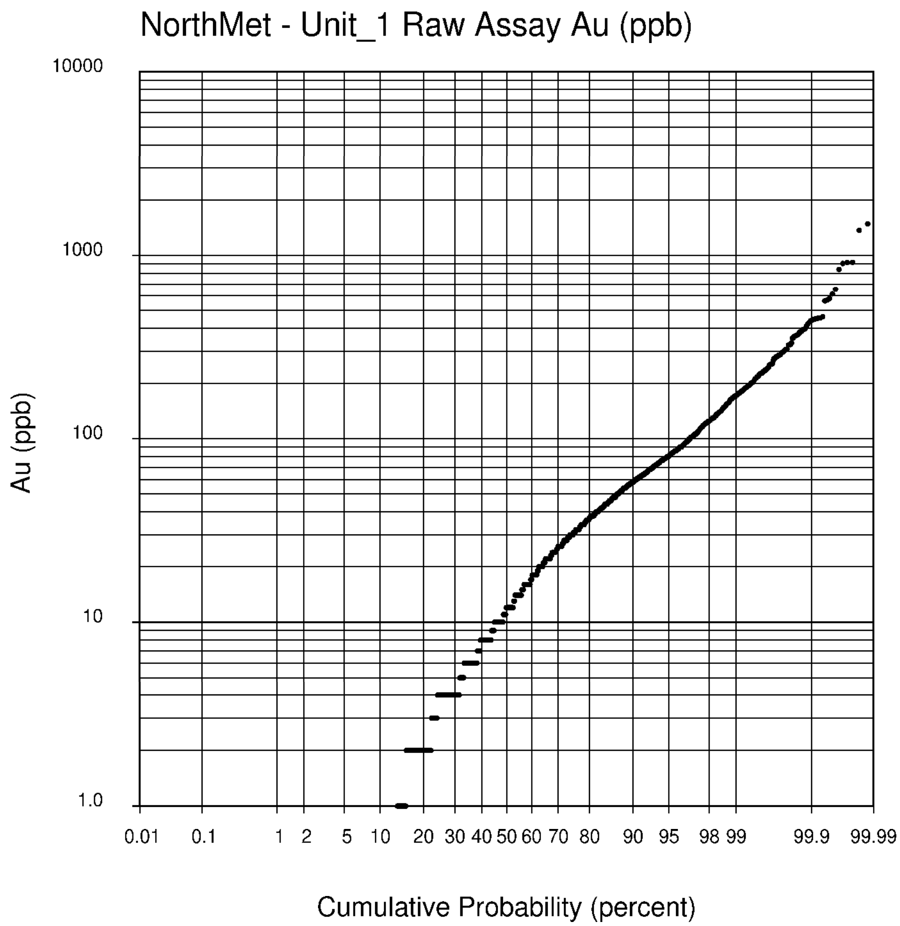

NorthMet - Unit_23 Raw Assay Pt (ppb)
Frequency (Percent)
Pt (ppb)
0
5
10
0
125
250
375
500
N 104
m 3
σ2 62
σ/m 2
min 0
q0.25 0
q0.50 0
q0.75 0
max 52
Class width = 5
The last class contains
all values ≥ 495

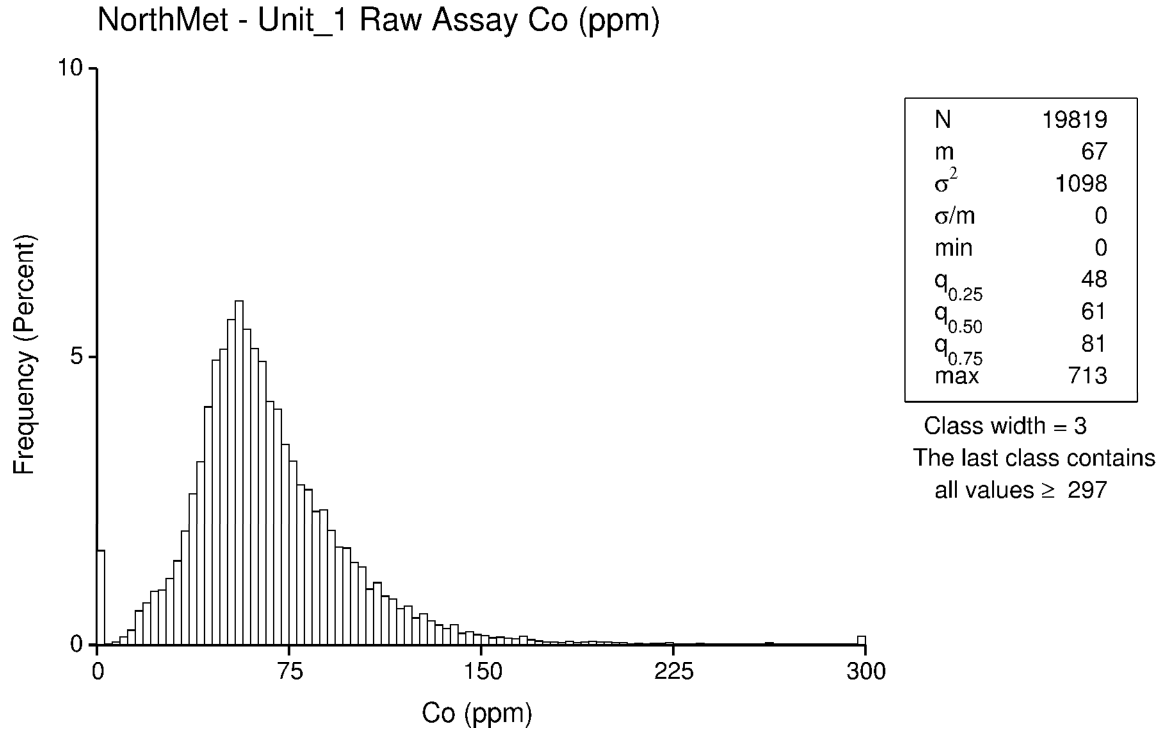

NorthMet - Unit_23 Raw Assay Pt (ppb)
Pt (ppb)
10000
1000
100
10
1.0
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

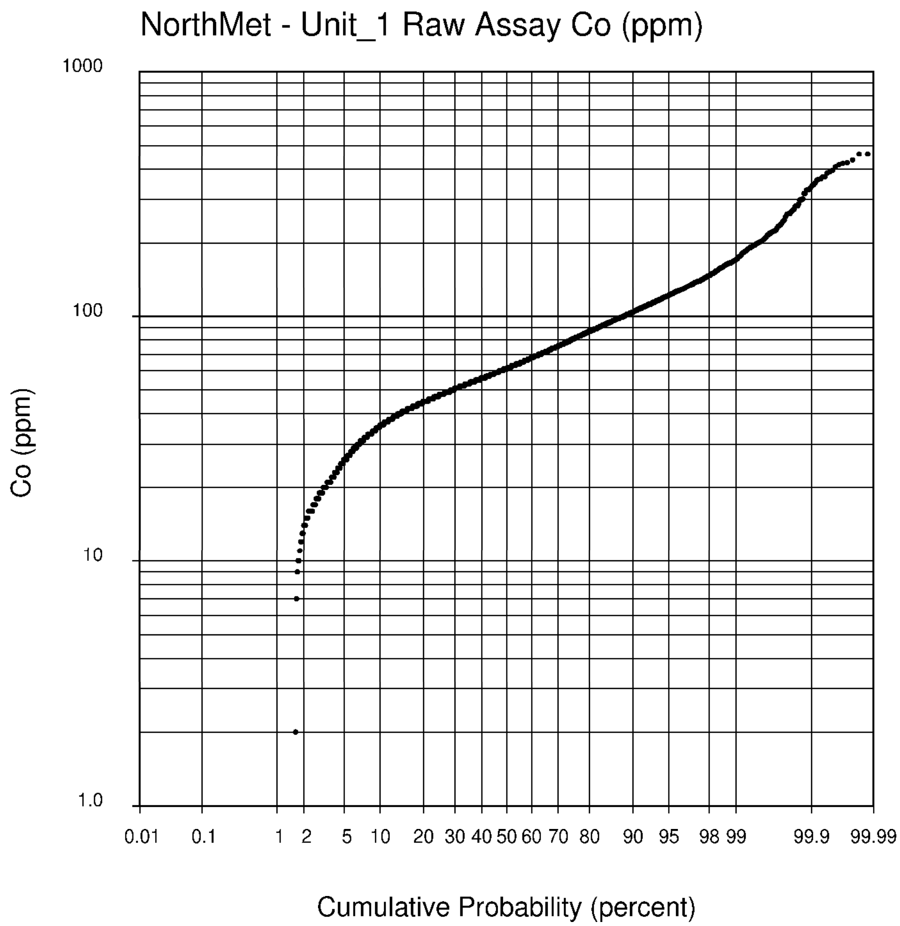

NorthMet - Unit_23 Raw Assay S (%)
6.7
12.5
5
0
Frequency (Percent)
0.00
1.25
2.50
3.75
5.00
S (%)
N 104
m 2.28
σ2 3.24
σ/m 0.79
min 0.00
q0.25 0.62
q0.50 1.99
q0.75 3.94
max 6.00
Class width = 0.05
The last class contains
all values ≥ 4.95


NorthMet - Unit_23 Raw Assay S (%)
100
10
1.0
0.10
0.010
S (%)
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

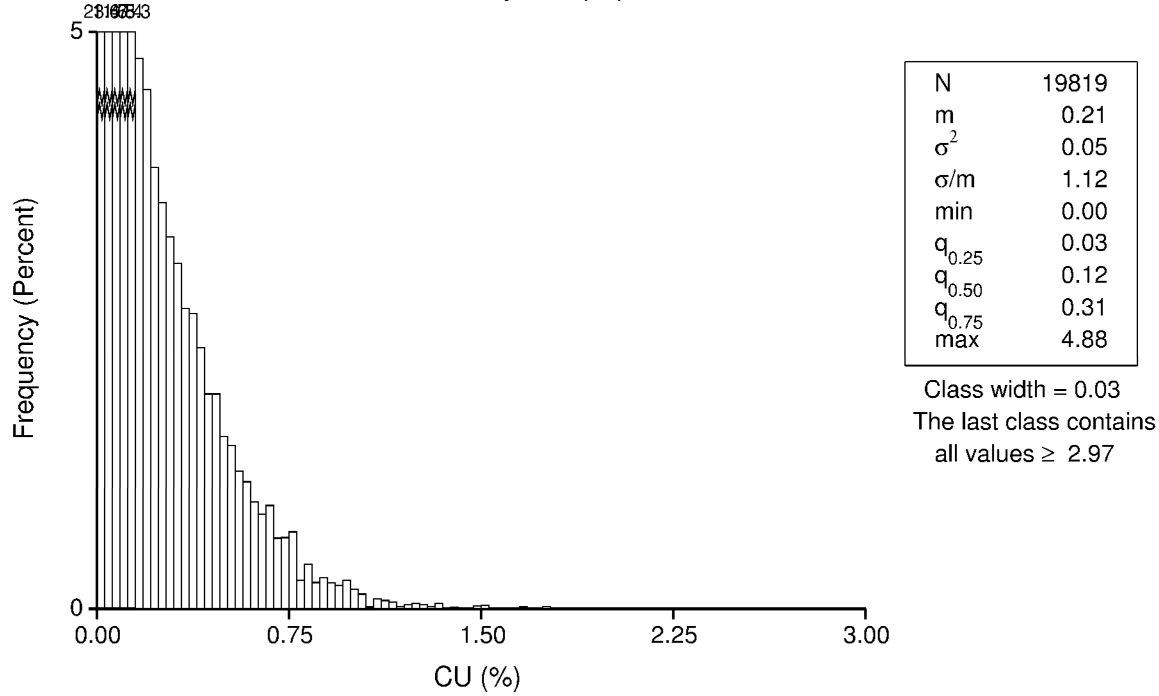

NorthMet - Unit_1 Raw Assay Au (ppb)
15.4
10
5
0
Frequency (Percent)
0
50
100
150
200
Au (ppb)
N 19819
m 24
σ2 1982
σ/m 2
min 0
q0.25 4
q0.50 12
q0.75 30
max 1926
Class width = 2
The last class contains
all values ≥ 198


NorthMet - Unit_1 Raw Assay Au (ppb)
10000
1000
100
10
1.0
Au (ppb)
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

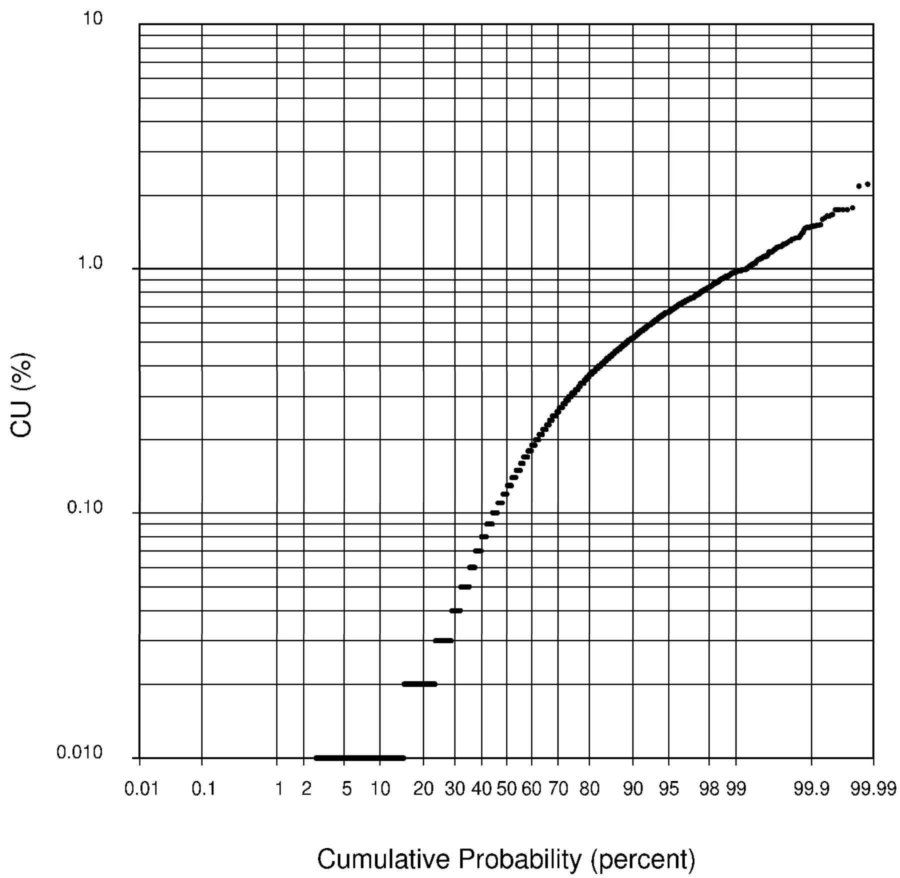

NorthMet - Unit_1 Raw Assay Co (ppm)
Frequency (Percent)
Co (ppm)
10
5
0
0
75
150
225
300
N 19819
m 67
σ2 1098
σ/m 0
min 0
q0.25 48
q0.50 61
q0.75 81
max 713
Class width = 3
The last class contains
all values ≥ 297


NorthMet - Unit_1 Raw Assay Co (ppm)
Co (ppm)
1000
100
10
1.0
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

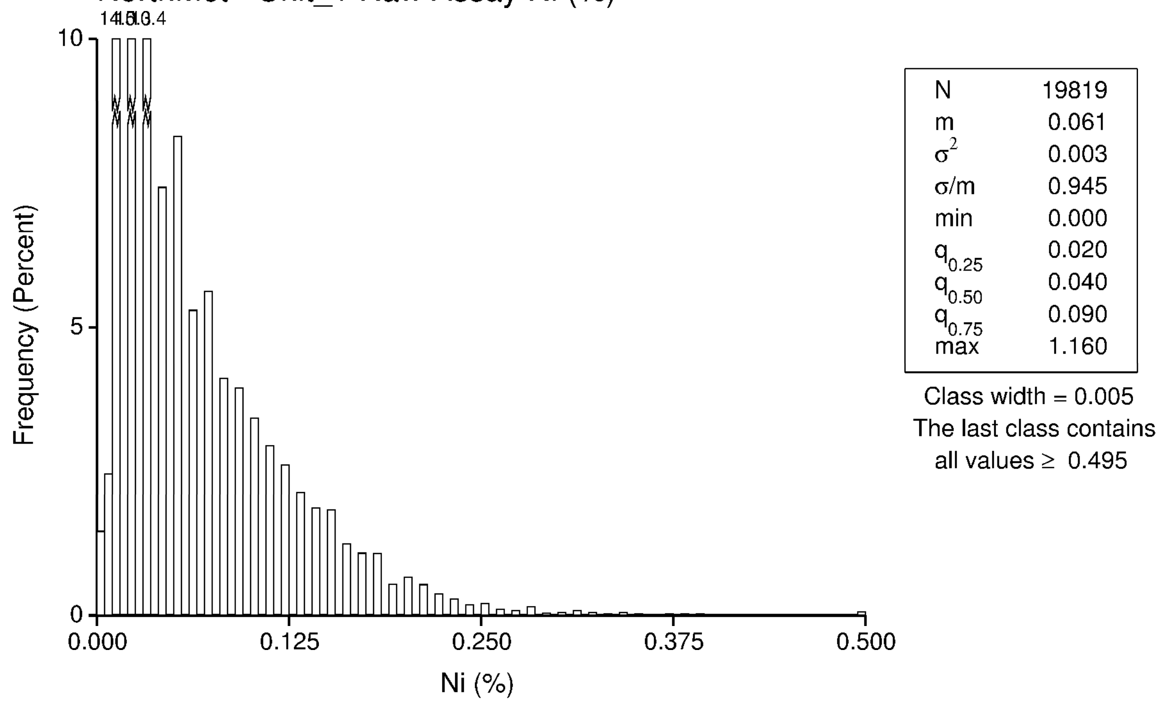
NorthMet - Unit_1 Raw Assay Cu (%)



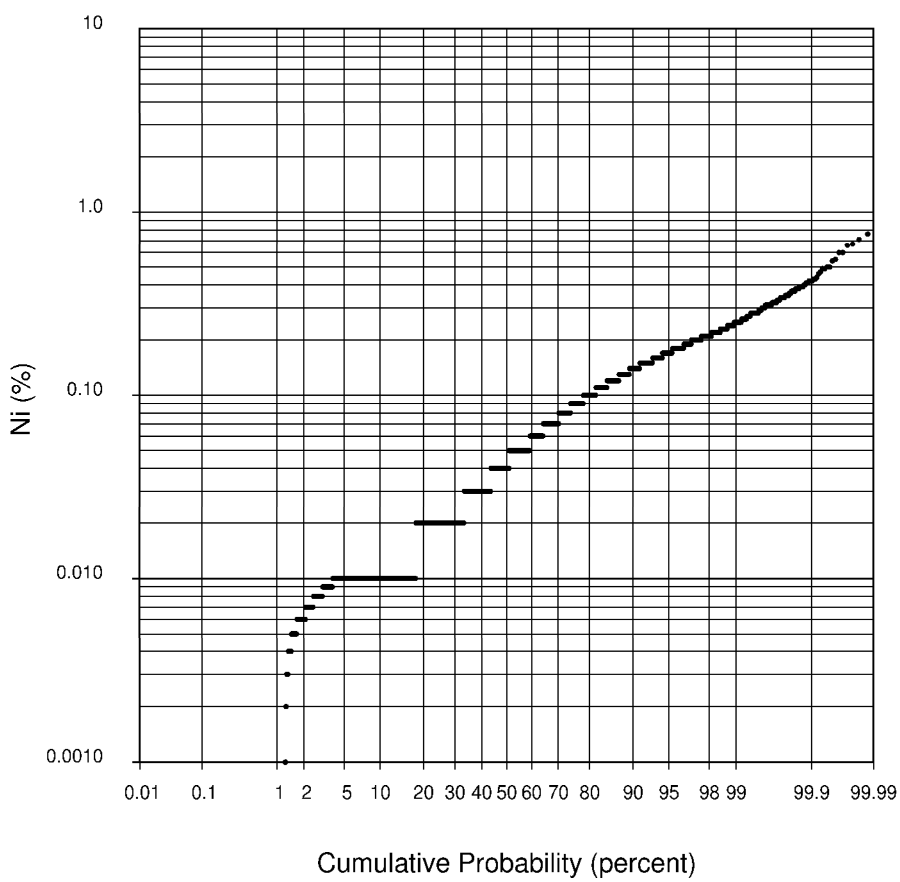
NorthMet - Unit_1 Raw Assay Cu (%)

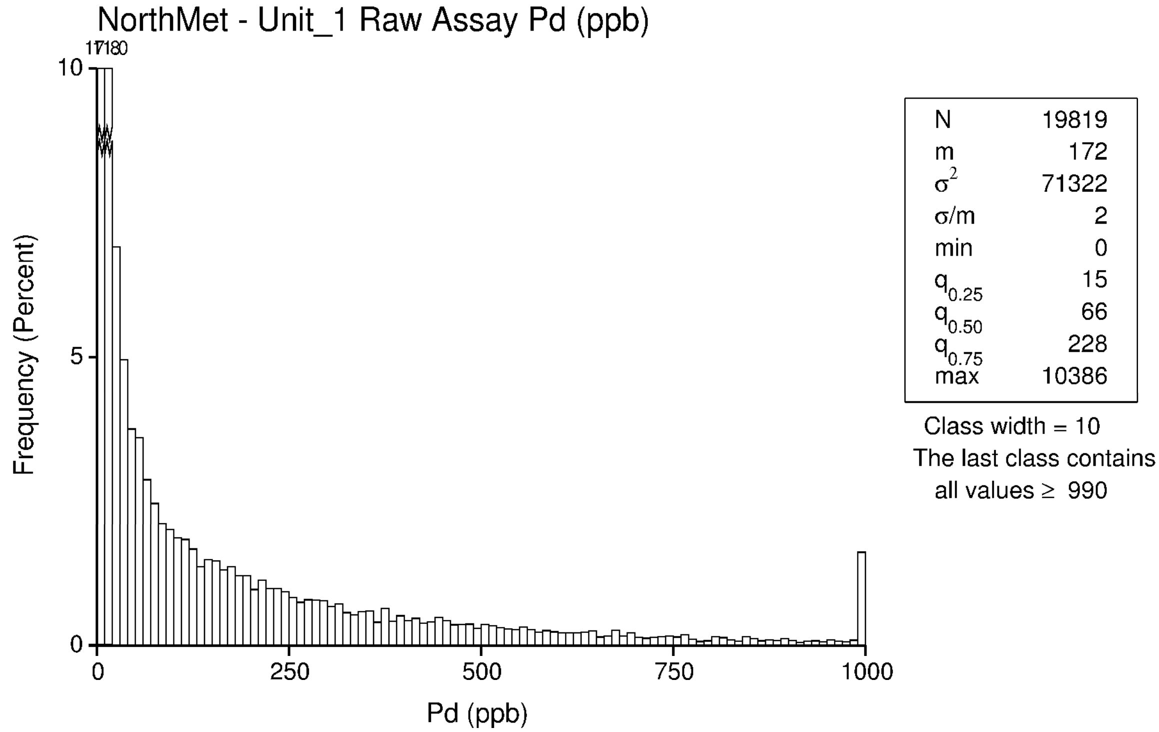


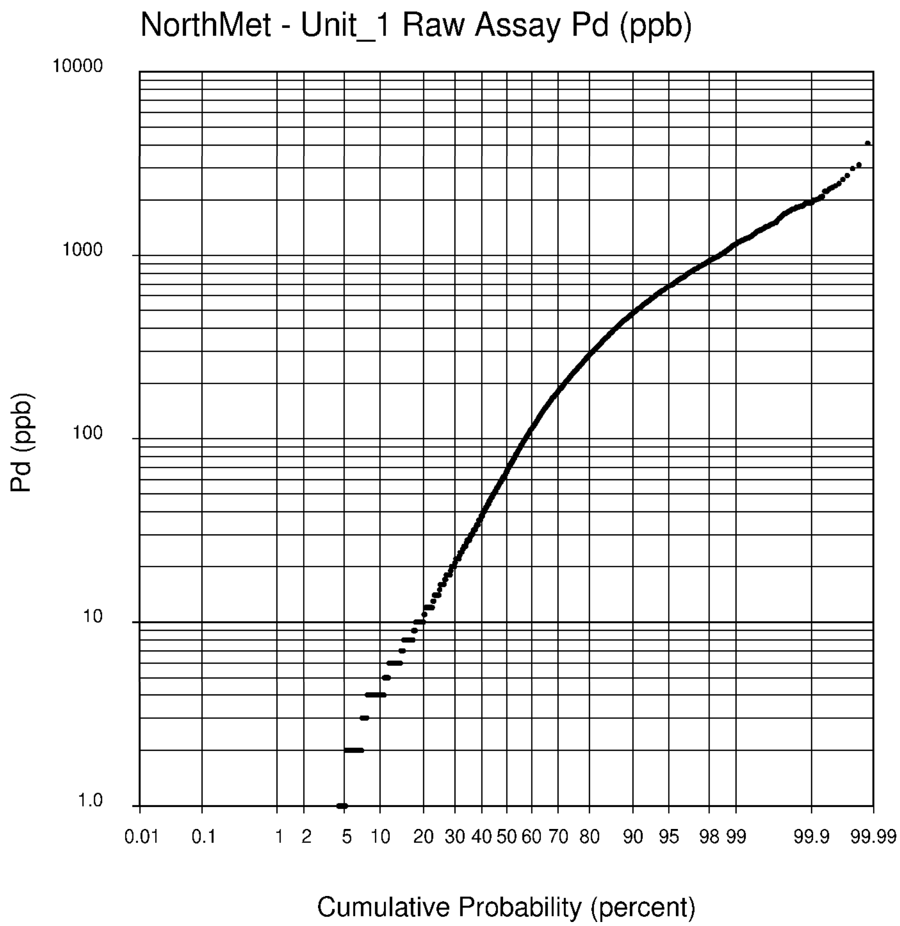
NorthMet - Unit_1 Raw Assay Ni (%)

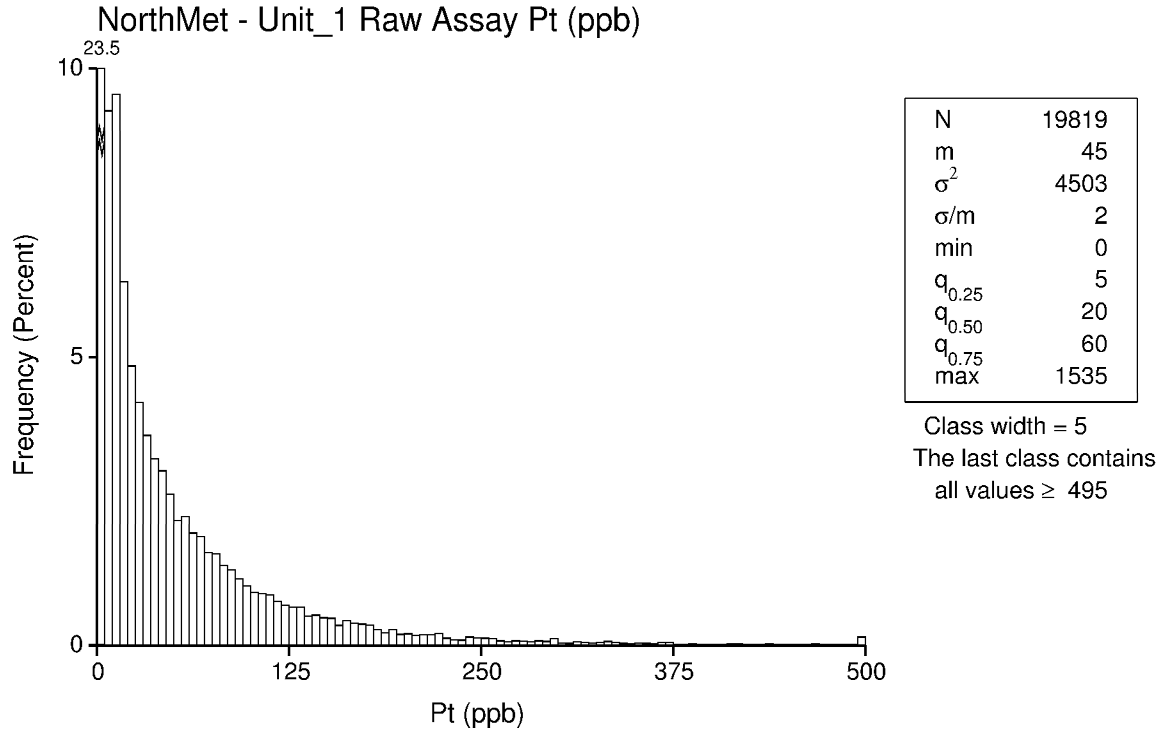


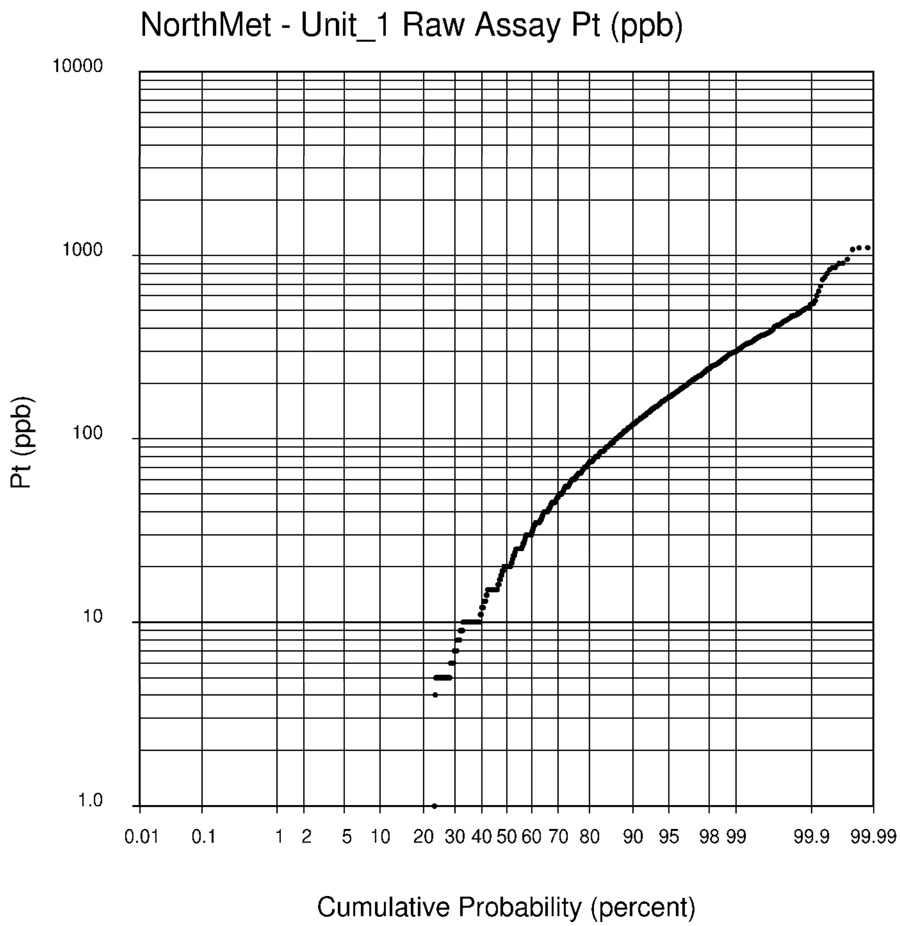
NorthMet - Unit_1 Raw Assay Ni (%)

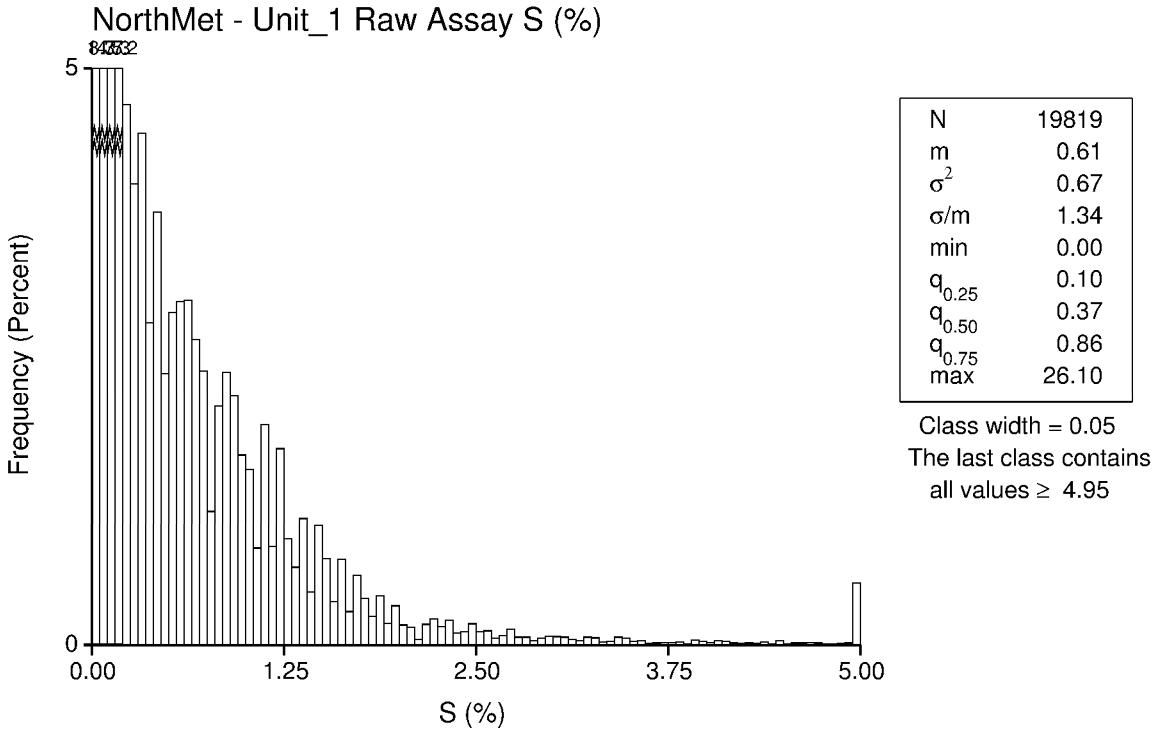


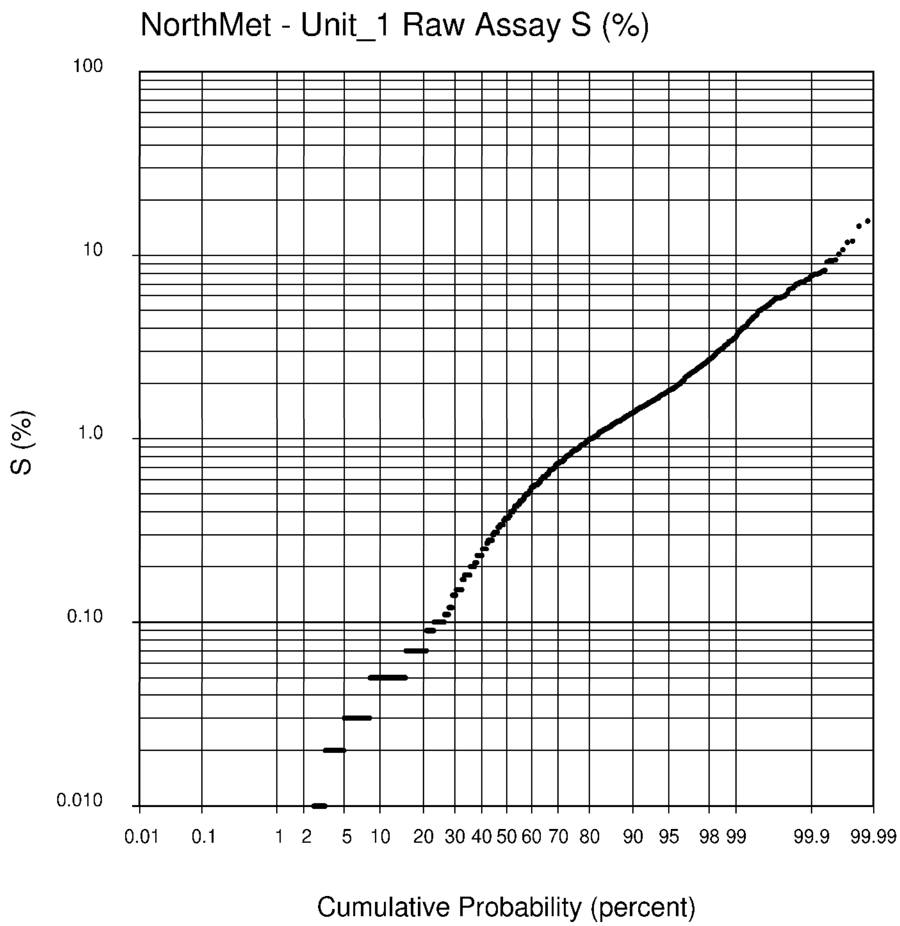

NorthMet - Unit_1 Raw Assay Pd (ppb)
1718
10
5
0
Frequency (Percent)
0
250
500
750
1000
Pd (ppb)
N 19819
m 172
σ² 71322
σ/m 2
min 0
q0.25 15
q0.50 66
q0.75 228
max 10386
Class width = 10
The last class contains
all values ≥ 990

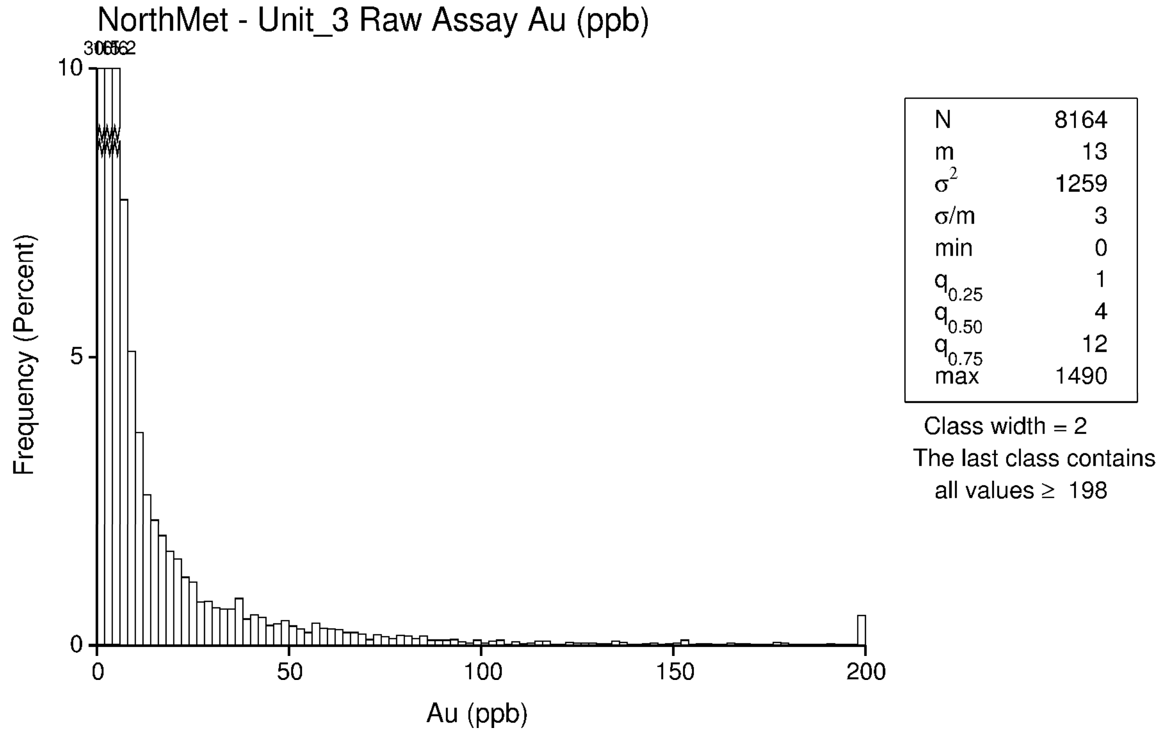

NorthMet - Unit_1 Raw Assay Pd (ppb)
10000
1000
100
10
1.0
Pd (ppb)
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

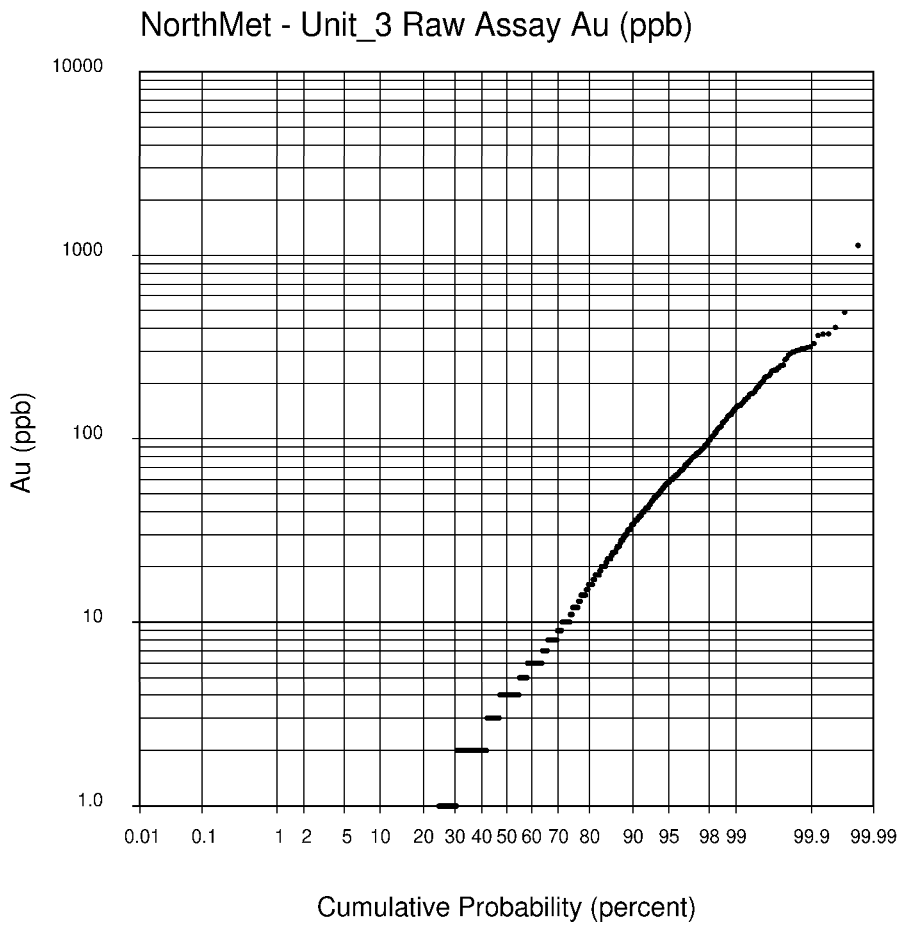

NorthMet - Unit_1 Raw Assay Pt (ppb)
23.5
10
5
0
Frequency (Percent)
0
125
250
375
500
Pt (ppb)
N 19819
m 45
σ2 4503
σ/m 2
min 0
q0.25 5
q0.50 20
q0.75 60
max 1535
Class width = 5
The last class contains
all values ≥ 495

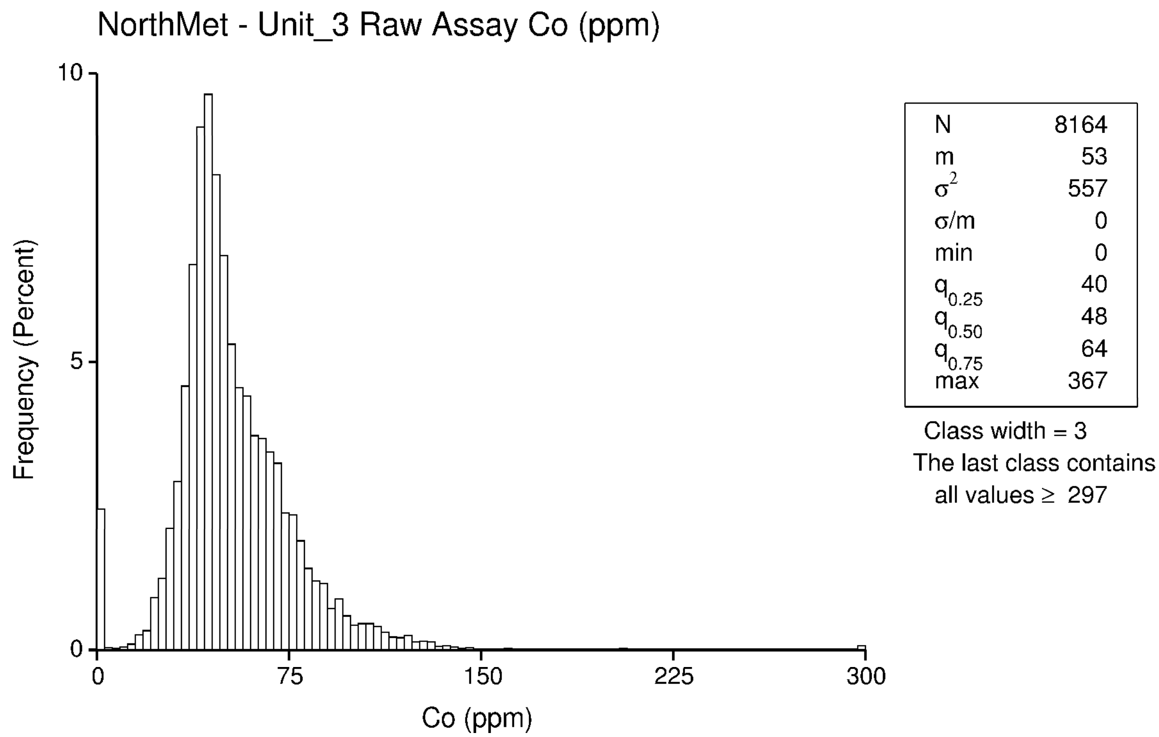

NorthMet - Unit_1 Raw Assay Pt (ppb)
10000
1000
100
10
1.0
Pt (ppb)
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)


NorthMet - Unit_1 Raw Assay S (%)
Frequency (Percent)
5
0
0.00
1.25
2.50
3.75
5.00
S (%)
N 19819
m 0.61
σ^2 0.67
σ/m 1.34
min 0.00
$q_{0.25}$ 0.10
$q_{0.50}$ 0.37
$q_{0.75}$ 0.86
max 26.10
Class width = 0.05
The last class contains
all values ≥ 4.95

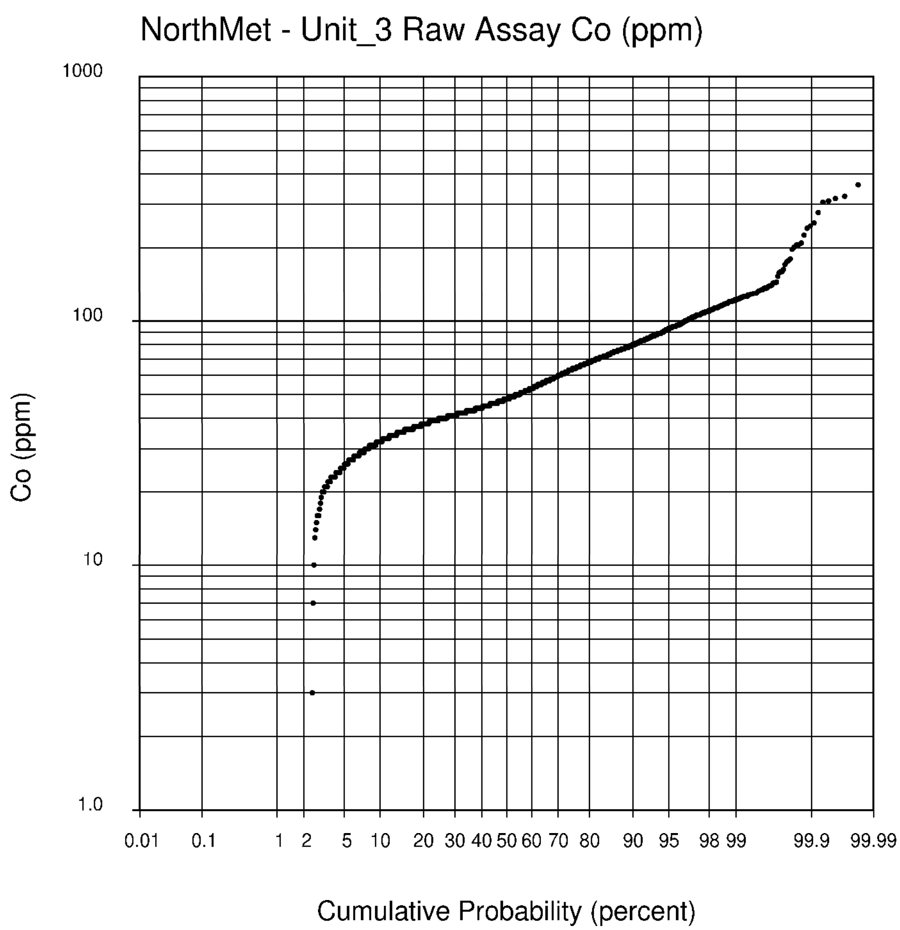

NorthMet - Unit_1 Raw Assay S (%)
S (%)
100
10
1.0
0.10
0.010
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)


NorthMet - Unit_3 Raw Assay Au (ppb)
Frequency (Percent)
Au (ppb)
N 8164
m 13
σ^2 1259
σ/m 3
min 0
$q_{0.25}$ 1
$q_{0.50}$ 4
$q_{0.75}$ 12
max 1490
Class width = 2
The last class contains
all values ≥ 198


NorthMet - Unit_3 Raw Assay Au (ppb)
Au (ppb)
Cumulative Probability (percent)

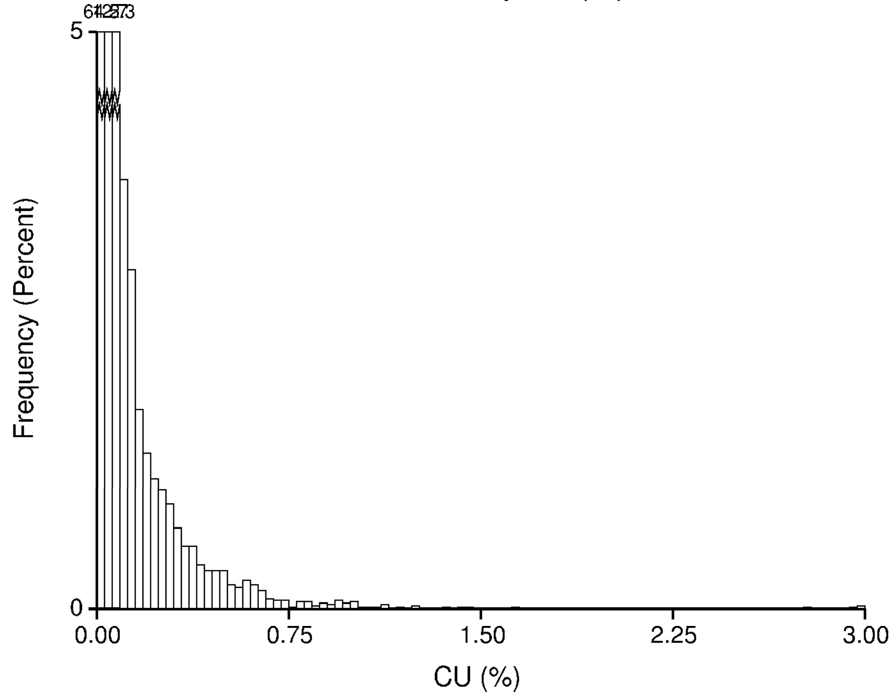


NorthMet - Unit_3 Raw Assay Co (ppm)
10
5
0
Frequency (Percent)
0
75
150
225
300
Co (ppm)
N 8164
m 53
σ² 557
σ/m 0
min 0
q0.25 40
q0.50 48
q0.75 64
max 367
Class width = 3
The last class contains
all values ≥ 297



NorthMet - Unit_3 Raw Assay Co (ppm)
1000
100
10
1.0
Co (ppm)
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

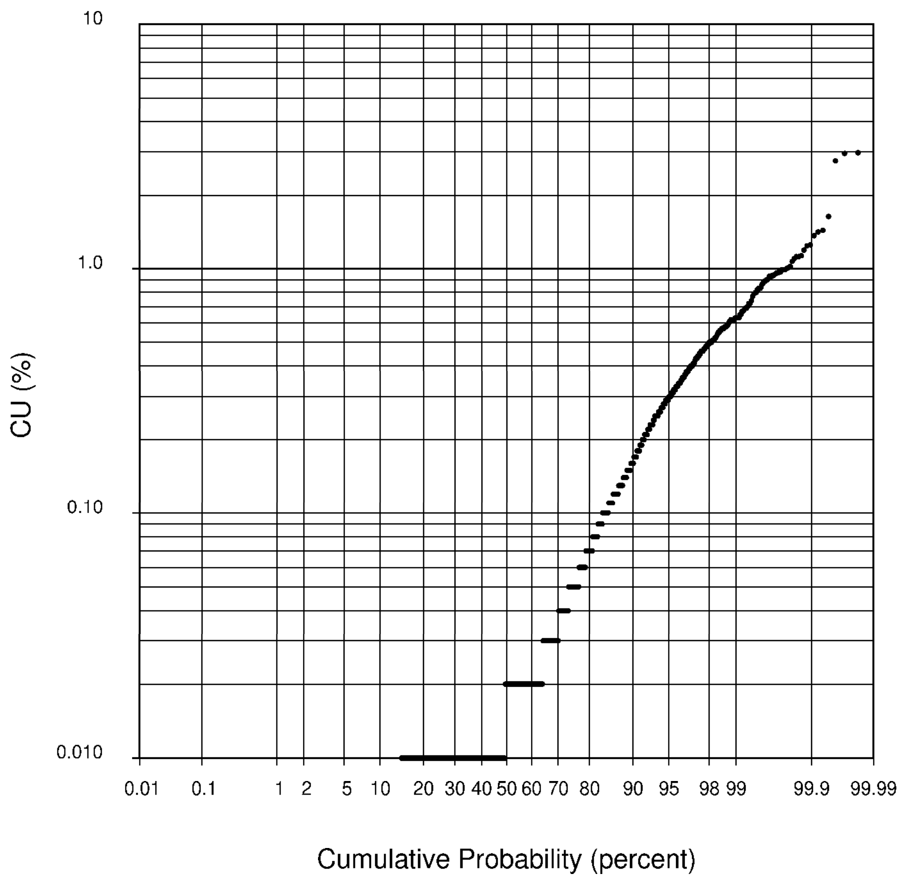
NorthMet - Unit_3 Raw Assay Cu (%)

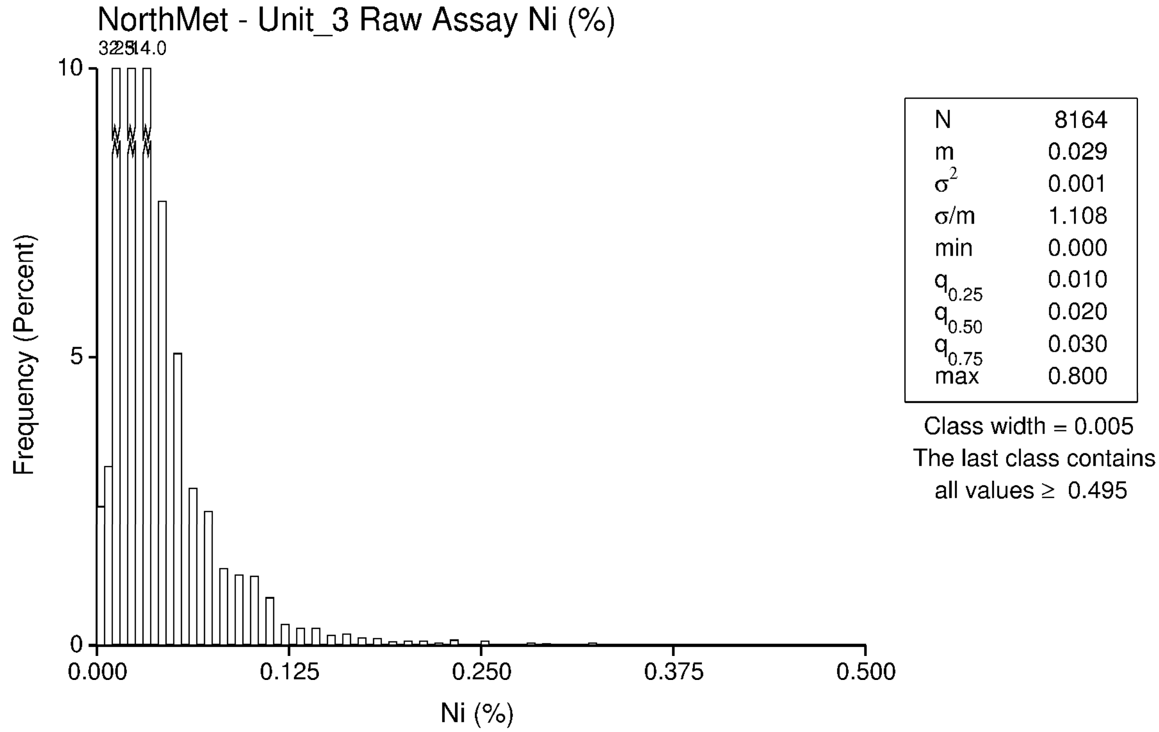


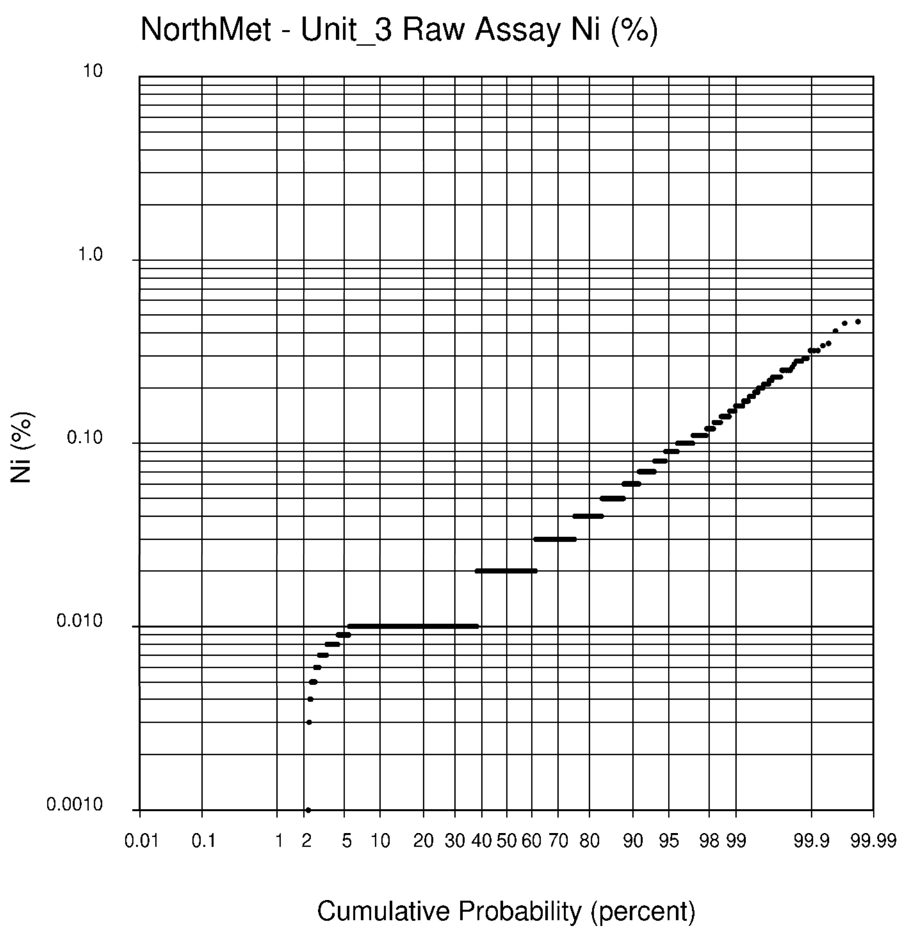
N	8164
m	0.06
σ^2	0.02
σ/m	2.28
min	0.00
$q_{0.25}$	0.01
$q_{0.50}$	0.02
$q_{0.75}$	0.05
max	4.17

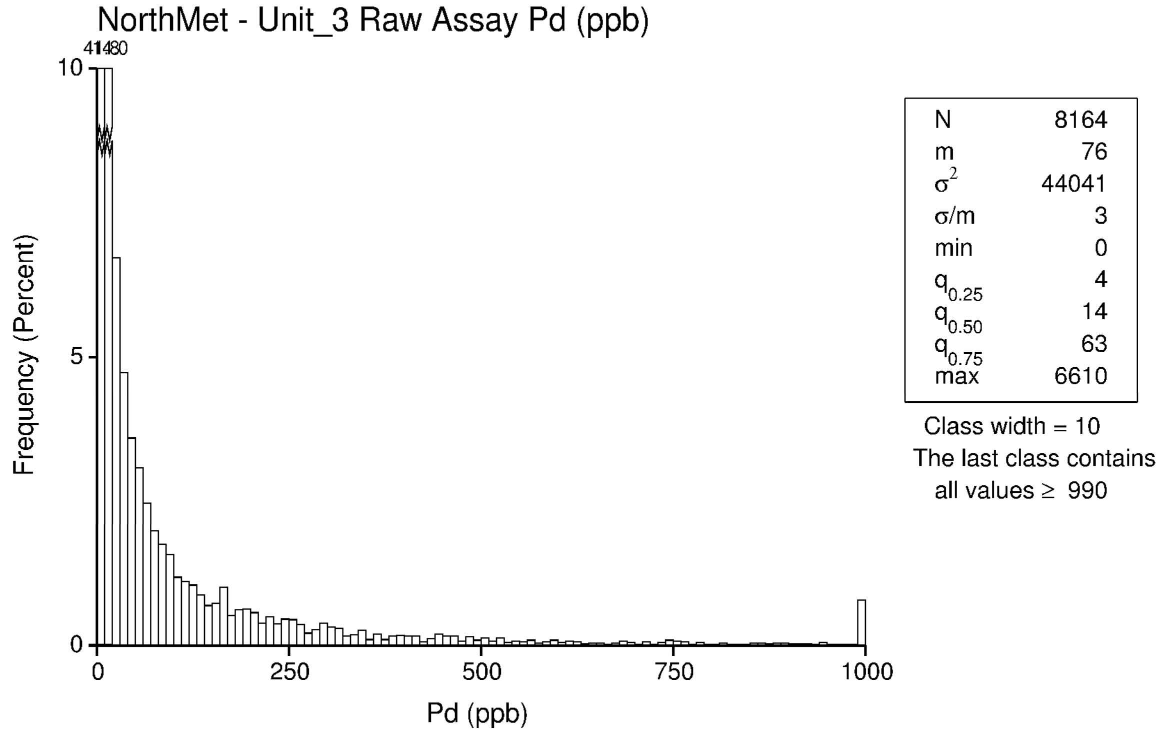
Class width = 0.03
The last class contains
all values ≥ 2.97

NorthMet - Unit_3 Raw Assay Cu (%)

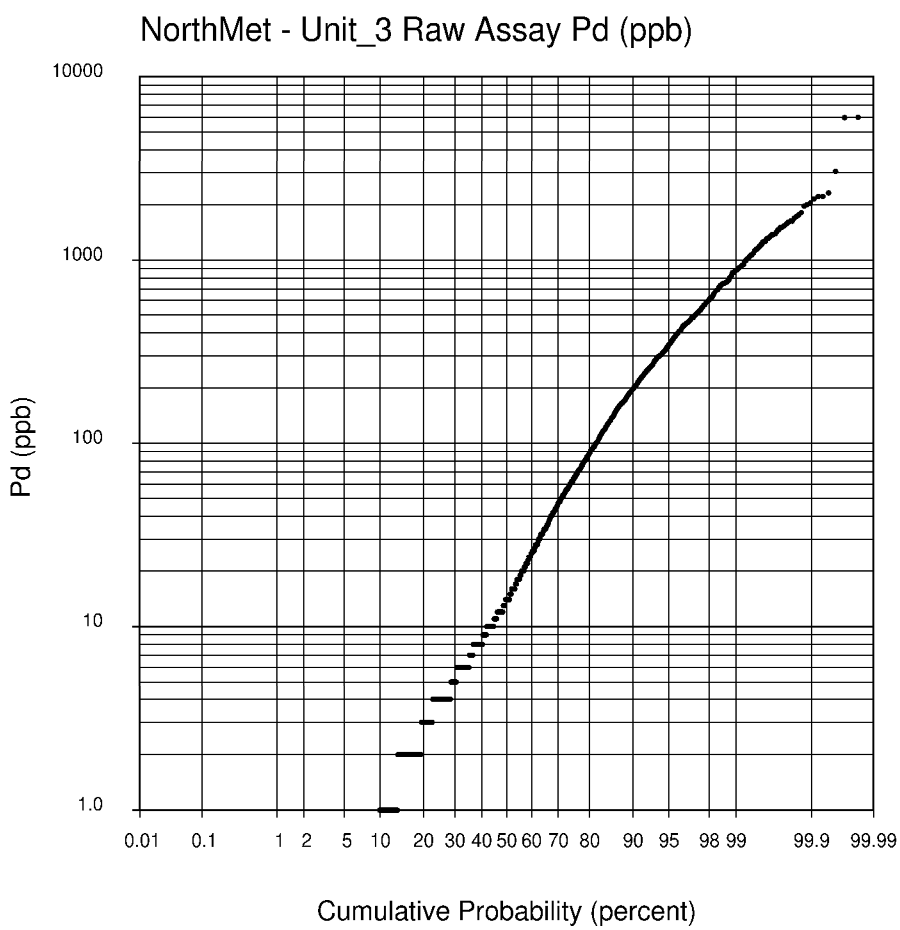



NorthMet - Unit_3 Raw Assay Ni (%)
32.8
25.1
14.0
Frequency (Percent)
Ni (%)
0.000
0.125
0.250
0.375
0.500
N 8164
m 0.029
σ² 0.001
σ/m 1.108
min 0.000
q0.25 0.010
q0.50 0.020
q0.75 0.030
max 0.800
Class width = 0.005
The last class contains
all values ≥ 0.495

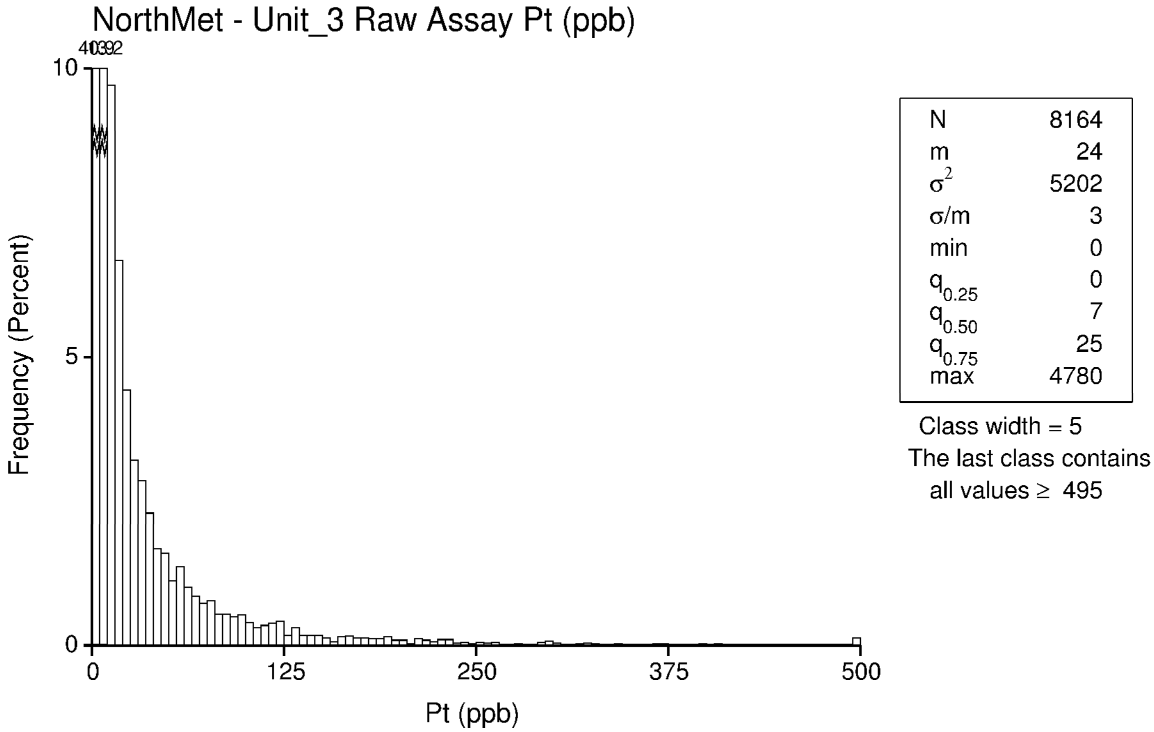

NorthMet - Unit_3 Raw Assay Ni (%)
Ni (%)
10
1.0
0.10
0.010
0.0010
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)



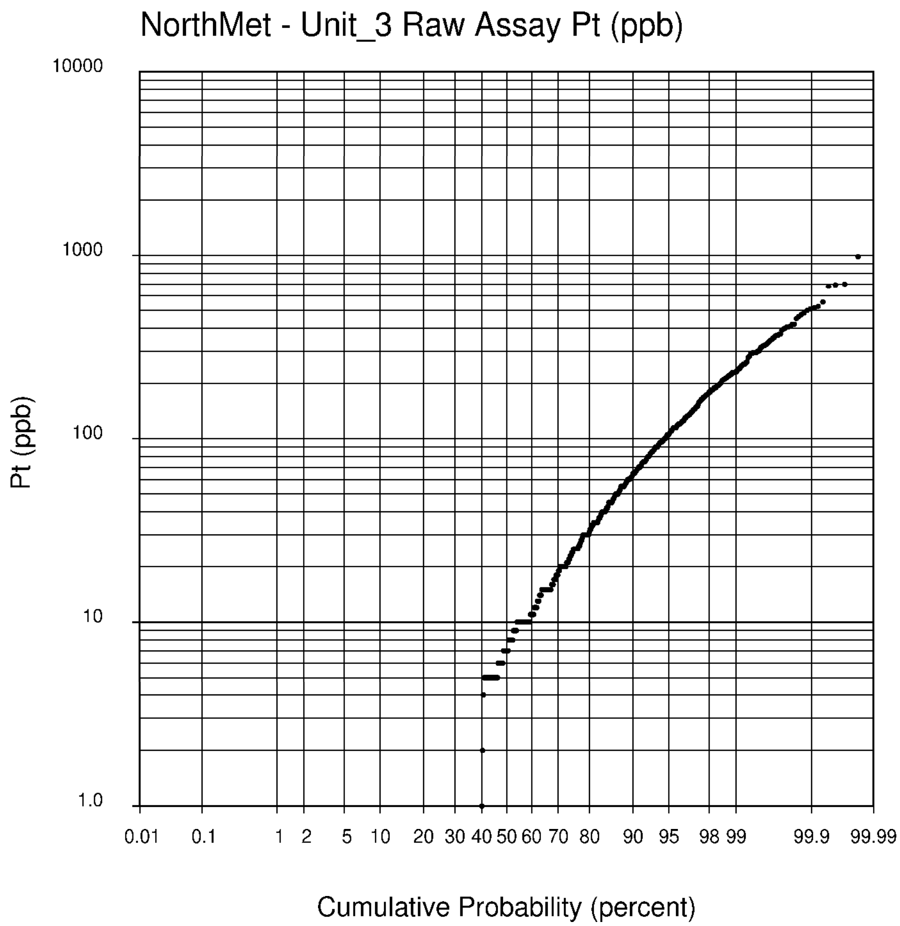
NorthMet - Unit_3 Raw Assay Pd (ppb)
Frequency (Percent)
Pd (ppb)
N 8164
m 76
σ2 44041
σ/m 3
min 0
q0.25 4
q0.50 14
q0.75 63
max 6610
Class width = 10
The last class contains
all values ≥ 990



NorthMet - Unit_3 Raw Assay Pd (ppb)
Pd (ppb)
Cumulative Probability (percent)

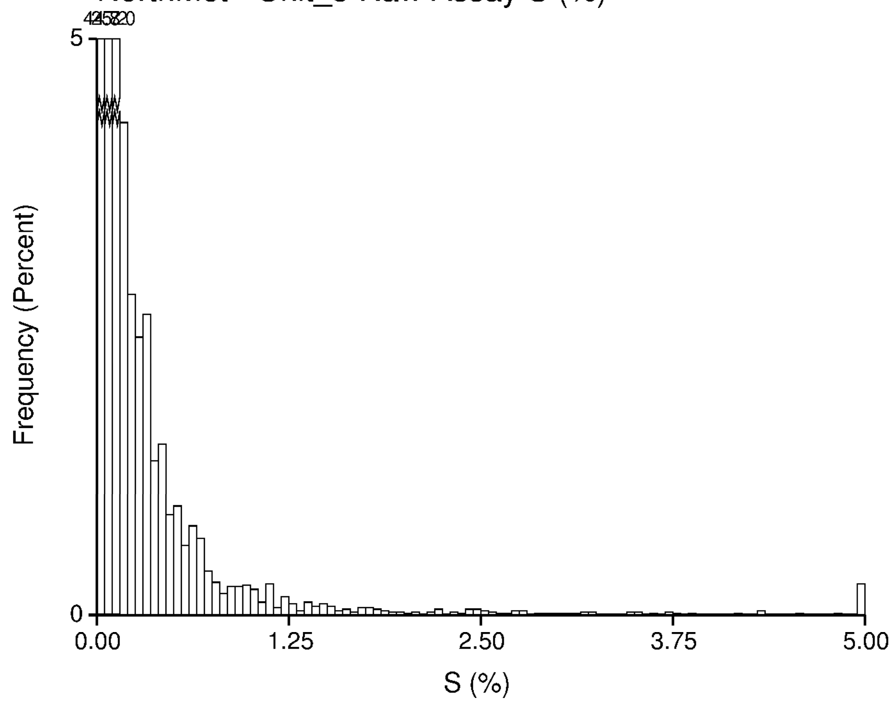


NorthMet - Unit_3 Raw Assay Pt (ppb)
Frequency (Percent)
Pt (ppb)
N 8164
m 24
σ² 5202
σ/m 3
min 0
q0.25 0
q0.50 7
q0.75 25
max 4780
Class width = 5
The last class contains
all values ≥ 495



NorthMet - Unit_3 Raw Assay Pt (ppb)
Pt (ppb)
Cumulative Probability (percent)

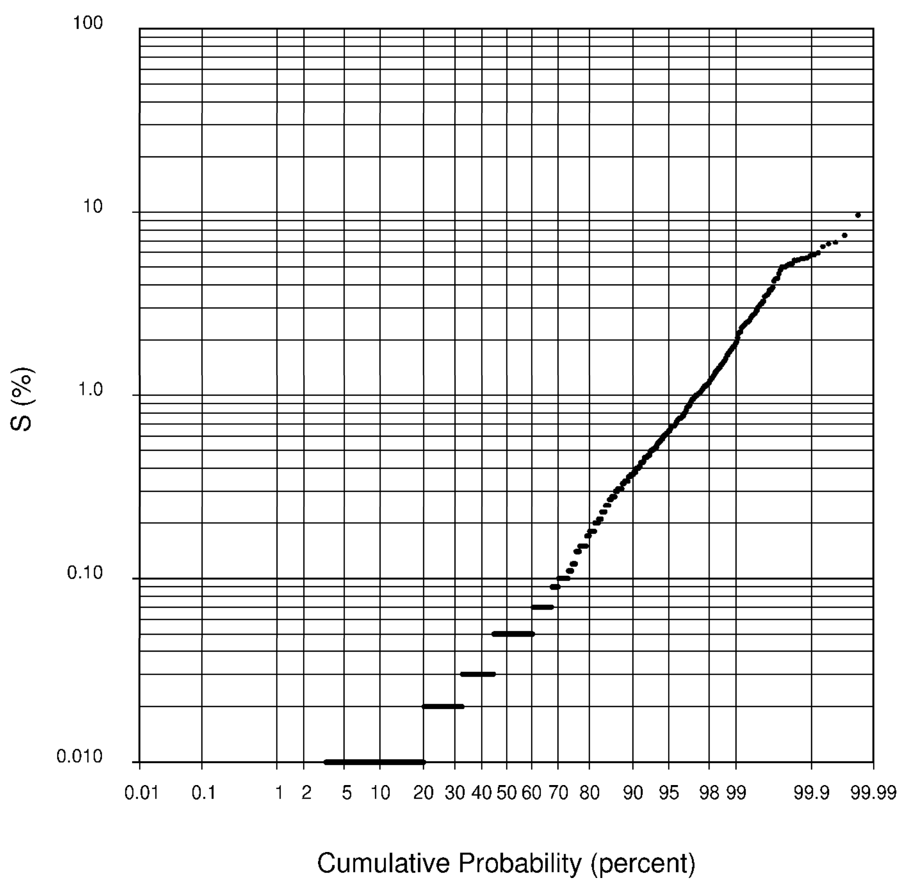
NorthMet - Unit_3 Raw Assay S (%)



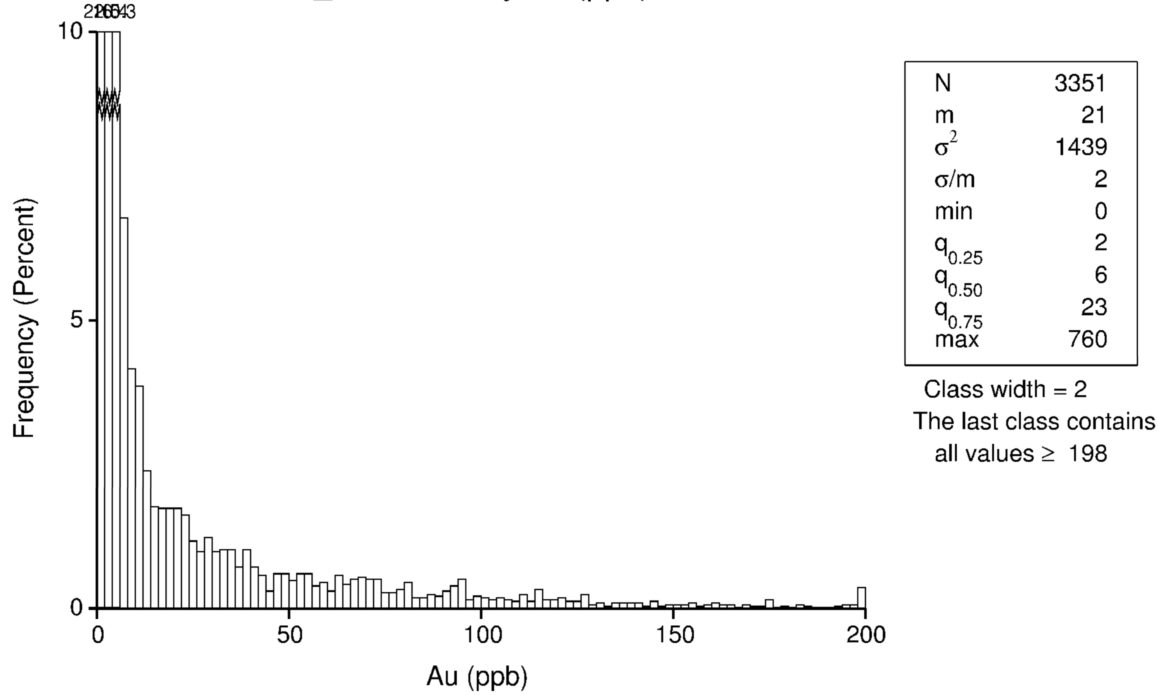
N	8164
m	0.16
σ^2	0.21
σ/m	2.81
min	0.00
$q_{0.25}$	0.02
$q_{0.50}$	0.05
$q_{0.75}$	0.12
max	10.80

Class width = 0.05
The last class contains all values ≥ 4.95

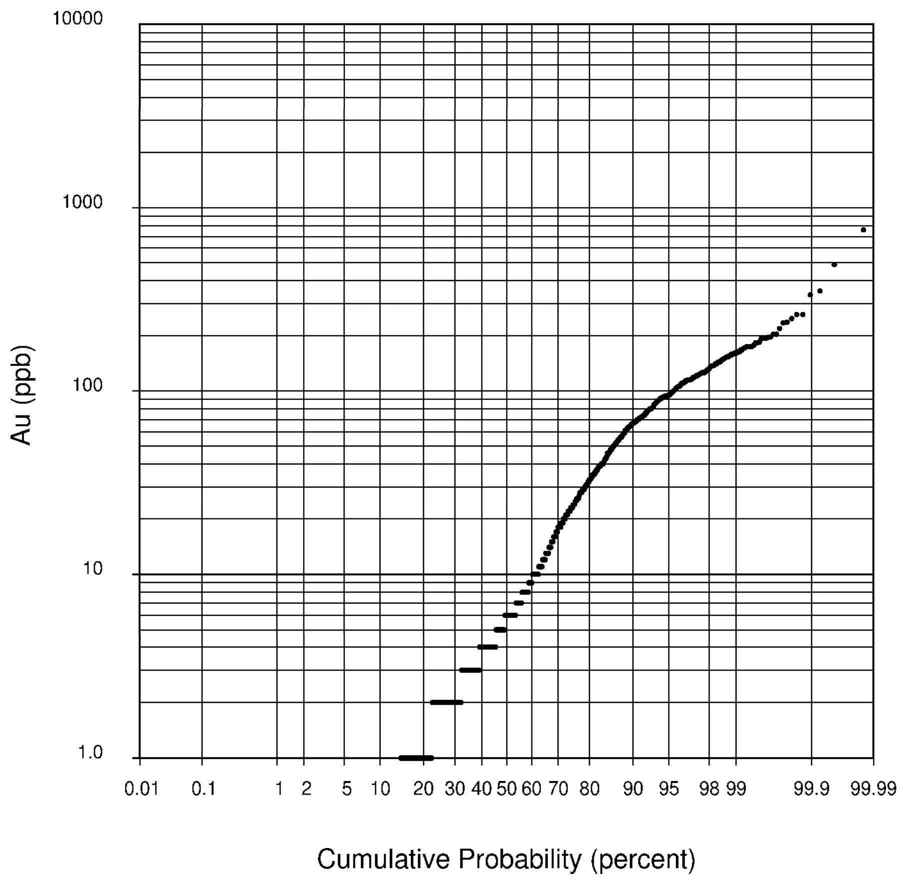
NorthMet - Unit_3 Raw Assay S (%)



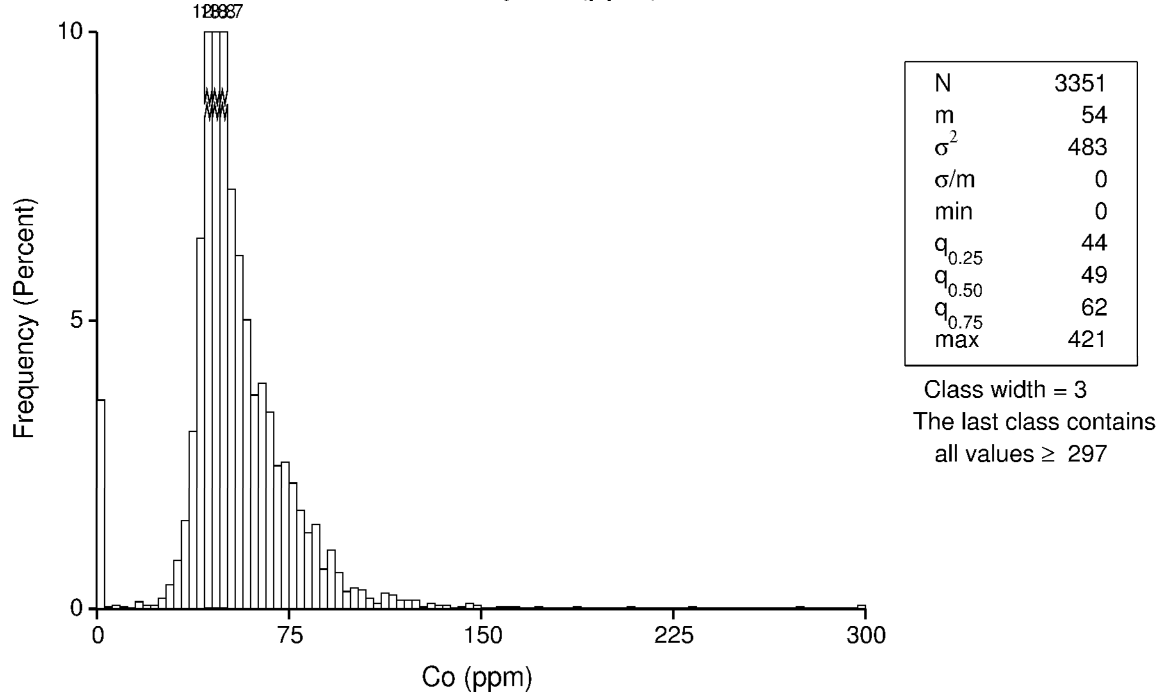
NorthMet - Unit_5 Raw Assay Au (ppb)



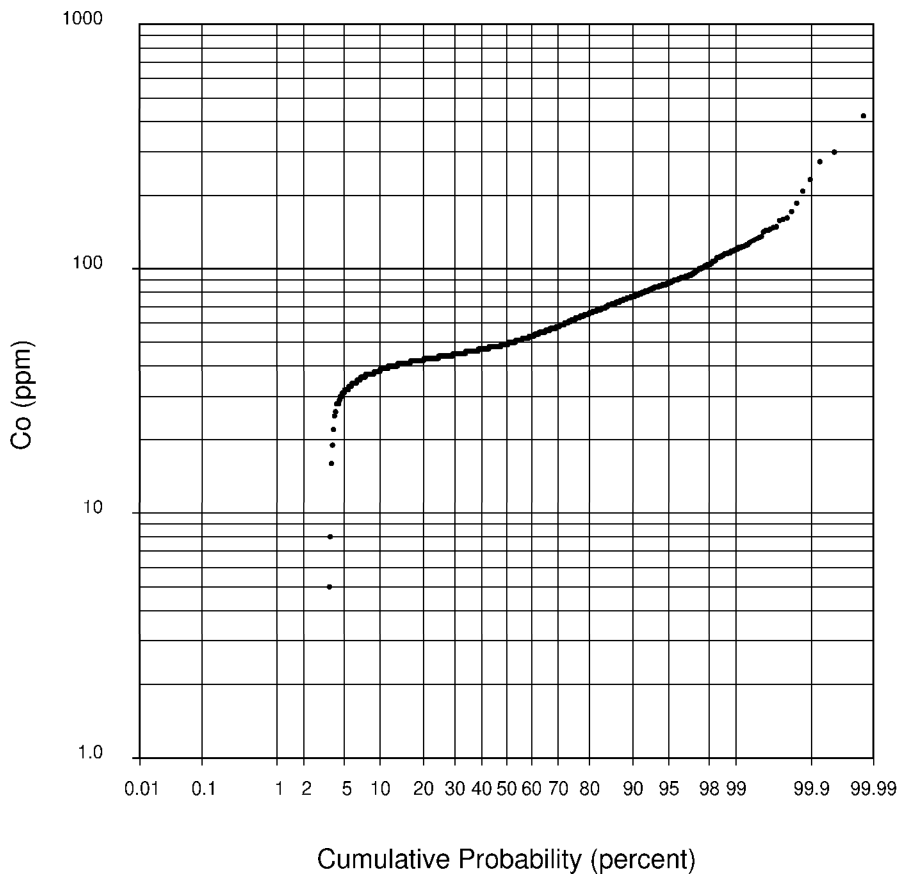
NorthMet - Unit_5 Raw Assay Au (ppb)

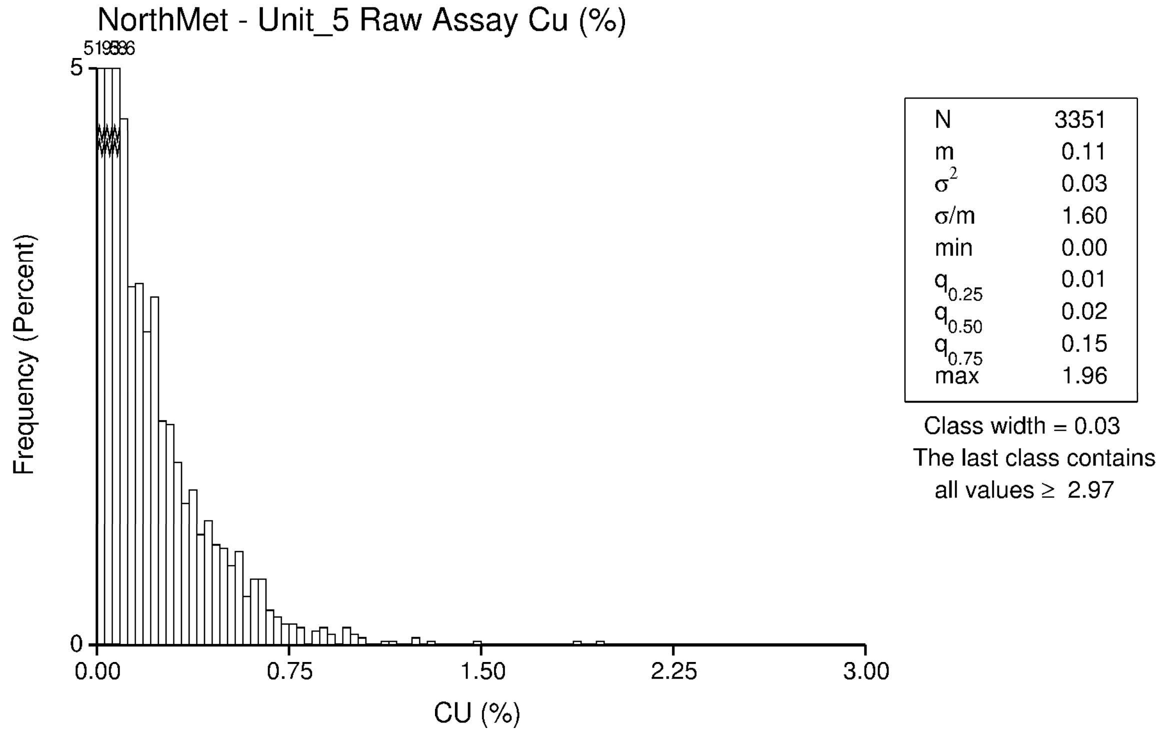


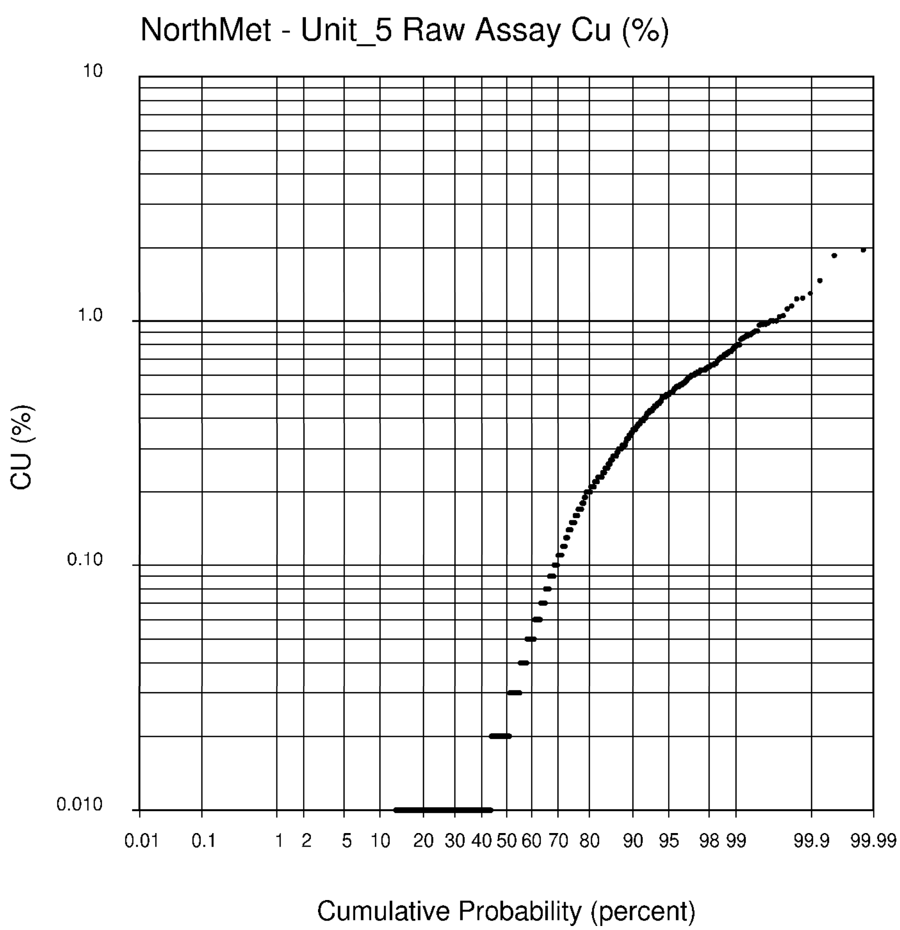
NorthMet - Unit_5 Raw Assay Co (ppm)

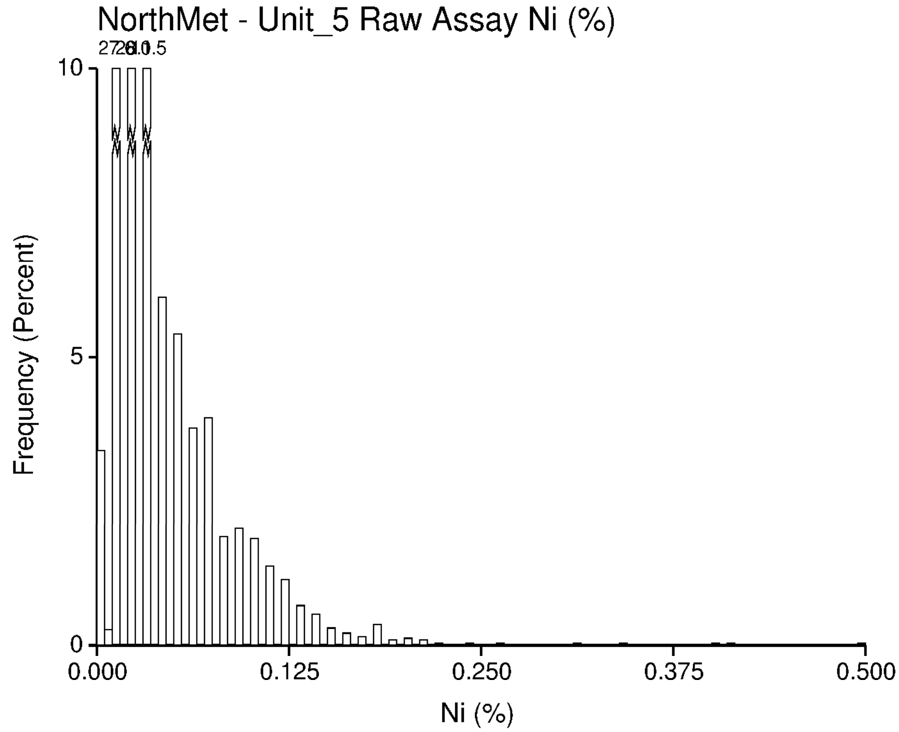


NorthMet - Unit_5 Raw Assay Co (ppm)



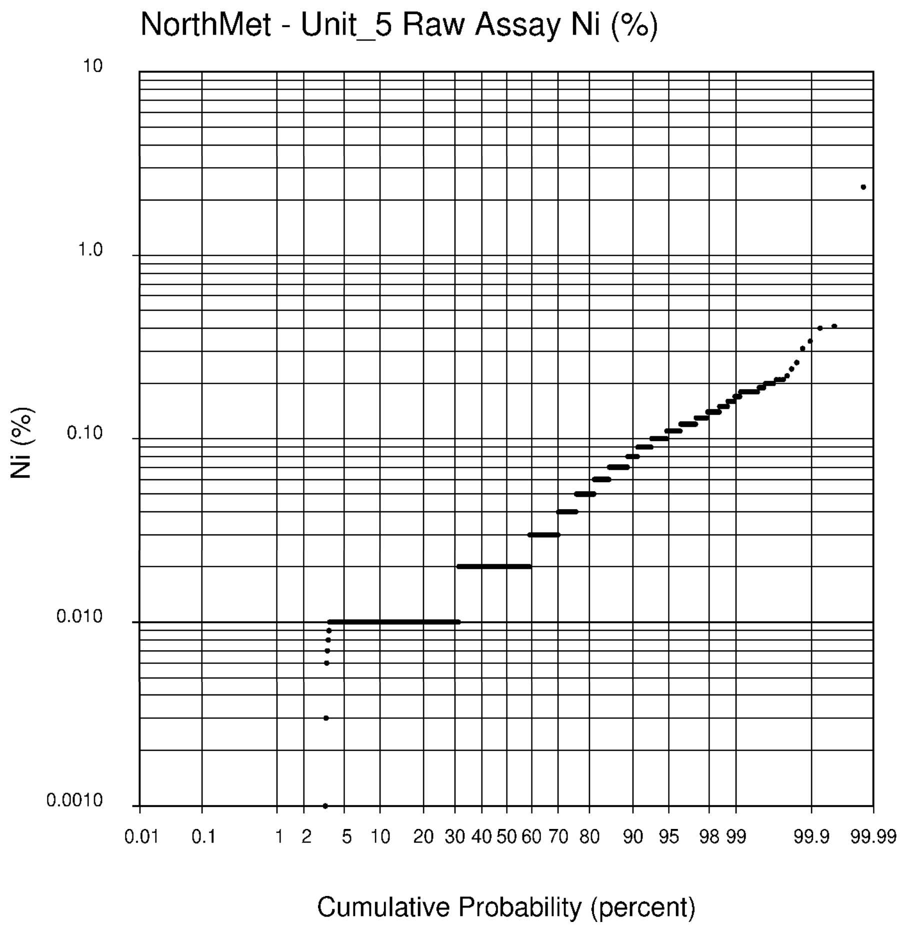

NorthMet - Unit_5 Raw Assay Cu (%)
Frequency (Percent)
CU (%)
0.00
0.75
1.50
2.25
3.00
N 3351
m 0.11
σ² 0.03
σ/m 1.60
min 0.00
q0.25 0.01
q0.50 0.02
q0.75 0.15
max 1.96
Class width = 0.03
The last class contains
all values ≥ 2.97


NorthMet - Unit_5 Raw Assay Cu (%)
CU (%)
10
1.0
0.10
0.010
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

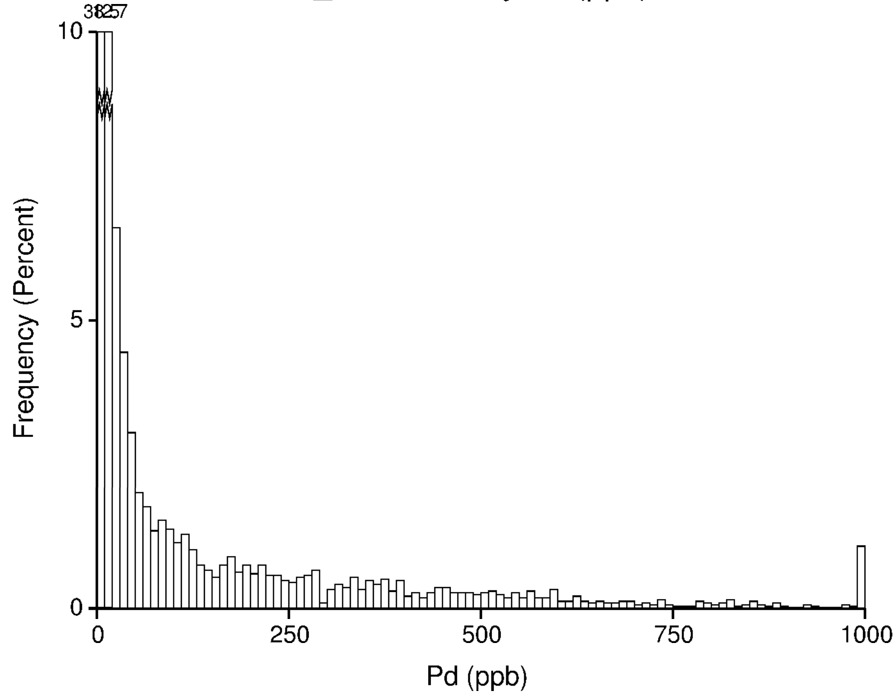


N	3351
m	0.035
σ^2	0.003
σ/m	1.525
min	0.000
$q_{0.25}$	0.010
$q_{0.50}$	0.020
$q_{0.75}$	0.040
max	2.350

Class width = 0.005
The last class contains all values ≥ 0.495



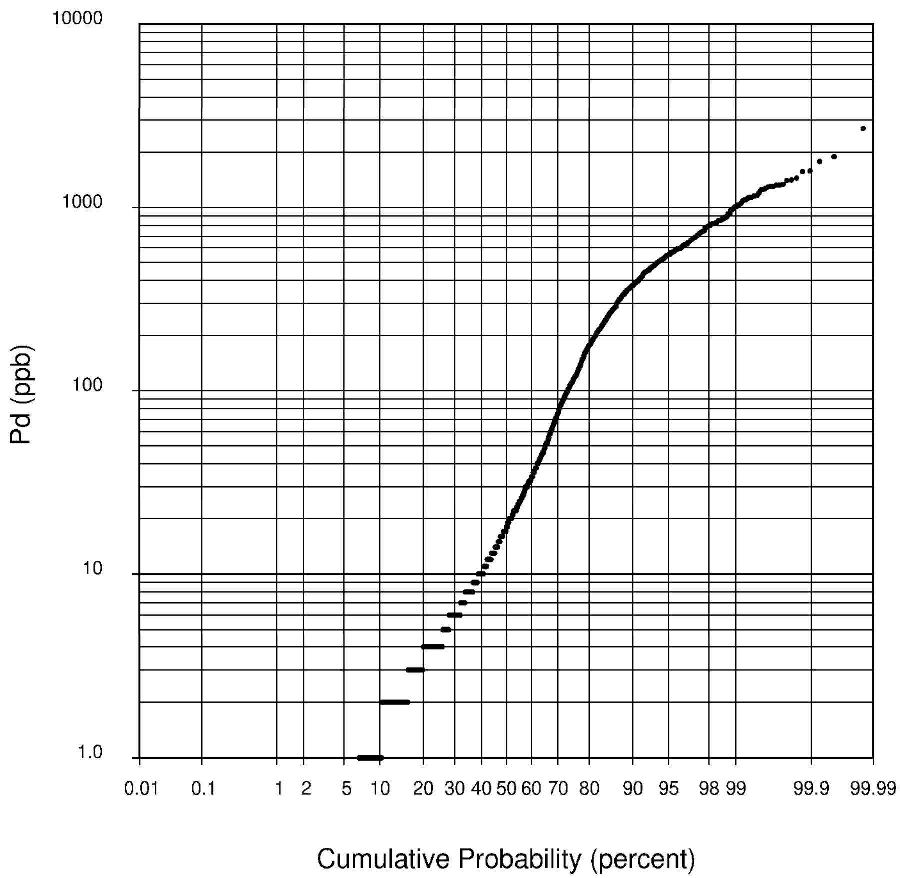
NorthMet - Unit_5 Raw Assay Pd (ppb)



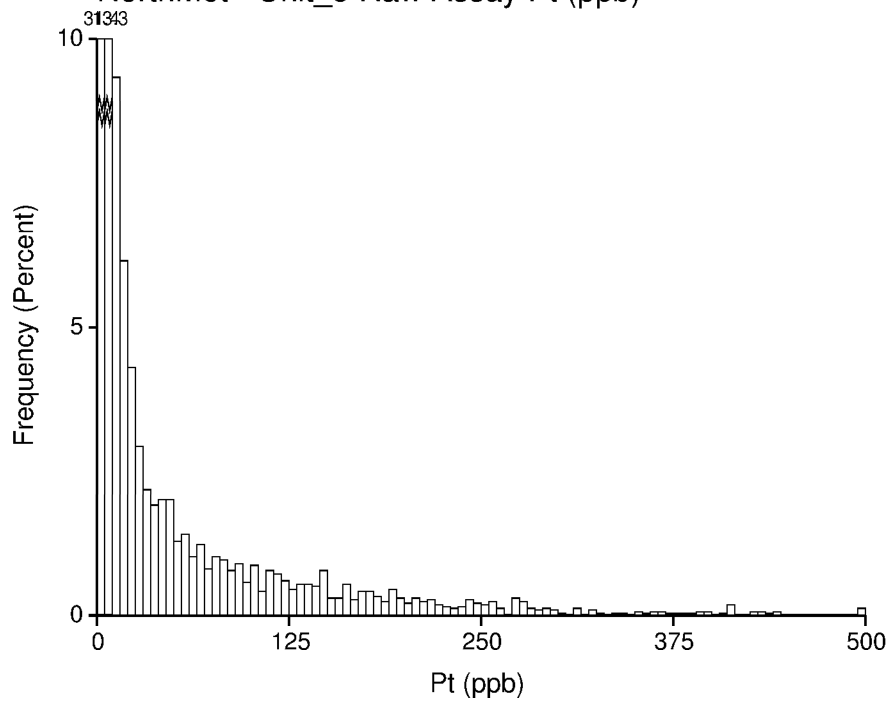
N	3351
m	113
σ^2	45350
σ/m	2
min	0
$q_{0.25}$	4
$q_{0.50}$	18
$q_{0.75}$	112
max	2690

Class width = 10
The last class contains all values ≥ 990

NorthMet - Unit_5 Raw Assay Pd (ppb)



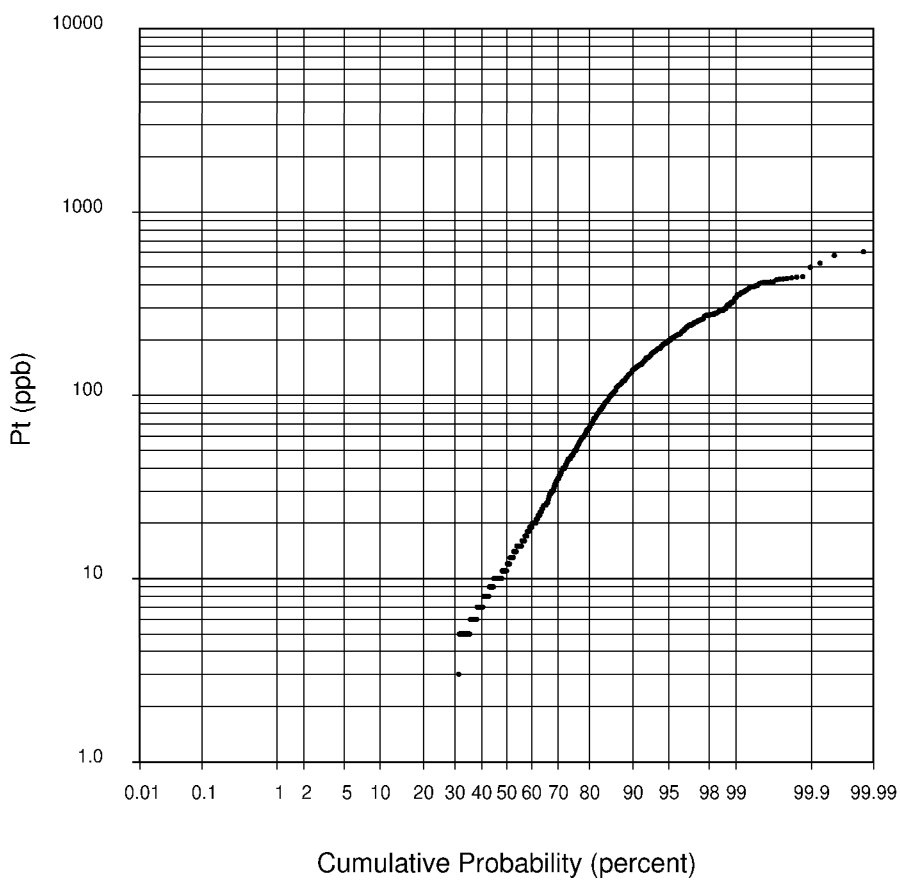
NorthMet - Unit_5 Raw Assay Pt (ppb)

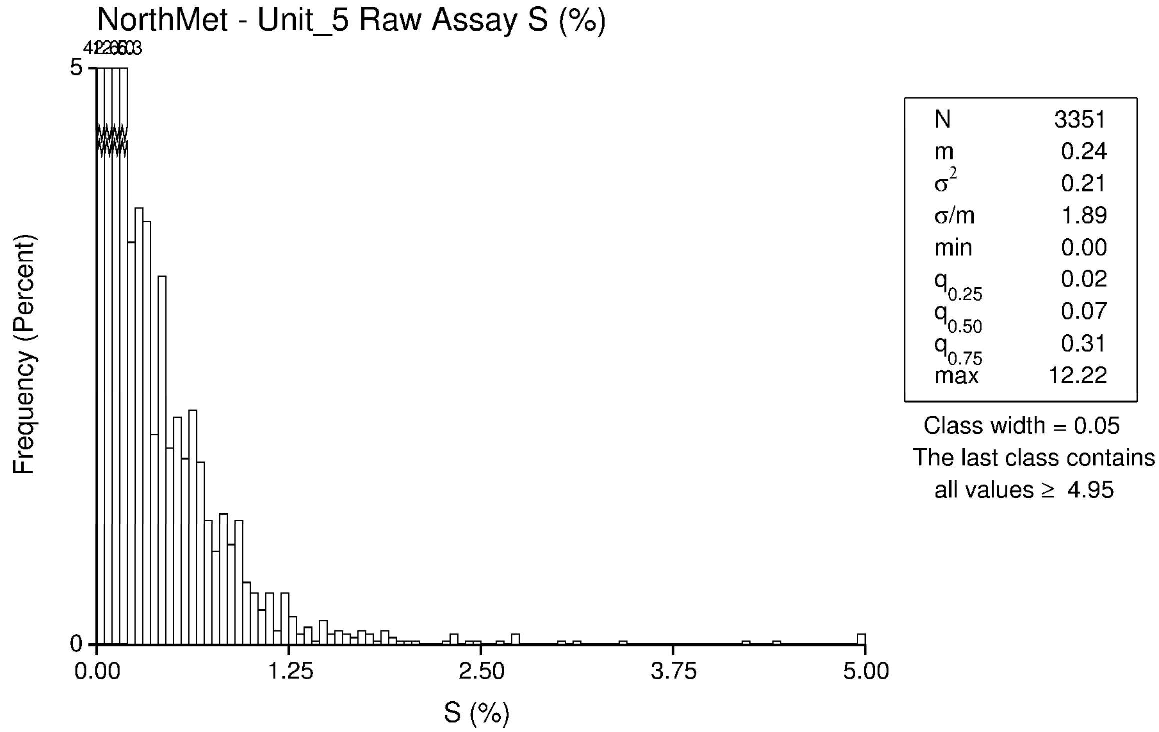


N	3351
m	43
σ^2	5176
σ/m	2
min	0
$q_{0.25}$	0
$q_{0.50}$	12
$q_{0.75}$	48
max	606

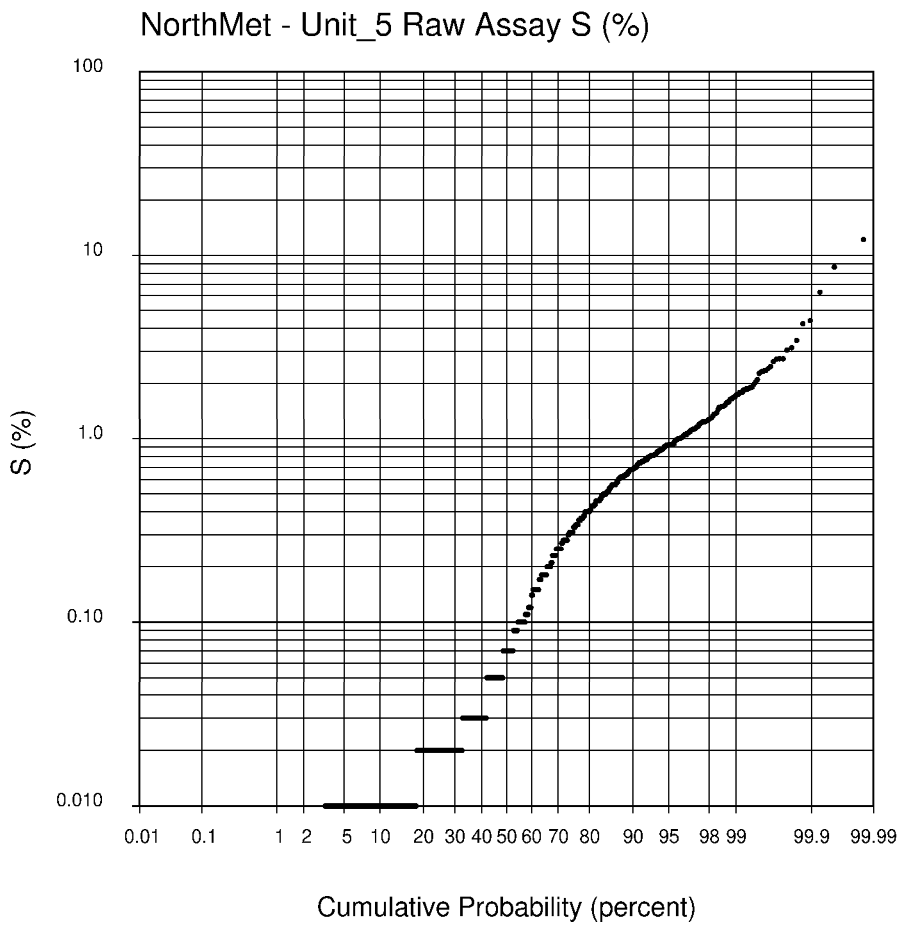
Class width = 5
The last class contains all values ≥ 495

NorthMet - Unit_5 Raw Assay Pt (ppb)



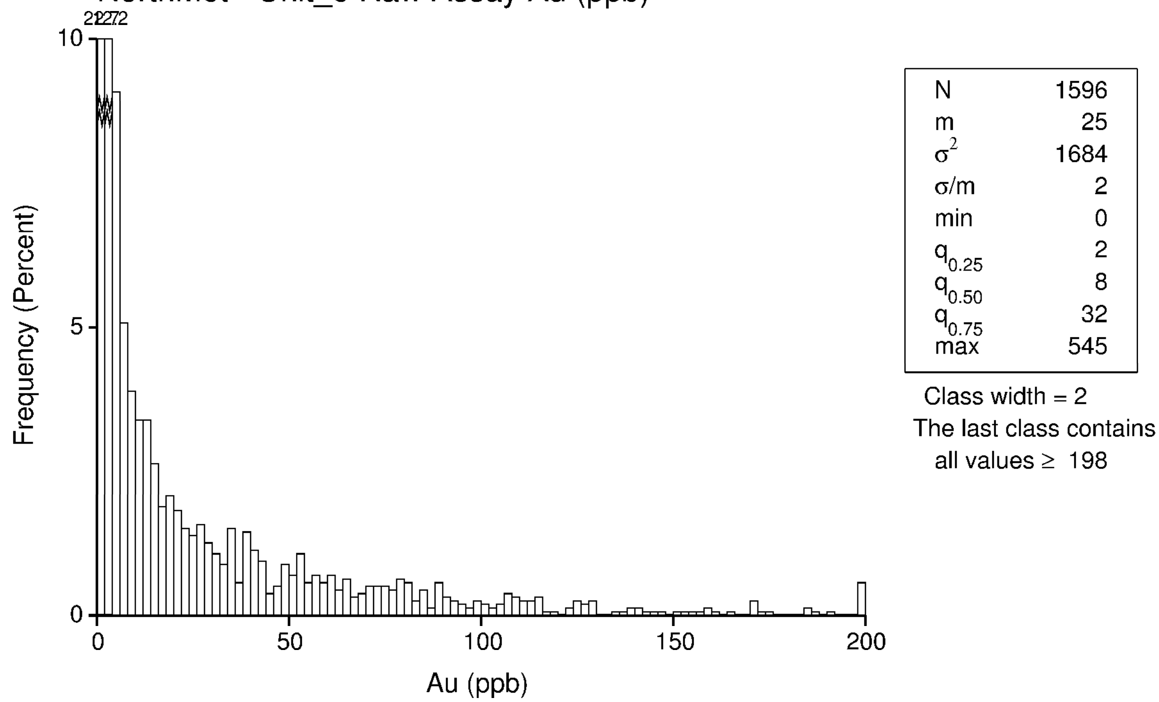


NorthMet - Unit_5 Raw Assay S (%)
Frequency (Percent)
S (%)
0.00
1.25
2.50
3.75
5.00
5
0
N 3351
m 0.24
σ² 0.21
σ/m 1.89
min 0.00
q0.25 0.02
q0.50 0.07
q0.75 0.31
max 12.22
Class width = 0.05
The last class contains
all values ≥ 4.95

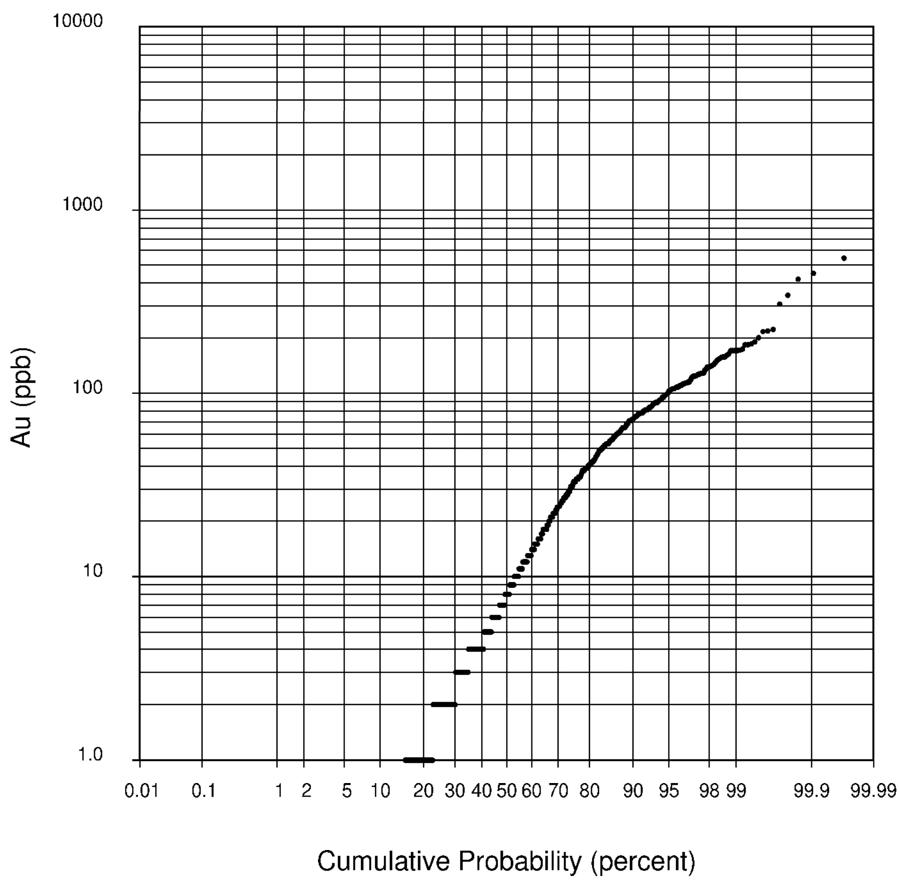


NorthMet - Unit_5 Raw Assay S (%)
S (%)
100
10
1.0
0.10
0.010
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

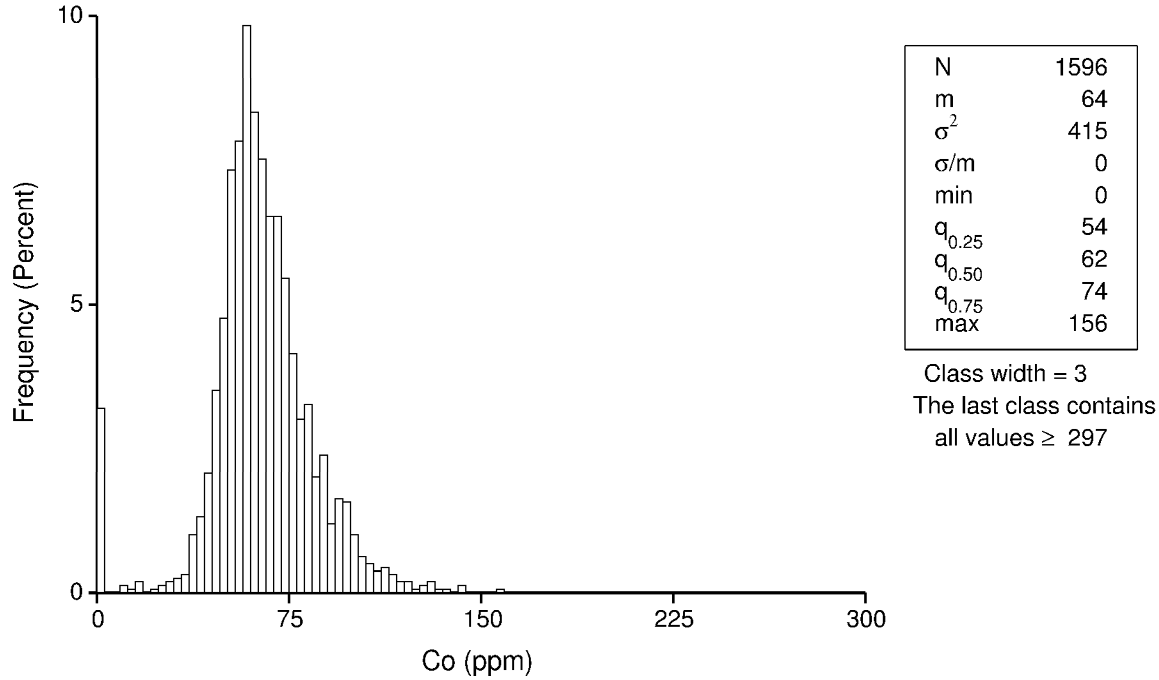
NorthMet - Unit_6 Raw Assay Au (ppb)



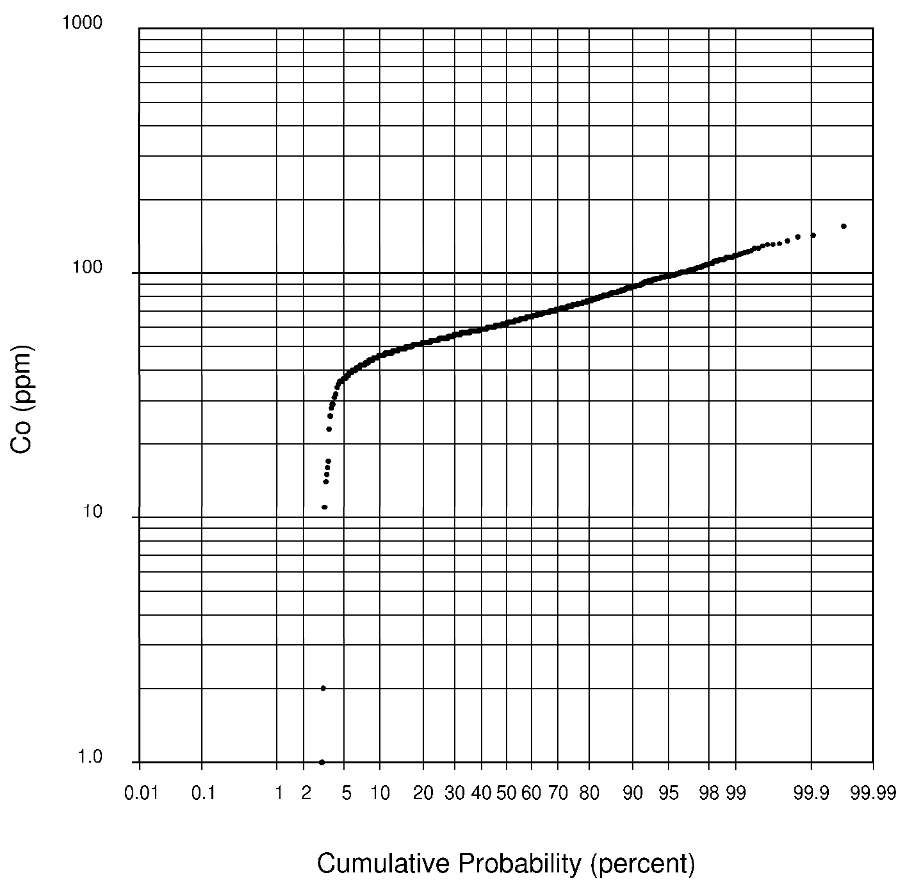
NorthMet - Unit_6 Raw Assay Au (ppb)

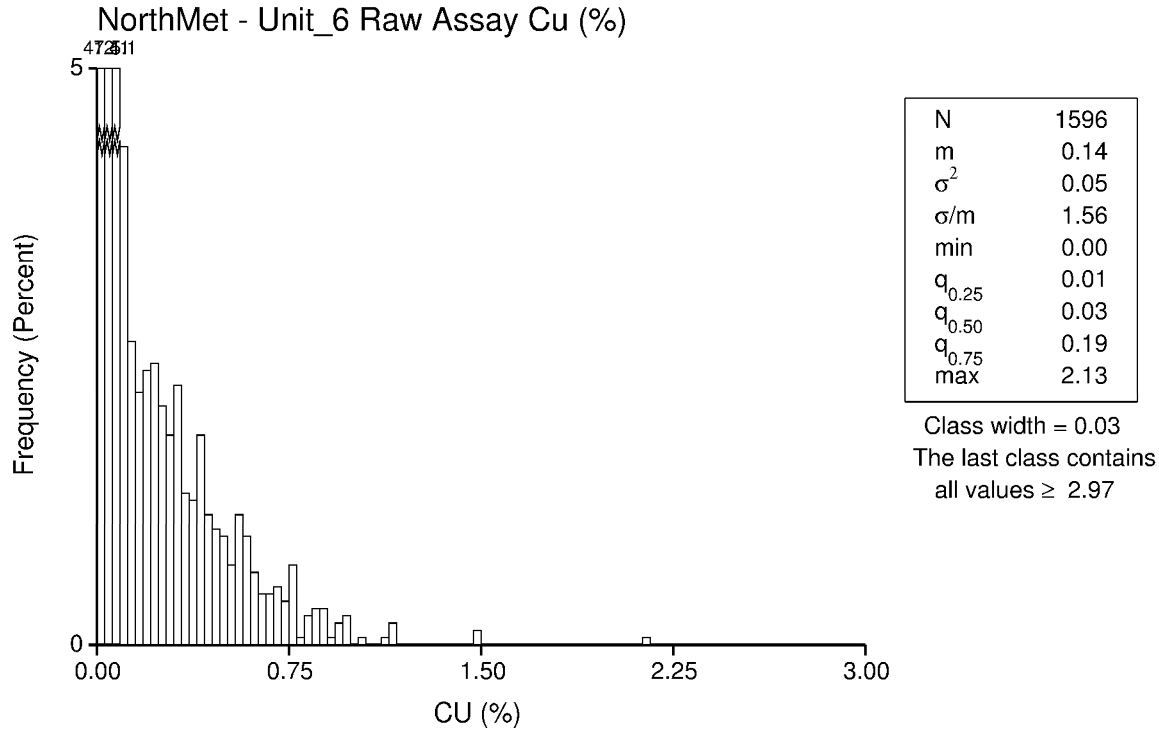


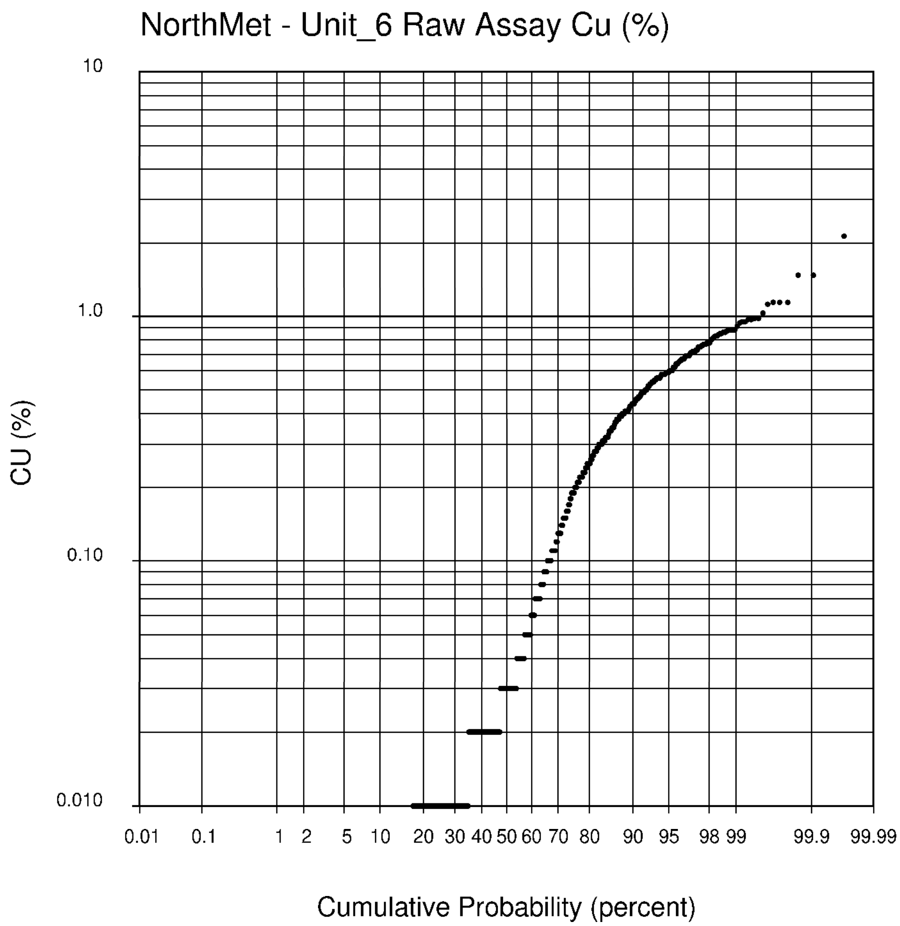
NorthMet - Unit_6 Raw Assay Co (ppm)

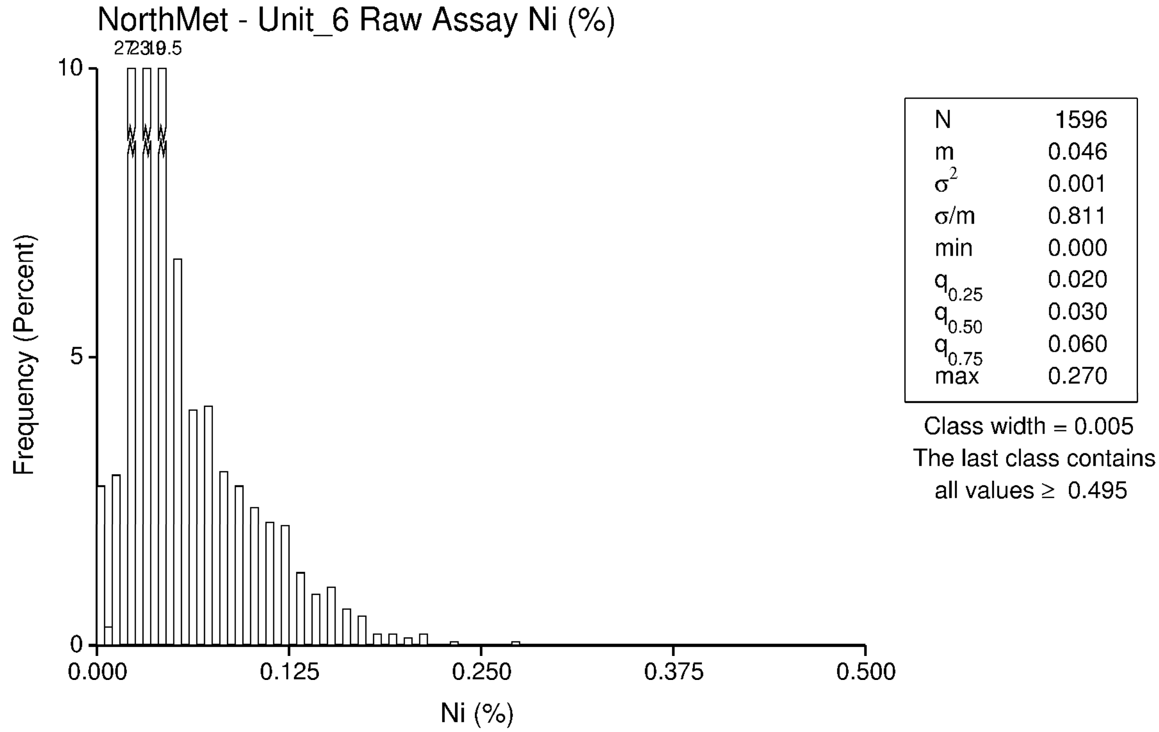


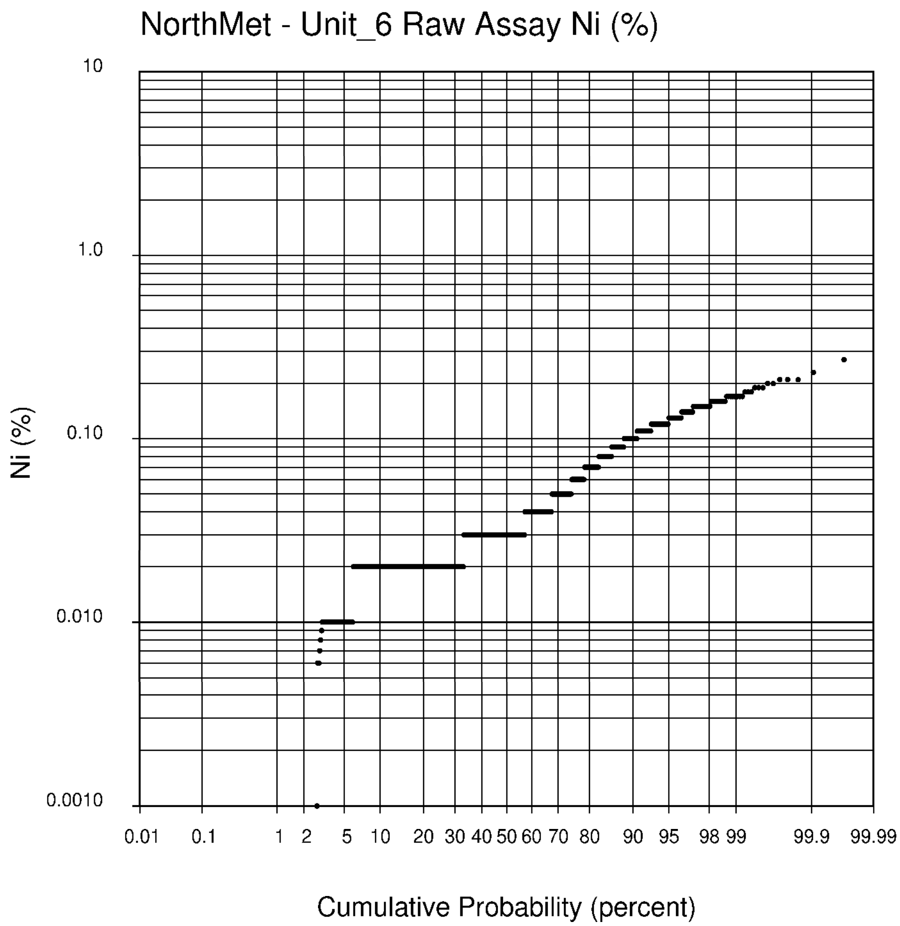
NorthMet - Unit_6 Raw Assay Co (ppm)



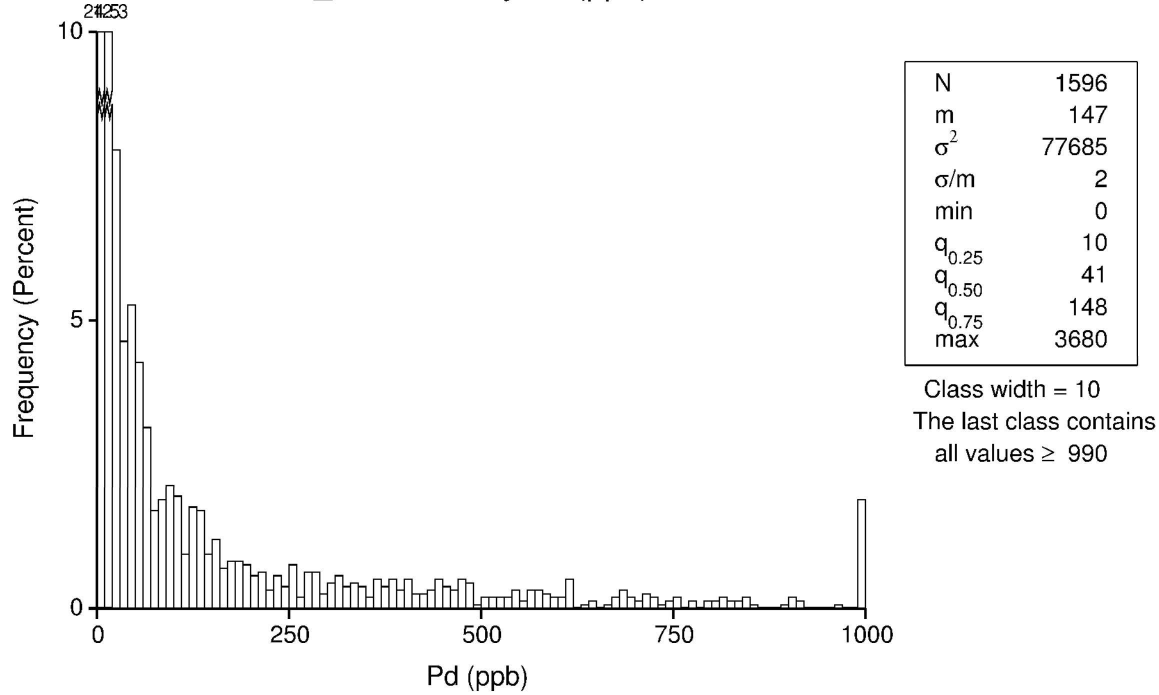

NorthMet - Unit_6 Raw Assay Cu (%)
Frequency (Percent)
CU (%)
0.00
0.75
1.50
2.25
3.00
5
0
N 1596
m 0.14
σ2 0.05
σ/m 1.56
min 0.00
q0.25 0.01
q0.50 0.03
q0.75 0.19
max 2.13
Class width = 0.03
The last class contains
all values ≥ 2.97


NorthMet - Unit_6 Raw Assay Cu (%)
CU (%)
10
1.0
0.10
0.010
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

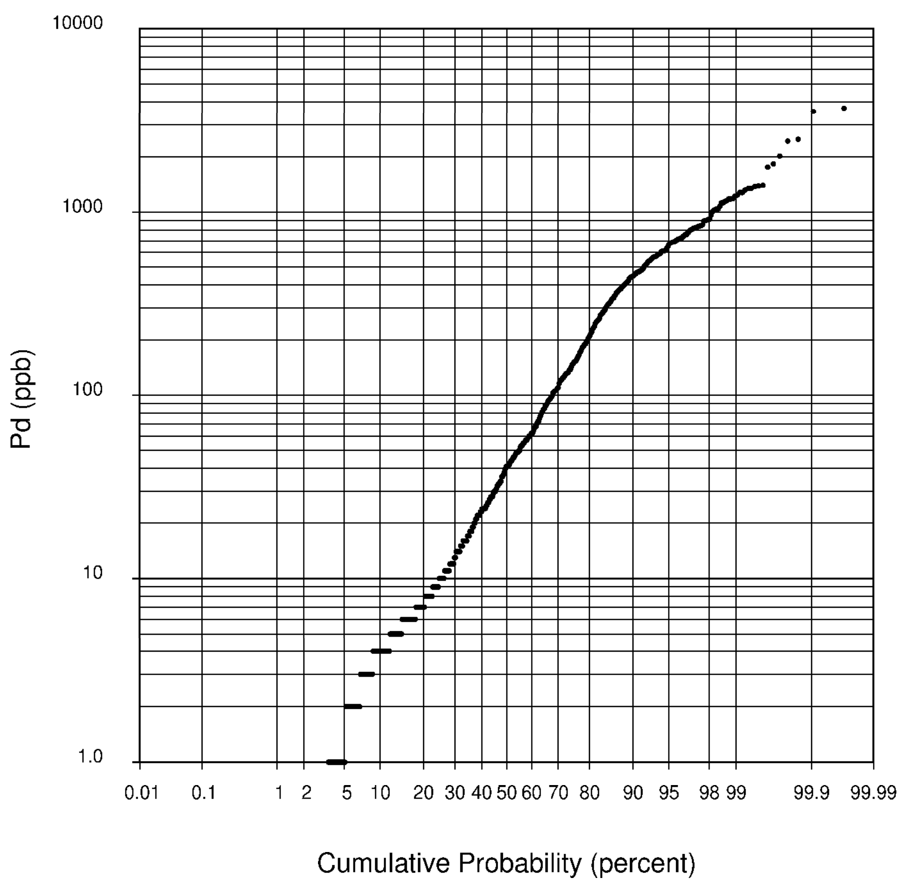

NorthMet - Unit_6 Raw Assay Ni (%)
27 23 19.5
Frequency (Percent)
10
5
0
0.000
0.125
0.250
0.375
0.500
Ni (%)
N 1596
m 0.046
σ2 0.001
σ/m 0.811
min 0.000
q0.25 0.020
q0.50 0.030
q0.75 0.060
max 0.270
Class width = 0.005
The last class contains
all values ≥ 0.495


NorthMet - Unit_6 Raw Assay Ni (%)
Ni (%)
10
1.0
0.10
0.010
0.0010
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)

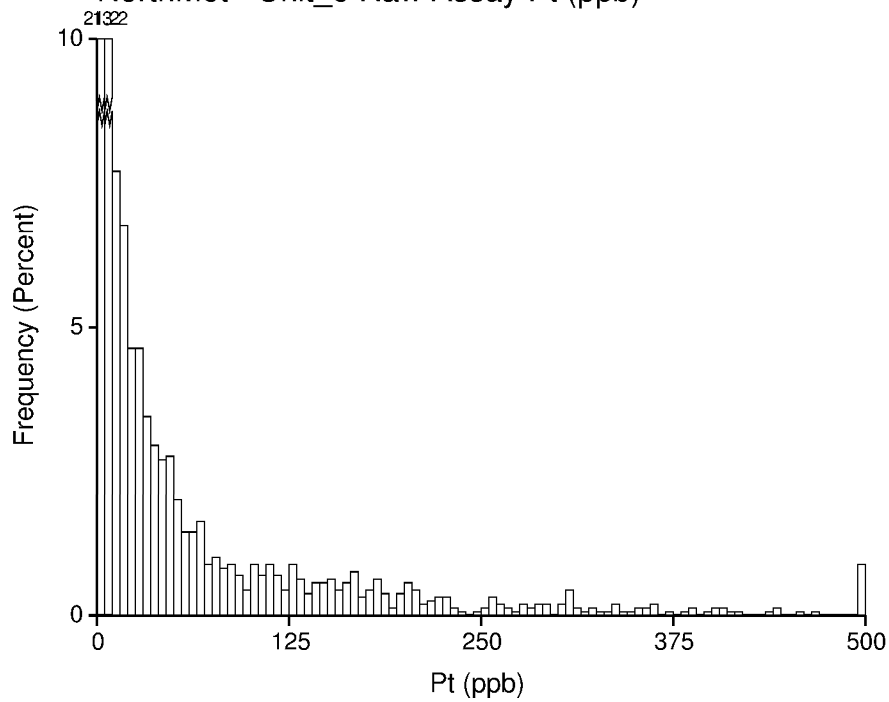
NorthMet - Unit_6 Raw Assay Pd (ppb)



NorthMet - Unit_6 Raw Assay Pd (ppb)



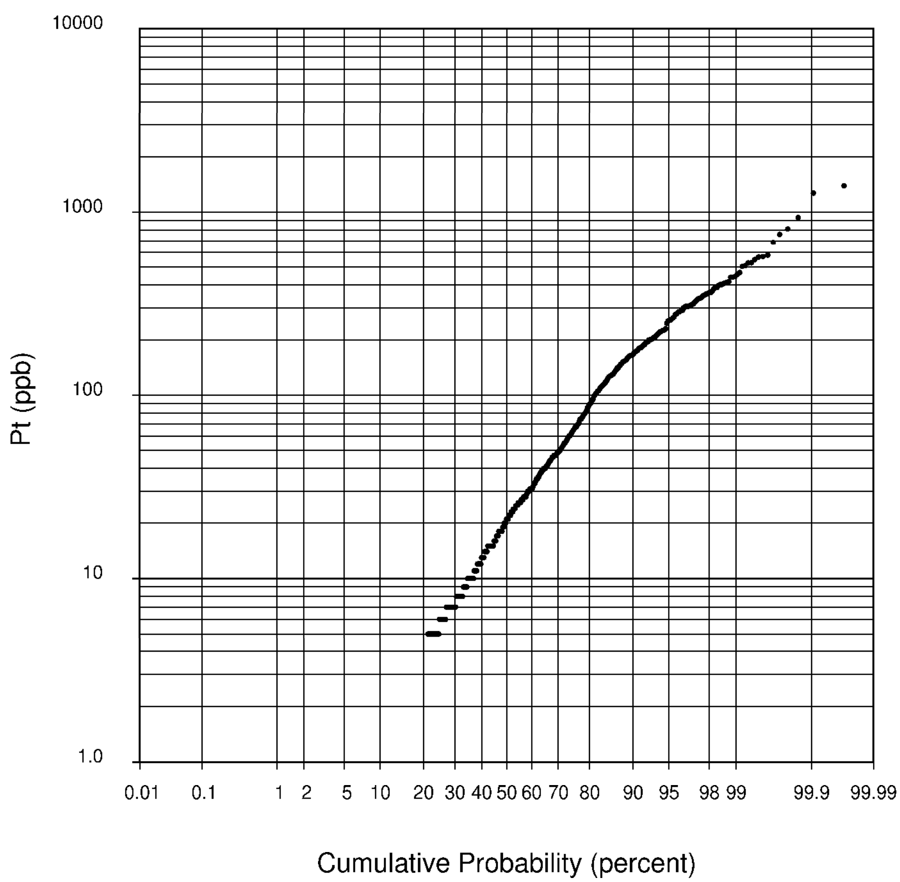
NorthMet - Unit_6 Raw Assay Pt (ppb)

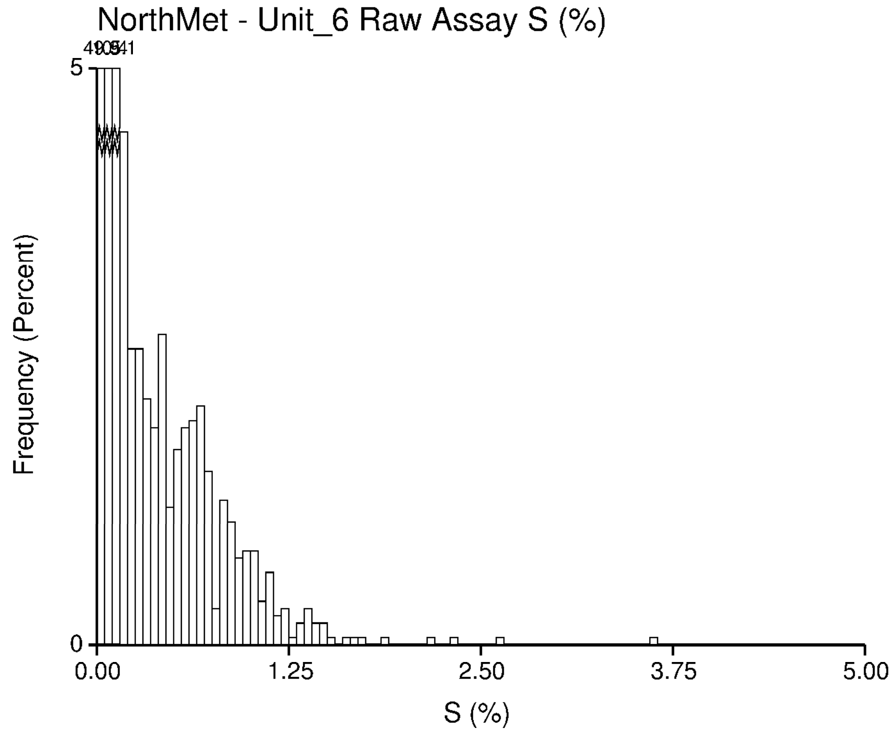


N	1596
m	59
σ^2	10881
σ/m	2
min	0
$q_{0.25}$	6
$q_{0.50}$	21
$q_{0.75}$	65
max	1390

Class width = 5
The last class contains
all values ≥ 495

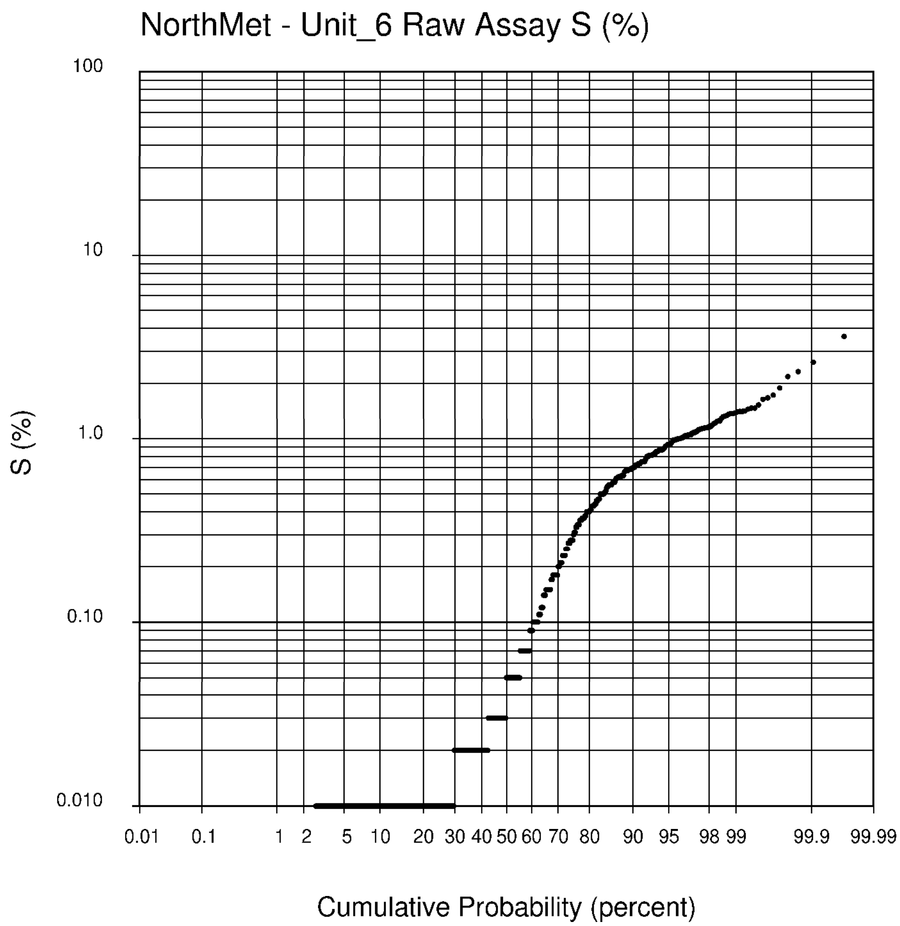
NorthMet - Unit_6 Raw Assay Pt (ppb)



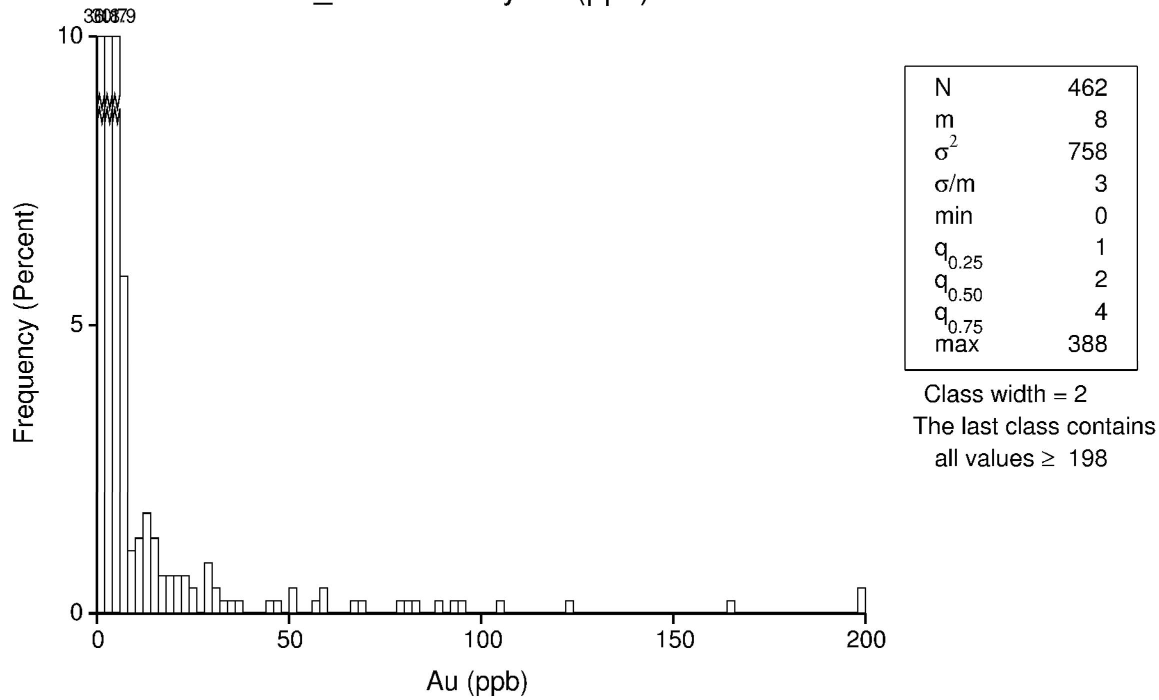


N	1596
m	0.21
σ^2	0.11
σ/m	1.58
min	0.00
$q_{0.25}$	0.01
$q_{0.50}$	0.05
$q_{0.75}$	0.30
max	3.61

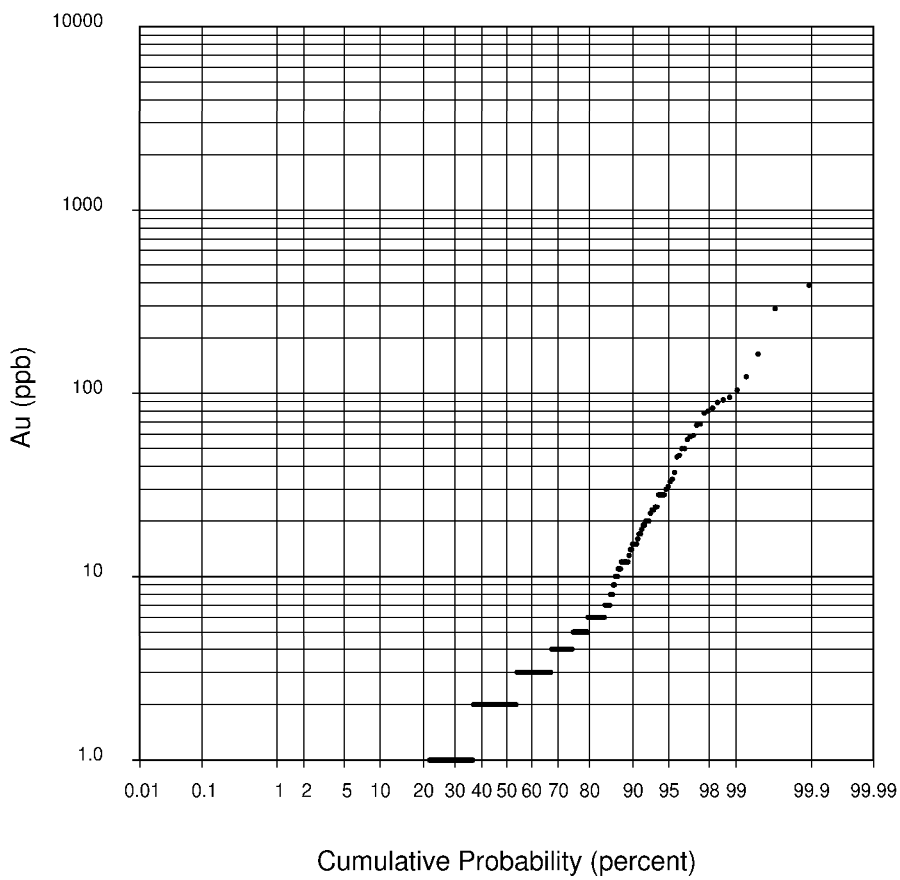
Class width = 0.05
The last class contains
all values ≥ 4.95

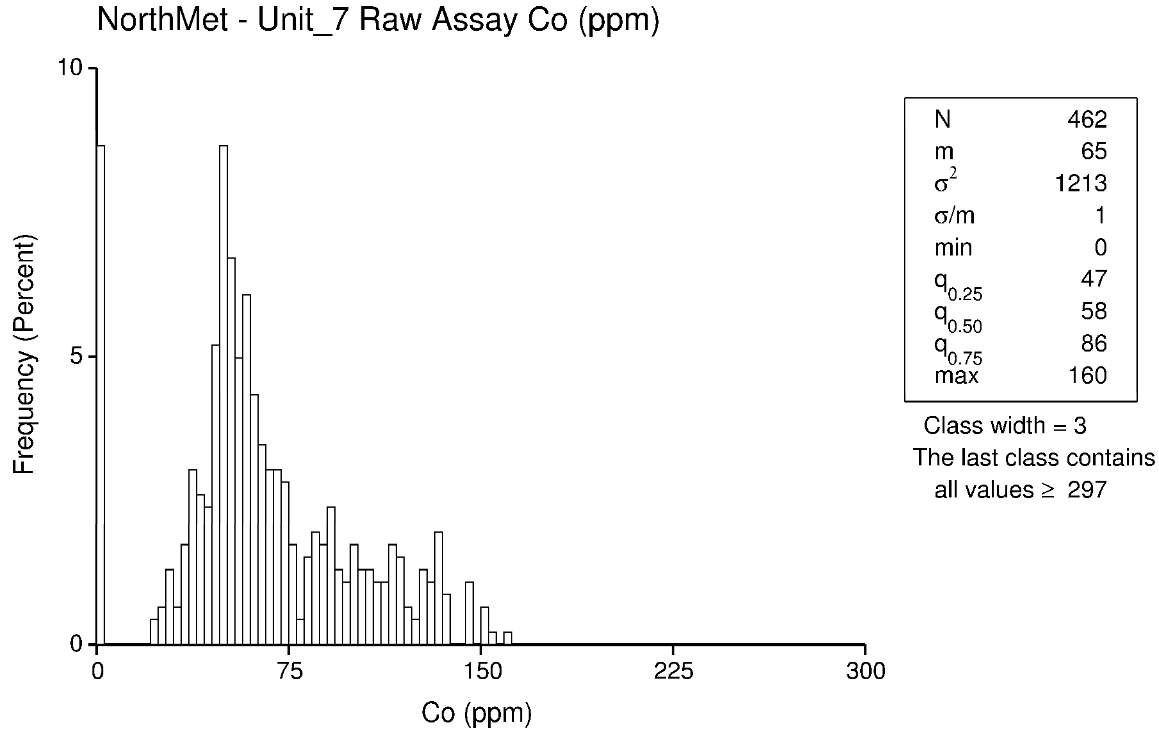


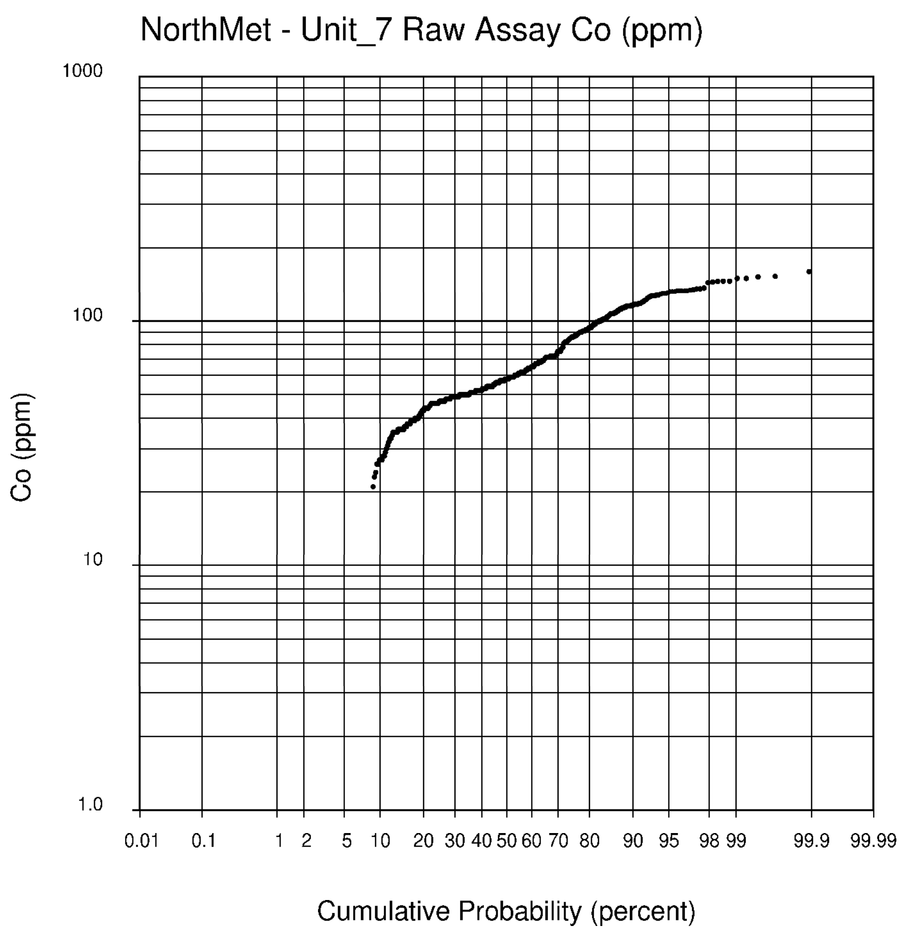
NorthMet - Unit_7 Raw Assay Au (ppb)

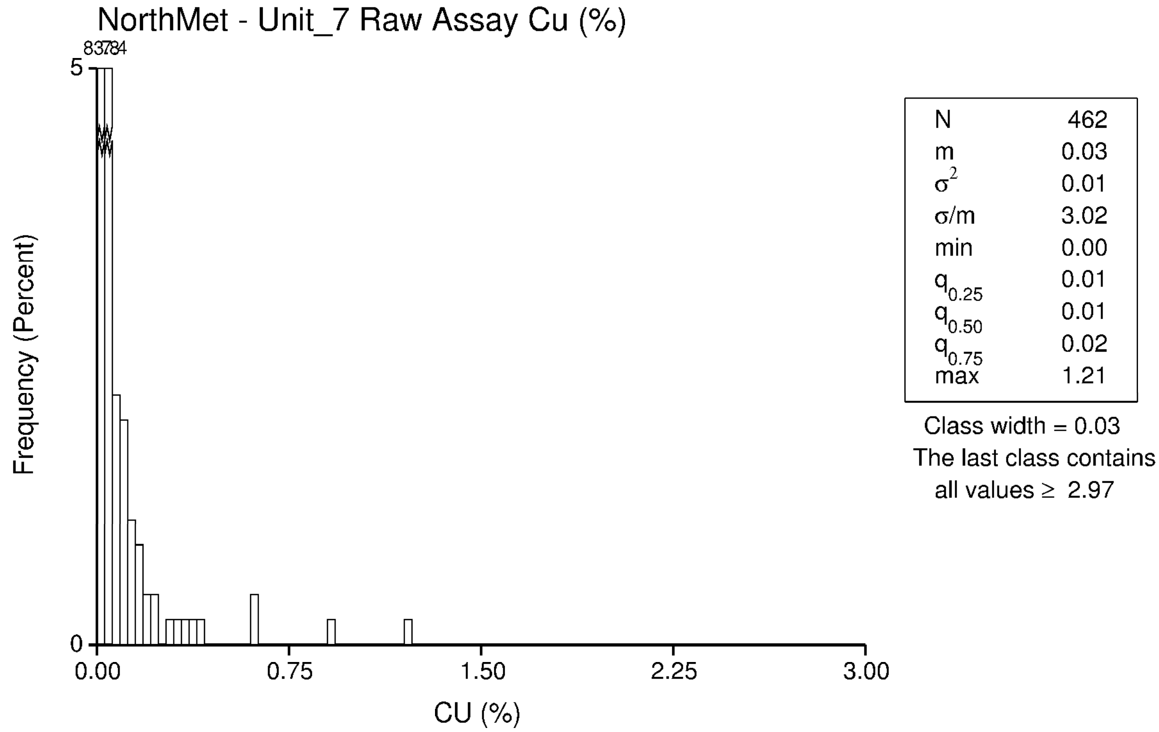


NorthMet - Unit_7 Raw Assay Au (ppb)

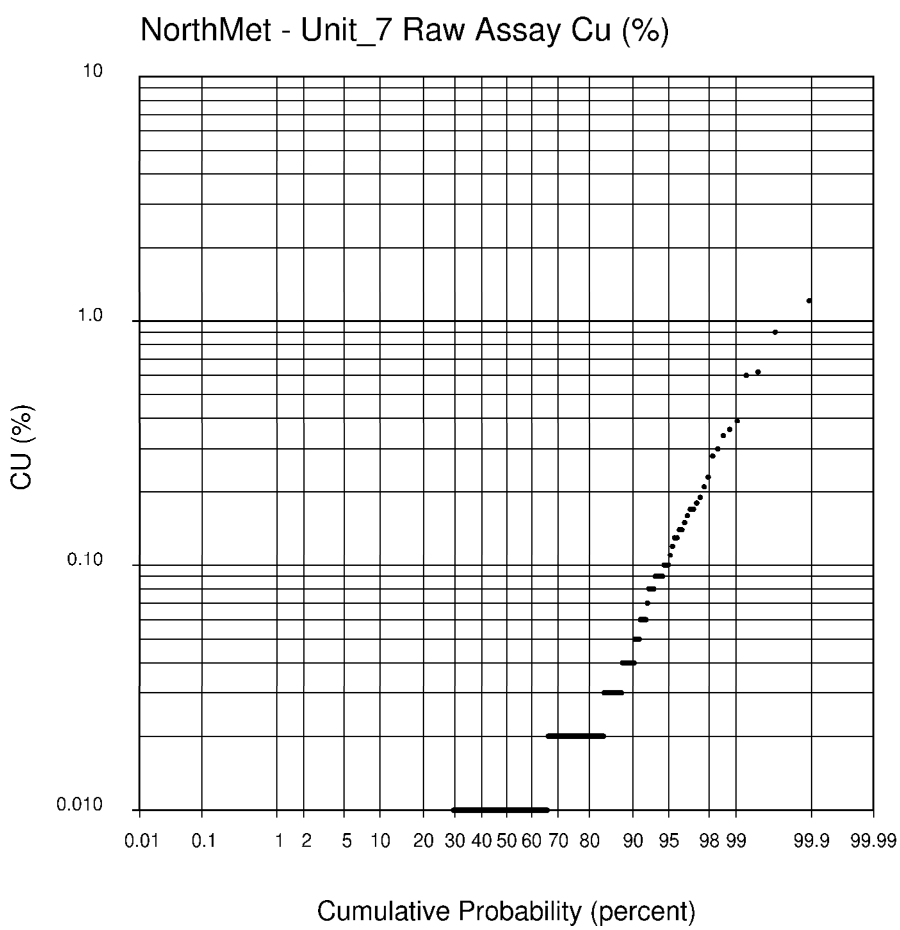



NorthMet - Unit_7 Raw Assay Co (ppm)
Frequency (Percent)
Co (ppm)
N 462
m 65
σ² 1213
σ/m 1
min 0
q0.25 47
q0.50 58
q0.75 86
max 160
Class width = 3
The last class contains
all values ≥ 297

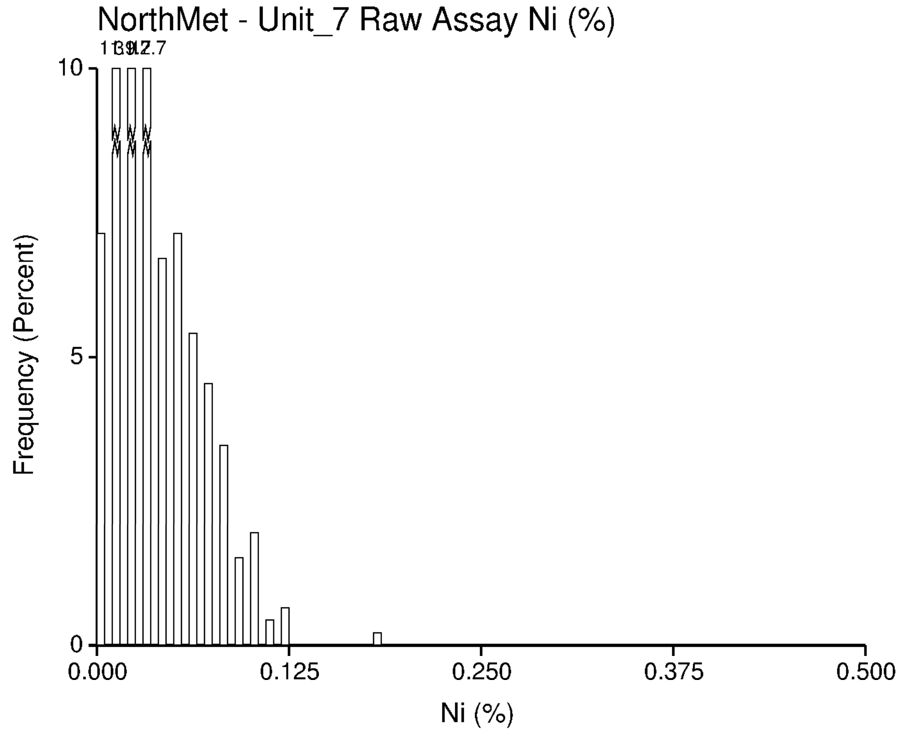

NorthMet - Unit_7 Raw Assay Co (ppm)
Co (ppm)
Cumulative Probability (percent)



NorthMet - Unit_7 Raw Assay Cu (%)
83784
5
0
0.00
0.75
1.50
2.25
3.00
CU (%)
Frequency (Percent)
N 462
m 0.03
σ^2 0.01
σ/m 3.02
min 0.00
$q_{0.25}$ 0.01
$q_{0.50}$ 0.01
$q_{0.75}$ 0.02
max 1.21
Class width = 0.03
The last class contains
all values ≥ 2.97

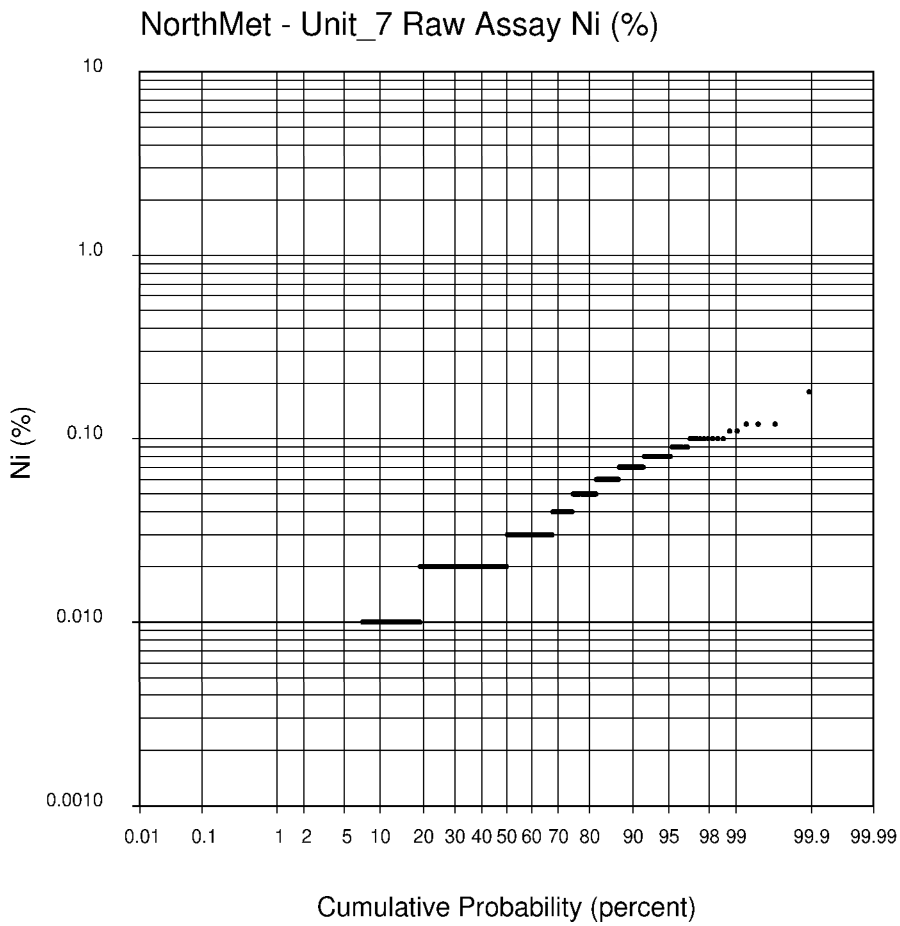


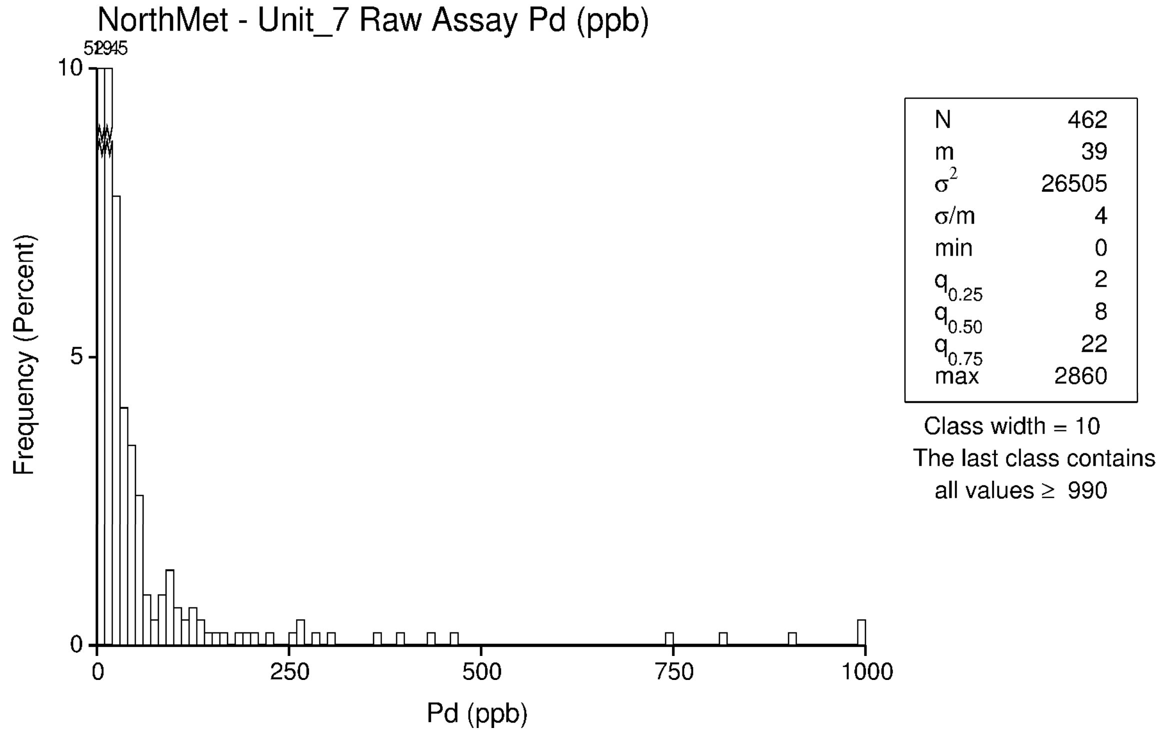
NorthMet - Unit_7 Raw Assay Cu (%)
10
1.0
0.10
0.010
CU (%)
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)



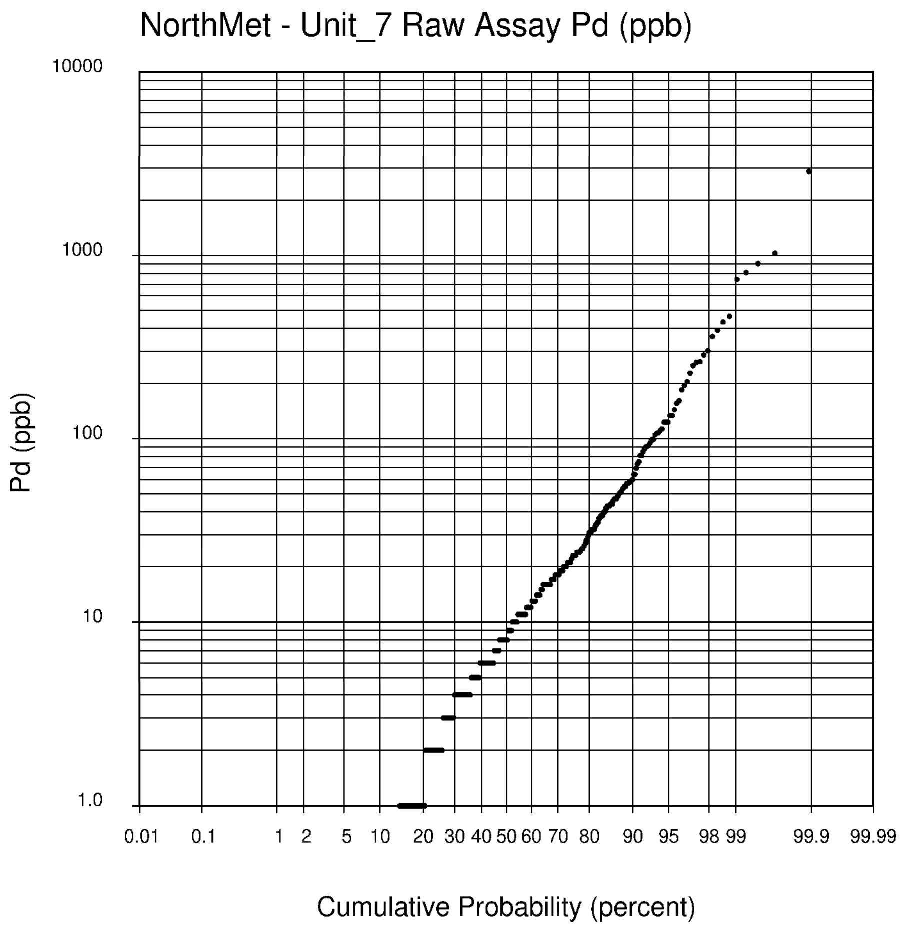
N	462
m	0.033
σ^2	0.001
σ/m	0.772
min	0.000
$q_{0.25}$	0.020
$q_{0.50}$	0.020
$q_{0.75}$	0.050
max	0.180

Class width = 0.005
The last class contains
all values ≥ 0.495

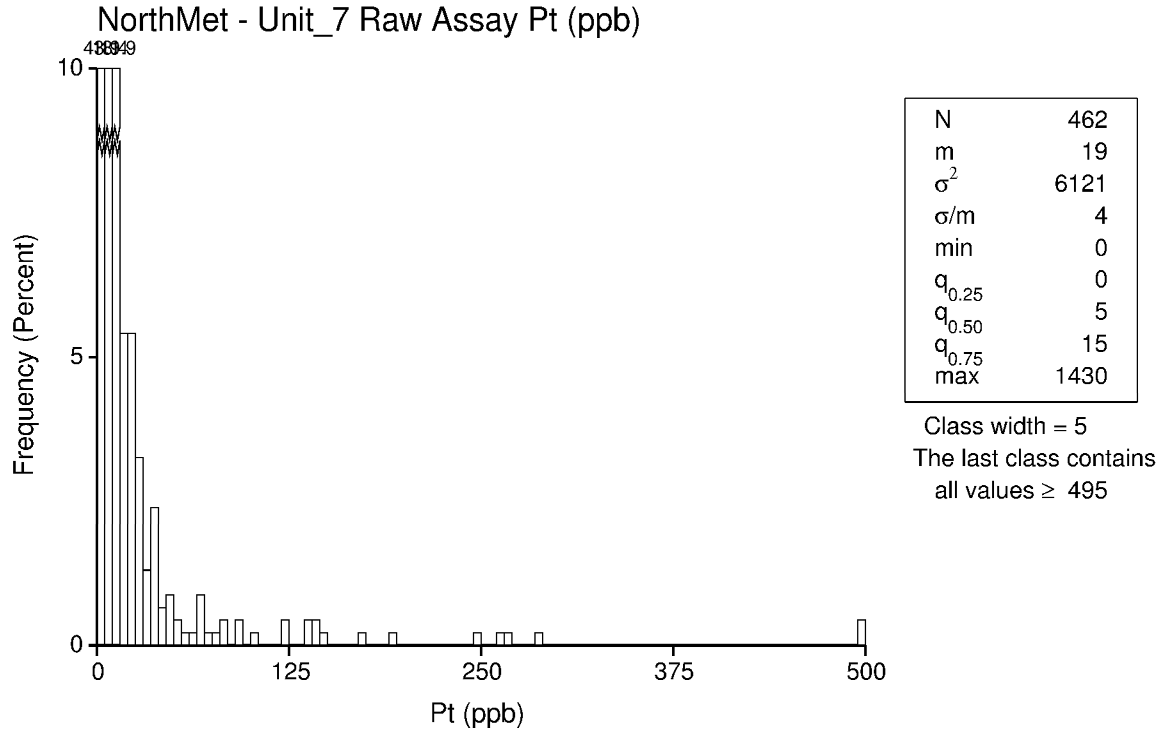


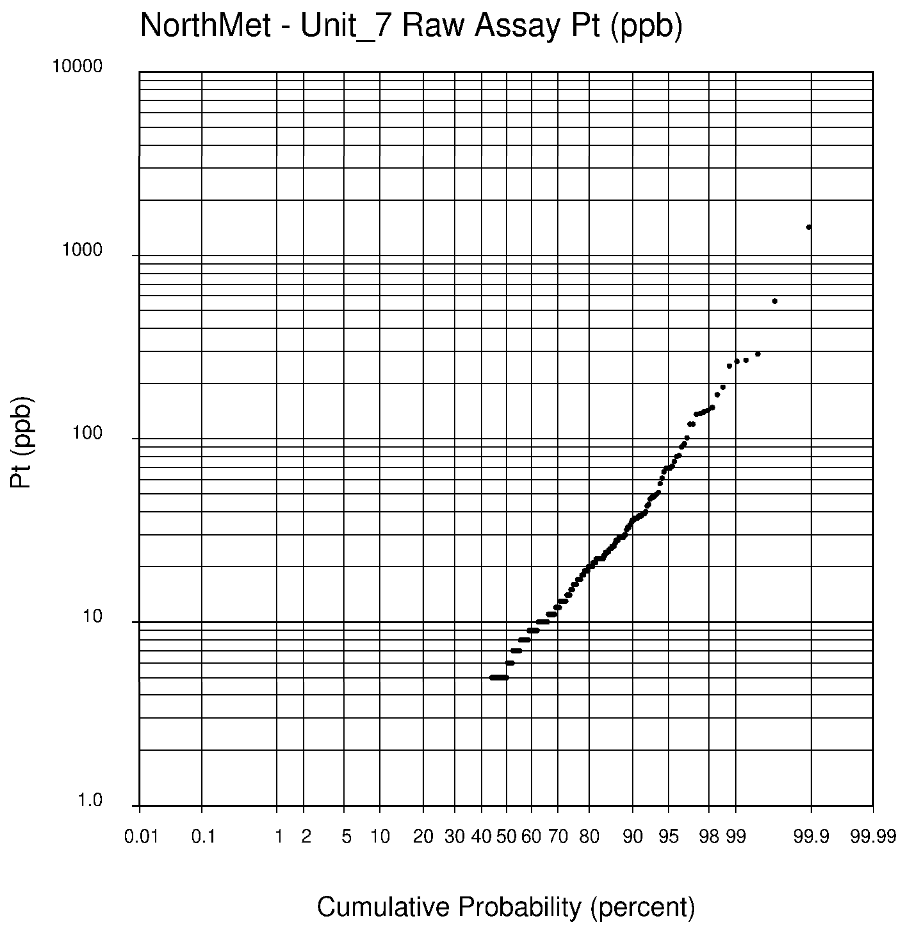


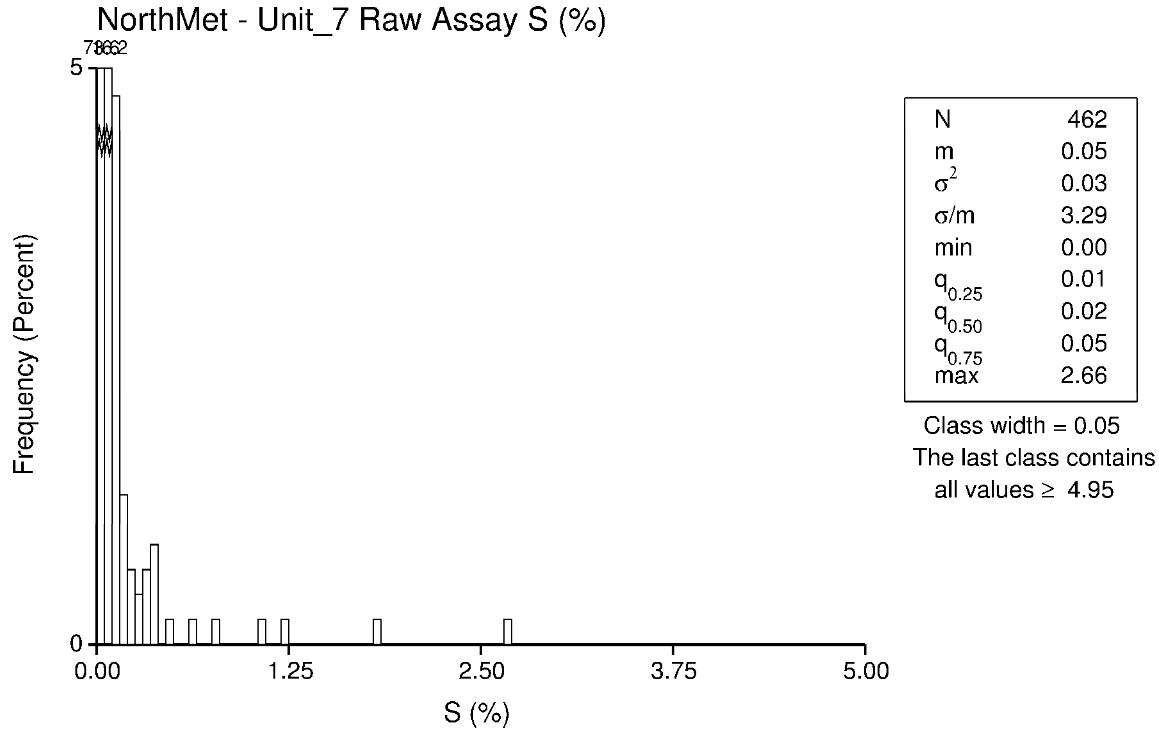
NorthMet - Unit_7 Raw Assay Pd (ppb)
Frequency (Percent)
Pd (ppb)
N 462
m 39
σ2 26505
σ/m 4
min 0
q0.25 2
q0.50 8
q0.75 22
max 2860
Class width = 10
The last class contains
all values ≥ 990

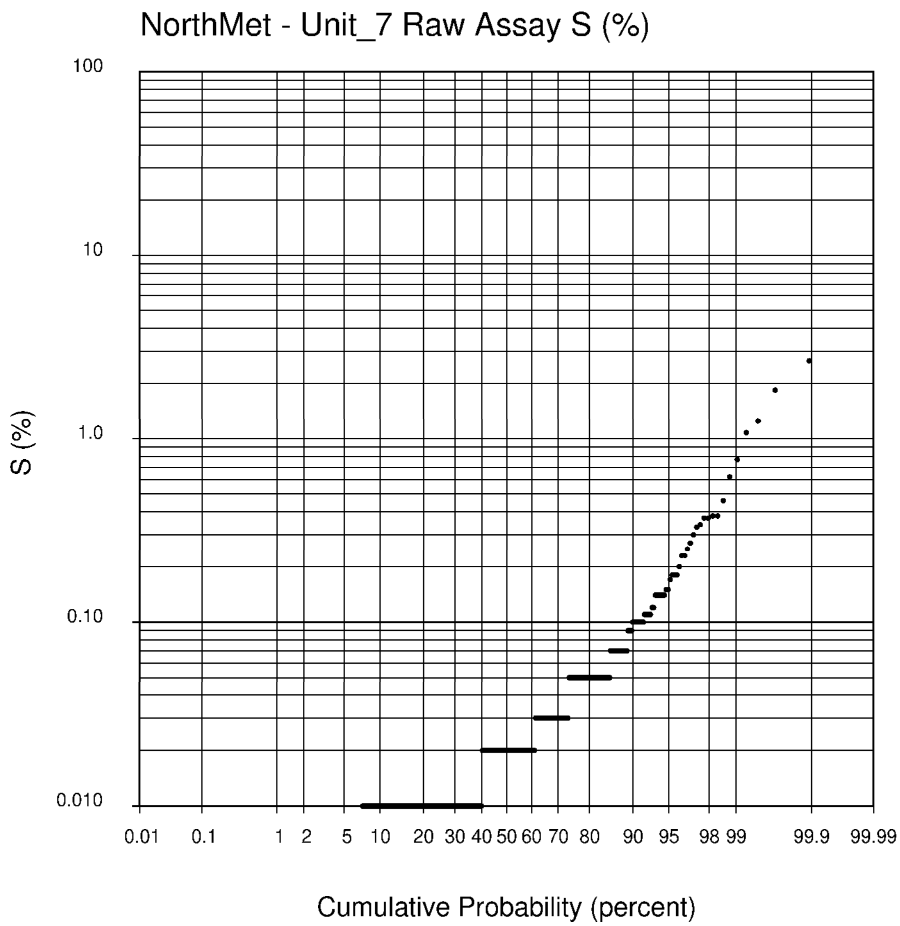


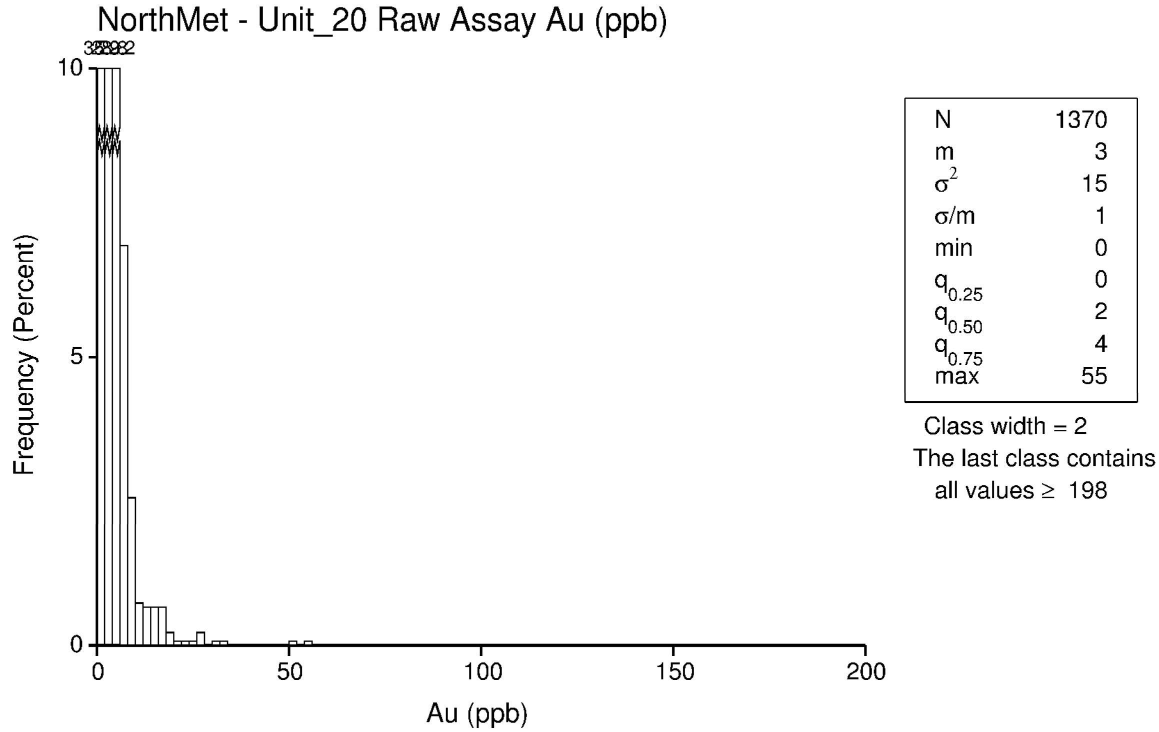
NorthMet - Unit_7 Raw Assay Pd (ppb)
Pd (ppb)
Cumulative Probability (percent)


NorthMet - Unit_7 Raw Assay Pt (ppb)
Frequency (Percent)
Pt (ppb)
0
125
250
375
500
N 462
m 19
σ2 6121
σ/m 4
min 0
q0.25 0
q0.50 5
q0.75 15
max 1430
Class width = 5
The last class contains
all values ≥ 495

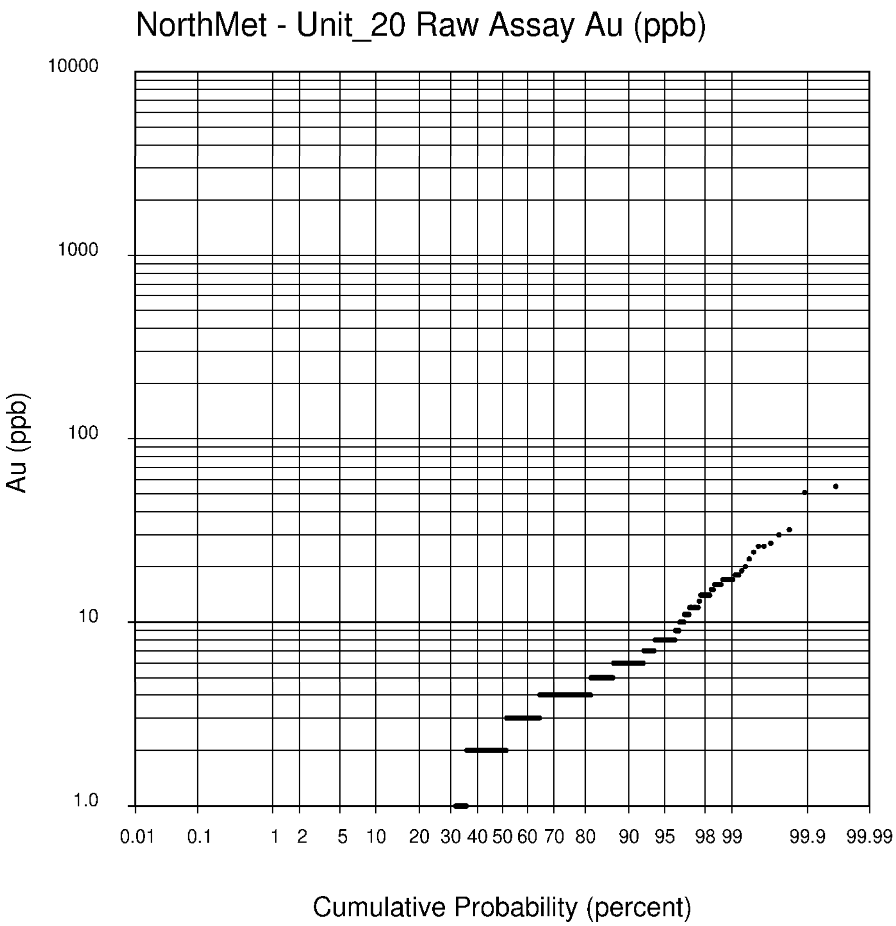

NorthMet - Unit_7 Raw Assay Pt (ppb)
Pt (ppb)
10000
1000
100
10
1.0
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)


NorthMet - Unit_7 Raw Assay S (%)
Frequency (Percent)
S (%)
N 462
m 0.05
σ2 0.03
σ/m 3.29
min 0.00
q0.25 0.01
q0.50 0.02
q0.75 0.05
max 2.66
Class width = 0.05
The last class contains
all values ≥ 4.95


NorthMet - Unit_7 Raw Assay S (%)
S (%)
Cumulative Probability (percent)

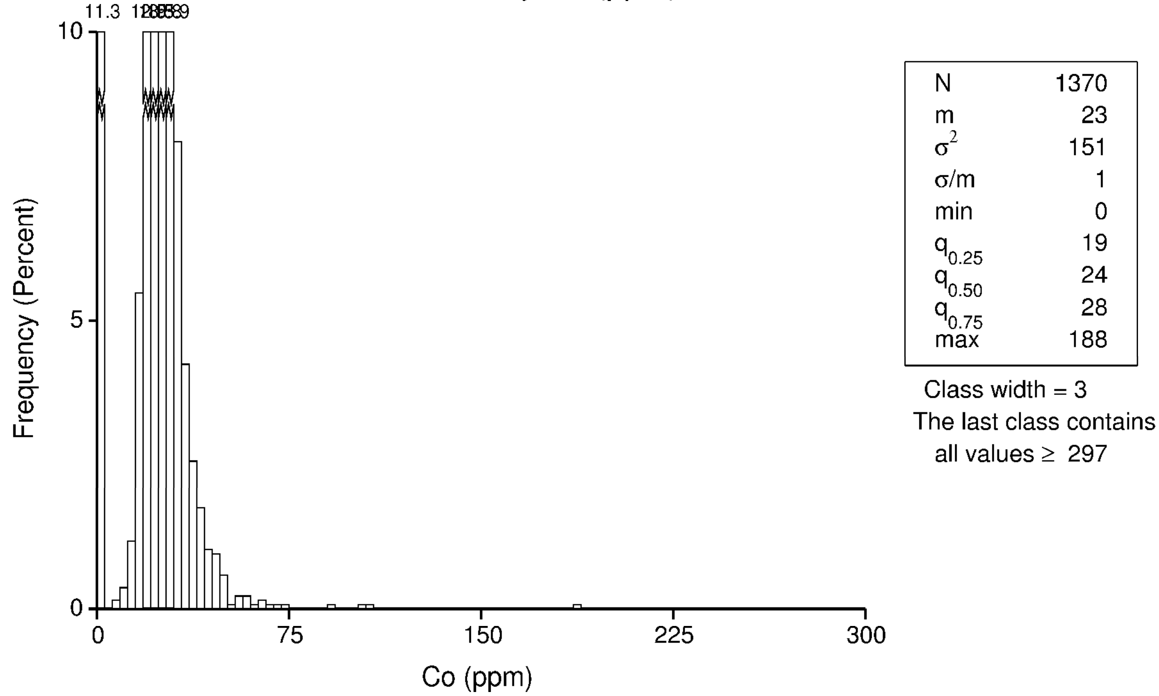


NorthMet - Unit_20 Raw Assay Au (ppb)
Frequency (Percent)
Au (ppb)
N 1370
m 3
σ² 15
σ/m 1
min 0
q0.25 0
q0.50 2
q0.75 4
max 55
Class width = 2
The last class contains
all values ≥ 198

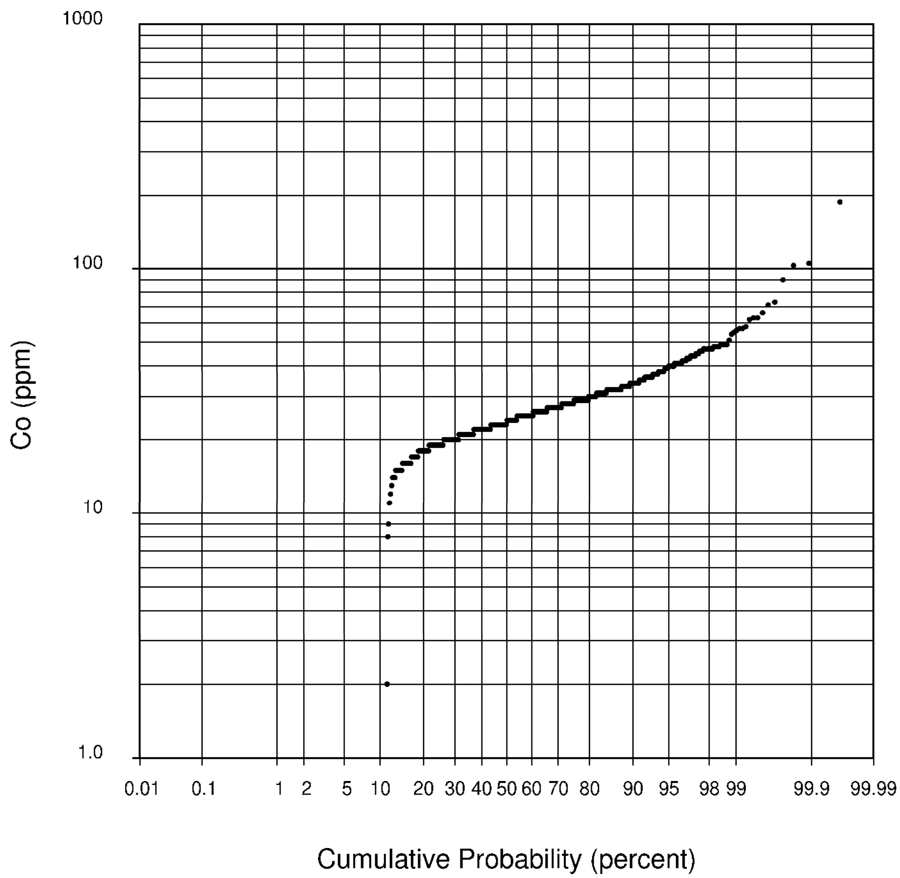


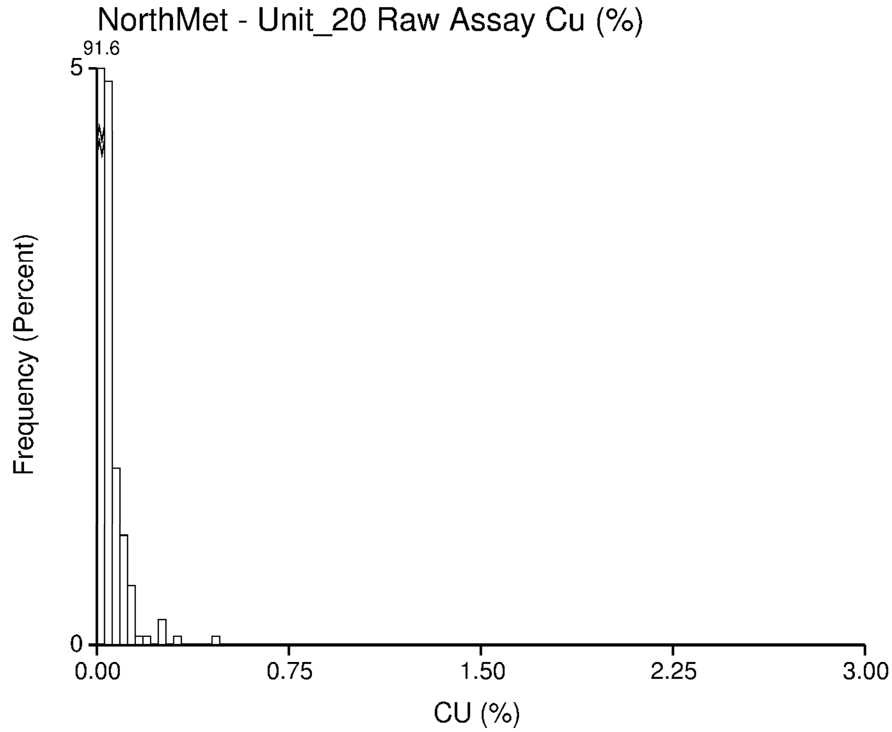
NorthMet - Unit_20 Raw Assay Au (ppb)
Au (ppb)
Cumulative Probability (percent)

NorthMet - Unit_20 Raw Assay Co (ppm)



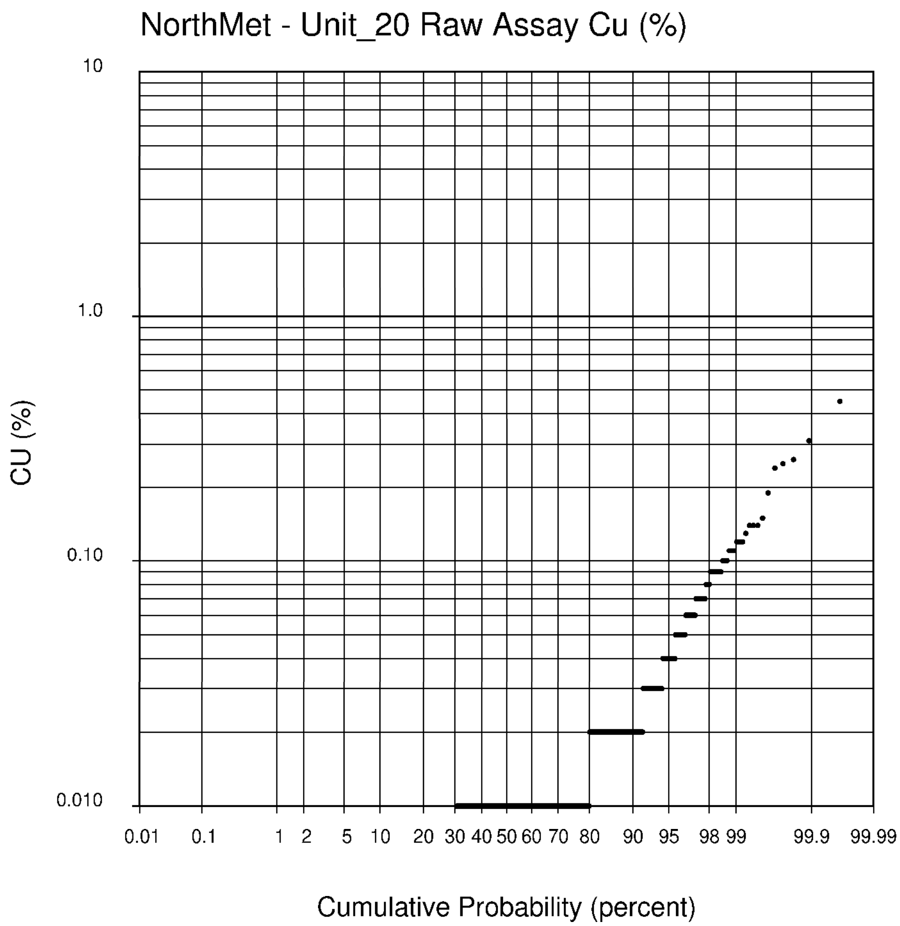
NorthMet - Unit_20 Raw Assay Co (ppm)



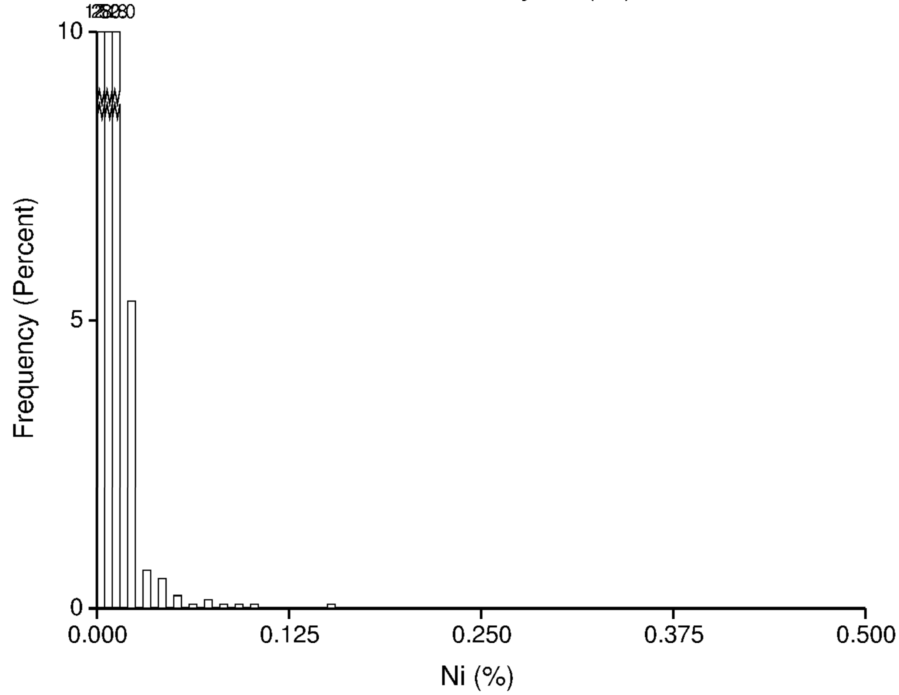


N	1370
m	0.01
σ^2	0.00
σ/m	1.71
min	0.00
$q_{0.25}$	0.01
$q_{0.50}$	0.01
$q_{0.75}$	0.01
max	0.45

Class width = 0.03
The last class contains all values ≥ 2.97



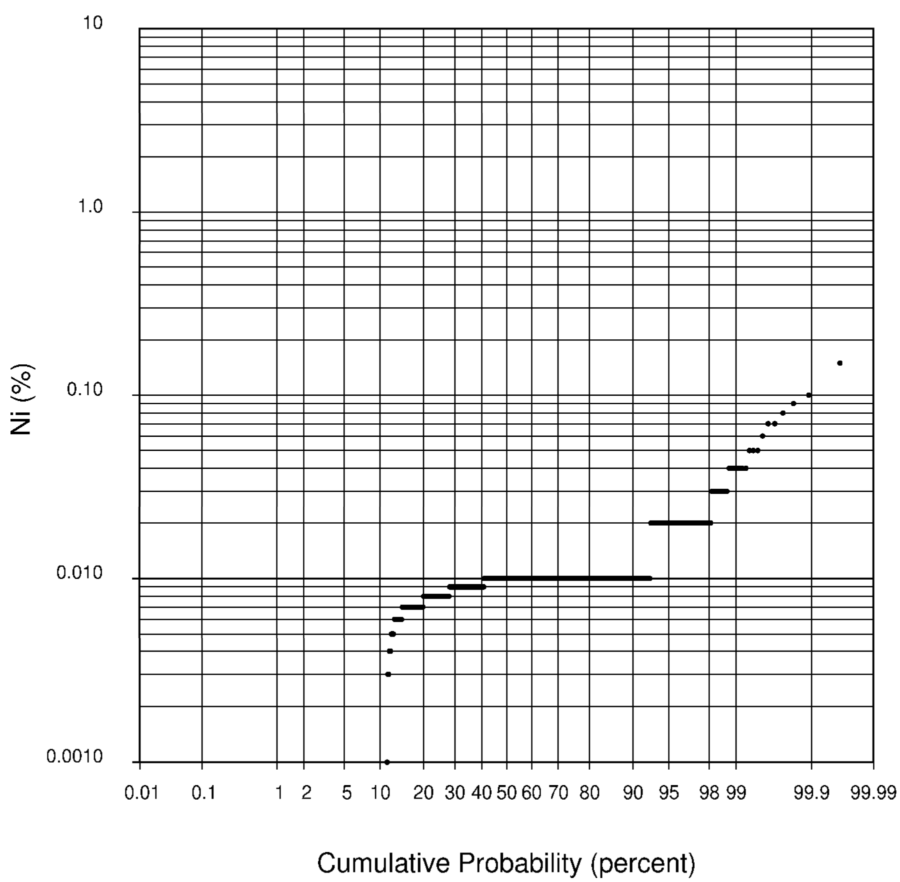
NorthMet - Unit_20 Raw Assay Ni (%)



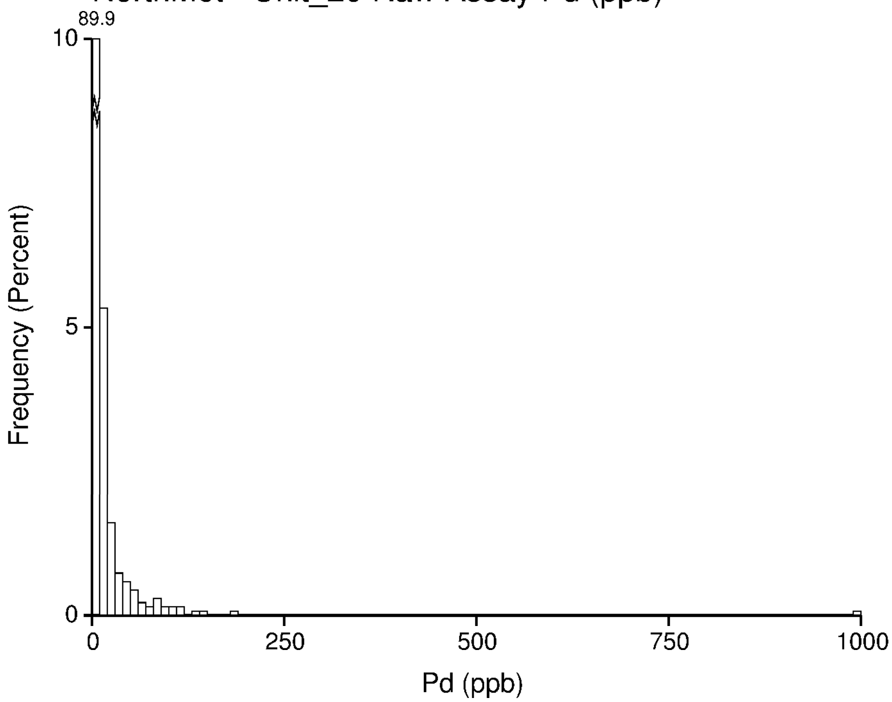
N	1370
m	0.010
σ^2	0.000
σ/m	0.838
min	0.000
$q_{0.25}$	0.008
$q_{0.50}$	0.010
$q_{0.75}$	0.010
max	0.150

Class width = 0.005
The last class contains
all values ≥ 0.495

NorthMet - Unit_20 Raw Assay Ni (%)



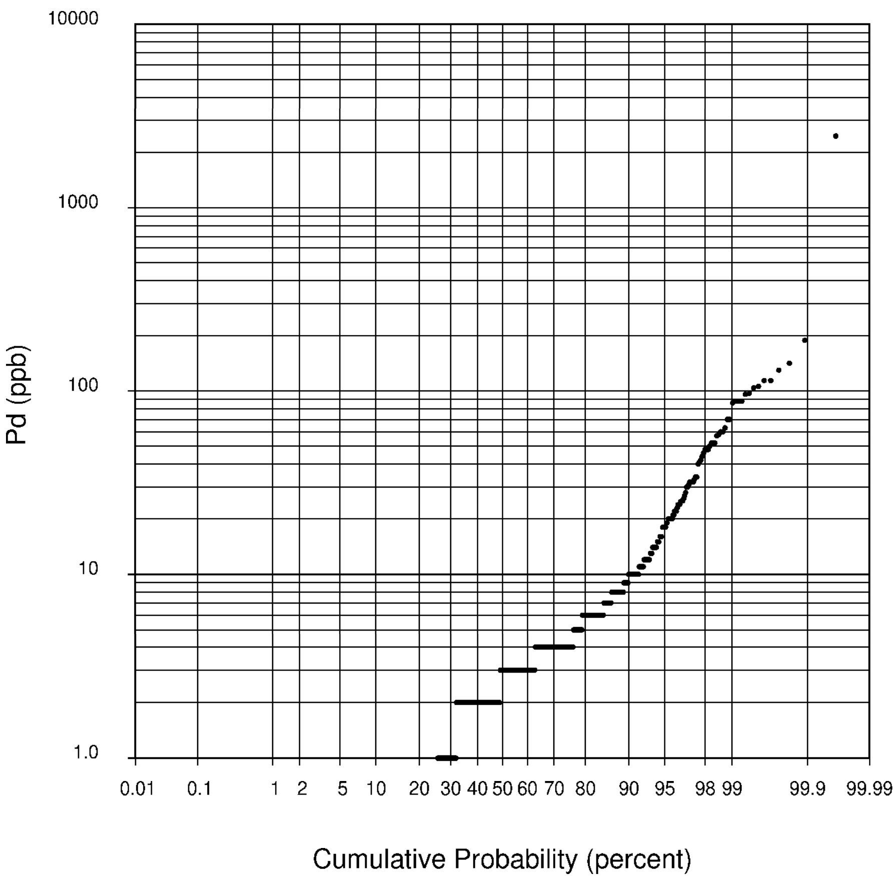
NorthMet - Unit_20 Raw Assay Pd (ppb)

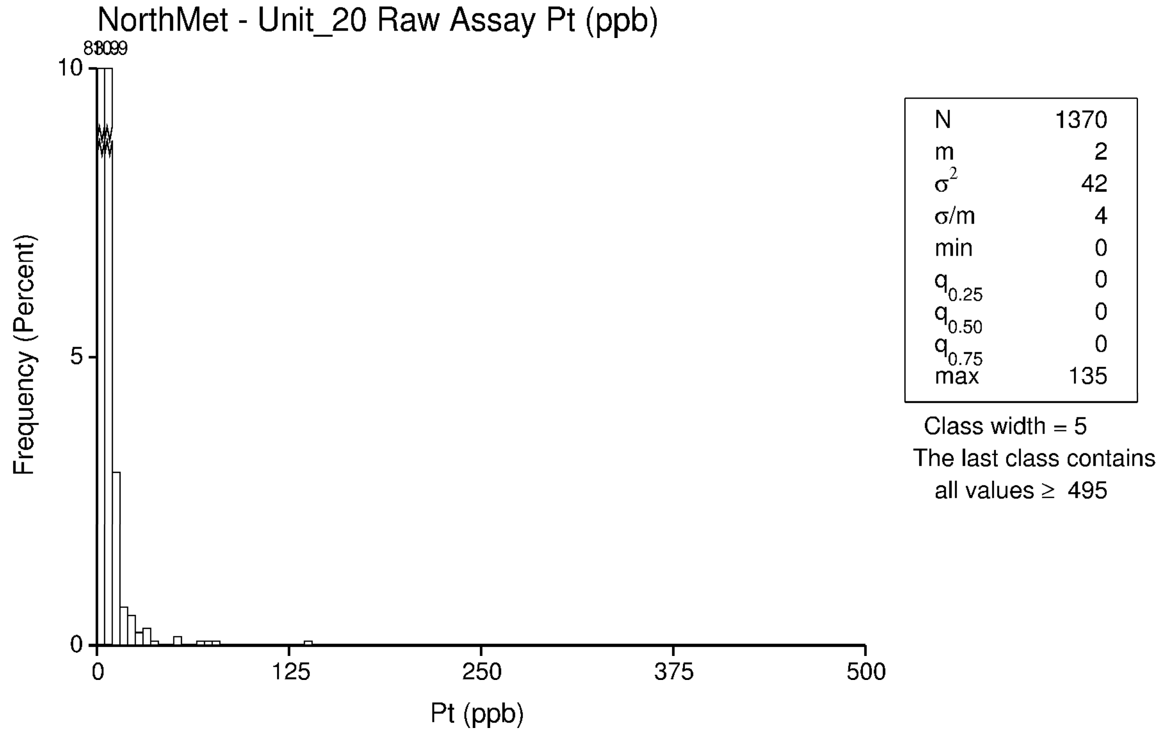


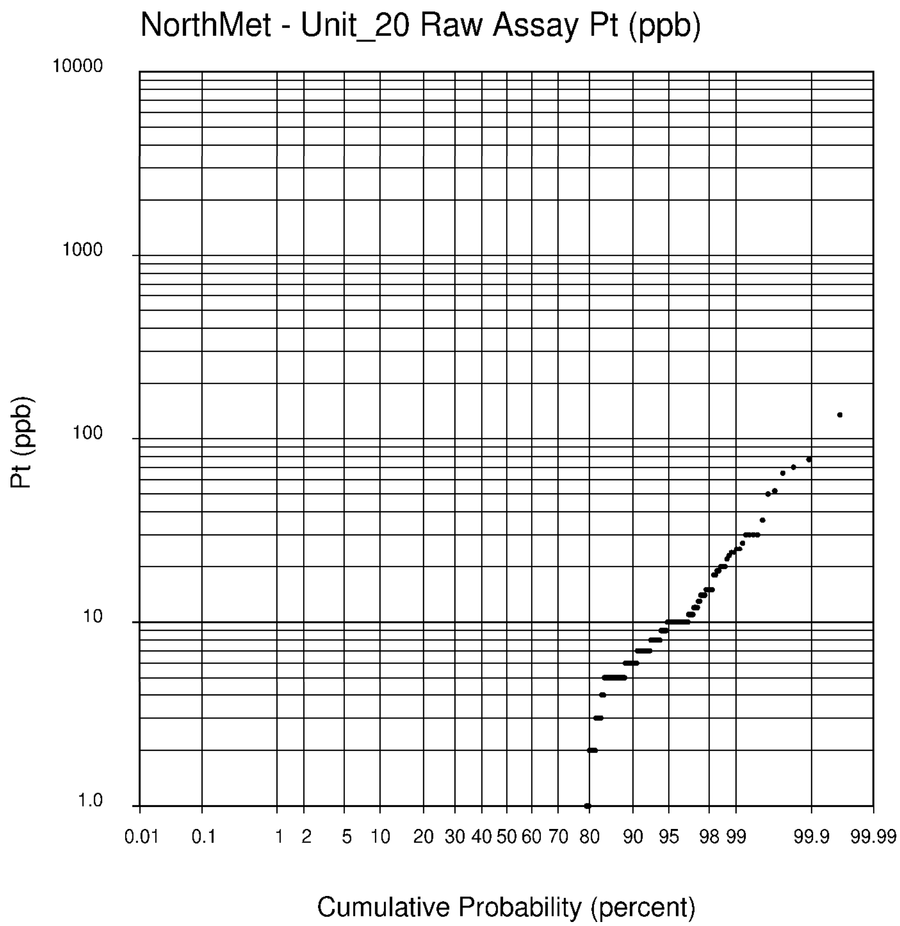
N	1370
m	7
σ^2	4540
σ/m	10
min	0
$q_{0.25}$	0
$q_{0.50}$	3
$q_{0.75}$	4
max	2453

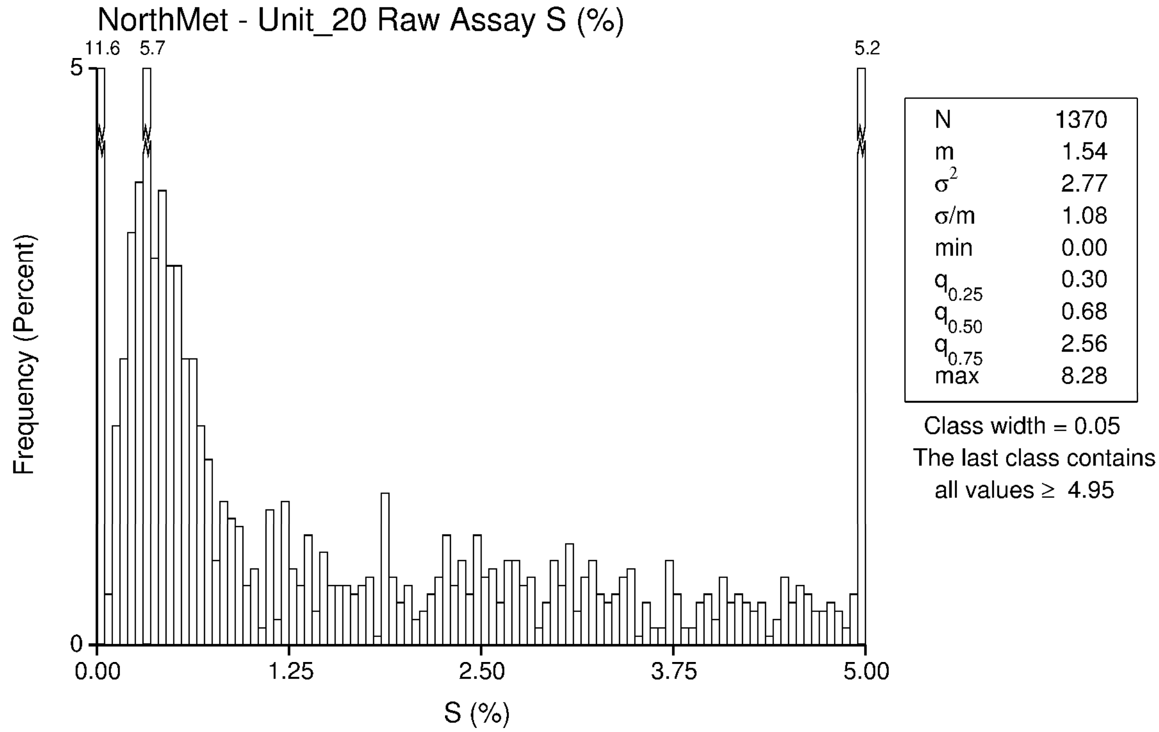
Class width = 10
The last class contains all values ≥ 990

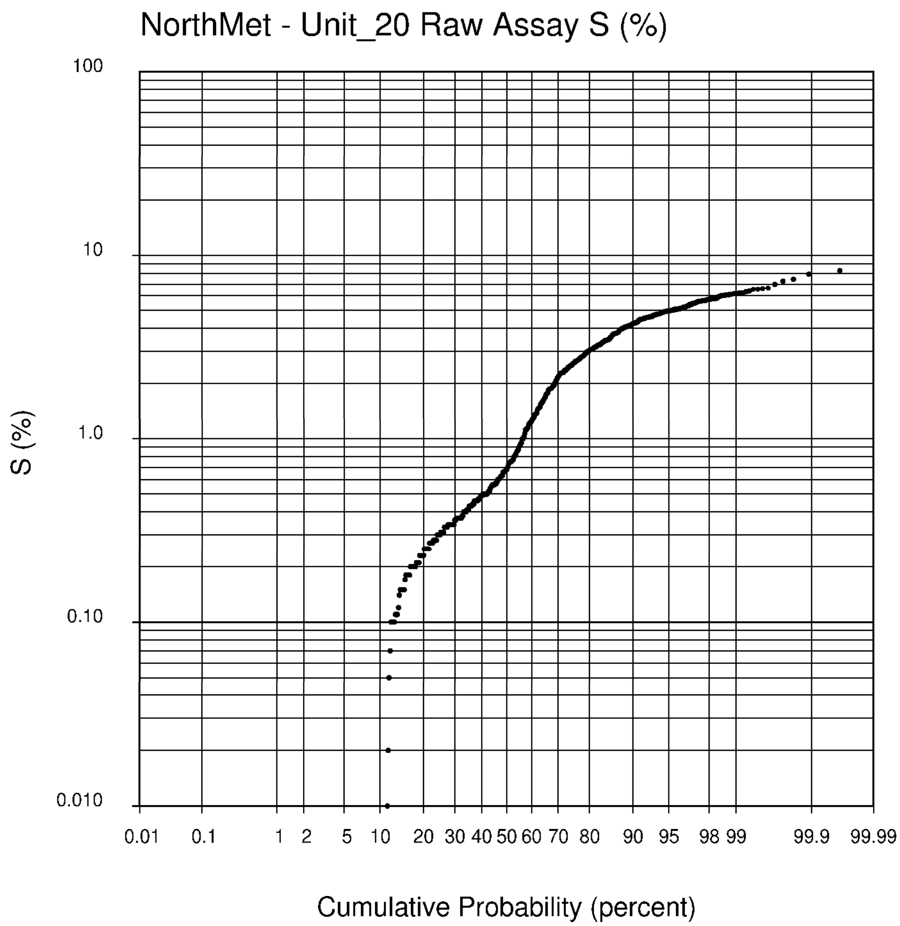
NorthMet - Unit_20 Raw Assay Pd (ppb)




NorthMet - Unit_20 Raw Assay Pt (ppb)
Frequency (Percent)
Pt (ppb)
0
5
10
0
125
250
375
500
N 1370
m 2
σ² 42
σ/m 4
min 0
q0.25 0
q0.50 0
q0.75 0
max 135
Class width = 5
The last class contains
all values ≥ 495


NorthMet - Unit_20 Raw Assay Pt (ppb)
Pt (ppb)
10000
1000
100
10
1.0
0.01
0.1
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.9
99.99
Cumulative Probability (percent)


NorthMet - Unit_20 Raw Assay S (%)
11.6
5.7
5.2
5
0
Frequency (Percent)
0.00
1.25
2.50
3.75
5.00
S (%)
N 1370
m 1.54
σ² 2.77
σ/m 1.08
min 0.00
q0.25 0.30
q0.50 0.68
q0.75 2.56
max 8.28
Class width = 0.05
The last class contains
all values ≥ 4.95


NorthMet - Unit_20 Raw Assay S (%)
100
10
1.0
0.10
0.010
S (%)
0.01 0.1 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9 99.99
Cumulative Probability (percent)

APPENDIX C

CAPPING ANALYSIS

The decile analysis performed by Wardrop for the September 2007 resource model was not updated with the October 2007 dataset as very few additional data points were added. Results of the decile analysis and grade capping studies uses the May 25th 2007 dataset and plots generated from the study were reproduced here for readability.

PolyMet - Domain 1 >>> Cu%

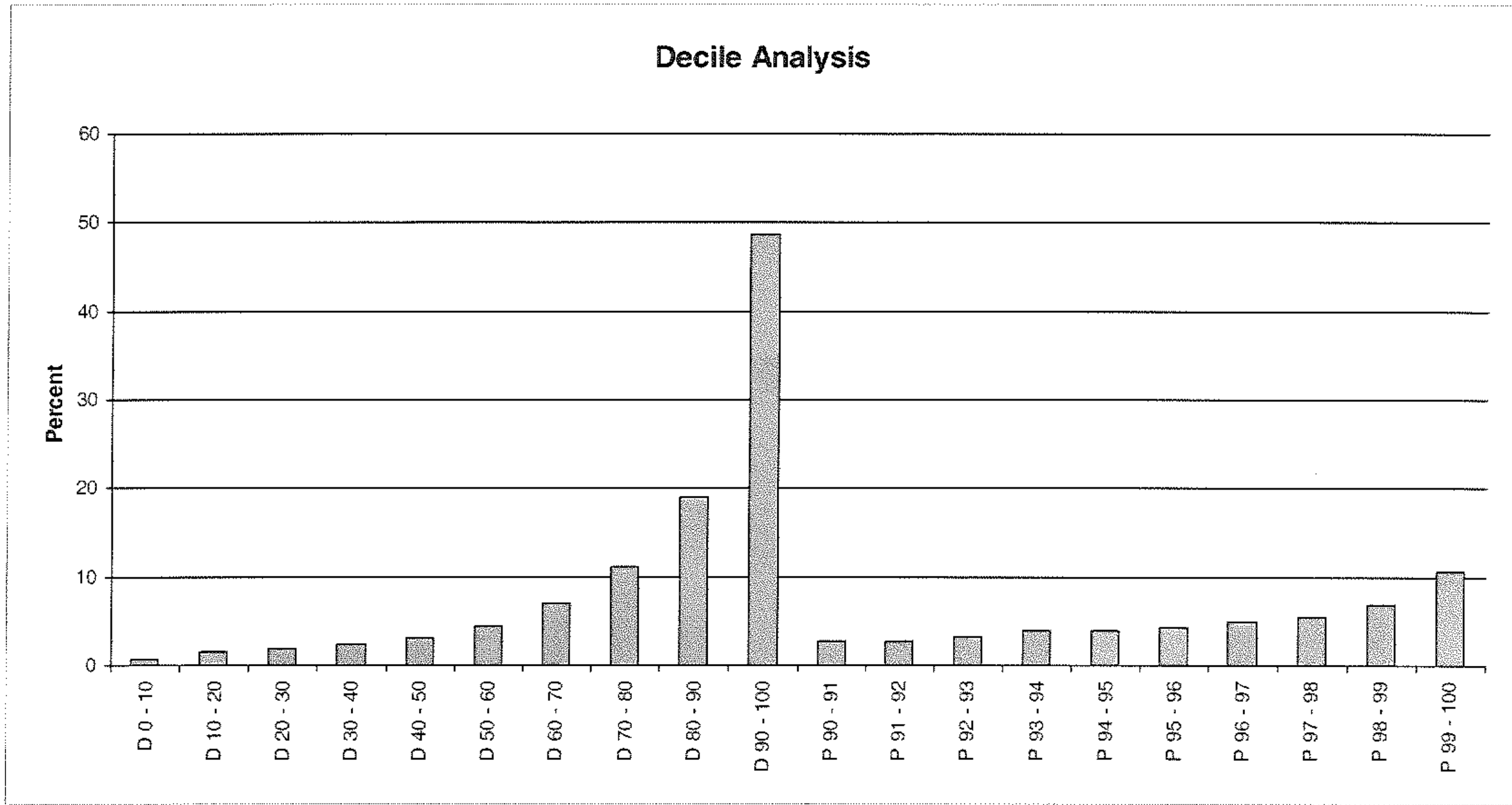
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	459	0.008	0.000	0.013	18.04	0.73	
	10	20	460	0.016	0.013	0.018	36.39	1.47	
	20	30	460	0.020	0.018	0.023	47.29	1.91	
	30	40	459	0.026	0.023	0.029	59.84	2.42	
	40	50	460	0.034	0.029	0.039	77.58	3.13	
	50	60	460	0.049	0.039	0.060	111.38	4.50	
	60	70	459	0.076	0.060	0.094	174.28	7.04	
	70	80	460	0.117	0.094	0.145	275.51	11.13	
	80	90	460	0.187	0.145	0.242	472.19	19.07	
	90	100	460	0.415	0.242	2.280	1,203.81	48.61	>40 >2.3x
Percentile									
	90	91	46	0.249	0.242	0.256	67.20	2.71	
	91	92	46	0.263	0.256	0.272	65.94	2.66	
	92	93	46	0.283	0.272	0.293	79.97	3.23	
	93	94	46	0.307	0.294	0.321	96.35	3.89	
	94	95	46	0.337	0.323	0.357	97.45	3.94	
	95	96	46	0.374	0.357	0.396	106.72	4.31	
	96	97	46	0.415	0.397	0.436	121.87	4.92	
	97	98	46	0.469	0.439	0.495	137.30	5.54	
	98	99	46	0.567	0.497	0.646	168.22	6.79	
	99	100	46	0.889	0.650	2.280	262.78	10.61	>10 <1.75x
Total									
	0	100	4597	0.095	0.000	2.280	2,476.31	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1 >>> Cu%



PolyMet - Domain 1 >>> Ni%

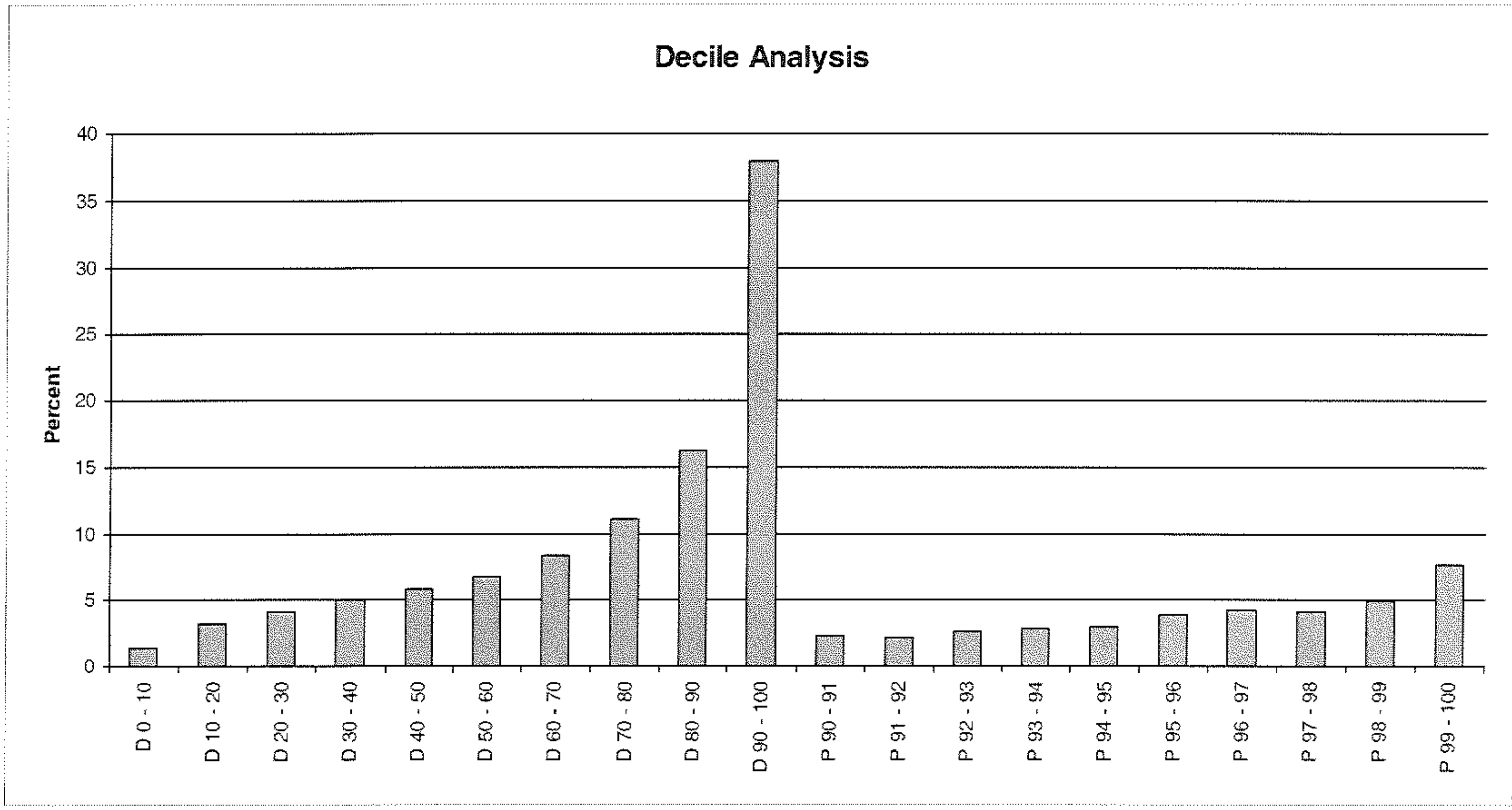
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	459	0.005	0.000	0.009	12.06	1.39	
	10	20	460	0.012	0.009	0.014	27.52	3.17	
	20	30	460	0.015	0.014	0.017	36.13	4.16	
	30	40	459	0.019	0.017	0.021	43.58	5.02	
	40	50	460	0.022	0.021	0.024	50.61	5.82	
	50	60	460	0.026	0.024	0.028	58.88	6.78	
	60	70	459	0.032	0.028	0.036	72.87	8.39	
	70	80	460	0.041	0.036	0.046	96.67	11.13	
	80	90	460	0.056	0.046	0.068	141.18	16.25	
	90	100	460	0.117	0.068	1.170	329.35	37.91	<40 >2.3x
Percentile									
	90	91	46	0.071	0.068	0.073	19.54	2.25	
	91	92	46	0.076	0.074	0.078	19.36	2.23	
	92	93	46	0.081	0.078	0.084	23.24	2.68	
	93	94	46	0.087	0.084	0.091	24.43	2.81	
	94	95	46	0.095	0.091	0.099	26.20	3.02	
	95	96	46	0.104	0.099	0.109	34.18	3.93	
	96	97	46	0.115	0.110	0.122	36.78	4.23	
	97	98	46	0.130	0.123	0.139	35.76	4.12	
	98	99	46	0.152	0.139	0.166	43.14	4.97	
	99	100	46	0.256	0.167	1.170	66.70	7.68	<10 <1.75x
Total									
	0	100	4597	0.034	0.000	1.170	868.85	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1 >>> Ni%



PolyMet - Domain 1 >>> Pd (ppb)

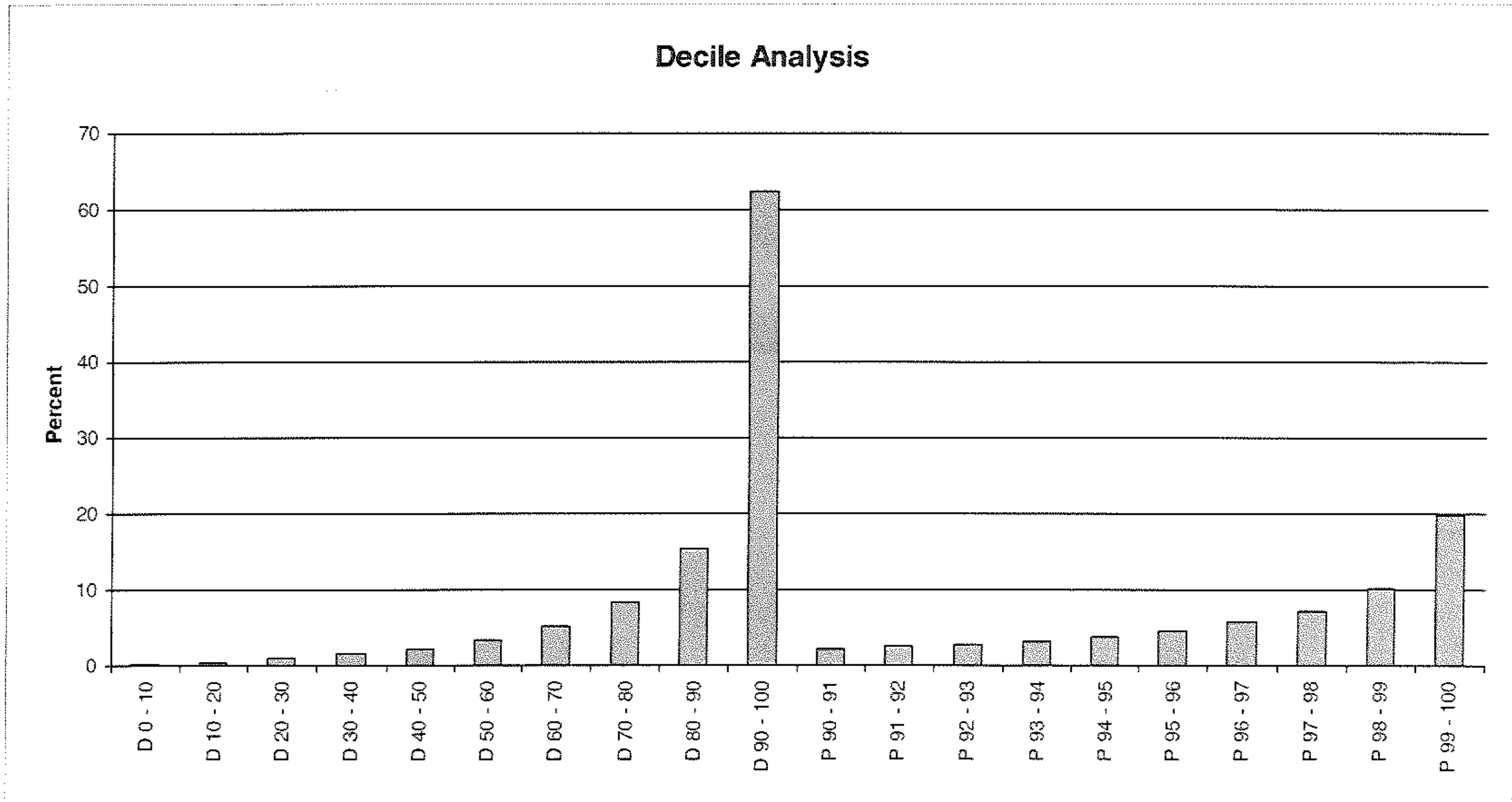
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	459	1.076	0.000	2.000	2,487.10	0.17	
	10	20	460	2.974	2.000	4.000	7,212.80	0.48	
	20	30	460	6.311	4.000	8.000	14,512.20	0.96	
	30	40	459	9.937	8.000	12.000	22,819.40	1.52	
	40	50	460	14.802	12.000	18.000	34,011.20	2.26	
	50	60	460	22.215	18.000	28.000	51,512.10	3.42	
	60	70	459	33.401	28.000	42.000	78,027.00	5.19	
	70	80	460	52.941	42.000	66.000	125,225.70	8.32	
	80	90	460	91.941	66.000	130.000	230,800.20	15.34	
	90	100	460	329.707	130.000	2,710.000	937,760.90	62.34	>40 >2.3x
Percentile									
	90	91	46	137.109	130.000	143.000	33,513.60	2.23	
	91	92	46	152.217	144.000	159.000	38,617.80	2.57	
	92	93	46	168.543	160.000	178.000	42,635.50	2.83	
	93	94	46	186.457	178.000	198.000	47,761.00	3.17	
	94	95	46	215.826	198.000	235.000	57,727.50	3.84	
	95	96	46	253.435	236.000	279.000	68,498.00	4.55	
	96	97	46	304.674	281.000	336.000	86,783.00	5.77	
	97	98	46	381.391	336.000	424.000	108,274.50	7.20	
	98	99	46	520.478	429.000	641.000	154,627.00	10.28	
	99	100	46	976.935	644.000	2,710.000	299,323.00	19.90	>10 >1.75x
Total									
	0	100	4597	56.558	0.000	2,710.000	1,504,368.60	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1 >>> Pd (ppb)



PolyMet - Domain 1 >>> Pt (ppb)

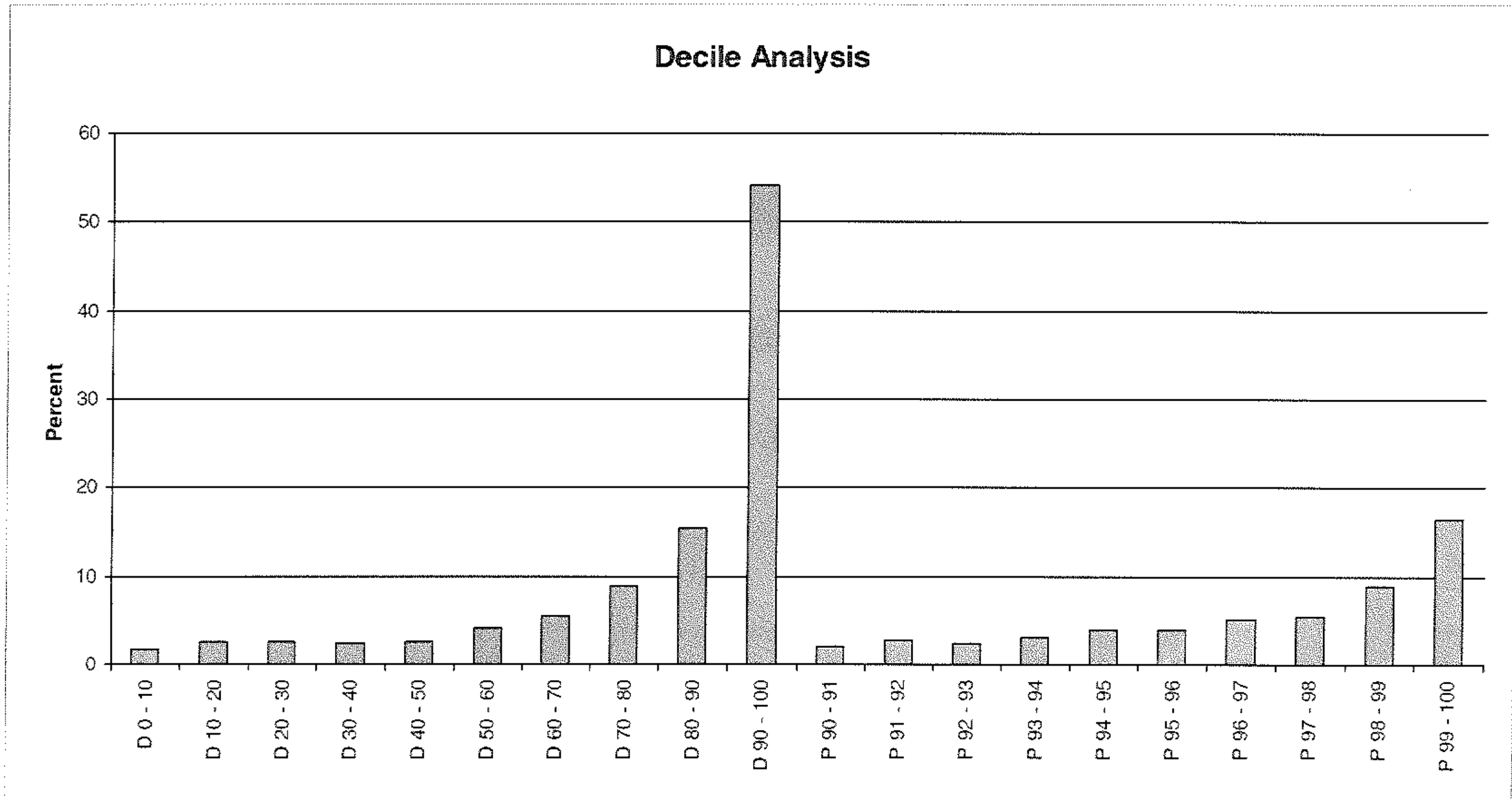
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	459	3.386	0.000	5.000	8,037.00	1.76	
	10	20	460	5.000	5.000	5.000	11,845.50	2.59	
	20	30	460	5.000	5.000	5.000	11,486.00	2.51	
	30	40	459	5.000	5.000	5.000	11,355.00	2.48	
	40	50	460	5.000	5.000	5.000	11,726.00	2.56	
	50	60	460	8.046	5.000	10.000	18,828.20	4.11	
	60	70	459	10.832	10.000	14.000	25,300.60	5.53	
	70	80	460	16.970	14.000	20.000	40,496.00	8.85	
	80	90	460	28.565	20.000	40.000	70,695.30	15.45	
	90	100	460	89.850	40.000	953.000	247,951.90	54.17	>40 >2.3x
Percentile									
	90	91	46	40.217	40.000	42.000	9,754.50	2.13	
	91	92	46	44.022	42.000	45.000	12,623.10	2.76	
	92	93	46	48.109	45.000	50.000	11,248.50	2.46	
	93	94	46	53.370	50.000	55.000	14,194.00	3.10	
	94	95	46	59.674	56.000	65.000	18,049.30	3.94	
	95	96	46	68.696	65.000	75.000	18,073.00	3.95	
	96	97	46	79.935	75.000	85.000	23,435.00	5.12	
	97	98	46	96.413	85.000	110.000	24,950.50	5.45	
	98	99	46	137.174	111.000	165.000	40,646.00	8.88	
	99	100	46	270.891	165.000	953.000	74,978.00	16.38	>10 >1.75x
Total									
	0	100	4597	17.772	0.000	953.000	457,721.50	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1 >>> Pt (ppb)



PolyMet - Domain 1 >>> Au (ppb)

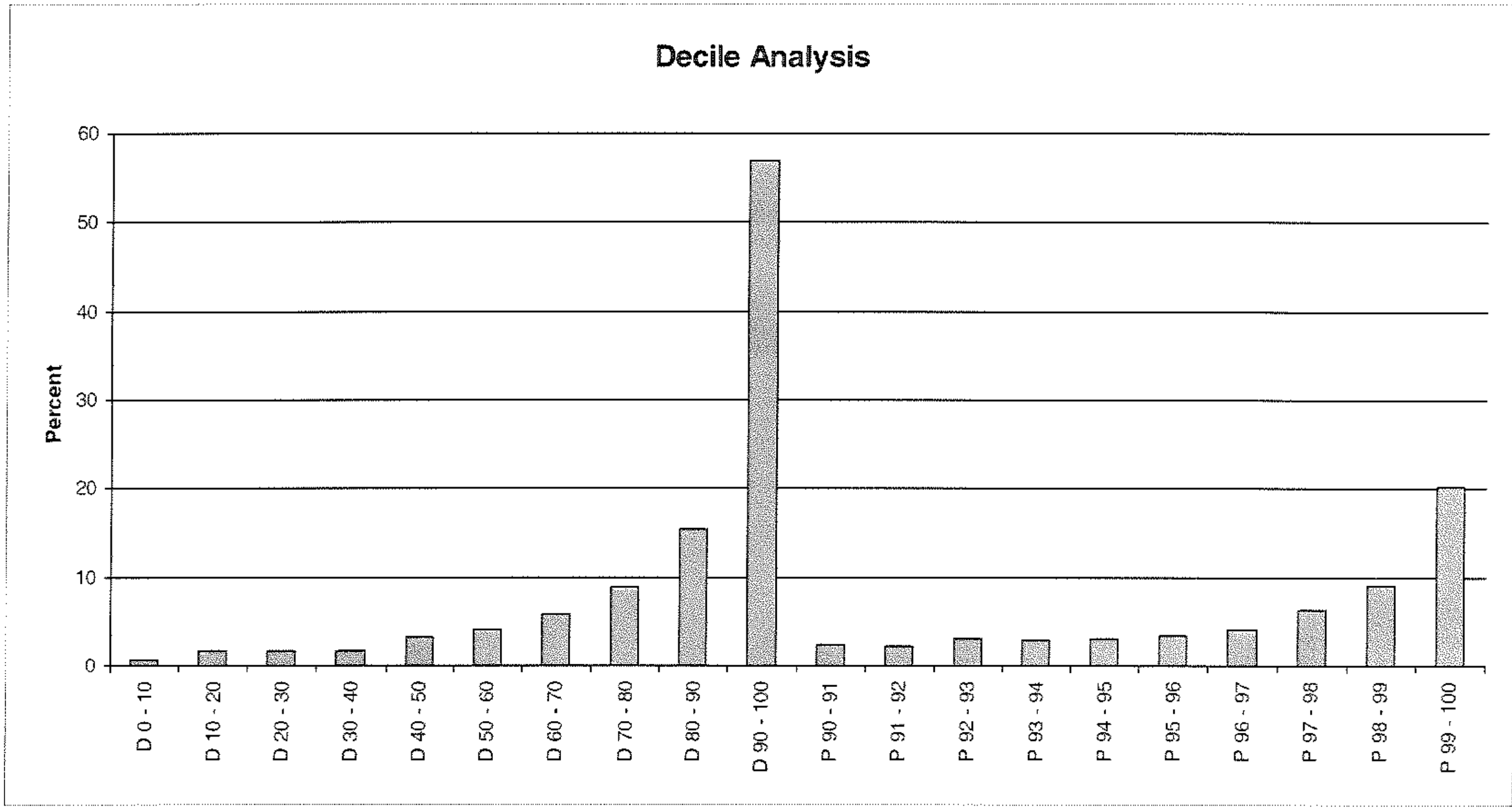
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	459	0.717	0.000	2.000	1,632.80	0.60	
	10	20	460	2.000	2.000	2.000	4,555.20	1.68	
	20	30	460	2.000	2.000	2.000	4,565.80	1.68	
	30	40	459	2.000	2.000	2.000	4,553.60	1.68	
	40	50	460	3.711	2.000	4.000	8,626.60	3.17	
	50	60	460	4.607	4.000	6.000	11,230.70	4.13	
	60	70	459	6.906	6.000	8.000	15,912.90	5.85	
	70	80	460	10.178	8.000	12.000	24,222.30	8.91	
	80	90	460	16.611	12.000	22.000	41,856.10	15.40	
	90	100	460	56.100	22.000	1,775.000	154,658.60	56.90	>40 >2.3x
Percentile									
	90	91	46	23.413	22.000	24.000	6,574.50	2.42	
	91	92	46	24.565	24.000	26.000	5,900.50	2.17	
	92	93	46	26.913	26.000	28.000	8,477.00	3.12	
	93	94	46	29.348	28.000	30.000	7,981.50	2.94	
	94	95	46	32.217	31.000	34.000	8,462.30	3.11	
	95	96	46	36.043	34.000	38.000	9,391.00	3.45	
	96	97	46	42.587	38.000	48.000	11,009.70	4.05	
	97	98	46	56.130	48.000	65.000	17,217.30	6.33	
	98	99	46	80.043	65.000	106.000	24,751.80	9.11	
	99	100	46	209.739	108.000	1,775.000	54,893.00	20.20	>10 >1.75x
Total									
	0	100	4597	10.488	0.000	1,775.000	271,814.60	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1 >>> Au (ppb)



PolyMet - Domain 1 >>> Co (ppm)

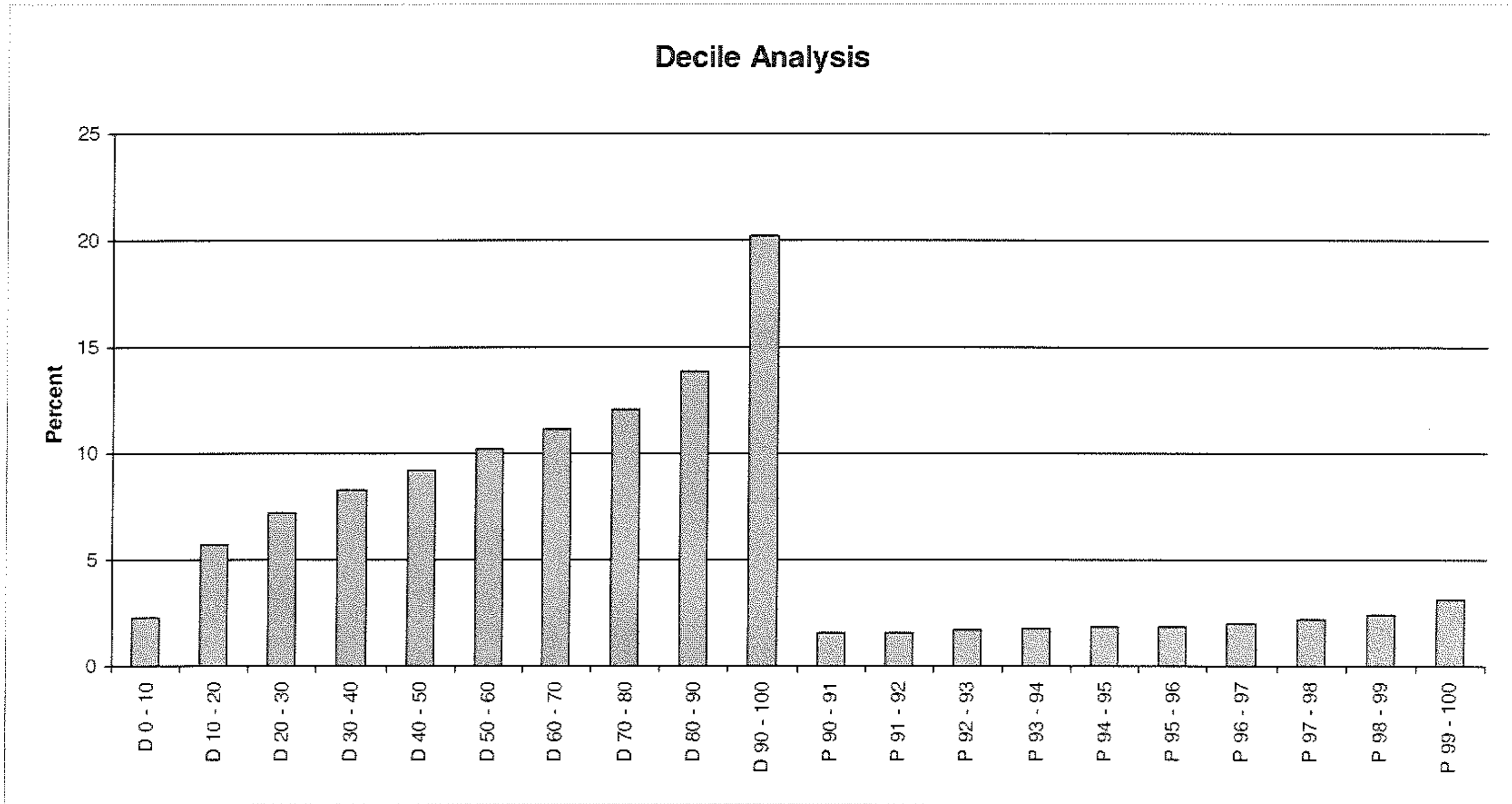
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	459	12.105	0.000	23.000	27,321.60	2.26	
	10	20	460	28.083	23.000	33.000	69,085.50	5.71	
	20	30	460	36.322	33.000	40.000	87,093.00	7.20	
	30	40	459	42.484	40.000	45.000	99,870.40	8.25	
	40	50	460	47.170	45.000	50.000	111,269.20	9.19	
	50	60	460	51.954	50.000	54.000	123,284.90	10.19	
	60	70	459	56.732	54.000	59.000	134,581.00	11.12	
	70	80	460	61.961	59.000	65.000	146,140.80	12.07	
	80	90	460	69.524	65.000	76.000	167,464.60	13.84	
	90	100	460	97.452	76.000	385.000	244,246.50	20.18	<40 <2.3x
Percentile									
	90	91	46	76.435	76.000	77.000	18,803.80	1.55	
	91	92	46	78.565	77.000	80.000	19,382.60	1.60	
	92	93	46	80.848	80.000	82.000	21,109.30	1.74	
	93	94	46	83.609	82.000	85.000	21,288.20	1.76	
	94	95	46	86.761	85.000	88.000	22,414.20	1.85	
	95	96	46	89.935	88.000	93.000	22,407.00	1.85	
	96	97	46	95.478	93.000	98.000	24,305.00	2.01	
	97	98	46	101.891	98.000	106.000	26,661.50	2.20	
	98	99	46	113.891	106.000	122.000	29,650.90	2.45	
	99	100	46	167.109	123.000	385.000	38,224.00	3.16	<10 <1.75x
Total									
	0	100	4597	50.387	0.000	385.000	1,210,357.50	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1 >>> Co (ppm)



PolyMet - Domain 1 >>> S%

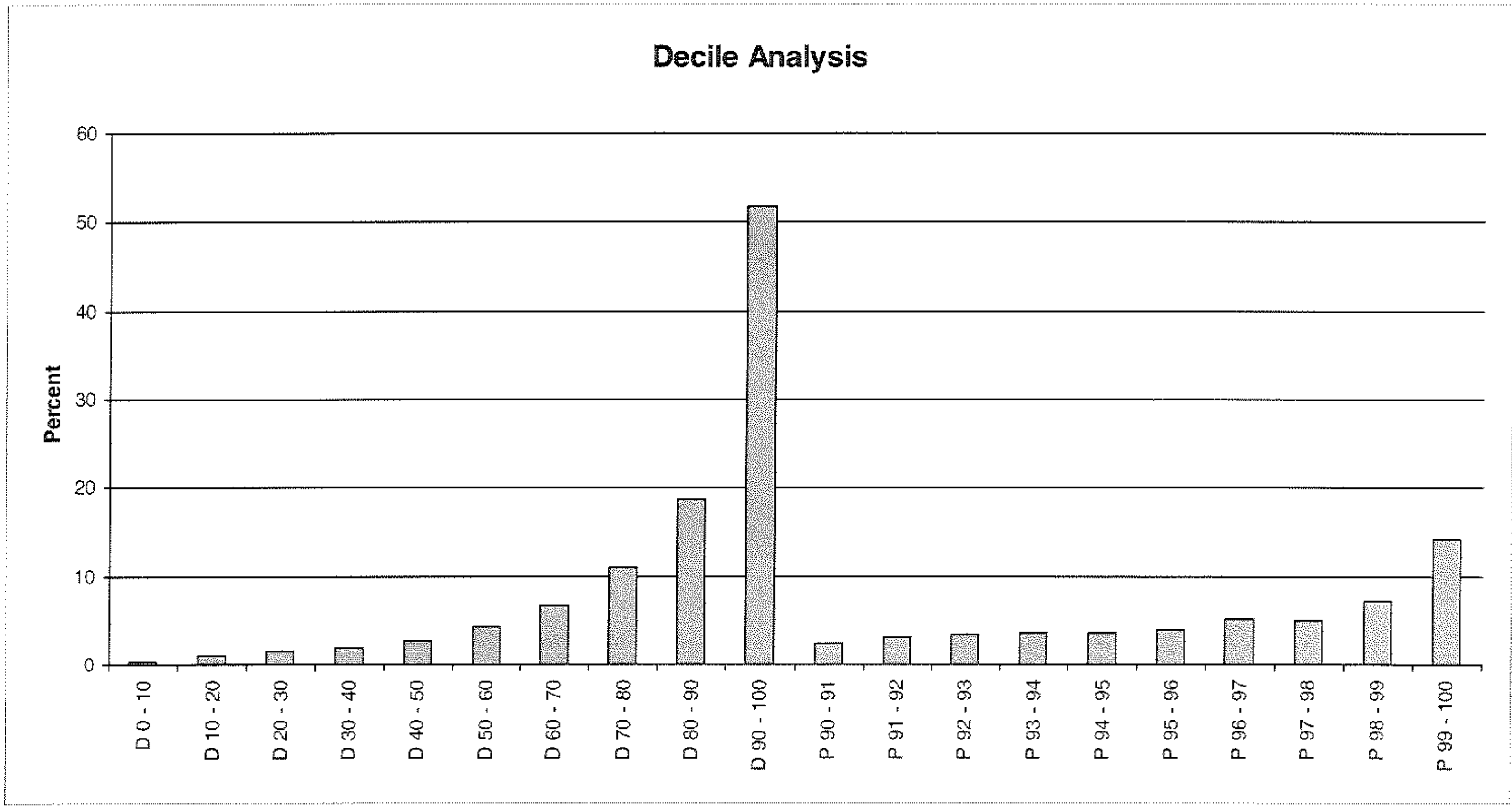
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	459	0.020	0.000	0.040	45.20	0.41	
	10	20	460	0.053	0.040	0.060	120.19	1.08	
	20	30	460	0.072	0.060	0.080	164.78	1.48	
	30	40	459	0.096	0.080	0.110	218.13	1.96	
	40	50	460	0.135	0.110	0.170	309.86	2.78	
	50	60	460	0.206	0.170	0.250	482.59	4.34	
	60	70	459	0.313	0.250	0.380	735.42	6.61	
	70	80	460	0.476	0.380	0.590	1,212.86	10.90	
	80	90	460	0.782	0.590	1.050	2,075.61	18.65	
	90	100	460	2.097	1.050	7.990	5,763.13	51.79	>40 >2.3x
Percentile									
	90	91	46	1.094	1.050	1.140	275.46	2.48	
	91	92	46	1.189	1.140	1.230	346.93	3.12	
	92	93	46	1.294	1.230	1.340	379.77	3.41	
	93	94	46	1.398	1.340	1.460	410.13	3.69	
	94	95	46	1.543	1.470	1.620	400.89	3.60	
	95	96	46	1.705	1.620	1.800	443.53	3.99	
	96	97	46	1.980	1.800	2.200	565.64	5.08	
	97	98	46	2.499	2.200	2.870	545.97	4.91	
	98	99	46	3.236	2.927	3.710	808.73	7.27	
	99	100	46	5.031	3.750	7.990	1,586.09	14.25	>10 >1.75x
Total									
	0	100	4597	0.425	0.000	7.990	11,127.77	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1 >>> S%



PolyMet - Domain 1001 + 1003 >>> Pd (ppb)

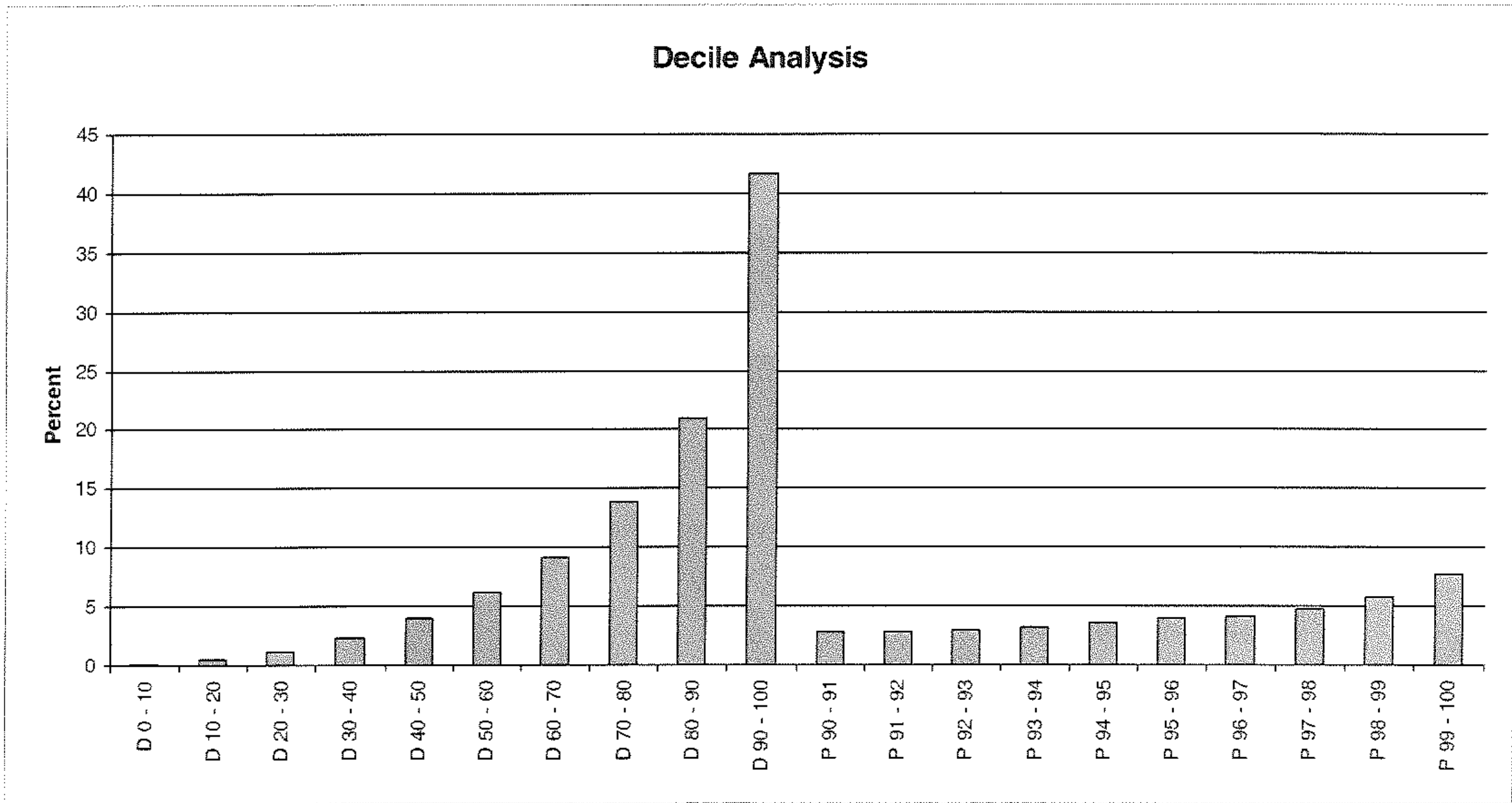
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1516	3.497	0.000	8.000	25,740.20	0.14	
	10	20	1516	13.088	8.000	20.000	99,538.30	0.55	
	20	30	1517	28.446	20.000	40.000	219,152.50	1.22	
	30	40	1516	53.617	40.000	70.000	420,073.80	2.33	
	40	50	1517	90.470	70.000	114.000	713,073.30	3.96	
	50	60	1516	141.029	114.000	170.000	1,119,108.80	6.21	
	60	70	1516	205.299	170.000	244.000	1,648,393.00	9.14	
	70	80	1517	296.623	244.000	358.000	2,492,842.80	13.83	
	80	90	1516	447.261	358.000	556.000	3,770,319.90	20.91	
	90	100	1517	862.173	556.000	10,386.000	7,521,046.00	41.72	>40 <2.3x
Percentile									
	90	91	152	571.625	556.000	588.000	502,542.50	2.79	
	91	92	151	603.874	588.000	622.000	500,783.40	2.78	
	92	93	152	639.697	622.000	660.000	541,097.20	3.00	
	93	94	152	681.217	660.000	701.000	584,566.80	3.24	
	94	95	151	728.748	702.000	756.000	647,692.10	3.59	
	95	96	152	785.039	756.000	818.000	707,042.20	3.92	
	96	97	152	858.605	819.000	897.000	737,392.80	4.09	
	97	98	151	951.993	898.000	1,015.000	865,706.00	4.80	
	98	99	152	1124.842	1,019.000	1,243.000	1,045,943.00	5.80	
	99	100	152	1674.099	1,245.000	10,386.000	1,388,280.00	7.70	<10 <1.75x
Total									
	0	100	15164	214.178	0.000	10,386.000	18,029,288.60	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1001 + 1003 >>> Pd (ppb)



PolyMet - Domain 1001 + 1003 >>> Pt(ppb)

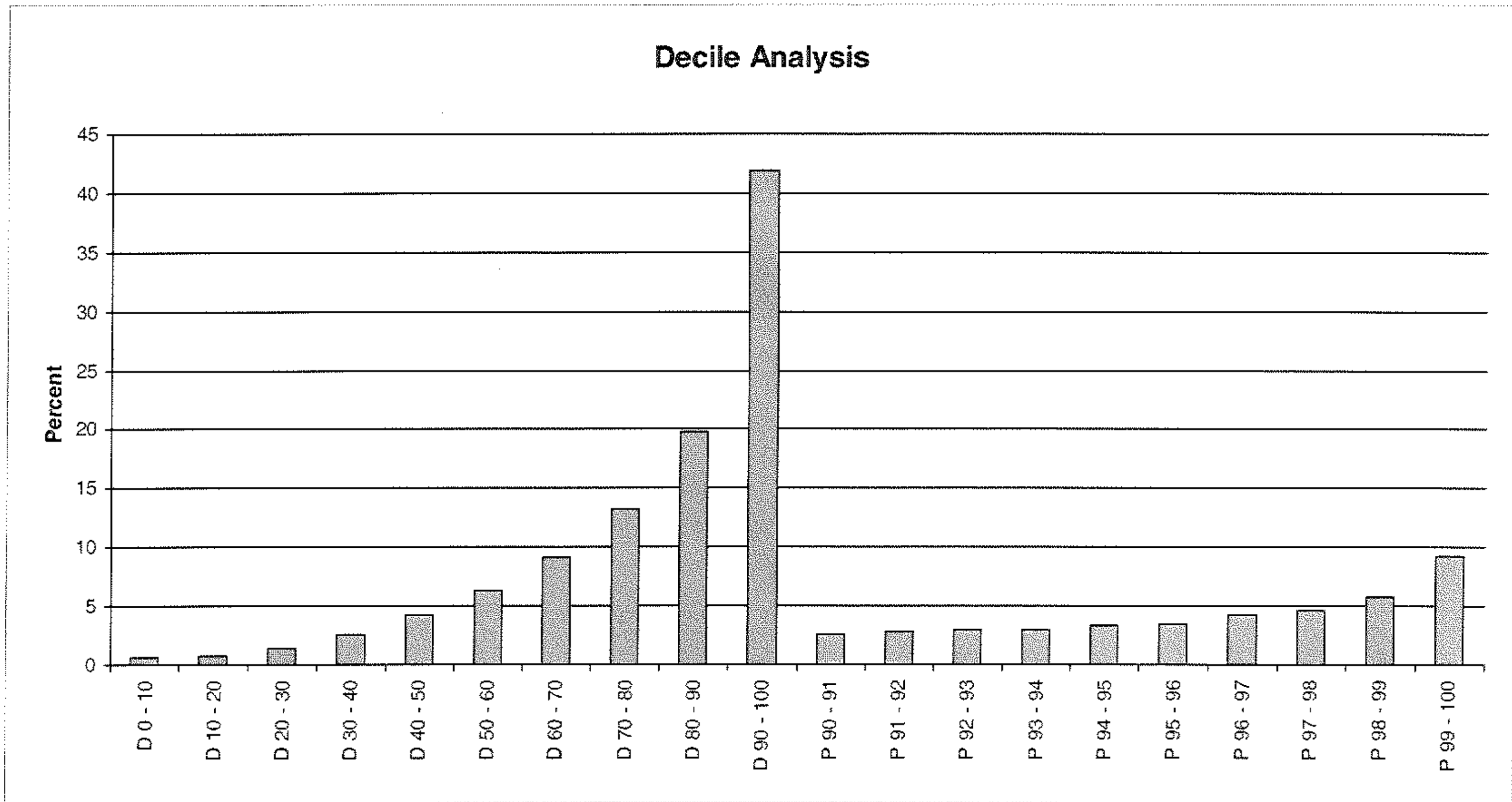
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1516	4.057	0.000	5.000	30,269.50	0.64	
	10	20	1516	5.000	5.000	5.000	37,149.00	0.78	
	20	30	1517	8.893	5.000	11.000	68,441.60	1.44	
	30	40	1516	15.898	11.000	20.000	124,006.30	2.62	
	40	50	1517	25.276	20.000	30.000	198,362.20	4.18	
	50	60	1516	37.727	30.000	45.000	300,536.60	6.34	
	60	70	1516	53.785	45.000	64.000	435,701.80	9.19	
	70	80	1517	75.700	64.000	90.000	625,450.20	13.19	
	80	90	1516	110.812	90.000	138.000	936,545.20	19.76	
	90	100	1517	220.171	138.000	1,535.000	1,984,038.60	41.85	>40 <2.3x
Percentile									
	90	91	152	141.789	138.000	145.000	120,001.50	2.53	
	91	92	151	149.430	145.000	154.000	131,759.70	2.78	
	92	93	152	159.118	154.000	165.000	137,693.50	2.90	
	93	94	152	169.487	165.000	175.000	140,357.70	2.96	
	94	95	151	180.834	175.000	189.000	158,536.00	3.34	
	95	96	152	196.421	189.000	205.000	165,379.60	3.49	
	96	97	152	216.099	205.000	228.000	200,424.30	4.23	
	97	98	151	244.311	228.000	260.000	217,026.60	4.58	
	98	99	152	291.178	260.000	326.000	272,268.00	5.74	
	99	100	152	452.480	326.000	1,535.000	440,591.70	9.29	<10 <1.75x
Total									
	0	100	15164	55.739	0.000	1,535.000	4,740,501.00	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1001 + 1003 >>> Pt(ppb)



PolyMet - Domain 1001 + 1003 >>> Au(ppb)

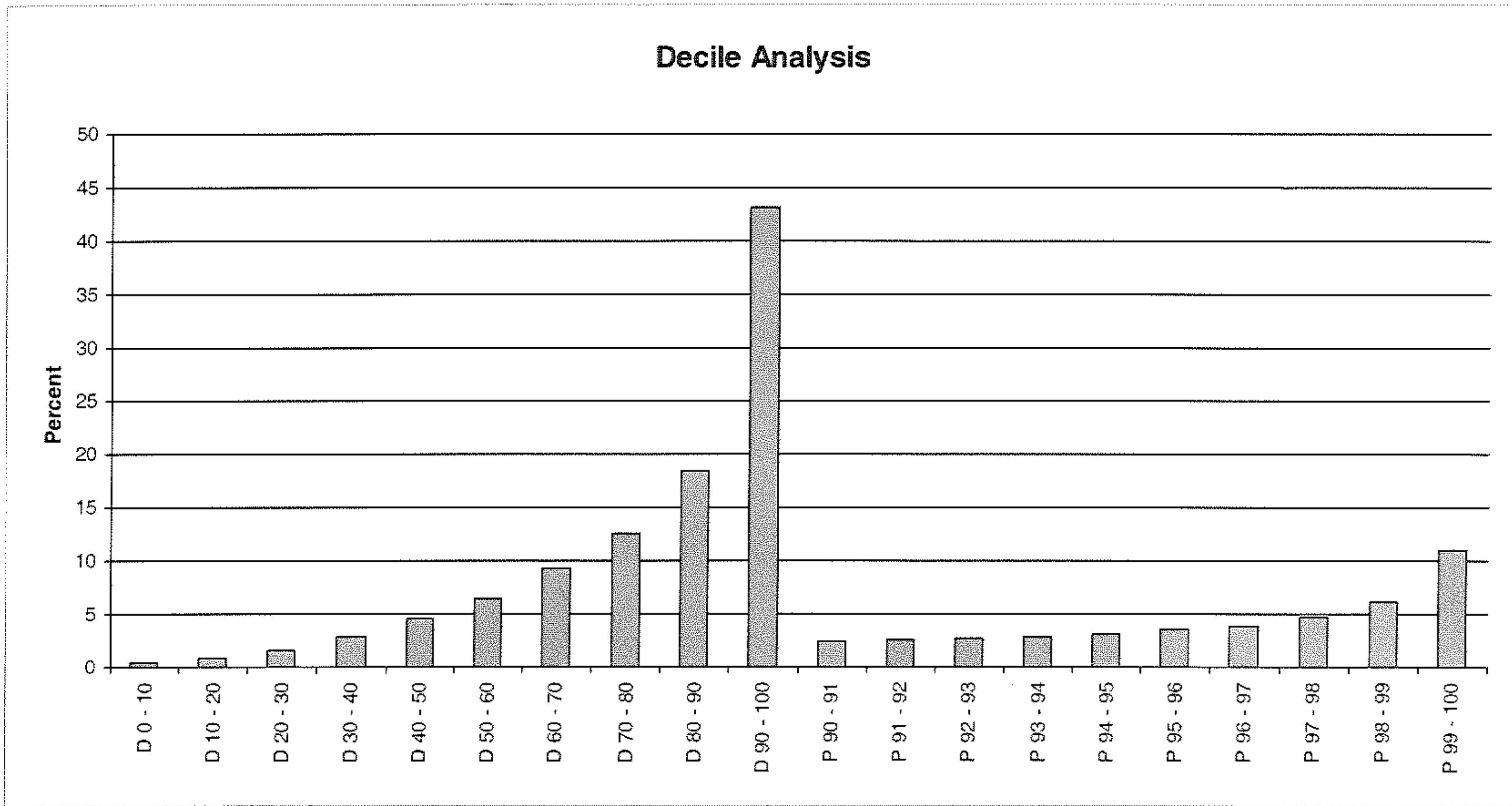
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1516	1.419	0.000	2.000	10,355.00	0.42	
	10	20	1516	2.628	2.000	4.000	19,661.10	0.79	
	20	30	1517	5.383	4.000	8.000	40,617.40	1.63	
	30	40	1516	9.286	8.000	12.000	71,817.30	2.89	
	40	50	1517	14.019	12.000	16.000	113,060.20	4.55	
	50	60	1516	20.172	16.000	24.000	160,723.10	6.47	
	60	70	1516	27.805	24.000	32.000	229,340.10	9.23	
	70	80	1517	37.810	32.000	44.000	311,252.60	12.52	
	80	90	1516	54.177	44.000	66.000	457,333.90	18.40	
	90	100	1517	120.206	66.000	1,926.000	1,071,313.00	43.10	>40 >2.3x
Percentile									
	90	91	152	68.026	66.000	70.000	61,132.20	2.46	
	91	92	151	71.775	70.000	74.000	62,705.70	2.52	
	92	93	152	76.158	74.000	78.000	65,884.90	2.65	
	93	94	152	81.039	78.000	84.000	72,710.20	2.93	
	94	95	151	87.033	84.000	90.000	78,317.60	3.15	
	95	96	152	95.375	90.000	102.000	88,407.80	3.56	
	96	97	152	108.520	102.000	118.000	97,638.50	3.93	
	97	98	151	128.060	118.000	140.000	117,855.50	4.74	
	98	99	152	162.934	140.000	192.000	153,207.20	6.16	
	99	100	152	322.651	193.000	1,926.000	273,453.40	11.00	>10 >1.75x
Total									
	0	100	15164	29.294	0.000	1,926.000	2,485,473.70	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1001 + 1003 >>> Au(ppb)



PolyMet - Domain 1001 + 1003 >>> Co (ppm)

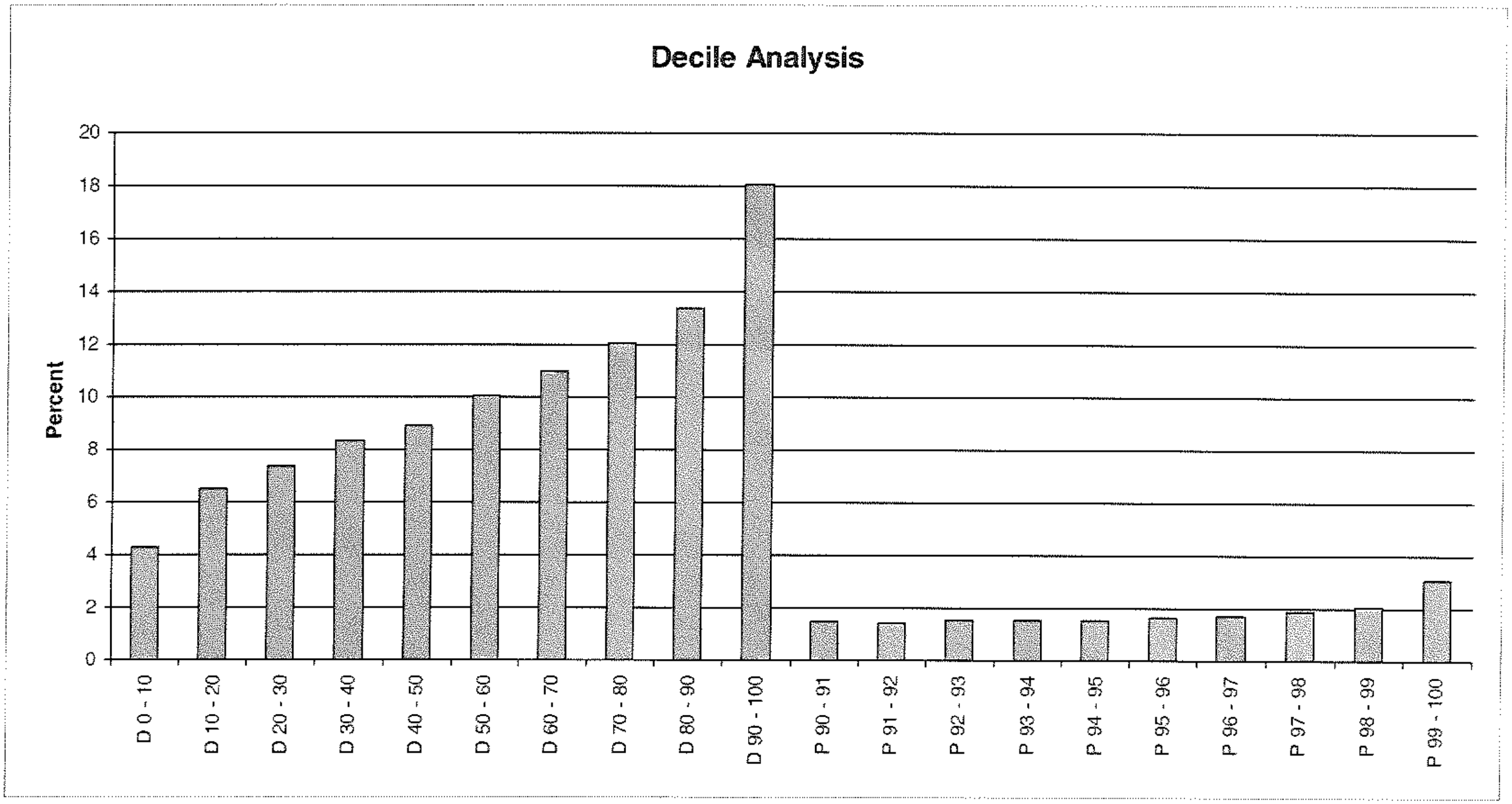
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1516	29.183	0.000	41.000	43,191.100	4.27	
	10	20	1516	45.336	41.000	49.000	72,266.700	6.53	
	20	30	1517	51.722	49.000	55.000	21,662.800	7.39	
	30	40	1516	57.286	55.000	60.000	75,000.700	8.33	
	40	50	1517	63.159	60.000	66.000	09,334.600	8.93	
	50	60	1516	69.757	66.000	73.000	73,527.400	10.06	
	60	70	1516	77.525	73.000	82.000	25,750.900	10.97	
	70	80	1517	87.162	82.000	93.000	87,351.800	12.05	
	80	90	1516	100.730	93.000	111.000	62,900.000	13.38	
	90	100	1517	141.296	111.000	713.000	31,027.600	18.08	<40 <2.3x
Percentile									
	90	91	152	111.842	111.000	113.000	85,496.200	1.50	
	91	92	151	114.709	113.000	116.000	82,290.900	1.44	
	92	93	152	117.829	116.000	120.000	88,981.900	1.56	
	93	94	152	121.270	120.000	123.000	88,989.800	1.56	
	94	95	151	125.464	123.000	128.000	89,298.800	1.57	
	95	96	152	130.322	128.000	133.000	96,084.300	1.69	
	96	97	152	137.480	133.000	141.000	97,267.500	1.71	
	97	98	151	147.517	142.000	155.000	07,202.200	1.88	
	98	99	152	165.803	155.000	183.000	18,187.000	2.07	
	99	100	152	240.487	183.000	713.000	77,229.000	3.11	<10 <1.75x
Total									
	0	100	15164	72.319	0.000	713.000	02,013.600	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1001 + 1003 >>> Co (ppm)



PolyMet - Domain 1001 + 1003 >>> S%

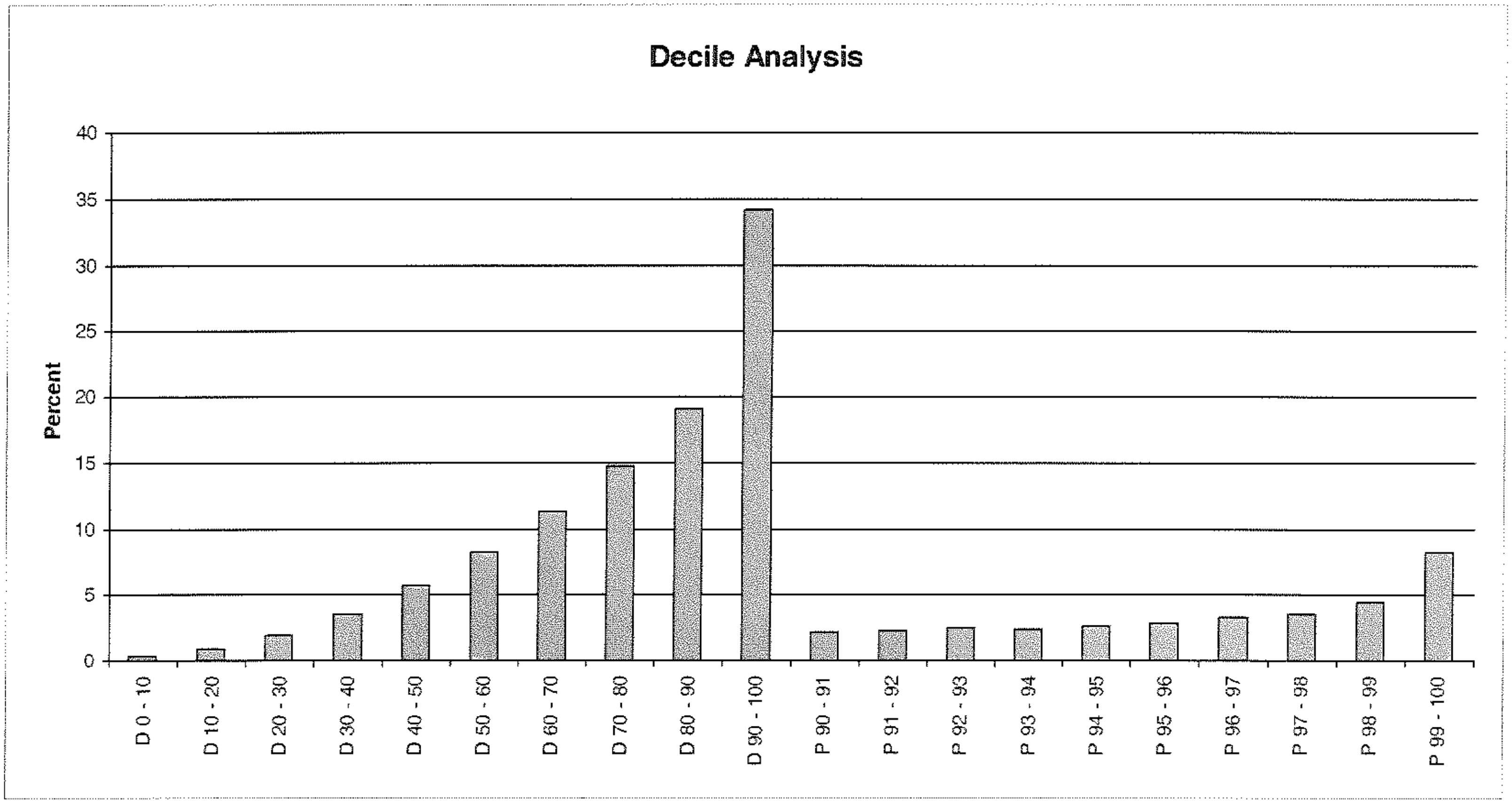
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1516	0.028	0.000	0.050	204.697	0.37	
	10	20	1516	0.070	0.050	0.100	510.556	0.93	
	20	30	1517	0.139	0.100	0.190	1,051.443	1.92	
	30	40	1516	0.248	0.190	0.310	1,923.714	3.51	
	40	50	1517	0.382	0.310	0.460	3,098.475	5.66	
	50	60	1516	0.538	0.460	0.620	4,497.073	8.21	
	60	70	1516	0.717	0.620	0.820	6,192.308	11.31	
	70	80	1517	0.936	0.820	1.060	8,095.973	14.78	
	80	90	1516	1.232	1.060	1.450	10,466.074	19.11	
	90	100	1517	2.325	1.450	26.100	18,729.116	34.20	<40 <2.3x
Percentile									
	90	91	152	1.474	1.450	1.500	1,172.564	2.14	
	91	92	151	1.535	1.500	1.560	1,227.677	2.24	
	92	93	152	1.603	1.560	1.650	1,376.423	2.51	
	93	94	152	1.689	1.650	1.740	1,298.888	2.37	
	94	95	151	1.792	1.740	1.850	1,425.672	2.60	
	95	96	152	1.916	1.850	1.990	1,551.513	2.83	
	96	97	152	2.139	1.990	2.300	1,790.194	3.27	
	97	98	151	2.427	2.300	2.603	1,950.046	3.56	
	98	99	152	2.947	2.603	3.450	2,442.115	4.46	
	99	100	152	5.721	3.450	26.100	4,494.024	8.21	<10 >1.75x
Total									
	0	100	15164	0.661	0.000	26.100	54,769.429	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1001 + 1003 >>> S%



PolyMet - Domain 1001 + 1003 >>> Cu%

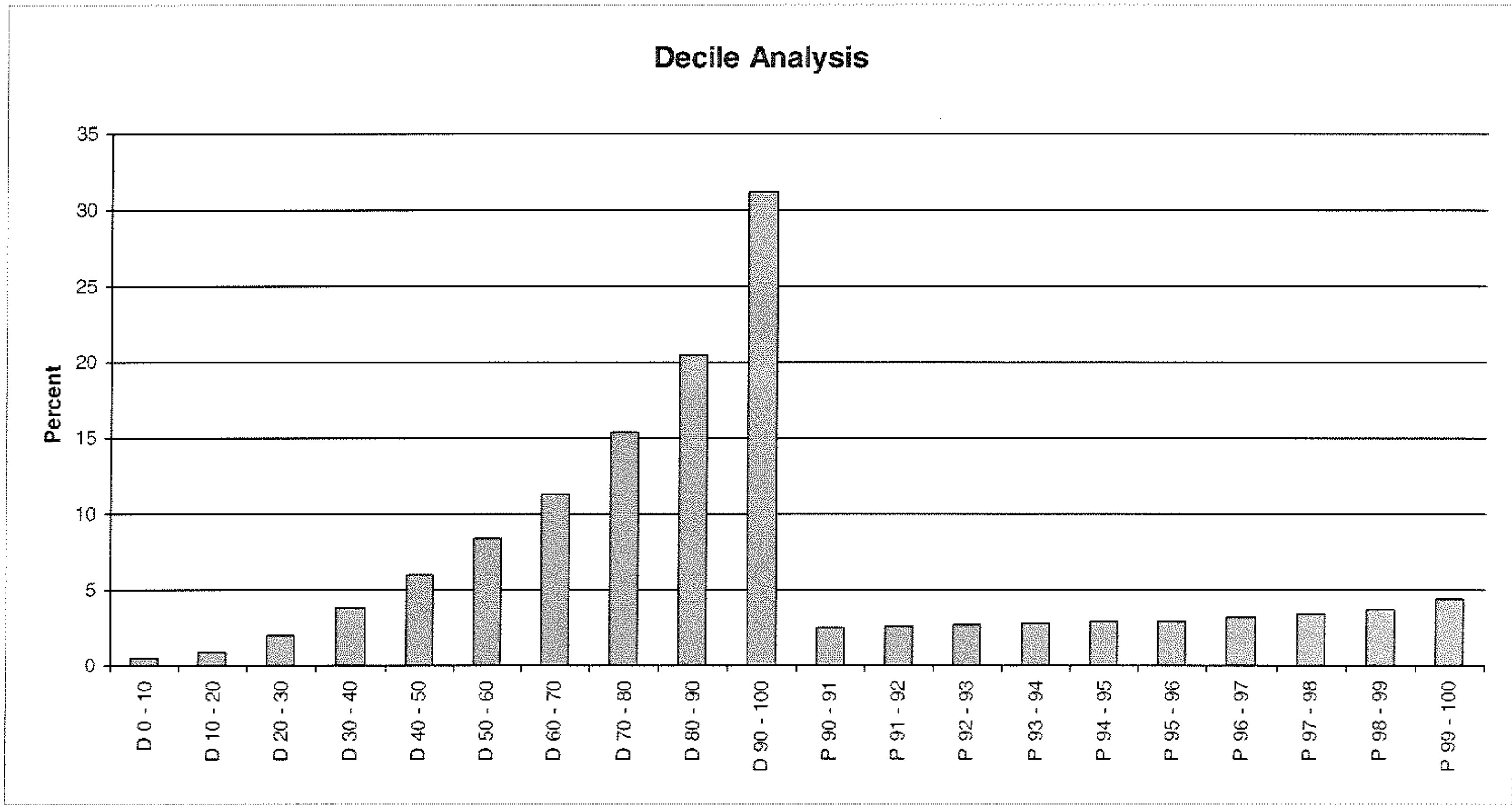
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1516	0.013	0.000	0.019	94.240	0.45	
	10	20	1516	0.027	0.019	0.037	196.545	0.95	
	20	30	1517	0.055	0.038	0.076	415.498	2.01	
	30	40	1516	0.100	0.076	0.125	784.106	3.78	
	40	50	1517	0.152	0.125	0.181	1,250.169	6.03	
	50	60	1516	0.212	0.181	0.247	1,748.610	8.44	
	60	70	1516	0.284	0.247	0.323	2,344.256	11.31	
	70	80	1517	0.373	0.324	0.425	3,182.453	15.36	
	80	90	1516	0.496	0.425	0.582	4,245.135	20.49	
	90	100	1517	0.778	0.582	4.890	6,458.509	31.17	<40 <2.3x
Percentile									
	90	91	152	0.593	0.582	0.603	516.954	2.50	
	91	92	151	0.616	0.603	0.629	540.186	2.61	
	92	93	152	0.643	0.630	0.658	566.191	2.73	
	93	94	152	0.670	0.658	0.684	586.289	2.83	
	94	95	151	0.704	0.684	0.721	601.753	2.90	
	95	96	152	0.740	0.721	0.760	602.973	2.91	
	96	97	152	0.786	0.761	0.817	665.261	3.21	
	97	98	151	0.854	0.818	0.895	705.469	3.40	
	98	99	152	0.948	0.897	0.995	756.519	3.65	
	99	100	152	1.225	0.996	4.890	916.913	4.43	<10 <1.75x
Total									
	0	100	15164	0.249	0.000	4.890	20,719.521	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1001 + 1003 >>> Cu%



PolyMet - Domain 1001 + 1003 >>> Ni%

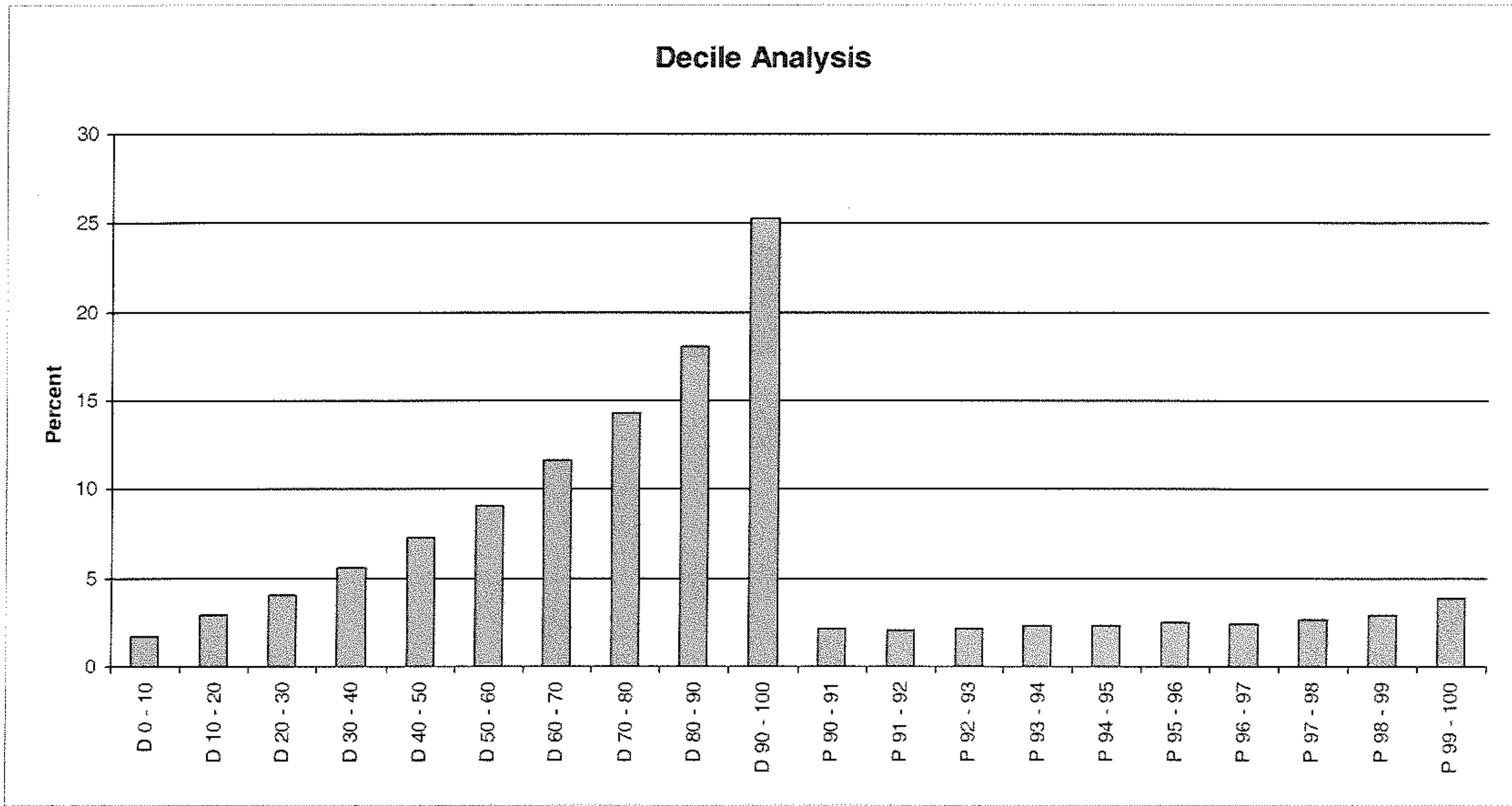
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1516	0.014	0.000	0.021	107.527	1.72	
	10	20	1516	0.025	0.021	0.029	184.768	2.95	
	20	30	1517	0.034	0.029	0.038	254.576	4.06	
	30	40	1516	0.044	0.038	0.050	348.051	5.55	
	40	50	1517	0.056	0.050	0.062	456.540	7.28	
	50	60	1516	0.069	0.062	0.077	571.036	9.11	
	60	70	1516	0.085	0.077	0.095	728.380	11.62	
	70	80	1517	0.106	0.095	0.119	898.330	14.33	
	80	90	1516	0.135	0.119	0.155	1,136.352	18.12	
	90	100	1517	0.205	0.155	0.970	1,584.228	25.27	<40 <2.3x
Percentile									
	90	91	152	0.158	0.155	0.160	133.232	2.12	
	91	92	151	0.163	0.160	0.166	127.605	2.04	
	92	93	152	0.169	0.166	0.172	132.265	2.11	
	93	94	152	0.176	0.172	0.179	146.502	2.34	
	94	95	151	0.184	0.180	0.188	146.256	2.33	
	95	96	152	0.193	0.188	0.199	157.423	2.51	
	96	97	152	0.206	0.199	0.212	149.842	2.39	
	97	98	151	0.219	0.212	0.228	168.728	2.69	
	98	99	152	0.245	0.228	0.264	181.860	2.90	
	99	100	152	0.338	0.265	0.970	240.515	3.84	<10 <1.75x
Total									
	0	100	15164	0.077	0.000	0.970	6,269.788	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 1001 + 1003 >>> Ni%



PolyMet - Domain 2000 >>> Cu%

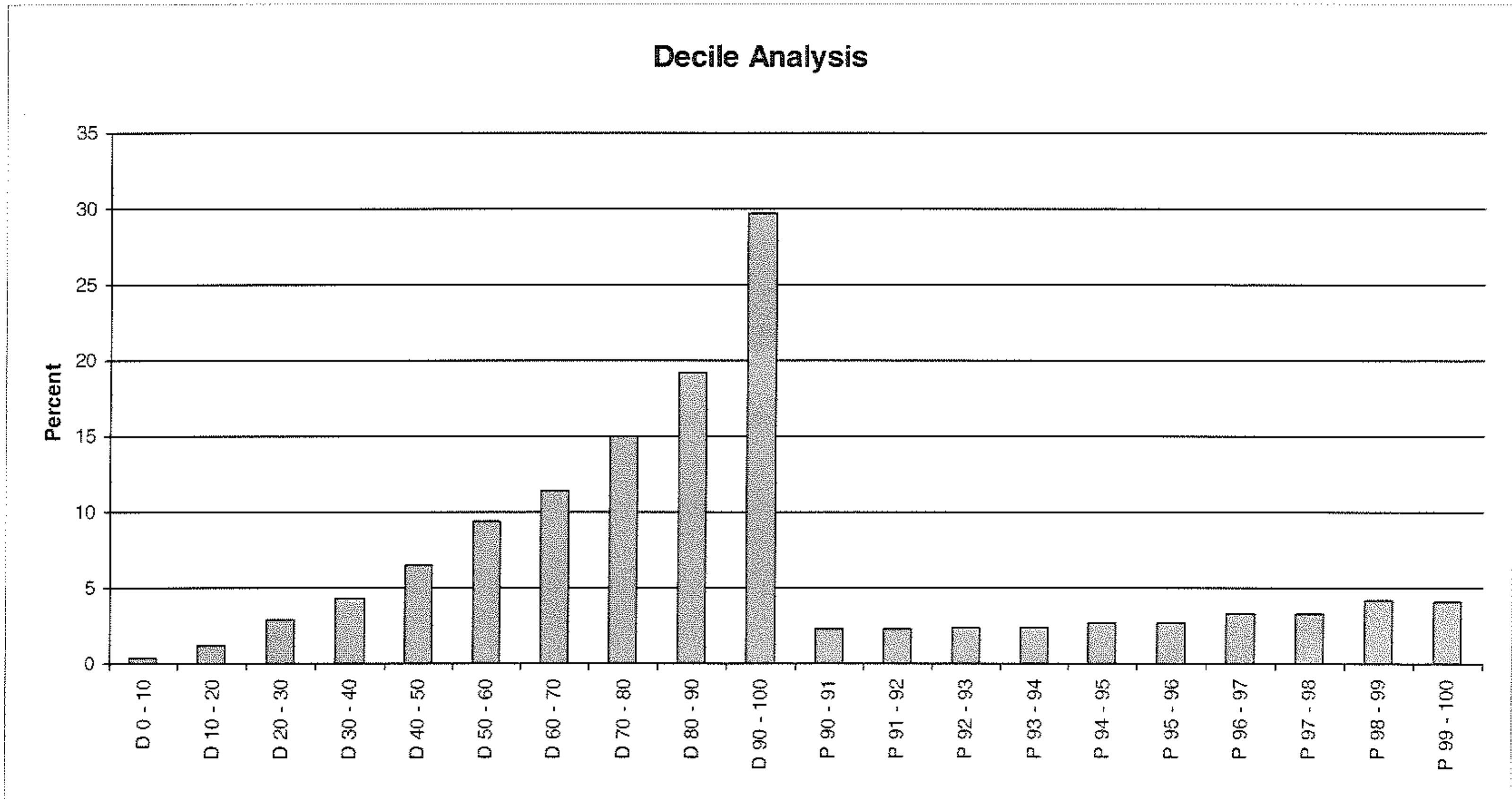
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	129	0.009	0.000	0.015	8.01	0.44	
	10	20	129	0.026	0.015	0.040	22.95	1.25	
	20	30	130	0.063	0.041	0.084	52.41	2.85	
	30	40	130	0.107	0.084	0.133	78.98	4.30	
	40	50	129	0.166	0.133	0.201	119.41	6.50	
	50	60	130	0.227	0.201	0.255	171.90	9.36	
	60	70	129	0.291	0.255	0.337	209.95	11.43	
	70	80	130	0.391	0.339	0.443	275.65	15.01	
	80	90	129	0.512	0.445	0.587	352.65	19.20	
	90	100	130	0.760	0.587	2.130	544.71	29.66	<40 <2.3x
Percentile									
	90	91	13	0.594	0.587	0.602	42.45	2.31	
	91	92	13	0.617	0.605	0.629	42.50	2.31	
	92	93	13	0.638	0.631	0.643	43.73	2.38	
	93	94	13	0.660	0.644	0.670	44.84	2.44	
	94	95	13	0.686	0.671	0.700	49.38	2.69	
	95	96	13	0.722	0.705	0.740	49.21	2.68	
	96	97	13	0.774	0.753	0.803	60.63	3.30	
	97	98	13	0.843	0.803	0.873	59.93	3.26	
	98	99	13	0.922	0.882	0.976	77.22	4.20	
	99	100	13	1.148	0.976	2.130	74.82	4.07	<10 <1.75x
Total									
	0	100	1295	0.255	0.000	2.130	1,836.64	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 2000 >>> Cu%



PolyMet - Domain 2000 >>> Ni%

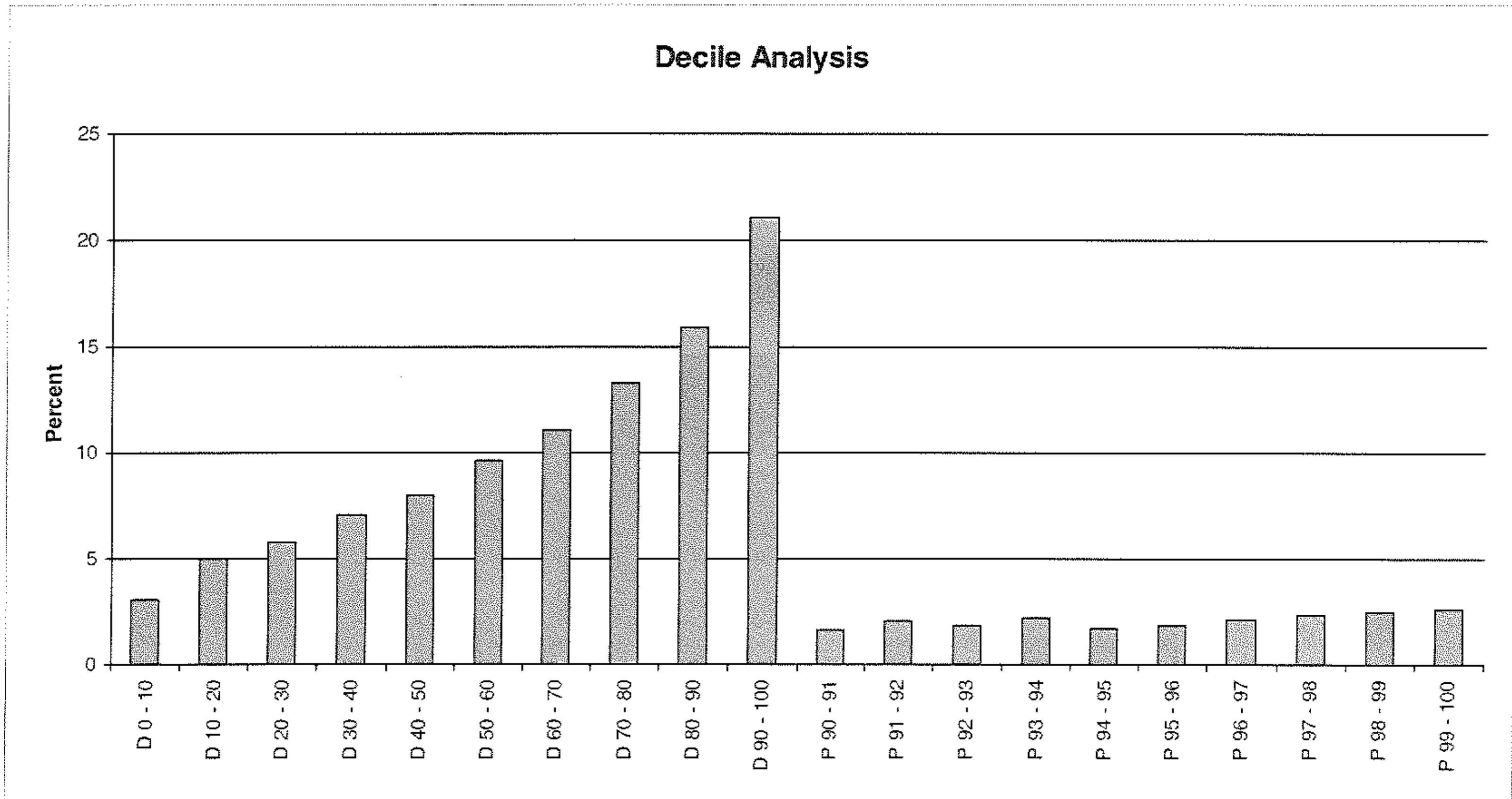
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	129	0.019	0.000	0.025	15.71	3.09	
	10	20	129	0.029	0.025	0.033	25.40	5.00	
	20	30	130	0.036	0.033	0.041	29.51	5.80	
	30	40	130	0.045	0.041	0.049	36.07	7.09	
	40	50	129	0.054	0.049	0.060	40.63	7.99	
	50	60	130	0.067	0.060	0.072	49.12	9.66	
	60	70	129	0.078	0.072	0.086	56.42	11.10	
	70	80	130	0.095	0.087	0.105	67.63	13.30	
	80	90	129	0.116	0.105	0.128	81.00	15.93	
	90	100	130	0.156	0.129	0.270	107.03	21.05	<40 <2.3x
Percentile									
	90	91	13	0.130	0.129	0.132	8.31	1.63	
	91	92	13	0.134	0.132	0.136	10.39	2.04	
	92	93	13	0.137	0.136	0.139	9.49	1.87	
	93	94	13	0.140	0.139	0.142	11.37	2.24	
	94	95	13	0.145	0.143	0.148	8.76	1.72	
	95	96	13	0.151	0.149	0.153	9.62	1.89	
	96	97	13	0.160	0.156	0.166	10.80	2.12	
	97	98	13	0.169	0.166	0.172	12.01	2.36	
	98	99	13	0.183	0.177	0.192	12.69	2.50	
	99	100	13	0.215	0.194	0.270	13.59	2.67	<10 <1.75x
Total									
	0	100	1295	0.070	0.000	0.270	508.52	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 2000 >>> Ni%



PolyMet - Domain 2000 >>> Pd (ppb)

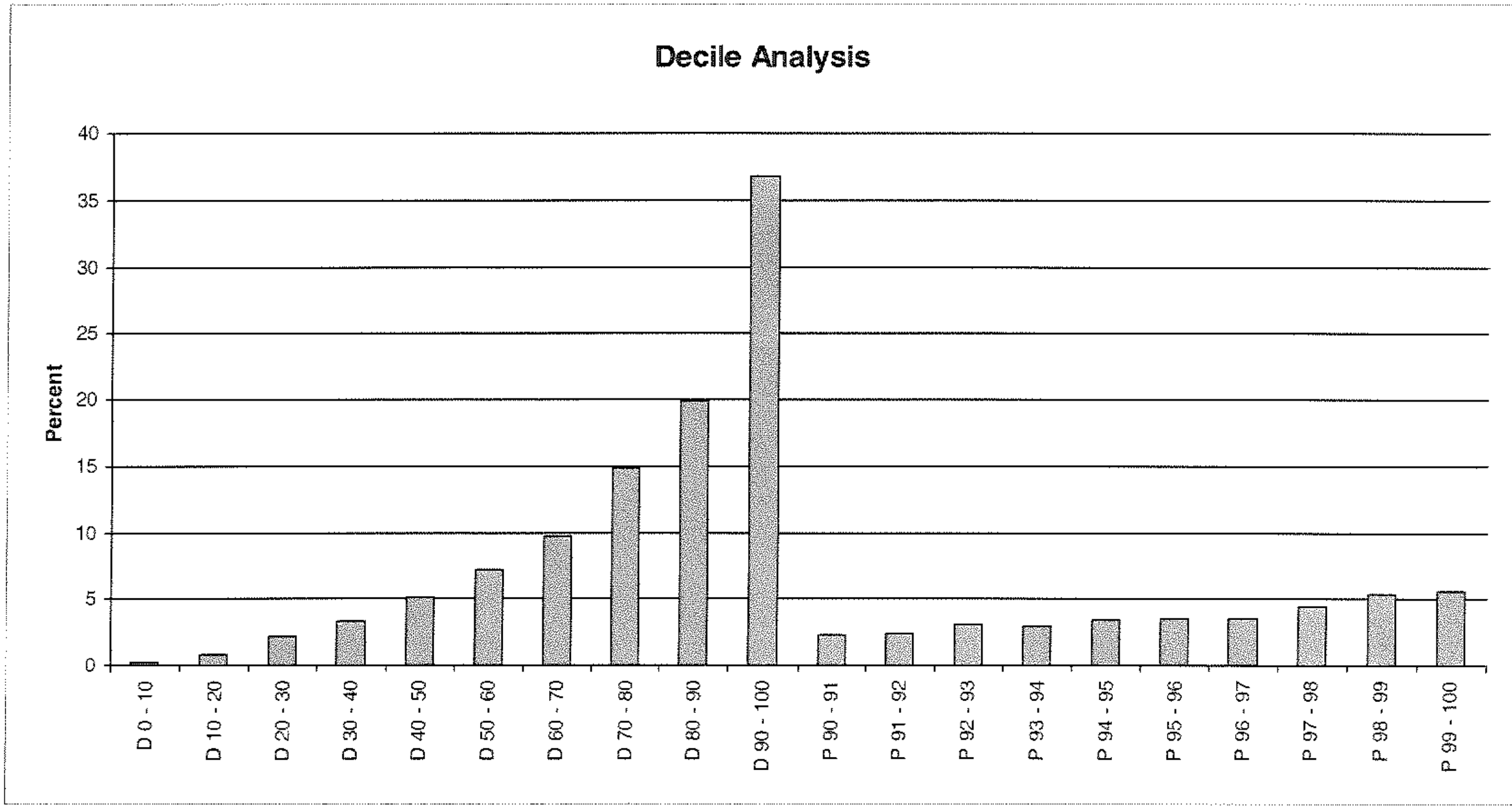
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	129	3.752	0.000	8.000	3,389.00	0.18	
	10	20	129	19.078	8.000	31.000	15,964.50	0.86	
	20	30	130	48.715	32.000	63.000	40,478.60	2.17	
	30	40	130	84.238	64.000	106.000	62,254.30	3.33	
	40	50	129	129.457	106.000	154.000	95,827.50	5.13	
	50	60	130	184.815	154.000	222.000	134,073.40	7.18	
	60	70	129	268.395	223.000	318.000	181,705.80	9.73	
	70	80	130	377.500	319.000	442.000	276,631.10	14.82	
	80	90	129	522.713	443.000	629.000	370,230.60	19.83	
	90	100	130	923.592	629.000	3,540.000	686,300.00	36.76	<40 <2.3x
Percentile									
	90	91	13	645.769	629.000	666.000	43,047.10	2.31	
	91	92	13	684.000	671.000	698.000	45,578.00	2.44	
	92	93	13	713.846	705.000	721.000	57,422.00	3.08	
	93	94	13	743.769	728.000	767.000	54,615.00	2.93	
	94	95	13	799.846	773.000	819.000	63,794.00	3.42	
	95	96	13	840.769	822.000	864.000	65,185.90	3.49	
	96	97	13	912.231	868.000	970.000	67,136.00	3.60	
	97	98	13	1037.846	980.000	1,081.000	83,373.00	4.47	
	98	99	13	1169.000	1,104.000	1,250.000	100,944.00	5.41	
	99	100	13	1688.846	1,270.000	3,540.000	105,205.00	5.64	<10 <1.75x
Total									
	0	100	1295	256.486	0.000	3,540.000	1,866,854.80	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 2000 >>> Pd (ppb)



PolyMet - Domain 2000 >>> Pt (ppb)

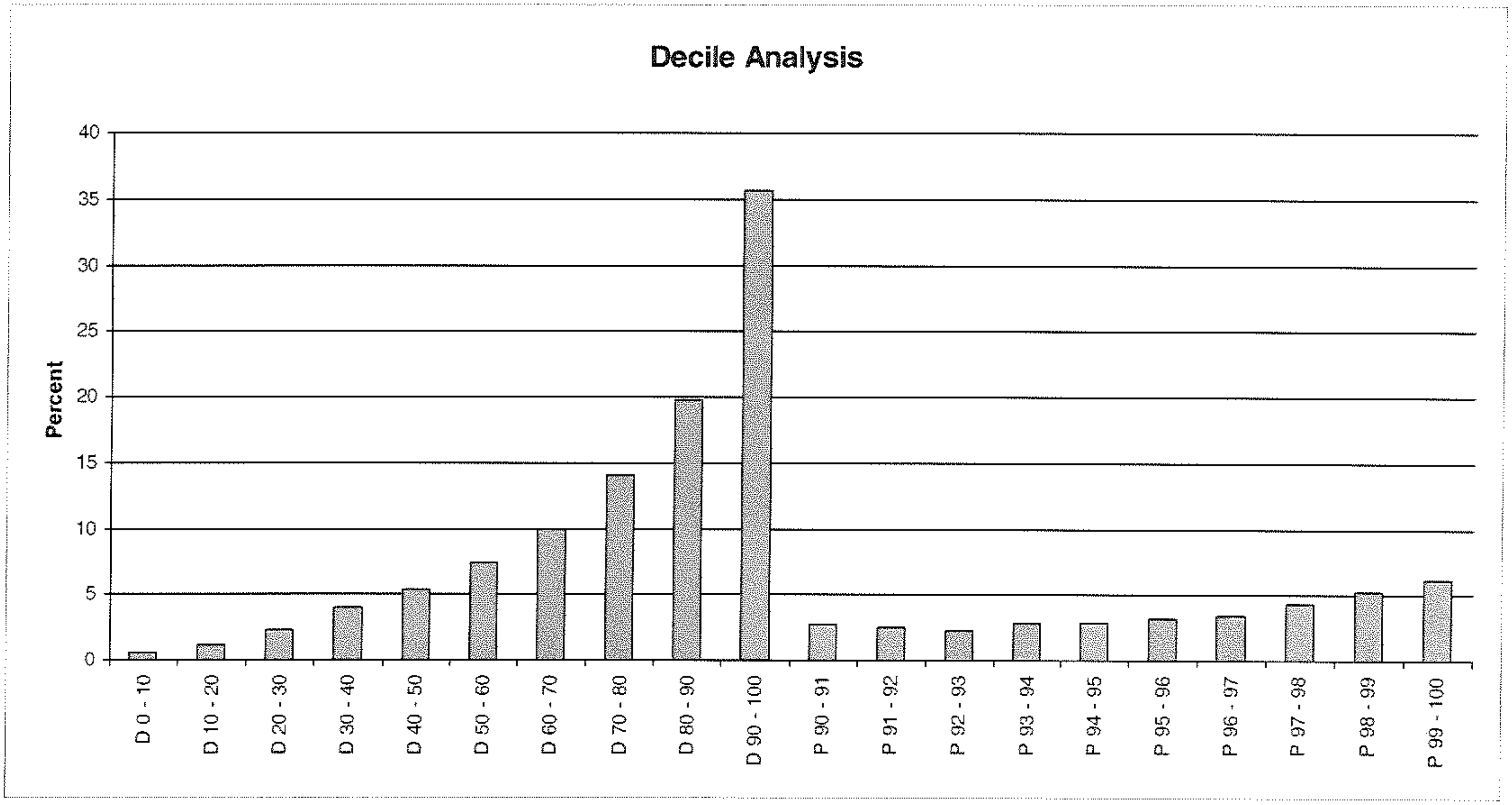
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	129	4.636	0.000	5.000	3,998.50	0.56	
	10	20	129	9.124	5.000	15.000	7,778.60	1.09	
	20	30	130	21.038	15.000	28.000	16,428.20	2.31	
	30	40	130	35.262	28.000	43.000	28,090.20	3.95	
	40	50	129	52.132	43.000	62.000	38,117.90	5.36	
	50	60	130	73.346	62.000	86.000	52,675.20	7.40	
	60	70	129	102.612	86.000	119.000	70,533.60	9.91	
	70	80	130	139.362	119.000	161.000	99,929.80	14.04	
	80	90	129	191.109	162.000	227.000	140,836.50	19.79	
	90	100	130	340.362	229.000	1,390.000	253,427.90	35.60	<40 <2.3x
Percentile									
	90	91	13	235.462	229.000	242.000	19,210.00	2.70	
	91	92	13	249.000	242.000	255.000	17,898.00	2.51	
	92	93	13	263.615	256.000	272.000	16,311.50	2.29	
	93	94	13	276.154	273.000	281.000	20,074.20	2.82	
	94	95	13	290.154	283.000	302.000	20,375.40	2.86	
	95	96	13	310.000	303.000	320.000	23,087.50	3.24	
	96	97	13	333.846	320.000	350.000	24,442.00	3.43	
	97	98	13	369.385	353.000	397.000	30,810.50	4.33	
	98	99	13	419.154	401.000	443.000	37,093.80	5.21	
	99	100	13	656.846	444.000	1,390.000	44,125.00	6.20	<10 <1.75x
Total									
	0	100	1295	96.995	0.000	1,390.000	711,816.40	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 2000 >>> Pt (ppb)



PolyMet - Domain 2000 >>> Au(ppb)

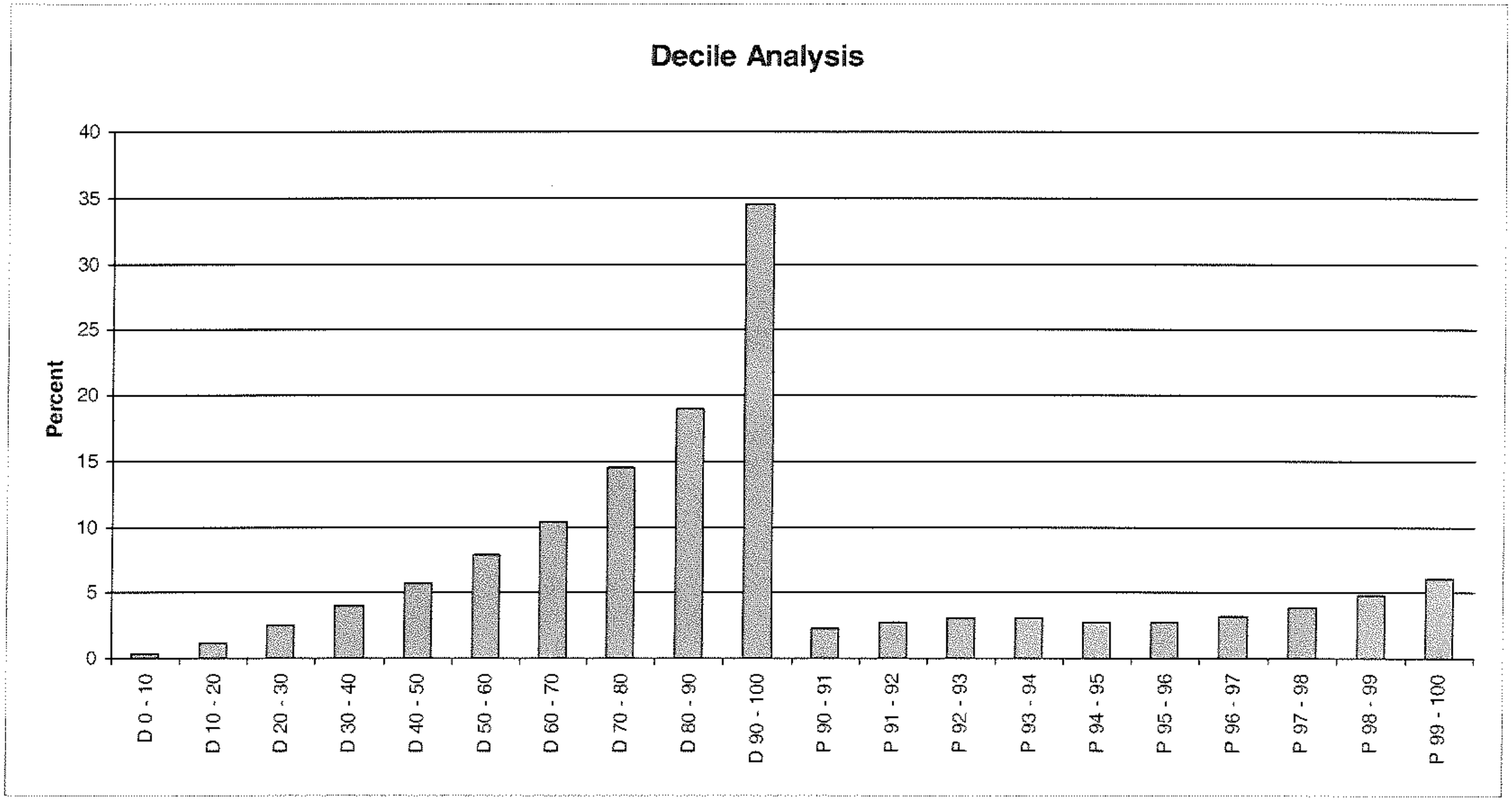
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	129	1.264	0.000	2.000	1,085.00	0.35	
	10	20	129	4.124	2.000	6.000	3,525.20	1.13	
	20	30	130	9.585	6.000	13.000	7,820.60	2.51	
	30	40	130	16.477	13.000	20.000	12,389.00	3.98	
	40	50	129	24.504	20.000	29.000	17,915.30	5.75	
	50	60	130	33.815	29.000	39.000	24,396.10	7.83	
	60	70	129	46.488	39.000	54.000	32,551.90	10.45	
	70	80	130	63.046	55.000	72.000	45,111.60	14.48	
	80	90	129	84.388	72.000	100.000	59,174.80	18.99	
	90	100	130	144.108	100.000	545.000	107,614.90	34.54	<40 <2.3x
Percentile									
	90	91	13	102.923	100.000	105.000	7,009.00	2.25	
	91	92	13	107.308	106.000	110.000	8,686.00	2.79	
	92	93	13	111.077	110.000	113.000	9,514.40	3.05	
	93	94	13	114.308	113.000	115.000	9,725.00	3.12	
	94	95	13	120.077	116.000	124.000	8,537.00	2.74	
	95	96	13	126.923	124.000	131.000	8,394.50	2.69	
	96	97	13	139.231	134.000	144.000	9,867.20	3.17	
	97	98	13	154.308	148.000	161.000	12,148.00	3.90	
	98	99	13	171.231	162.000	183.000	15,016.00	4.82	
	99	100	13	293.692	184.000	545.000	18,717.80	6.01	<10 <1.75x
Total									
	0	100	1295	42.821	0.000	545.000	311,584.40	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 2000 >>> Au(ppb)



PolyMet - Domain 2000 >>> Co (ppm)

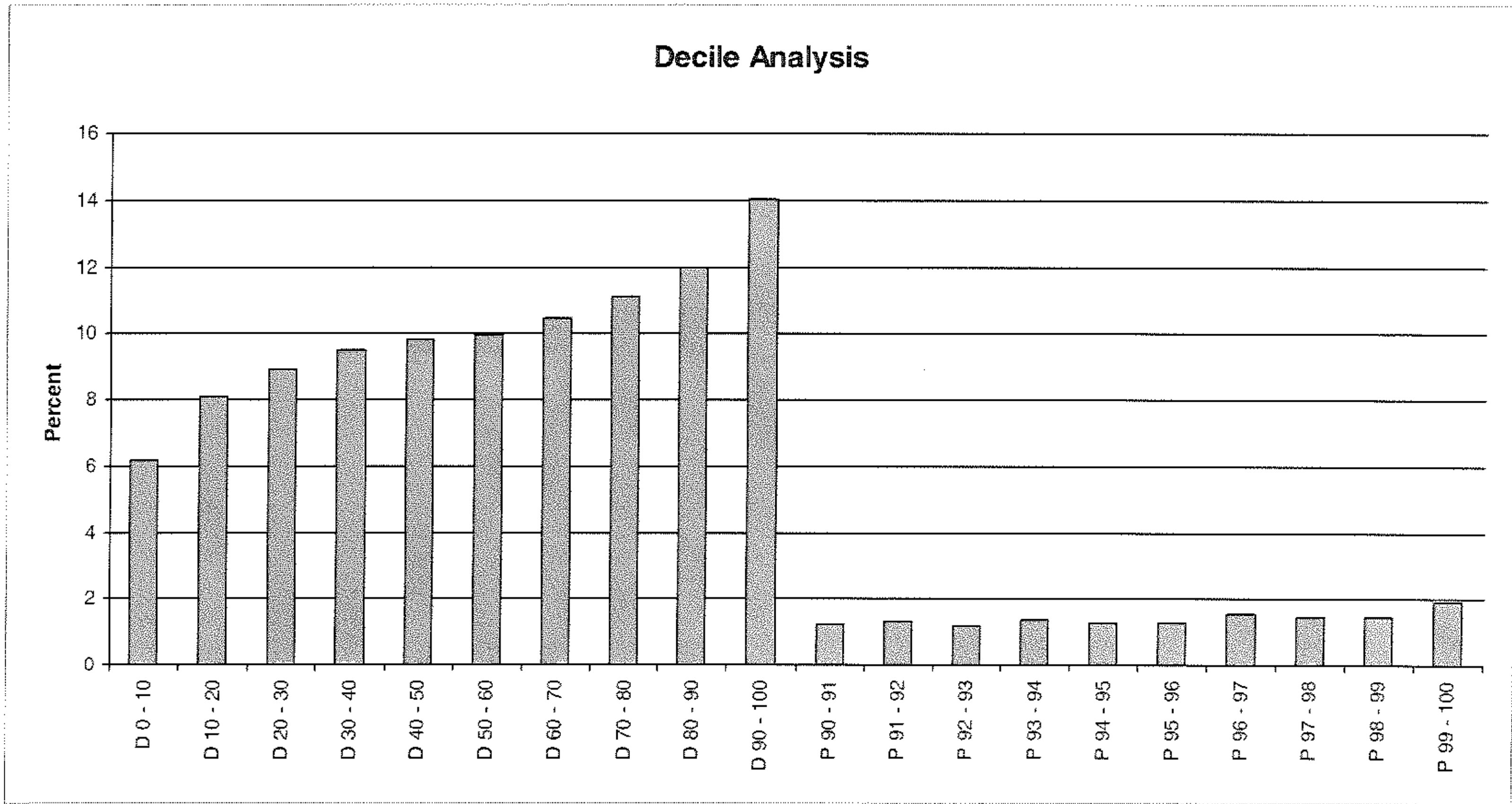
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	129	34.566	0.000	44.000	30,221.80	6.18	
	10	20	129	47.628	44.000	50.000	39,518.00	8.08	
	20	30	130	52.977	50.000	56.000	43,580.30	8.91	
	30	40	130	57.685	56.000	60.000	46,478.00	9.50	
	40	50	129	62.000	60.000	64.000	48,005.30	9.81	
	50	60	130	66.100	64.000	69.000	48,770.20	9.97	
	60	70	129	71.178	69.000	74.000	51,273.40	10.48	
	70	80	130	76.877	74.000	80.000	54,245.50	11.09	
	80	90	129	84.372	80.000	89.000	58,494.50	11.96	
	90	100	130	101.862	89.000	156.000	68,678.30	14.04	<40 <2.3x
Percentile									
	90	91	13	89.923	89.000	91.000	5,998.00	1.23	
	91	92	13	91.615	91.000	92.000	6,535.30	1.34	
	92	93	13	93.000	92.000	94.000	5,721.00	1.17	
	93	94	13	94.462	94.000	95.000	6,660.00	1.36	
	94	95	13	96.385	96.000	97.000	6,222.00	1.27	
	95	96	13	98.308	97.000	100.000	6,243.00	1.28	
	96	97	13	101.077	100.000	103.000	7,578.00	1.55	
	97	98	13	106.692	103.000	111.000	7,097.00	1.45	
	98	99	13	115.385	111.000	120.000	7,206.50	1.47	
	99	100	13	131.769	121.000	156.000	9,417.50	1.92	<10 <1.75x
Total									
	0	100	1295	65.546	0.000	156.000	489,265.30	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 2000 >>> Co (ppm)



PolyMet - Domain 2000 >>> S%

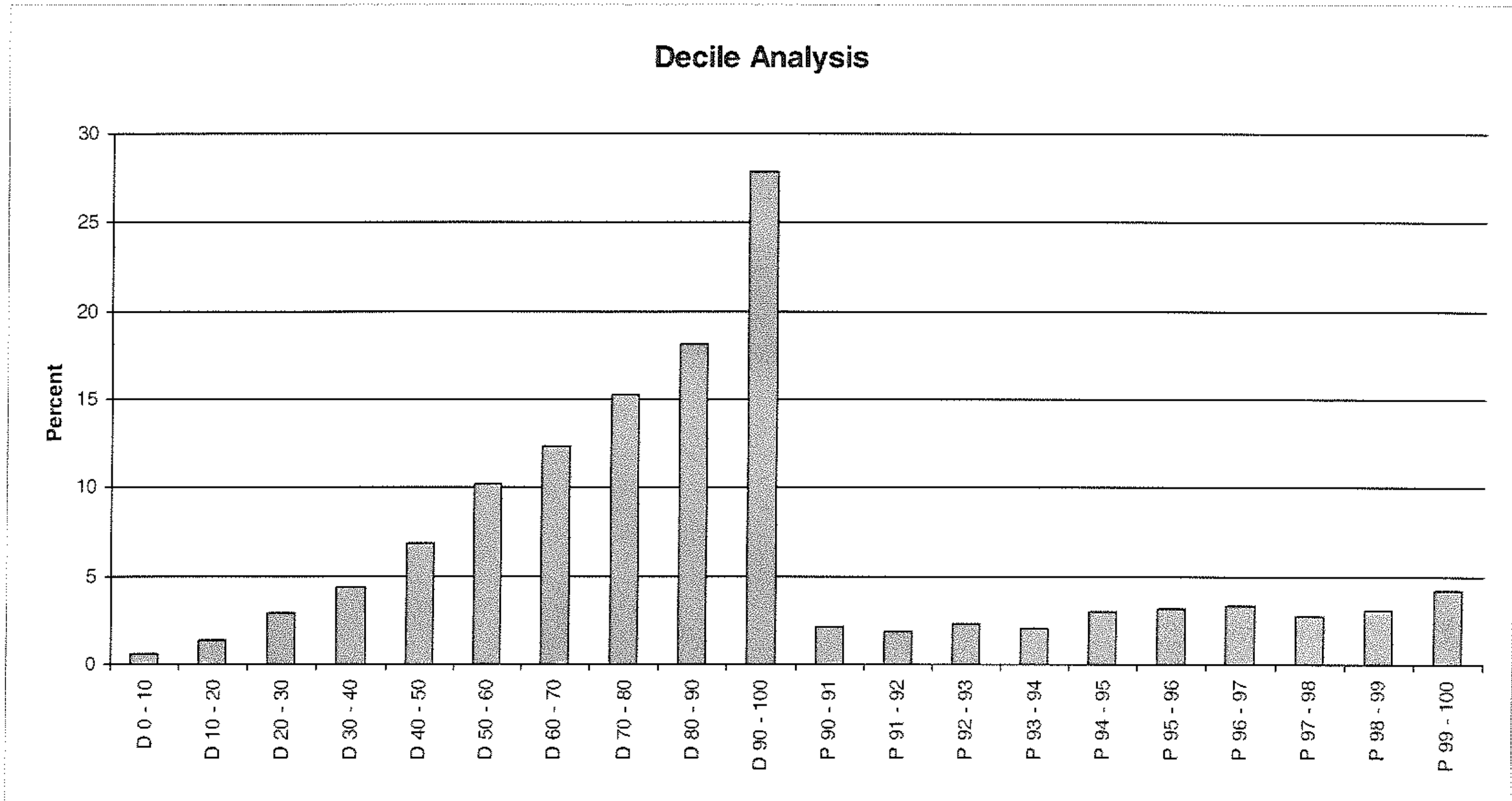
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	129	0.020	0.000	0.030	17.98	0.61	
	10	20	129	0.045	0.030	0.070	39.27	1.33	
	20	30	130	0.105	0.070	0.150	85.91	2.92	
	30	40	130	0.182	0.150	0.230	129.24	4.39	
	40	50	129	0.284	0.230	0.340	203.15	6.90	
	50	60	130	0.390	0.340	0.440	300.40	10.20	
	60	70	129	0.498	0.440	0.560	363.00	12.32	
	70	80	130	0.624	0.560	0.700	449.09	15.24	
	80	90	129	0.776	0.700	0.880	536.02	18.20	
	90	100	130	1.169	0.880	3.618	821.80	27.90	<40 <2.3x
Percentile									
	90	91	13	0.898	0.880	0.920	62.04	2.11	
	91	92	13	0.934	0.920	0.940	56.04	1.90	
	92	93	13	0.965	0.940	0.990	67.00	2.27	
	93	94	13	1.005	0.990	1.020	61.30	2.08	
	94	95	13	1.040	1.020	1.060	87.91	2.98	
	95	96	13	1.078	1.060	1.130	93.53	3.17	
	96	97	13	1.162	1.140	1.210	97.96	3.33	
	97	98	13	1.248	1.210	1.300	80.20	2.72	
	98	99	13	1.385	1.320	1.440	90.99	3.09	
	99	100	13	1.977	1.450	3.618	124.84	4.24	<10 <1.75x
Total									
	0	100	1295	0.410	0.000	3.618	2,945.86	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 2000 >>> S%



PolyMet - Domain 3000 >>> Cu%

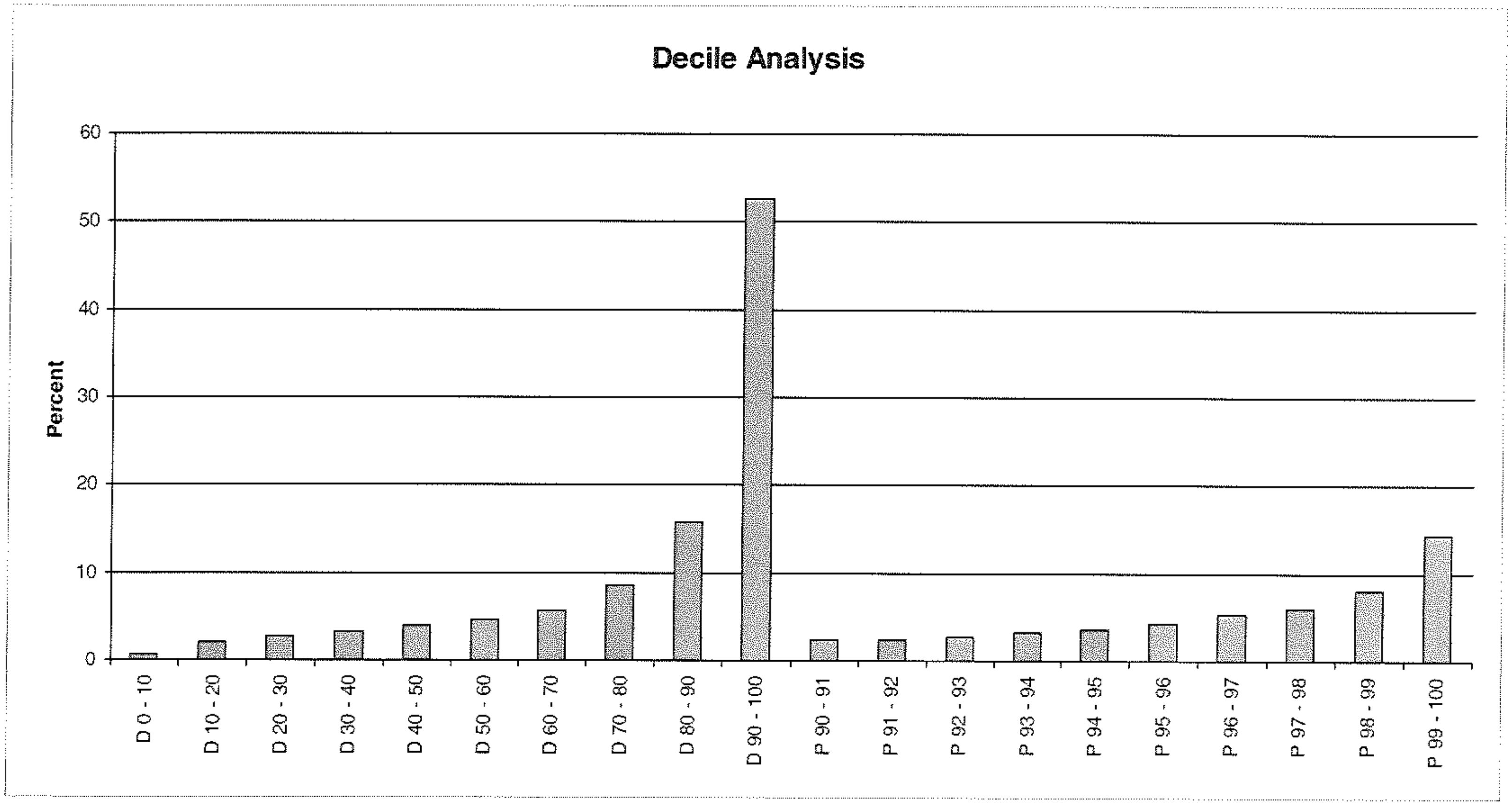
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1008	0.003	0.000	0.006	23.87	0.74	
	10	20	1008	0.008	0.006	0.010	65.61	2.05	
	20	30	1009	0.012	0.010	0.013	89.25	2.78	
	30	40	1009	0.014	0.013	0.016	106.40	3.32	
	40	50	1008	0.017	0.016	0.018	127.40	3.97	
	50	60	1009	0.020	0.018	0.022	147.23	4.59	
	60	70	1008	0.025	0.022	0.030	181.08	5.65	
	70	80	1008	0.038	0.030	0.050	272.99	8.52	
	80	90	1009	0.074	0.050	0.110	506.37	15.80	
	90	100	1009	0.273	0.110	4.170	1,685.08	52.57	>40 >2.3x
Percentile									
	90	91	101	0.116	0.110	0.122	77.38	2.41	
	91	92	101	0.128	0.122	0.135	78.34	2.44	
	92	93	101	0.141	0.135	0.149	90.58	2.83	
	93	94	100	0.159	0.149	0.169	105.68	3.30	
	94	95	101	0.182	0.169	0.199	116.60	3.64	
	95	96	101	0.218	0.200	0.236	139.66	4.36	
	96	97	101	0.259	0.237	0.287	168.60	5.26	
	97	98	101	0.313	0.287	0.348	190.91	5.96	
	98	99	101	0.404	0.349	0.482	256.96	8.02	
	99	100	101	0.811	0.482	4.170	460.38	14.36	>10 >1.75x
Total									
	0	100	10085	0.048	0.000	4.170	3,205.28	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 3000 >>> Cu%



PolyMet - Domain 3000 >>> Ni%

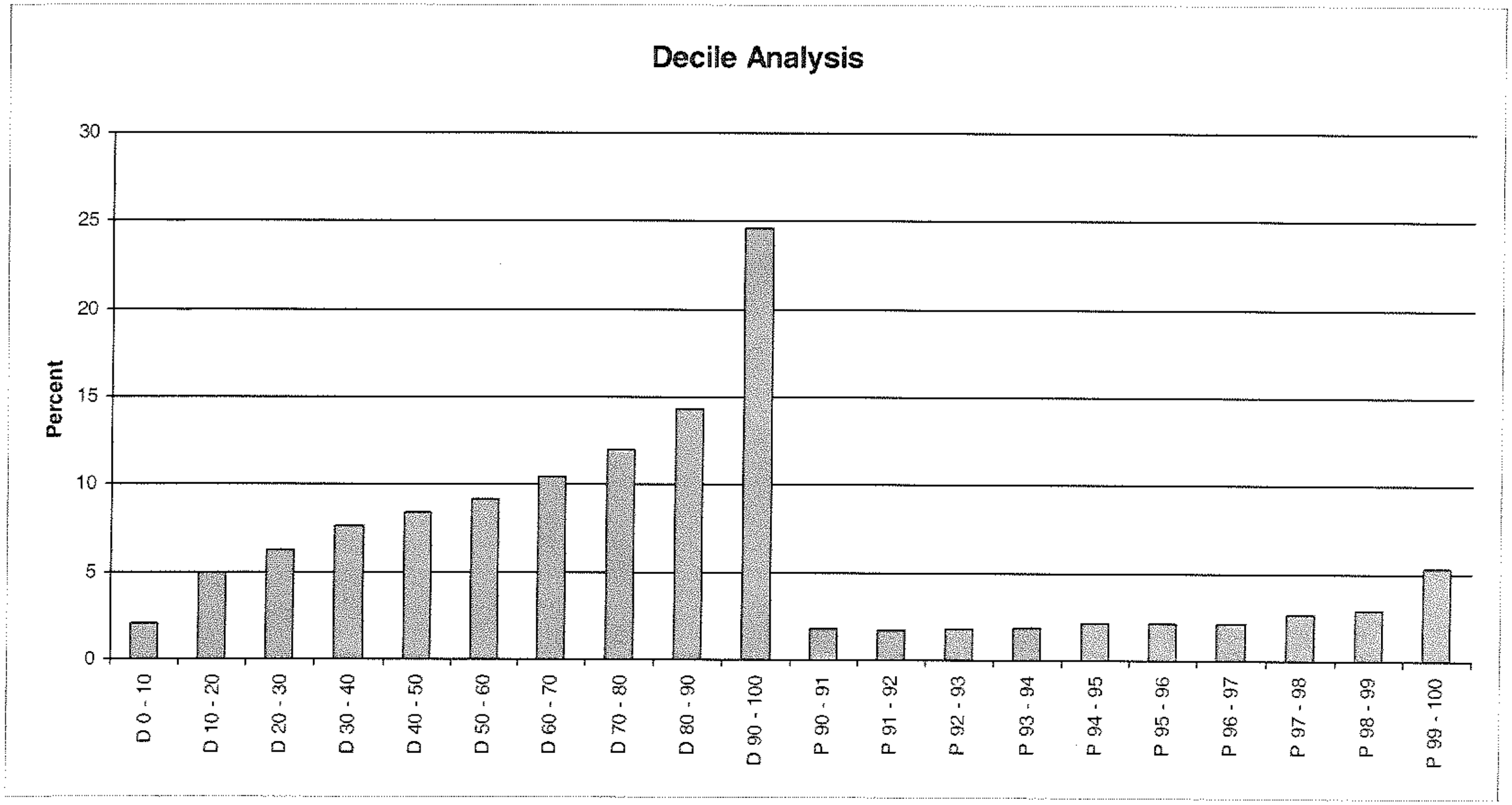
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1008	0.007	0.000	0.013	43.36	2.07	
	10	20	1008	0.015	0.013	0.017	103.28	4.94	
	20	30	1009	0.018	0.017	0.019	131.04	6.27	
	30	40	1009	0.020	0.019	0.021	160.43	7.67	
	40	50	1008	0.022	0.021	0.023	176.35	8.43	
	50	60	1009	0.025	0.023	0.027	192.28	9.19	
	60	70	1008	0.029	0.027	0.032	219.31	10.49	
	70	80	1008	0.035	0.032	0.038	250.23	11.96	
	80	90	1009	0.043	0.038	0.050	300.06	14.35	
	90	100	1009	0.081	0.050	2.359	514.99	24.63	<40 <2.3x
Percentile									
	90	91	101	0.052	0.050	0.053	37.14	1.78	
	91	92	101	0.054	0.053	0.055	36.40	1.74	
	92	93	101	0.057	0.055	0.058	38.44	1.84	
	93	94	100	0.060	0.058	0.062	40.04	1.91	
	94	95	101	0.065	0.063	0.067	44.25	2.12	
	95	96	101	0.070	0.068	0.074	45.05	2.15	
	96	97	101	0.077	0.074	0.081	45.02	2.15	
	97	98	101	0.086	0.081	0.092	55.25	2.64	
	98	99	101	0.101	0.092	0.113	61.62	2.95	
	99	100	101	0.190	0.114	2.359	111.79	5.35	<10 >1.75x
Total									
	0	100	10085	0.029	0.000	2.359	2,091.32	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 3000 >>> Ni%



PolyMet - Domain 3000 >>> Pd (ppb)

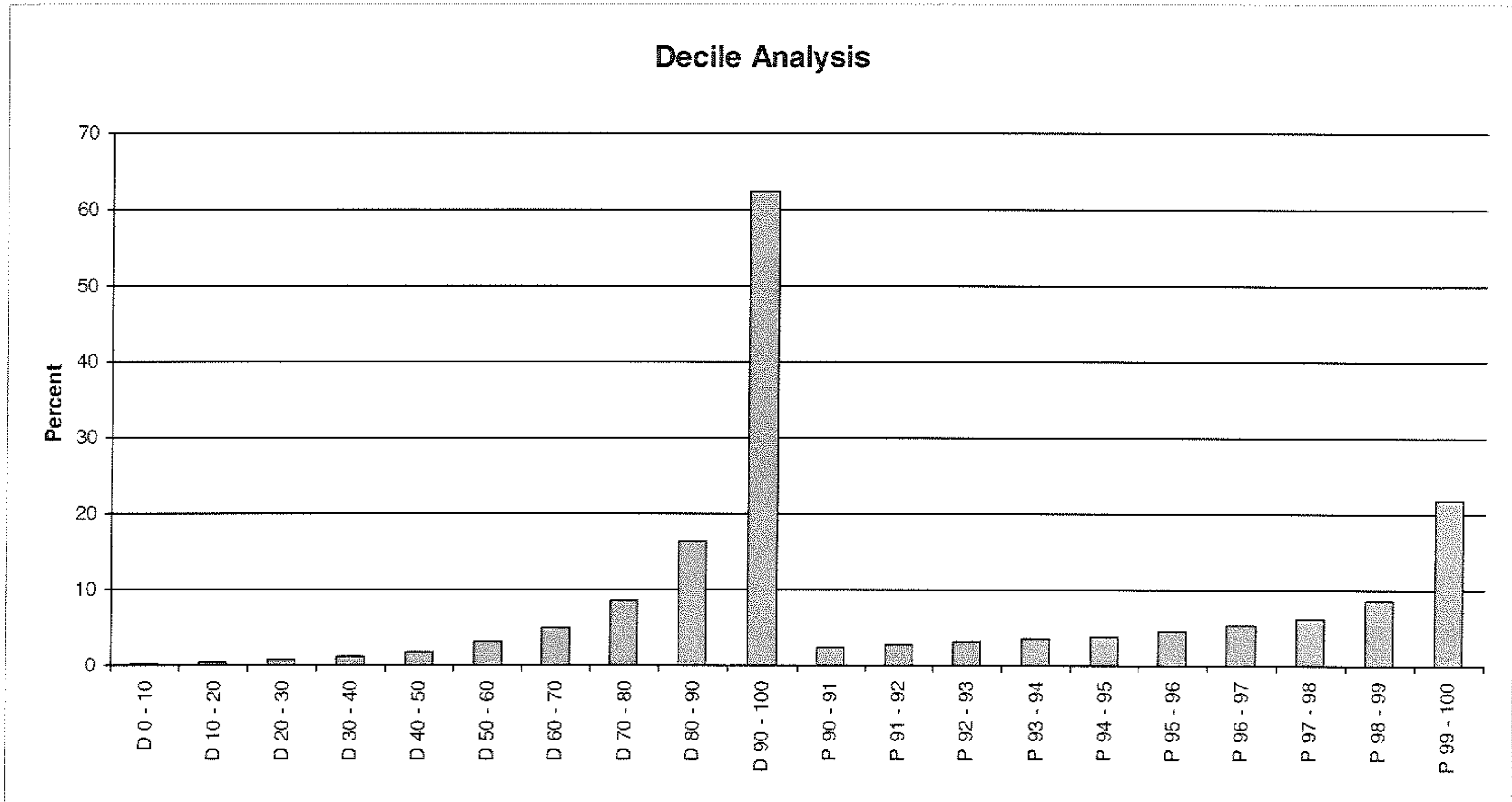
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1008	0.607	0.000	1.000	5,567.60	0.17	
	10	20	1008	1.980	1.000	2.000	13,240.40	0.40	
	20	30	1009	3.449	2.000	4.000	26,134.70	0.78	
	30	40	1009	5.592	4.000	7.000	41,843.70	1.25	
	40	50	1008	8.787	7.000	11.000	63,310.50	1.90	
	50	60	1009	13.541	11.000	17.000	104,319.70	3.12	
	60	70	1008	22.511	17.000	30.000	167,183.40	5.01	
	70	80	1008	39.932	30.000	54.000	284,146.50	8.51	
	80	90	1009	79.753	54.000	118.000	547,899.60	16.41	
	90	100	1009	330.604	118.000	6,610.000	2,085,316.60	62.45	>40 >2.3x
Percentile									
	90	91	101	123.436	118.000	129.000	82,161.40	2.46	
	91	92	101	135.941	129.000	144.000	93,268.40	2.79	
	92	93	101	154.366	144.000	163.000	106,583.50	3.19	
	93	94	100	173.440	164.000	187.000	117,022.00	3.50	
	94	95	101	198.941	187.000	213.000	130,214.70	3.90	
	95	96	101	230.020	213.000	249.000	151,351.60	4.53	
	96	97	101	273.376	250.000	299.000	183,243.90	5.49	
	97	98	101	341.119	300.000	394.000	206,237.60	6.18	
	98	99	101	475.129	394.000	568.000	290,231.50	8.69	
	99	100	101	1198.713	577.000	6,610.000	725,002.00	21.71	>10 >1.75x
Total									
	0	100	10085	50.693	0.000	6,610.000	3,338,962.70	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 3000 >>> Pd (ppb)



PolyMet - Domain 3000 >>> Pt (ppb)

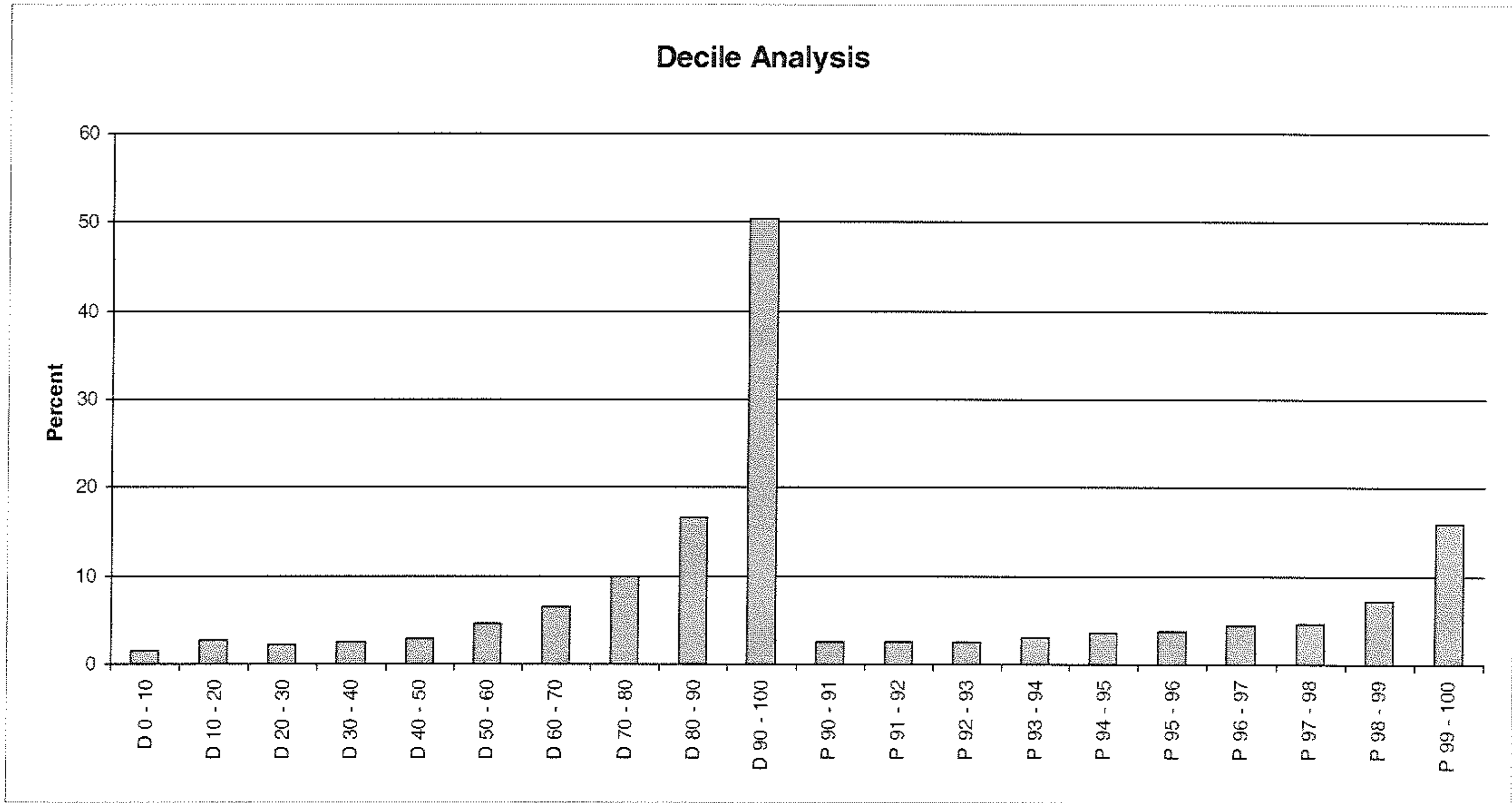
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1008	2.819	0.000	5.000	20,323.50	1.46	
	10	20	1008	5.000	5.000	5.000	39,349.00	2.82	
	20	30	1009	5.000	5.000	5.000	31,061.00	2.23	
	30	40	1009	5.000	5.000	5.000	36,167.50	2.60	
	40	50	1008	5.113	5.000	6.000	40,031.80	2.87	
	50	60	1009	8.046	6.000	10.000	63,839.60	4.58	
	60	70	1008	11.926	10.000	15.000	90,757.00	6.51	
	70	80	1008	18.438	15.000	24.000	137,345.00	9.86	
	80	90	1009	32.500	24.000	45.000	232,332.10	16.68	
	90	100	1009	107.564	45.000	4,780.000	702,056.30	50.39	>40 >2.3x
Percentile									
	90	91	101	46.317	45.000	49.000	35,772.00	2.57	
	91	92	101	50.653	49.000	54.000	35,885.00	2.58	
	92	93	101	55.891	54.000	58.000	36,644.20	2.63	
	93	94	100	61.350	59.000	65.000	41,819.60	3.00	
	94	95	101	68.842	65.000	74.000	49,137.40	3.53	
	95	96	101	79.069	74.000	85.000	53,111.40	3.81	
	96	97	101	93.208	85.000	100.000	61,179.80	4.39	
	97	98	101	113.317	100.000	125.000	65,634.70	4.71	
	98	99	101	152.743	125.000	185.000	100,024.50	7.18	
	99	100	101	353.792	185.000	4,780.000	222,847.70	15.99	>10 >1.75x
Total									
	0	100	10085	20.146	0.000	4,780.000	1,393,262.80	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 3000 >>> Pt (ppb)



PolyMet - Domain 3000 >>> Au (ppb)

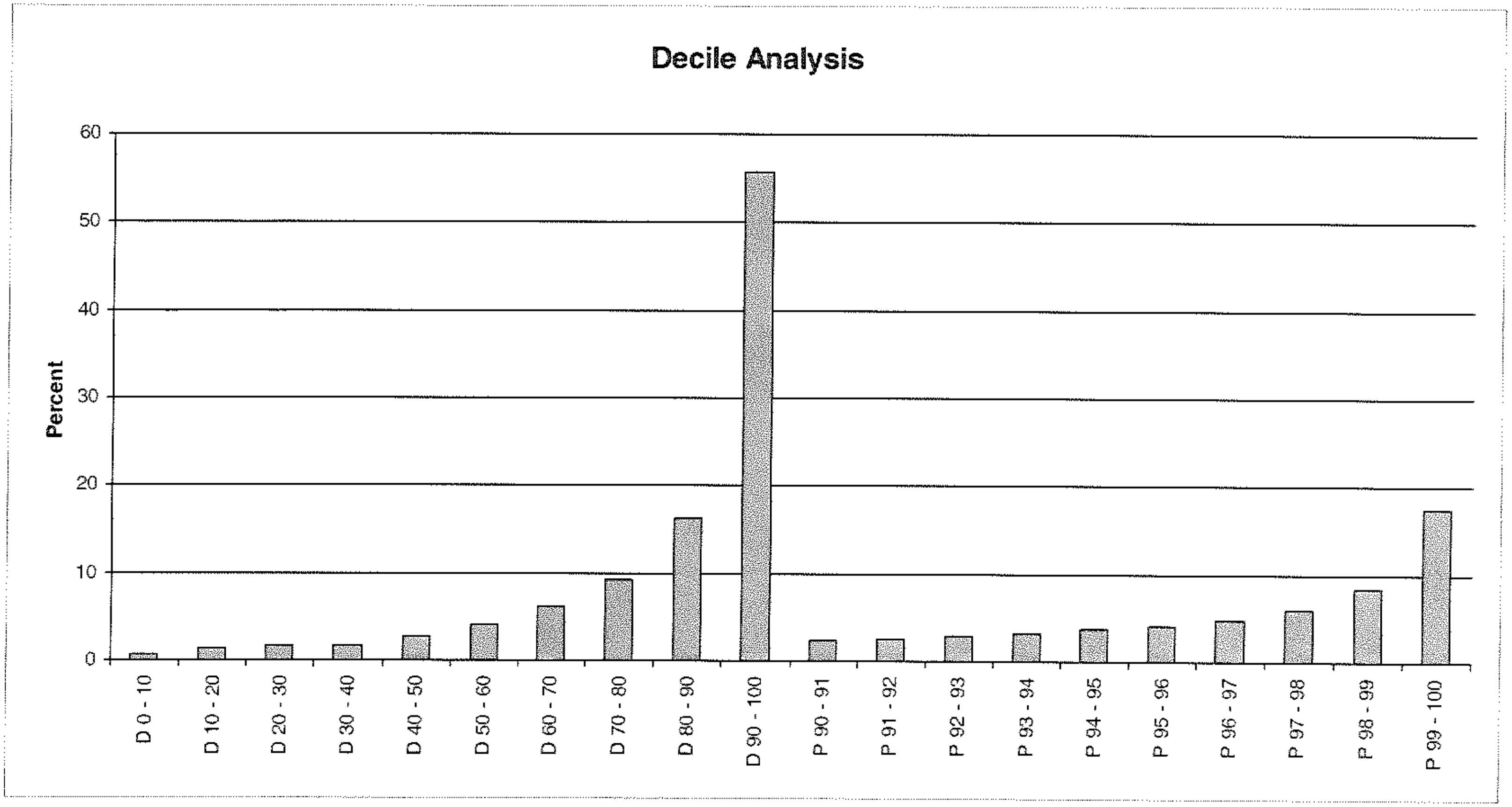
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1008	0.607	0.000	1.000	5,090.40	0.76	
	10	20	1008	1.000	1.000	1.000	9,079.90	1.36	
	20	30	1009	1.848	1.000	2.000	11,907.40	1.79	
	30	40	1009	2.000	2.000	2.000	11,776.20	1.77	
	40	50	1008	2.371	2.000	3.000	18,565.20	2.78	
	50	60	1009	3.722	3.000	4.000	27,188.00	4.08	
	60	70	1008	5.422	4.000	6.000	40,840.60	6.13	
	70	80	1008	8.491	6.000	11.000	61,991.50	9.30	
	80	90	1009	15.488	11.000	22.000	108,540.70	16.28	
	90	100	1009	58.578	22.000	1,490.000	371,641.70	55.75	>40 >2.3x
Percentile									
	90	91	101	23.188	22.000	24.000	15,641.90	2.35	
	91	92	101	25.277	24.000	27.000	17,416.00	2.61	
	92	93	101	28.752	27.000	30.000	19,316.40	2.90	
	93	94	100	32.770	30.000	34.000	21,827.90	3.27	
	94	95	101	36.663	34.000	39.000	25,533.80	3.83	
	95	96	101	42.158	39.000	46.000	27,702.70	4.16	
	96	97	101	50.594	46.000	56.000	32,485.00	4.87	
	97	98	101	61.812	56.000	70.000	39,950.80	5.99	
	98	99	101	86.109	70.000	106.000	55,547.30	8.33	
	99	100	101	198.198	106.000	1,490.000	116,219.90	17.43	>10 >1.75x
Total									
	0	100	10085	9.956	0.000	1,490.000	666,621.60	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 3000 >>> Au (ppb)



PolyMet - Domain 3000 >>> Co (ppm)

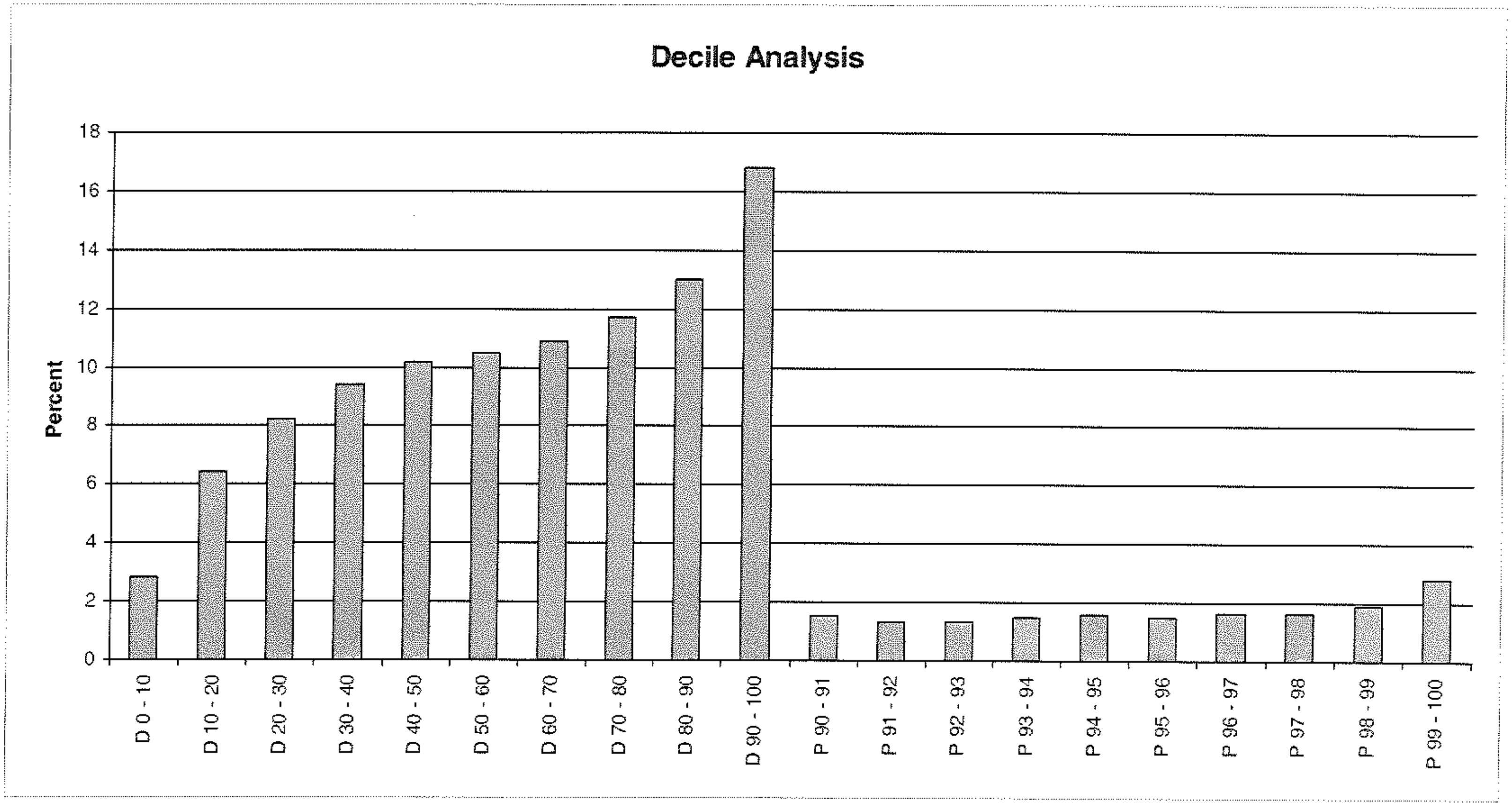
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1008	17.131	0.000	33.000	104,102.40	2.82	
	10	20	1008	36.149	33.000	39.000	238,079.00	6.44	
	20	30	1009	40.389	39.000	42.000	303,939.80	8.22	
	30	40	1009	43.247	42.000	45.000	348,562.30	9.43	
	40	50	1008	46.026	45.000	48.000	375,849.10	10.17	
	50	60	1009	49.248	48.000	51.000	388,381.00	10.51	
	60	70	1008	53.641	51.000	56.000	401,994.60	10.88	
	70	80	1008	59.873	56.000	64.000	433,722.60	11.74	
	80	90	1009	68.502	64.000	74.000	480,409.00	13.00	
	90	100	1009	93.481	74.000	421.000	620,582.30	16.79	<40 <2.3x
Percentile									
	90	91	101	75.040	74.000	76.000	56,206.50	1.52	
	91	92	101	76.465	76.000	77.000	49,145.30	1.33	
	92	93	101	78.178	77.000	79.000	49,487.40	1.34	
	93	94	100	80.540	79.000	82.000	54,415.40	1.47	
	94	95	101	83.792	82.000	85.000	58,194.10	1.57	
	95	96	101	87.079	85.000	89.000	55,482.90	1.50	
	96	97	101	91.960	89.000	95.000	61,395.70	1.66	
	97	98	101	98.584	95.000	103.000	61,174.00	1.66	
	98	99	101	109.861	103.000	117.000	71,135.70	1.92	
	99	100	101	153.178	117.000	421.000	103,945.30	2.81	<10 <1.75x
Total									
	0	100	10085	50.773	0.000	421.000	3,695,622.10	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 3000 >>> Co (ppm)



PolyMet - Domain 3000 >>> S%

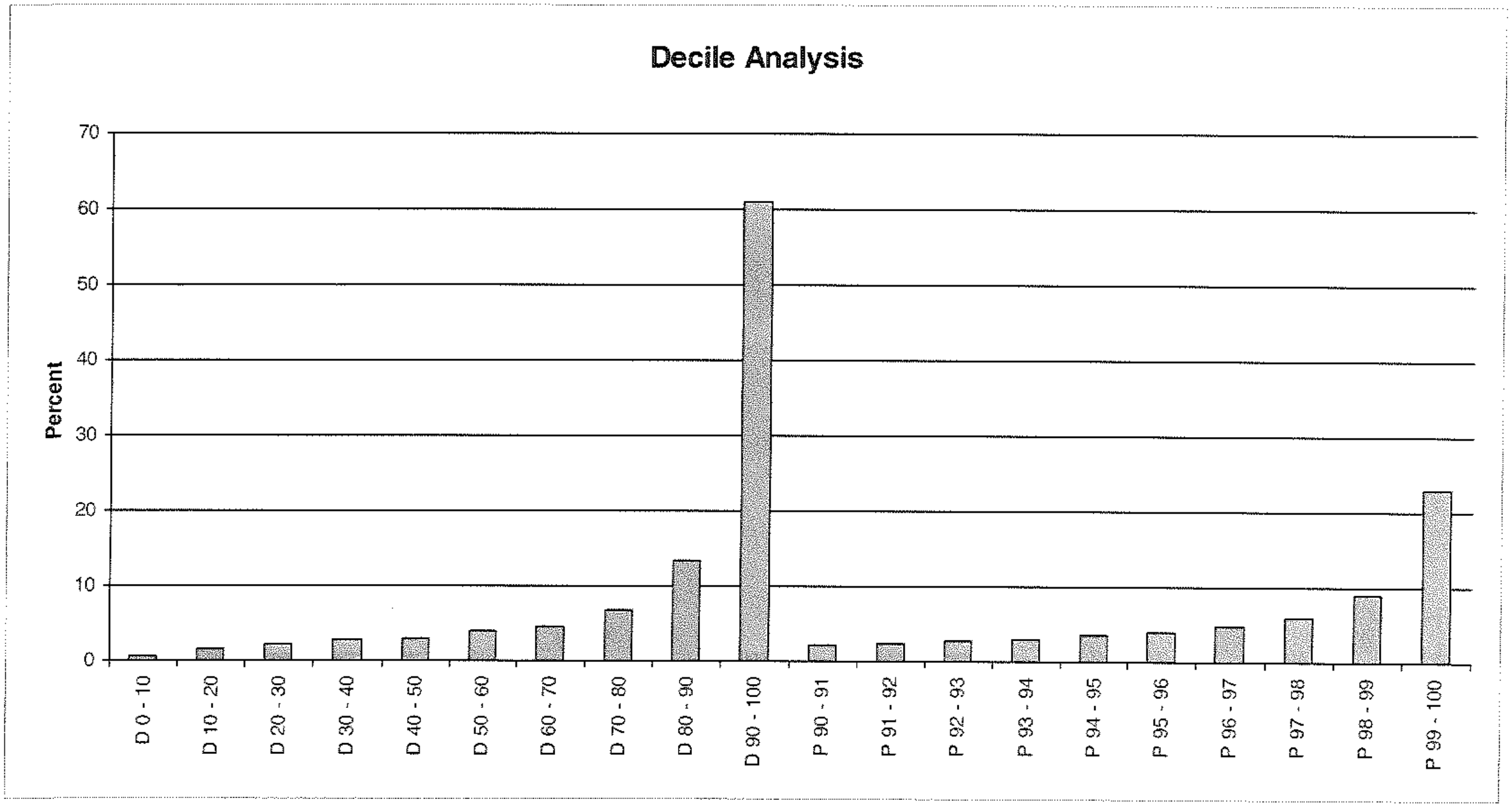
Sort	From	To	Sample	Mean	Min	Max	Metal	Percent	Notes
Decile									
	0	10	1008	0.006	0.000	0.010	45.82	0.53	
	10	20	1008	0.016	0.010	0.020	135.94	1.59	
	20	30	1009	0.025	0.020	0.030	187.55	2.19	
	30	40	1009	0.030	0.030	0.030	245.50	2.87	
	40	50	1008	0.038	0.030	0.040	265.11	3.09	
	50	60	1009	0.045	0.040	0.050	343.49	4.01	
	60	70	1008	0.057	0.050	0.070	393.95	4.60	
	70	80	1008	0.085	0.070	0.110	584.88	6.83	
	80	90	1009	0.168	0.110	0.260	1,142.70	13.34	
	90	100	1009	0.820	0.260	12.220	5,221.29	60.95	>40 >2.3x
Percentile									
	90	91	101	0.279	0.260	0.290	185.67	2.17	
	91	92	101	0.307	0.290	0.320	210.20	2.45	
	92	93	101	0.343	0.320	0.360	231.39	2.70	
	93	94	100	0.388	0.360	0.410	264.27	3.09	
	94	95	101	0.454	0.410	0.490	310.93	3.63	
	95	96	101	0.543	0.490	0.600	344.90	4.03	
	96	97	101	0.665	0.600	0.740	414.41	4.84	
	97	98	101	0.857	0.740	1.000	514.26	6.00	
	98	99	101	1.234	1.010	1.660	768.28	8.97	
	99	100	101	3.124	1.660	12.220	1,976.97	23.08	>10 >1.75x
Total									
	0	100	10085	0.129	0.000	12.220	8,566.23	100.00	

Interpretation notes:

Cutting is warranted if:
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 3000 >>> S %



PolyMet - Domain 20 >>> Cu%

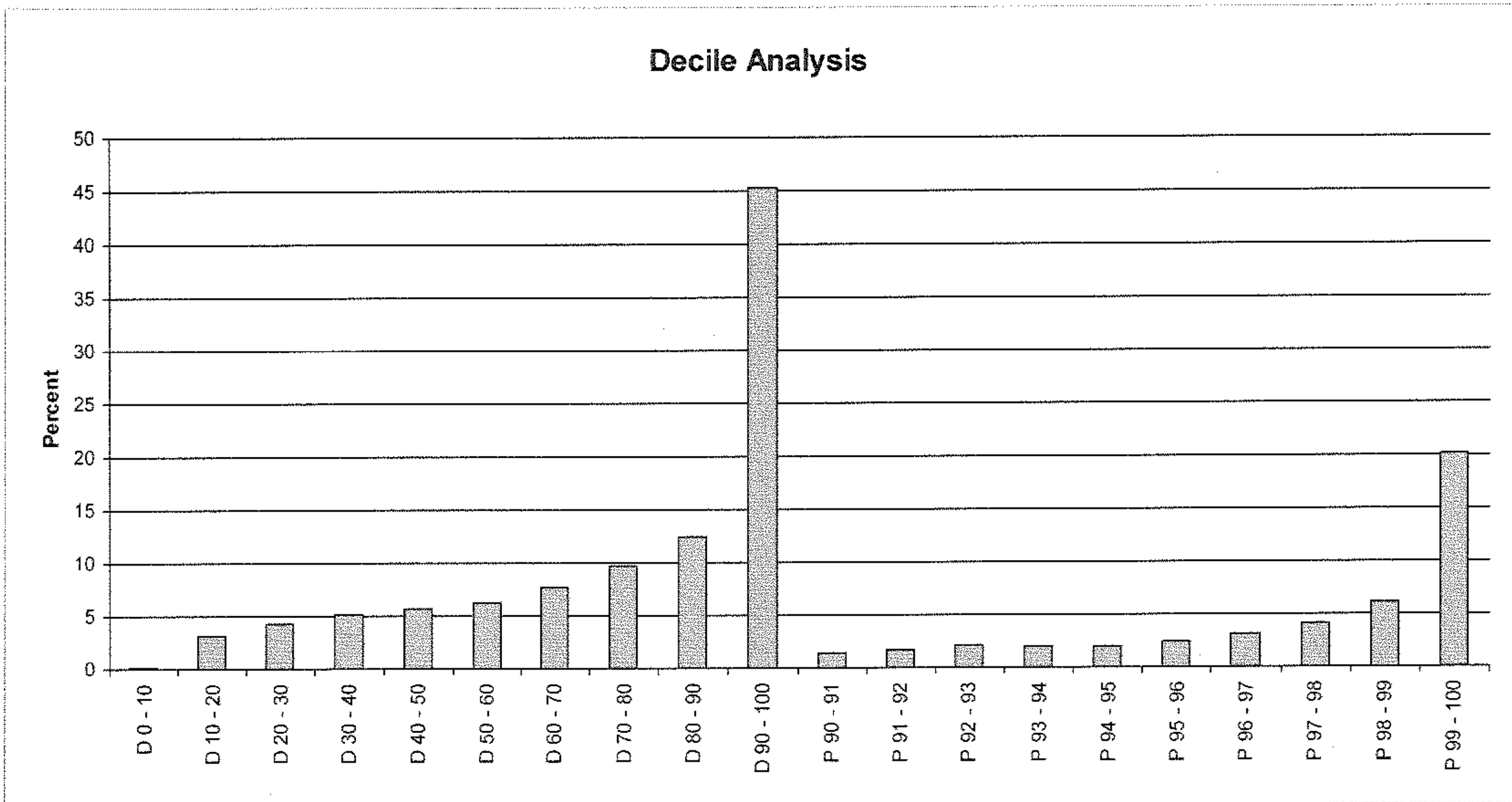
From	To	Count	Mean	Min	Max	Metal	Percent	Capping Note
Decile								
0	10	179	0.000	0.000	0.004	0.39	0.14	
10	20	179	0.006	0.004	0.008	9.09	3.19	
20	30	179	0.009	0.008	0.010	12.28	4.31	
30	40	180	0.010	0.010	0.011	14.53	5.10	
40	50	179	0.012	0.011	0.013	16.42	5.76	
50	60	179	0.014	0.013	0.015	17.92	6.29	
60	70	180	0.017	0.015	0.018	22.18	7.78	
70	80	179	0.020	0.018	0.022	27.81	9.76	
80	90	179	0.026	0.022	0.035	35.32	12.40	
90	100	180	0.109	0.035	0.744	129.01	45.27	>40 >2.3x -- <50 >3x
Percentile								
90	91	18	0.036	0.035	0.037	4.11	1.44	
91	92	18	0.039	0.037	0.041	4.90	1.72	
92	93	18	0.043	0.041	0.045	6.07	2.13	
93	94	18	0.048	0.045	0.050	5.79	2.03	
94	95	18	0.058	0.051	0.063	5.65	1.98	
95	96	18	0.072	0.066	0.076	6.91	2.43	
96	97	18	0.090	0.077	0.099	8.84	3.10	
97	98	18	0.120	0.103	0.138	11.83	4.15	
98	99	18	0.173	0.140	0.241	17.35	6.09	
99	100	18	0.417	0.257	0.744	57.57	20.20	>10 >1.75x -- >15 >2x
Total								
0	100	1793	0.022	0.000	0.744	284.96	100.00	

Interpretation notes:

Capping is warranted if
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 20 >>> Cu%



PolyMet - Domain 20 >>> Ni%

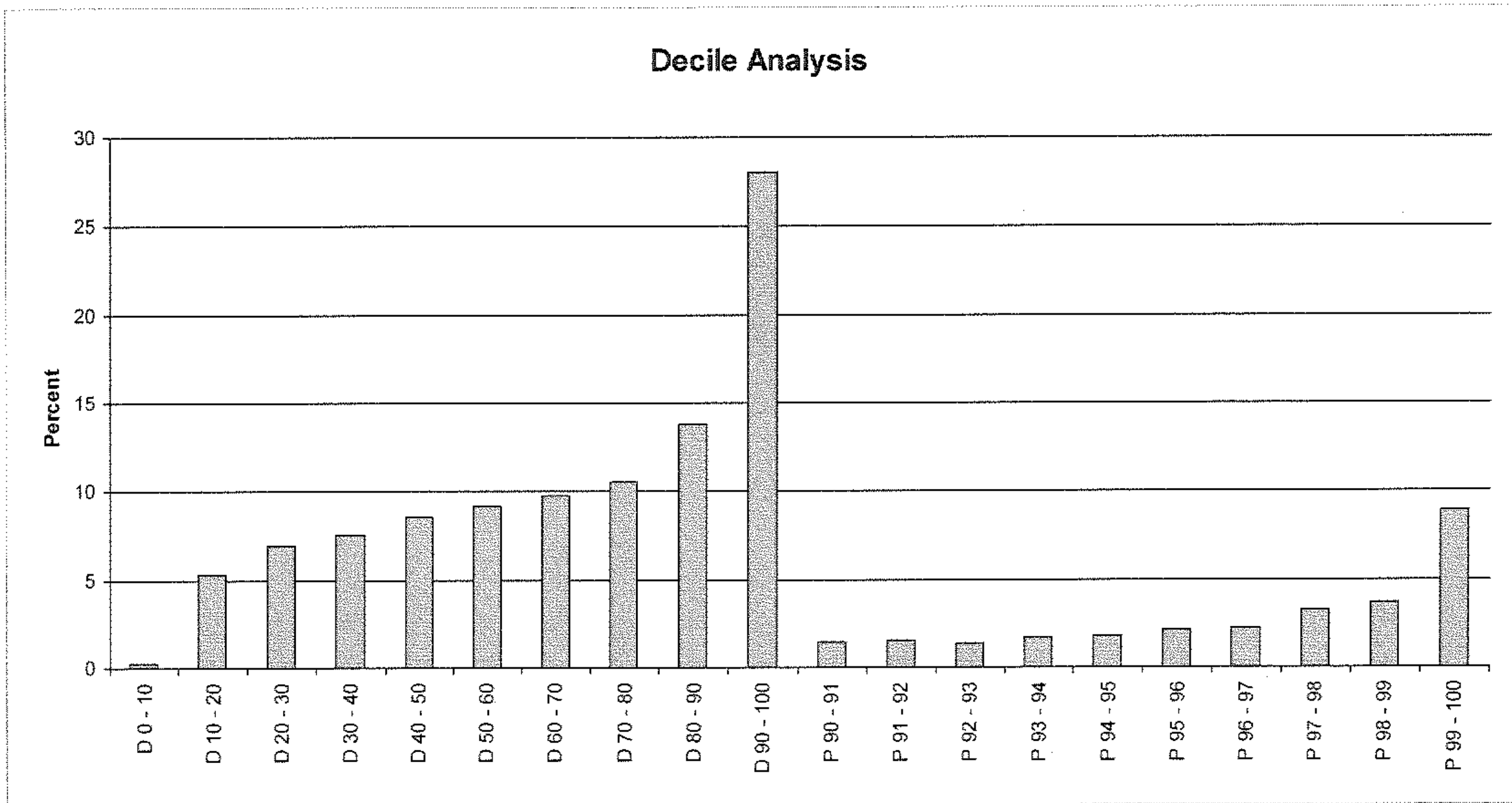
From	To	Count	Mean	Min	Max	Metal	Percent	Capping Note
Decile								
0	10	179	0.000	0.000	0.005	0.49	0.29	
10	20	179	0.007	0.005	0.008	8.97	5.32	
20	30	179	0.008	0.008	0.009	11.69	6.93	
30	40	180	0.009	0.009	0.009	12.79	7.58	
40	50	179	0.010	0.009	0.010	14.43	8.56	
50	60	179	0.011	0.010	0.011	15.50	9.19	
60	70	180	0.012	0.011	0.013	16.51	9.79	
70	80	179	0.015	0.013	0.016	17.79	10.55	
80	90	179	0.018	0.016	0.020	23.21	13.77	
90	100	180	0.040	0.020	0.181	47.25	28.02	<40 <2.3x -- <50 <3x
Percentile								
90	91	18	0.021	0.020	0.021	2.50	1.48	
91	92	18	0.022	0.021	0.022	2.58	1.53	
92	93	18	0.023	0.022	0.023	2.26	1.34	
93	94	18	0.024	0.023	0.025	2.82	1.67	
94	95	18	0.027	0.025	0.029	3.05	1.81	
95	96	18	0.031	0.029	0.034	3.66	2.17	
96	97	18	0.037	0.034	0.041	3.72	2.21	
97	98	18	0.045	0.041	0.050	5.42	3.21	
98	99	18	0.062	0.050	0.078	6.14	3.64	
99	100	18	0.112	0.078	0.181	15.10	8.96	<10 >1.75x -- <15 >2x
Total								
0	100	1793	0.013	0.000	0.181	168.64	100.00	

Interpretation notes:

Capping is warranted if
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 20 >>> Ni%



PolyMet - Domain 20 >>> Pd (ppb)

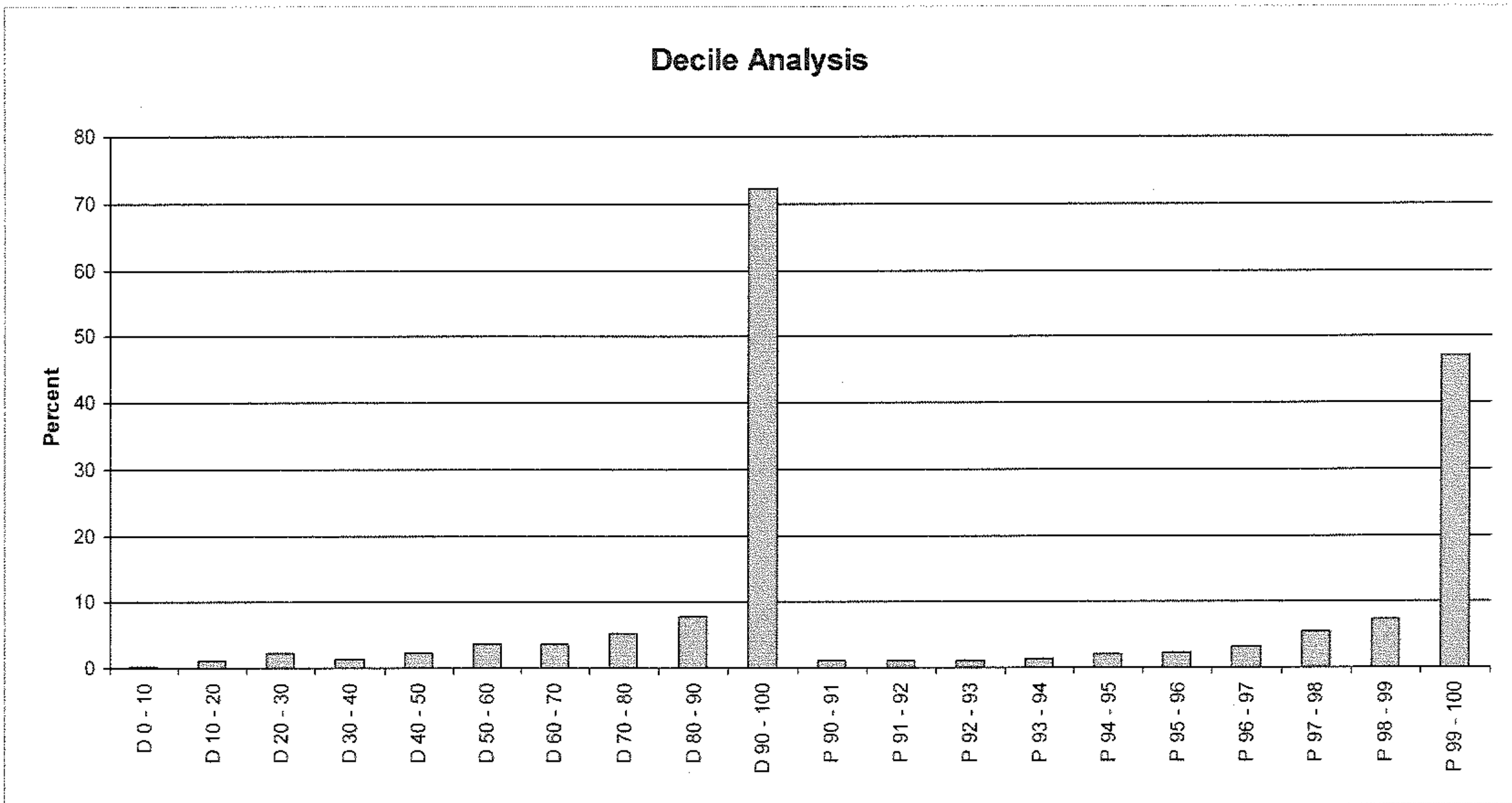
From	To	Count	Mean	Min	Max	Metal	Percent	Capping Note
Decile								
0	10	179	0.123	0.000	1.000	187.50	0.14	
10	20	179	1.106	1.000	2.000	1,702.40	1.25	
20	30	179	2.000	2.000	2.000	3,031.80	2.22	
30	40	180	2.000	2.000	2.000	1,980.00	1.45	
40	50	179	2.335	2.000	3.000	3,202.10	2.34	
50	60	179	3.061	3.000	4.000	5,029.10	3.68	
60	70	180	4.000	4.000	4.000	5,143.20	3.76	
70	80	179	5.380	4.000	6.000	7,037.60	5.15	
80	90	179	8.503	6.000	11.000	10,730.90	7.85	
90	100	180	79.978	11.000	2,453.000	98,640.90	72.17	>40 >2.3x -- >50 >3x
Percentile								
90	91	18	11.889	11.000	12.000	1,426.00	1.04	
91	92	18	13.056	12.000	14.000	1,513.50	1.11	
92	93	18	15.056	14.000	18.000	1,659.60	1.21	
93	94	18	19.278	18.000	21.000	1,851.00	1.35	
94	95	18	23.944	21.000	27.000	2,656.50	1.94	
95	96	18	30.556	27.000	34.000	3,240.80	2.37	
96	97	18	44.111	36.000	52.000	4,423.50	3.24	
97	98	18	65.556	52.000	86.000	7,420.00	5.43	
98	99	18	109.944	86.000	142.000	10,033.50	7.34	
99	100	18	466.389	150.000	2,453.000	64,416.50	47.13	>10 >1.75x -- >15 >2x
Total								
0	100	1793	10.878	0.000	2,453.000	136,685.50	100.00	

Interpretation notes:

Capping is warranted if
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 20 >>> Pd (ppb)



PolyMet - Domain 20 >>> Pt (ppb)

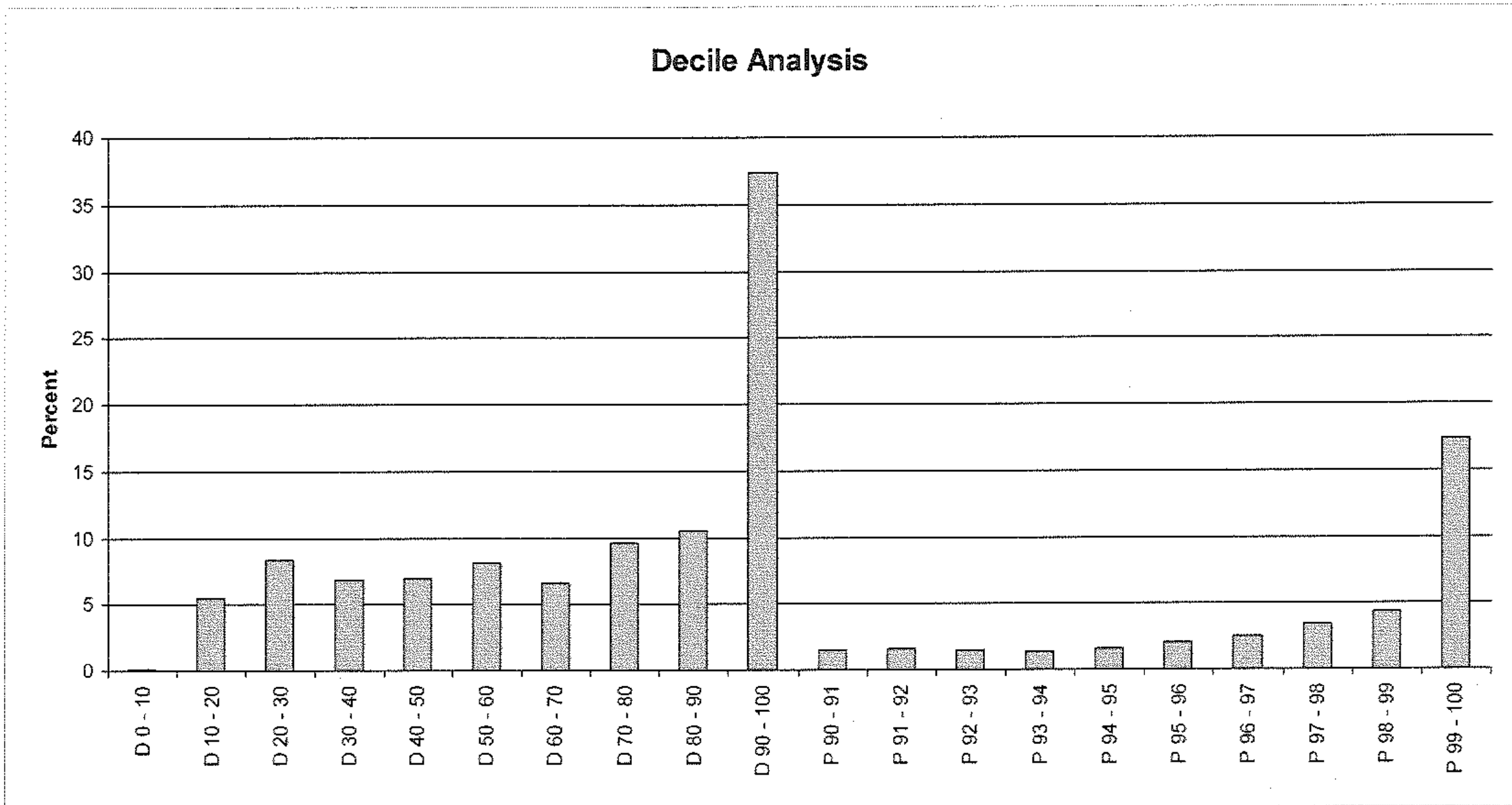
From	To	Count	Mean	Min	Max	Metal	Percent	Capping Note
Decile								
0	10	179	0.162	0.000	2.000	145.00	0.17	
10	20	179	4.441	2.000	5.000	4,758.50	5.45	
20	30	179	5.000	5.000	5.000	7,330.00	8.40	
30	40	180	5.000	5.000	5.000	5,970.00	6.84	
40	50	179	5.000	5.000	5.000	6,100.00	6.99	
50	60	179	5.000	5.000	5.000	7,107.50	8.14	
60	70	180	5.000	5.000	5.000	5,787.50	6.63	
70	80	179	5.000	5.000	5.000	8,330.00	9.54	
80	90	179	5.844	5.000	8.000	9,163.00	10.50	
90	100	180	24.533	8.000	412.000	32,590.20	37.34	<40 >2.3x -- <50 >3x
Percentile								
90	91	18	8.000	8.000	8.000	1,256.00	1.44	
91	92	18	8.833	8.000	9.000	1,423.50	1.63	
92	93	18	9.722	9.000	10.000	1,319.00	1.51	
93	94	18	10.000	10.000	10.000	1,240.00	1.42	
94	95	18	10.444	10.000	11.000	1,371.70	1.57	
95	96	18	13.056	12.000	15.000	1,837.00	2.10	
96	97	18	17.222	15.000	20.000	2,189.00	2.51	
97	98	18	24.000	20.000	29.000	2,947.50	3.38	
98	99	18	36.500	29.000	52.000	3,817.00	4.37	
99	100	18	107.556	52.000	412.000	15,189.50	17.40	>10 >1.75x -- >15 >2x
Total								
0	100	1793	6.506	0.000	412.000	87,281.70	100.00	

Interpretation notes:

Capping is warranted if
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 20 >>> Pt (ppb)



PolyMet - Domain 20 >>> Au (ppb)

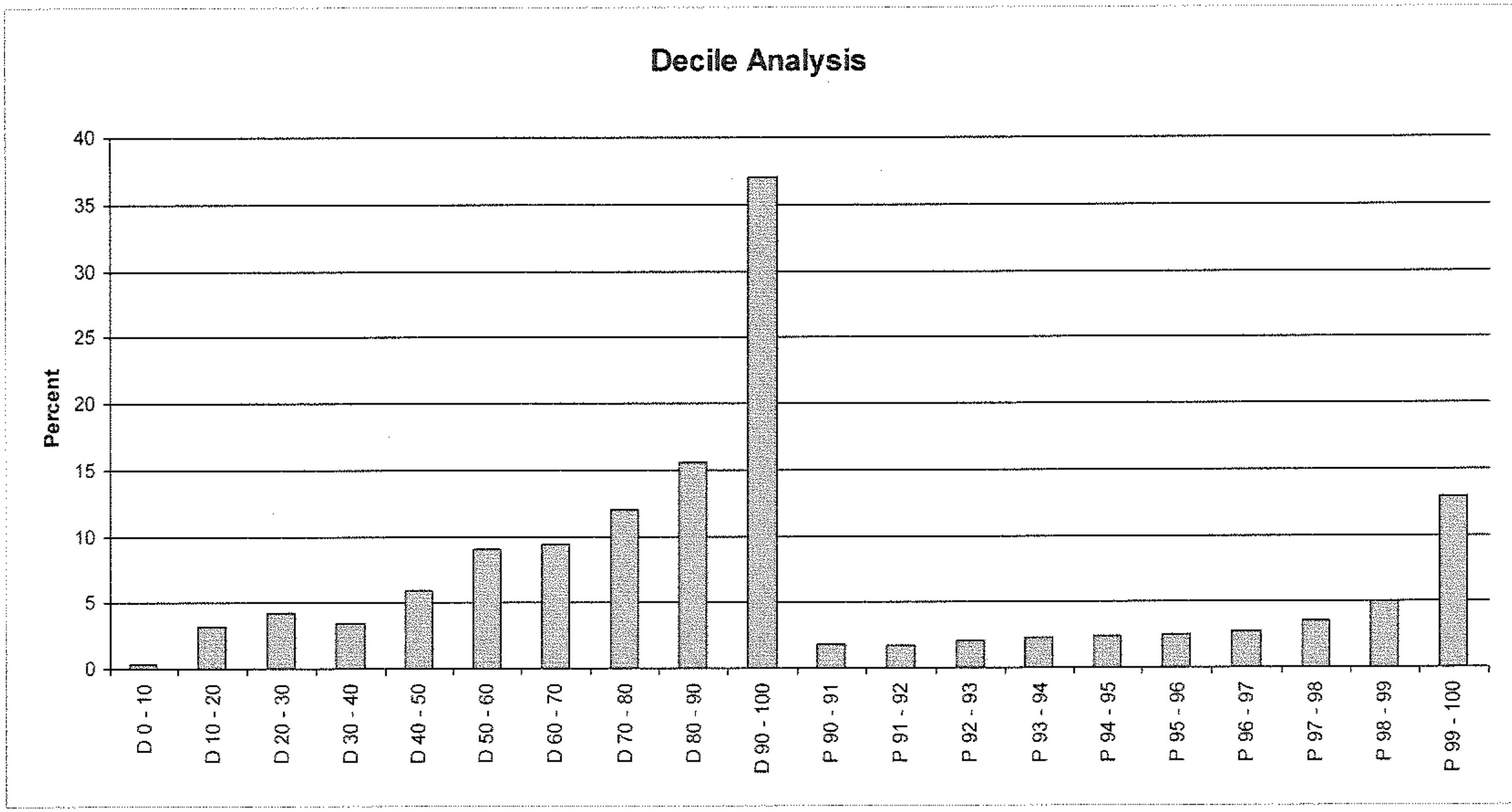
From	To	Count	Mean	Min	Max	Metal	Percent	Capping Note
Decile								
0	10	179	0.123	0.000	1.000	181.40	0.32	
10	20	179	1.425	1.000	2.000	1,831.00	3.21	
20	30	179	2.000	2.000	2.000	2,399.60	4.20	
30	40	180	2.000	2.000	2.000	1,972.00	3.45	
40	50	179	2.508	2.000	3.000	3,372.80	5.91	
50	60	179	3.235	3.000	4.000	5,150.00	9.02	
60	70	180	4.000	4.000	4.000	5,338.00	9.35	
70	80	179	4.609	4.000	5.000	6,825.80	11.95	
80	90	179	6.073	5.000	7.000	8,887.70	15.56	
90	100	180	15.528	7.000	81.000	21,144.40	37.03	<40 >2.3x -- <50 <3x
Percentile								
90	91	18	7.333	7.000	8.000	1,013.30	1.77	
91	92	18	8.000	8.000	8.000	952.00	1.67	
92	93	18	8.000	8.000	8.000	1,192.00	2.09	
93	94	18	8.944	8.000	10.000	1,301.50	2.28	
94	95	18	10.333	10.000	11.000	1,355.50	2.37	
95	96	18	11.778	11.000	13.000	1,446.40	2.53	
96	97	18	14.056	13.000	15.000	1,585.00	2.78	
97	98	18	16.556	15.000	18.000	2,023.40	3.54	
98	99	18	22.944	19.000	27.000	2,902.30	5.08	
99	100	18	47.333	29.000	81.000	7,373.00	12.91	>10 >1.75x -- <15 >2x
Total								
0	100	1793	4.155	0.000	81.000	57,102.70	100.00	

Interpretation notes:

Capping is warranted if
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 20 >>> Au (ppb)



PolyMet - Domain 20 >>> Co (ppm)

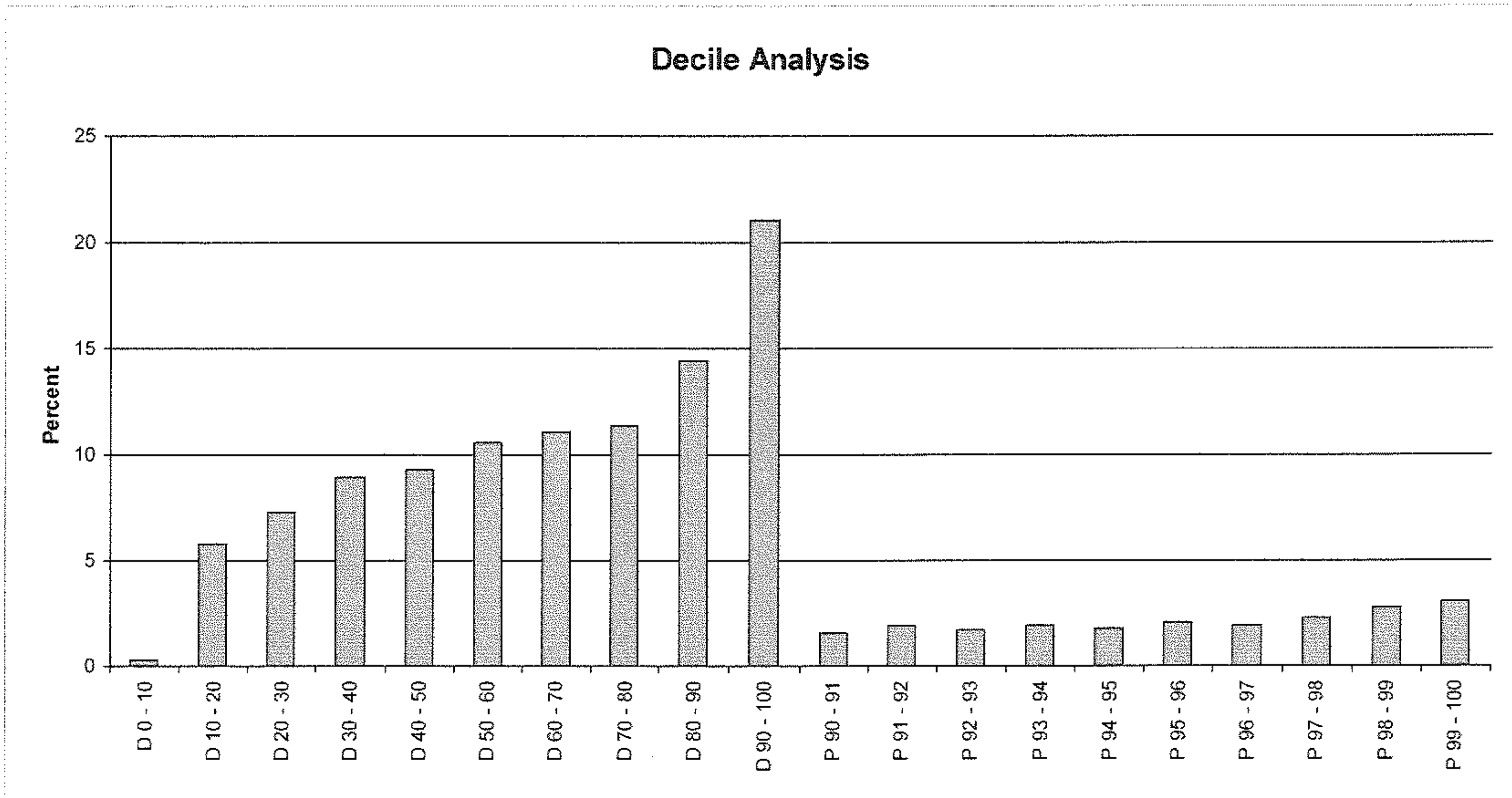
From	To	Count	Mean	Min	Max	Metal	Percent	Capping Note
Decile								
0	10	179	1.212	0.000	13.000	1,068.50	0.30	
10	20	179	16.894	13.000	19.000	20,577.30	5.79	
20	30	179	20.168	19.000	21.000	25,994.50	7.31	
30	40	180	22.222	21.000	23.000	31,762.50	8.94	
40	50	179	24.235	23.000	25.000	32,942.50	9.27	
50	60	179	26.190	25.000	27.000	37,506.70	10.55	
60	70	180	28.278	27.000	29.000	39,242.30	11.04	
70	80	179	31.358	29.000	33.000	40,311.50	11.34	
80	90	179	37.855	33.000	43.000	51,165.80	14.40	
90	100	180	56.872	43.000	188.000	74,830.80	21.06	<40 <2.3x -- <50 <3x
Percentile								
90	91	18	43.556	43.000	44.000	5,620.50	1.58	
91	92	18	44.667	44.000	45.000	6,920.50	1.95	
92	93	18	45.944	45.000	47.000	6,109.00	1.72	
93	94	18	47.222	47.000	48.000	6,960.50	1.96	
94	95	18	49.111	48.000	50.000	6,261.00	1.76	
95	96	18	51.556	50.000	53.000	7,378.00	2.08	
96	97	18	54.944	53.000	57.000	6,826.00	1.92	
97	98	18	60.278	57.000	66.000	8,114.70	2.28	
98	99	18	71.556	67.000	75.000	9,814.00	2.76	
99	100	18	99.889	76.000	188.000	10,826.60	3.05	<10 <1.75x -- <15 <2x
Total								
0	100	1793	26.544	0.000	188.000	355,402.40	100.00	

Interpretation notes:

Capping is warranted if
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 20 >>> Co (ppm)



PolyMet - Domain 20 >>> S%

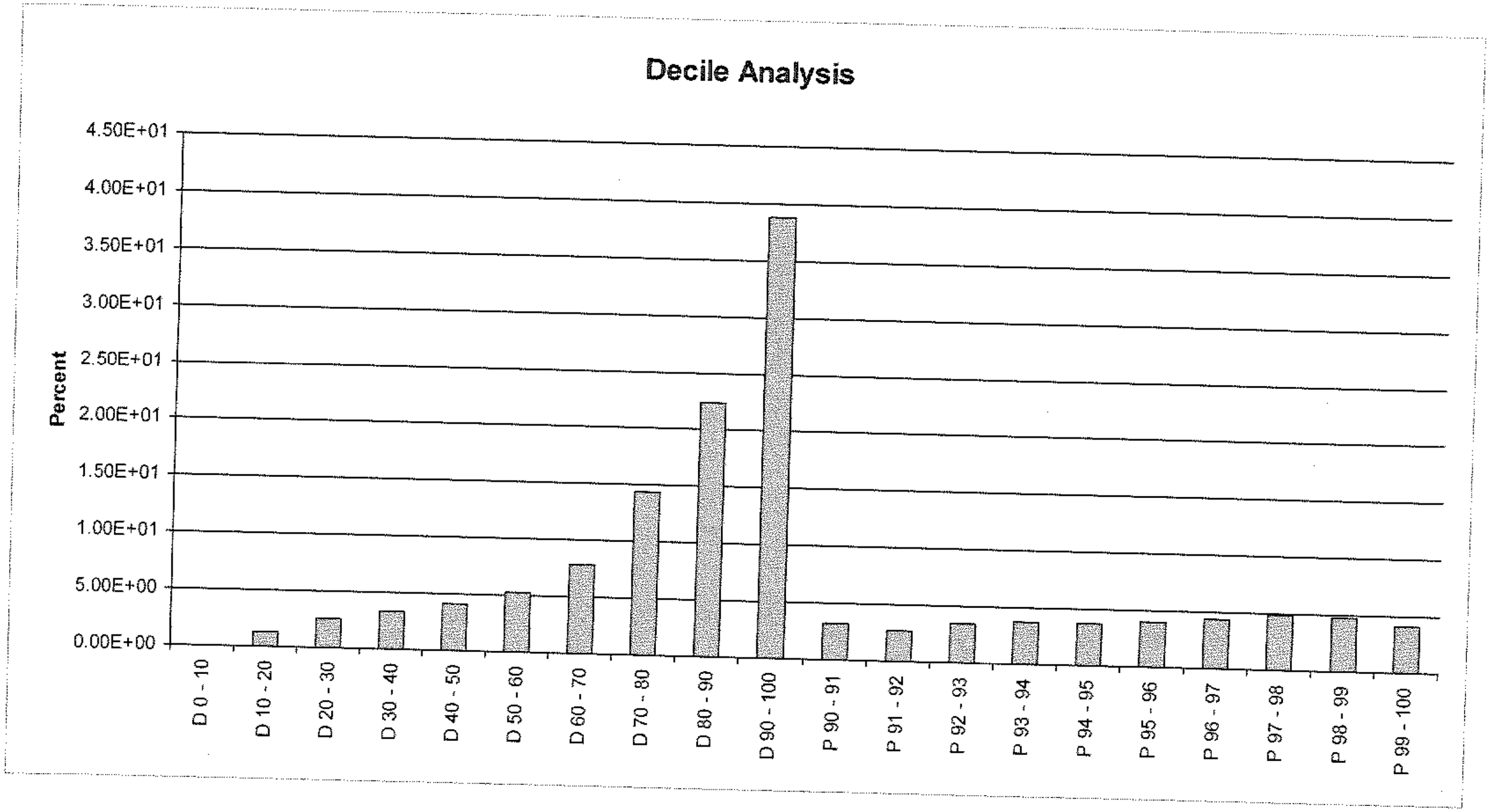
From	To	Count	Mean	Min	Max	Metal	Percent	Capping Note
Decile								
0	10	179	0.003	0.000	0.040	3.71	0.02	
10	20	179	0.148	0.040	0.220	203.57	1.23	
20	30	179	0.266	0.220	0.310	416.01	2.51	
30	40	180	0.354	0.310	0.400	547.05	3.30	
40	50	179	0.460	0.400	0.520	680.28	4.11	
50	60	179	0.636	0.520	0.770	874.02	5.28	
60	70	180	1.107	0.780	1.500	1,301.49	7.86	
70	80	179	2.083	1.530	2.640	2,385.26	14.41	
80	90	179	3.222	2.640	4.007	3,712.95	22.43	
90	100	180	5.021	4.007	8.290	6,431.18	38.85	<40 <2.3x -- <50 <3x
Percentile								
90	91	18	4.078	4.007	4.136	536.73	3.24	
91	92	18	4.226	4.140	4.300	437.62	2.64	
92	93	18	4.425	4.300	4.510	566.07	3.42	
93	94	18	4.589	4.520	4.644	621.92	3.76	
94	95	18	4.755	4.666	4.850	617.72	3.73	
95	96	18	4.963	4.882	5.033	668.69	4.04	
96	97	18	5.130	5.033	5.249	718.41	4.34	
97	98	18	5.479	5.270	5.620	812.78	4.91	
98	99	18	5.826	5.648	6.080	777.28	4.69	
99	100	18	6.743	6.091	8.290	673.96	4.07	<10 <1.75x -- <15 <2x
Total								
0	100	1793	1.332	0.000	8.290	16,555.52	100.00	

Interpretation notes:

Capping is warranted if
The last decile has more than 40 percent of metal; or,
the last decile contains more than 2.3 times the metal quantity contained in the one before last; or,
the last centile contains more than 10 percent of metal; or,
the last centile contains more than 1.75 times the metal quantity contained in the one before last.

Exception will be made if all following conditions are met:
The last decile has more than 50 percent metal; and,
the last decile contains more than 3 times the metal quantity contained in the one before last; and,
the last centile contains more than 15 percent of the metal; and,
the last centile contains more than 2 times the metal quantity contained in the one before last.

PolyMet - Domain 20 >>> S%



NorthMet Project - Capping Matrix (from Decile analysis)

Domain	Cu%	Ni%	Pd (ppb)	Pt (ppb)	Au (ppb)	Co (ppm)	S%	Notes
1001 and 1003 (Dom1)	No	No	No	No	No	No	No	Bulk of the Ore i.e. 0.249% Cu
2000 (Magenta Zone)	No	No	No	No	No	No	No	Bulk of the Ore i.e. 0.255% Cu
1 (Unit 1 excluding Dom1)	Border line	Border line	Yes	Yes	Yes	No	Yes	Low grade i.e. 0.095% Cu
3000 (Unit 3, 4, 5, 6 and 7 excluding Dom1 and Magenta zone)	Yes	No	Yes	Yes	Yes	No	Yes	Low grade i.e. 0.048% Cu
20 (Virginia formation)	Yes	Border line	Yes	Border line	Border line	No	No	Grades are low except for S

NorthMet Project - Decile analysis 99% average

Domain	Cu%	Ni%	Pd (ppb)	Pt (ppb)	Au (ppb)	Co (ppm)	S%	Notes
1001 and 1003 (Dom1)	1.2	0.3	1670	452	323	240	5.7	
2000 (Magenta Zone)	1.1	0.22	1688	657	171	132	1.98	
1 (Unit 1 excluding Dom1)	0.9	0.256	976	271	210	167	5	
3000 (Unit 3, 4, 5, 6 and 7 excluding Dom1 and Magenta zone)	0.81	0.19	1199	354	198	153	3.12	
20 (Virginia formation)	0.42	0.013	466	107	47	100	6.74	

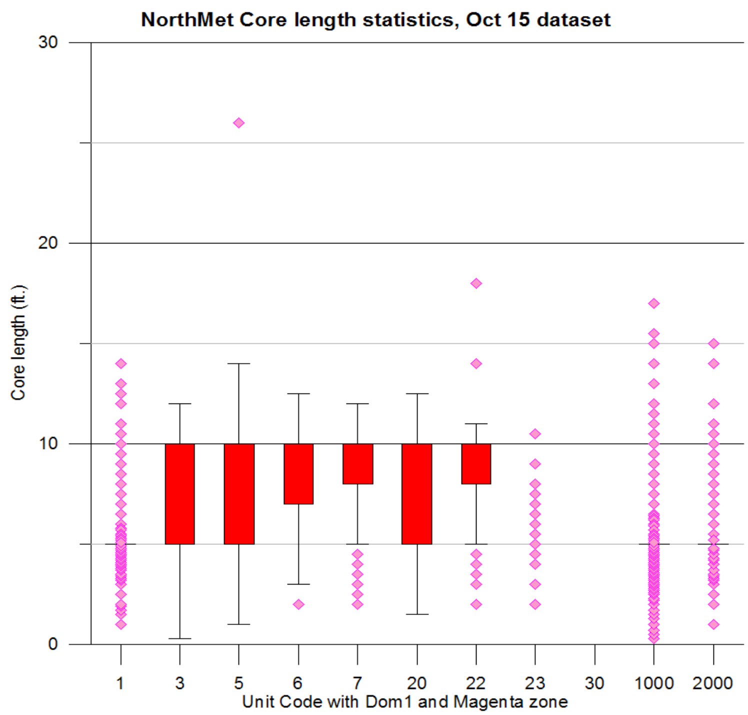
NorthMet Project - Histograms capping level suggested

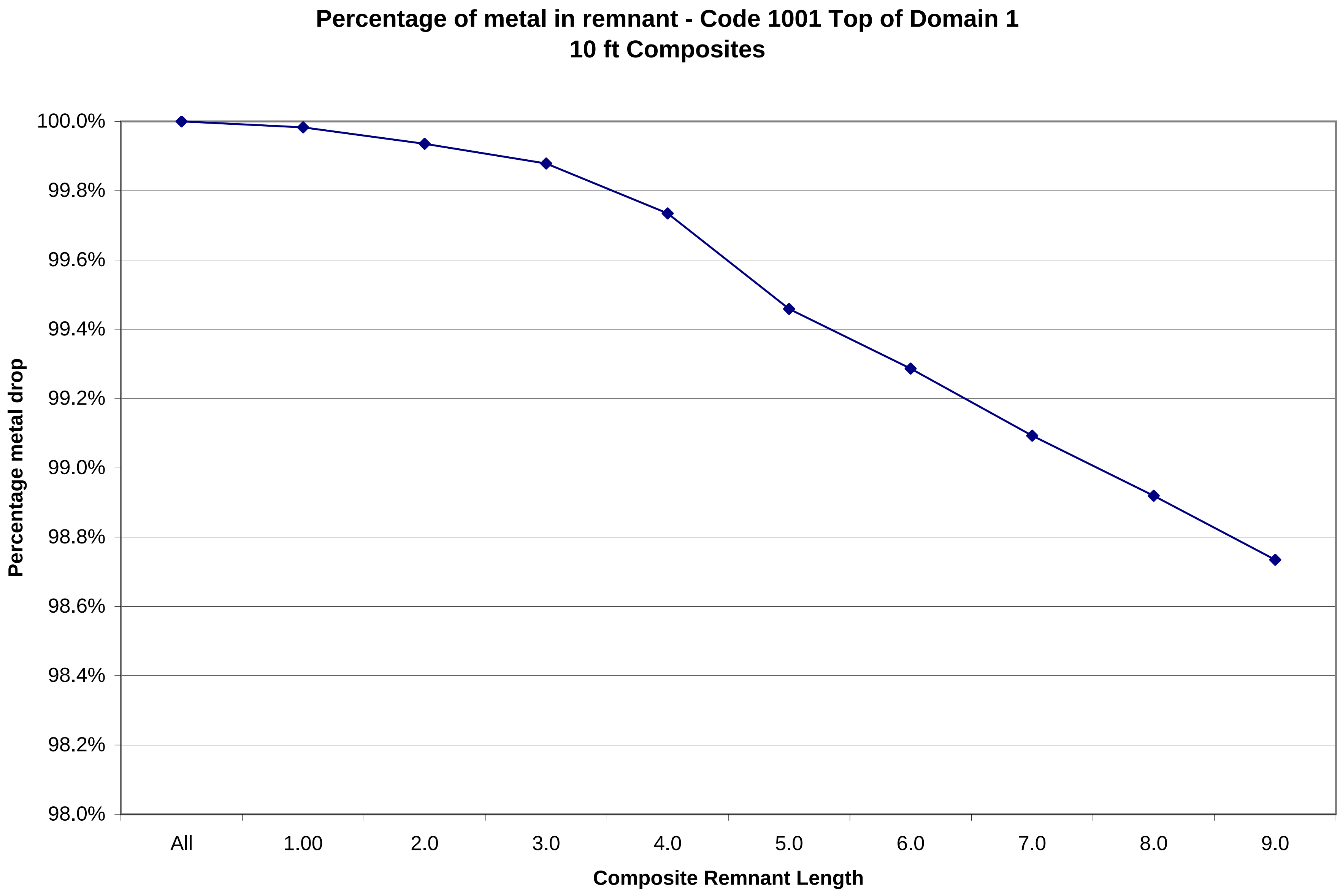
Domain	Cu%	Ni%	Pd (ppb)	Pt (ppb)	Au (ppb)	Co (ppm)	S%	Notes
1001 (Dom1 bot)	2.0	No	3100	1000	1000	No	10.8	Just a few Outliers
1003 (Dom 1 top)	No	0.4	2500	700	450	250	8	Just a few outliers except for Co
2000 (Magenta Zone)	1.3	0.25	1600	1000	250	No	2	Upper section of cum prob is discontinuous
1 (Unit 1 excluding Dom1)	1.8	0.6	1600	450	500	300	No	Discontinuous past 99.9 cum prob
3000 (Unit 3, 4, 5, 6 and 7 excluding Dom1 and Magenta zone)	2.1	No	4000	700	500	No	8	Co and S ok, top cum prob discontinuous for others
20 (Virginia formation)	No	No	1000	200	No	180	No	Just a few outliers

APPENDIX D

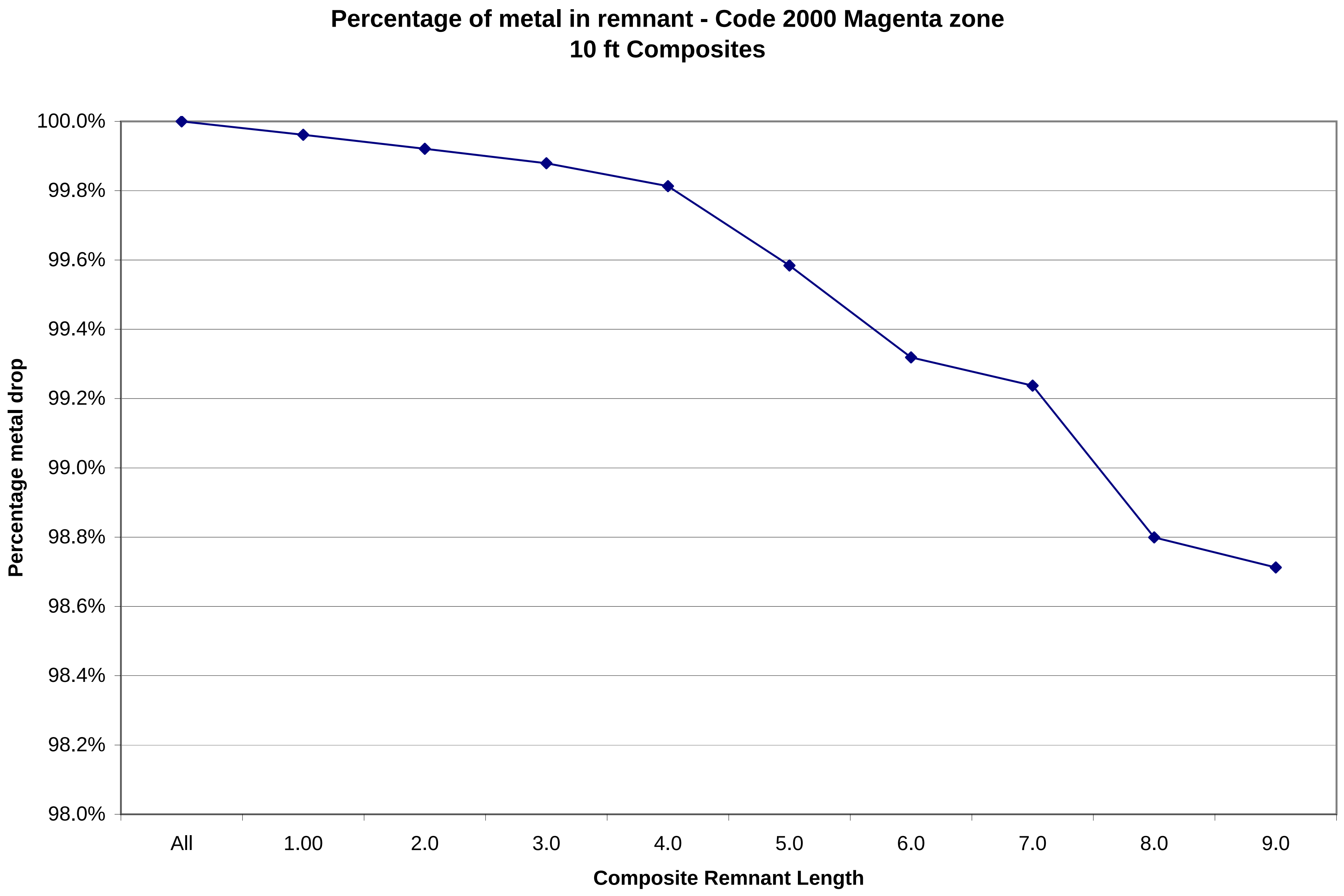
CORE LENGTH STATISTICS

NorthMet Core length statistics sorted by Unit Code with Dom 1 and Magenta zone (October 15 dataset)											
	1	3	5	6	7	20	22	23	30	1000	2000
Number of values	4698	6857	2189	845	427	982	508	101	2	15495	1894
Sum	24,536	46,194	18,086	7,305	3,817	6,338	4,472	927	20	81,853	11,056
Minimum	1.0	0.3	1.0	2.0	2.0	1.5	2.0	2.0	10.0	0.3	1.0
Maximum	14.0	12.0	26.0	12.5	12.0	12.5	18.0	10.5	10.0	17.0	15.0
Range	13.0	11.7	25.0	10.5	10.0	11.0	16.0	8.5	-	16.7	14.0
Mean	5.2	6.7	8.3	8.6	8.9	6.5	8.8	9.2	10.0	5.3	5.8
Median	5.0	5.0	10.0	10.0	10.0	5.0	10.0	10.0	10.0	5.0	5.0
First quartile	5.0	5.0	5.0	7.0	8.0	5.0	8.0	10.0	#N/A	5.0	5.0
Third quartile	5.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	#N/A	5.0	5.0
Standard error	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	-	0.0	0.0
95% confidence interval	0.0	0.1	0.1	0.1	0.2	0.1	0.2	0.4	-	0.0	0.1
99% confidence interval	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.5	-	0.0	0.1
Variance	1.9	6.4	6.0	4.9	3.6	5.3	4.5	3.9	-	2.9	4.4
Average deviation	0.7	2.4	2.2	1.9	1.5	2.0	1.8	1.4	-	1.0	1.6
Standard deviation	1.4	2.5	2.5	2.2	1.9	2.3	2.1	2.0	-	1.7	2.1
Coefficient of variation	0.3	0.4	0.3	0.3	0.2	0.4	0.2	0.2	-	0.3	0.4
Skew	2.5	0.4	(0.6)	(1.1)	(1.5)	0.8	(1.0)	(2.4)	#N/A	2.0	1.3
Kurtosis	7.9	(1.6)	0.1	(0.5)	1.1	(1.0)	0.6	4.6	#N/A	4.4	0.6

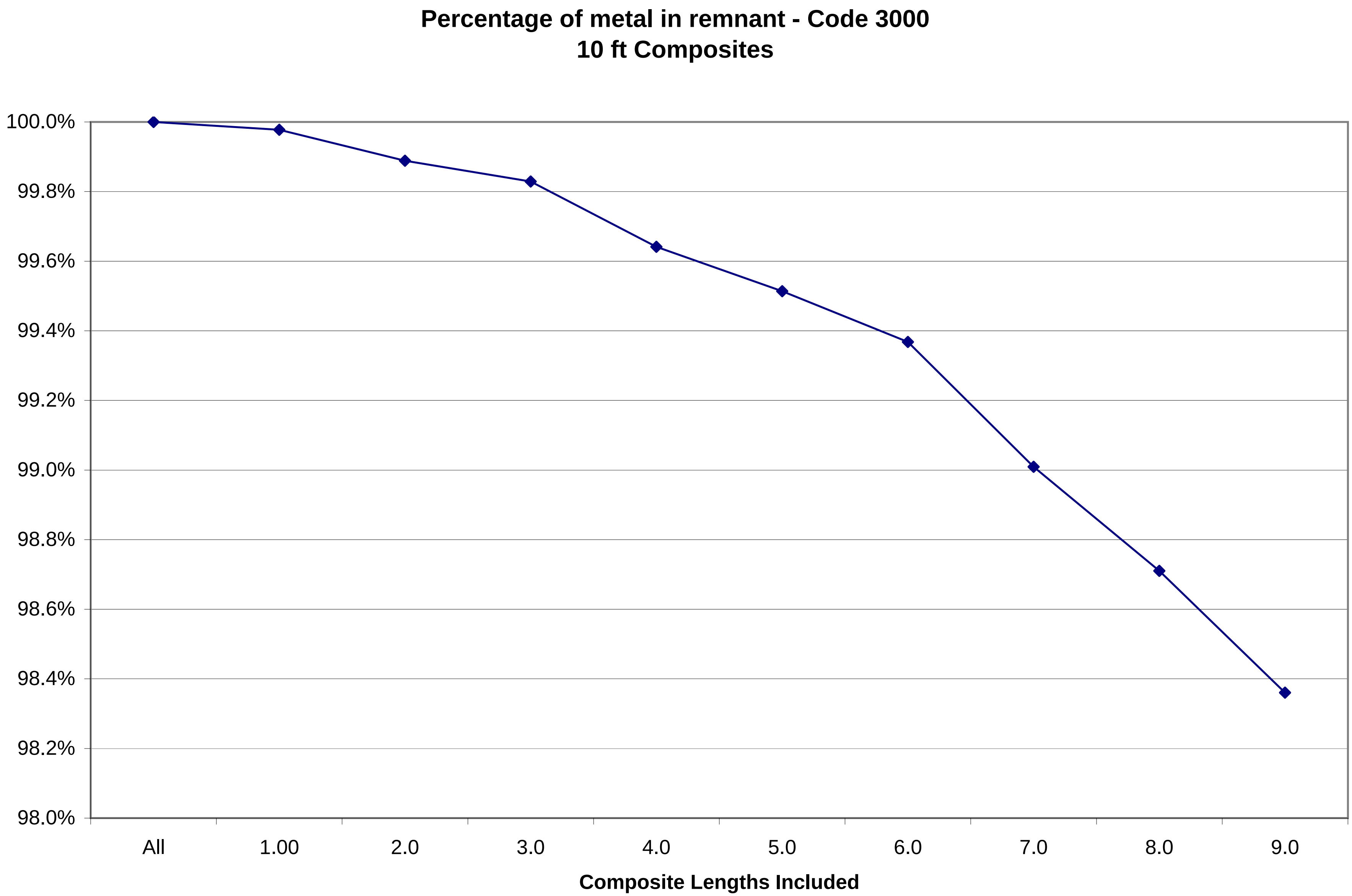




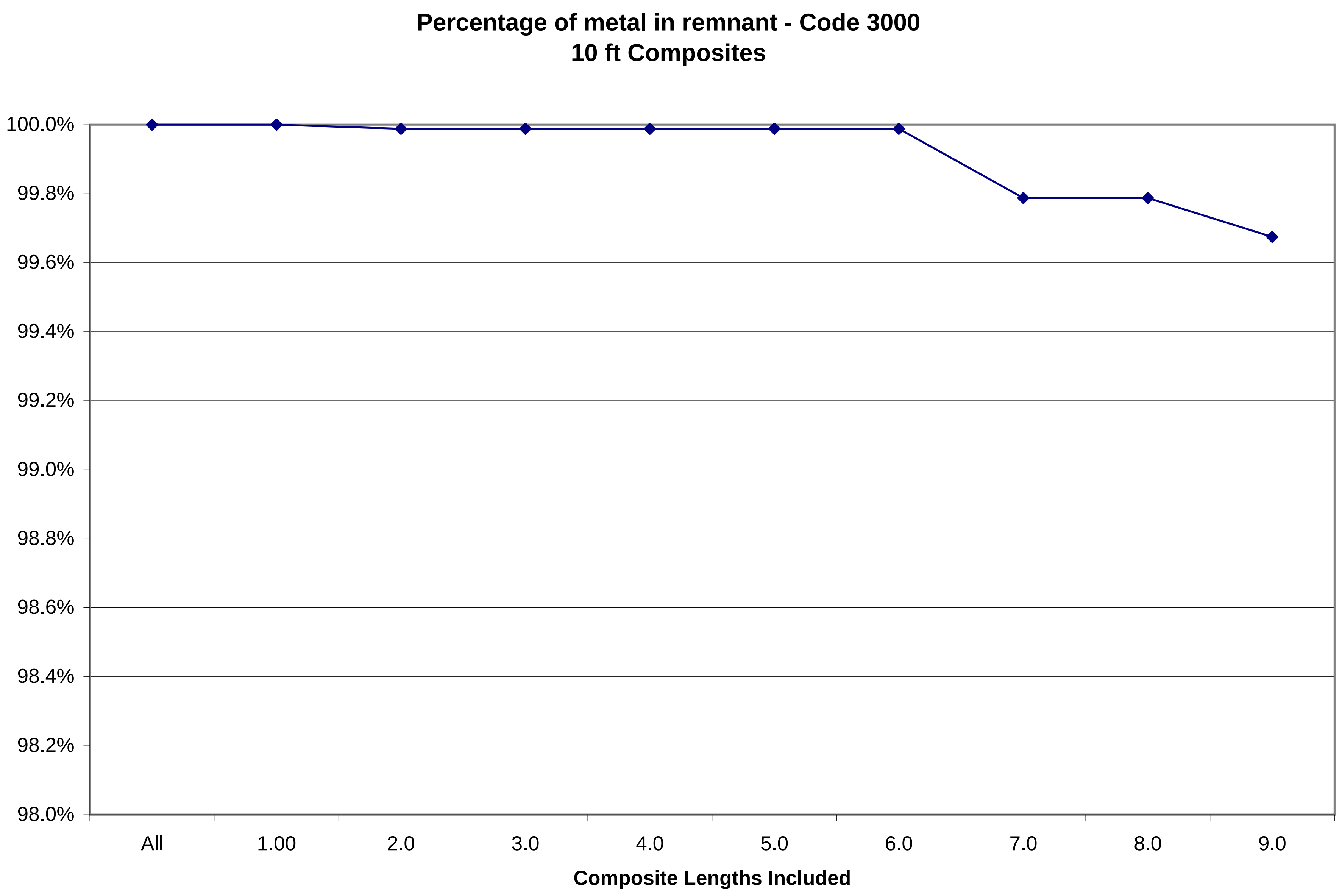
Percentage of metal in remnant - Code 1001 Top of Domain 1
10 ft Composites
100.0%
99.8%
99.6%
99.4%
99.2%
99.0%
98.8%
98.6%
98.4%
98.2%
98.0%
Percentage metal drop
All
1.00
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Composite Remnant Length



Percentage of metal in remnant - Code 2000 Magenta zone
10 ft Composites
Percentage metal drop
100.0%
99.8%
99.6%
99.4%
99.2%
99.0%
98.8%
98.6%
98.4%
98.2%
98.0%
All
1.00
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Composite Remnant Length



Percentage of metal in remnant - Code 3000
10 ft Composites
100.0%
99.8%
99.6%
99.4%
99.2%
99.0%
98.8%
98.6%
98.4%
98.2%
98.0%
All
1.00
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Composite Lengths Included



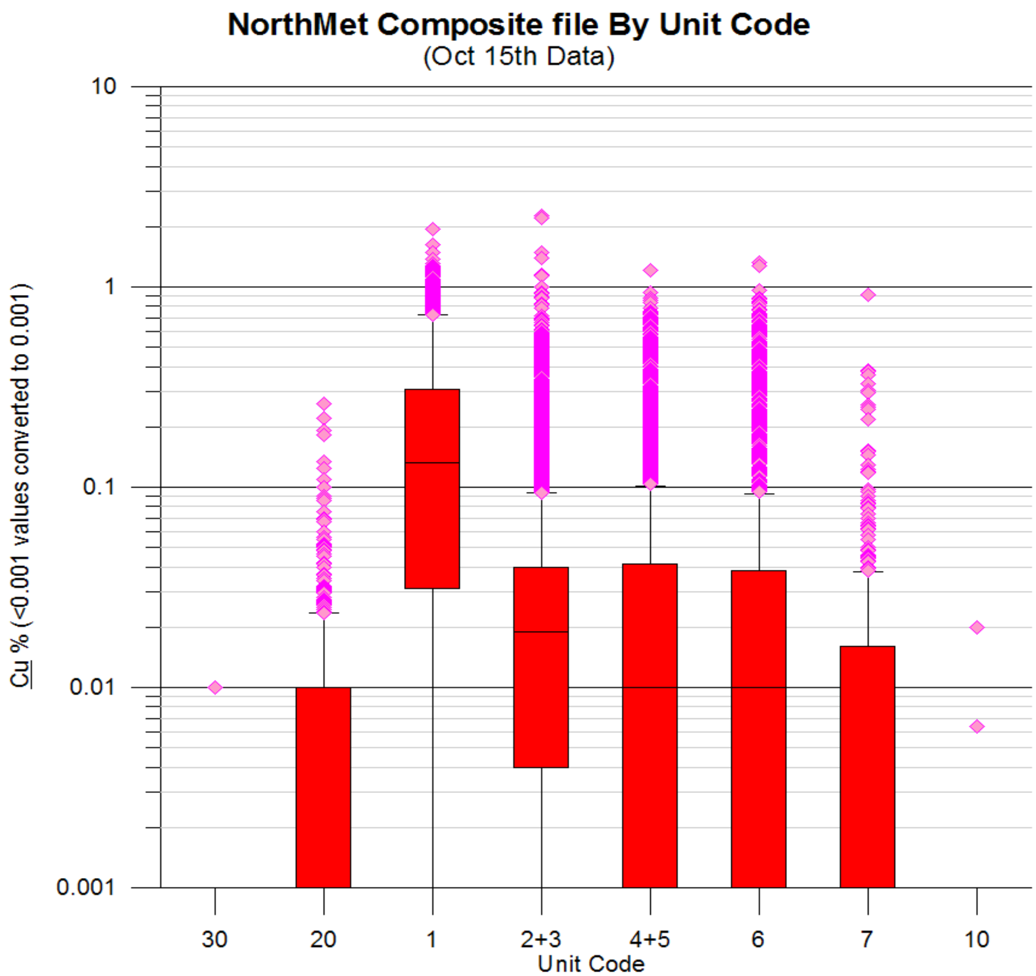
Percentage of metal in remnant - Code 3000
10 ft Composites
100.0%
99.8%
99.6%
99.4%
99.2%
99.0%
98.8%
98.6%
98.4%
98.2%
98.0%
All
1.00
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Composite Lengths Included

APPENDIX E

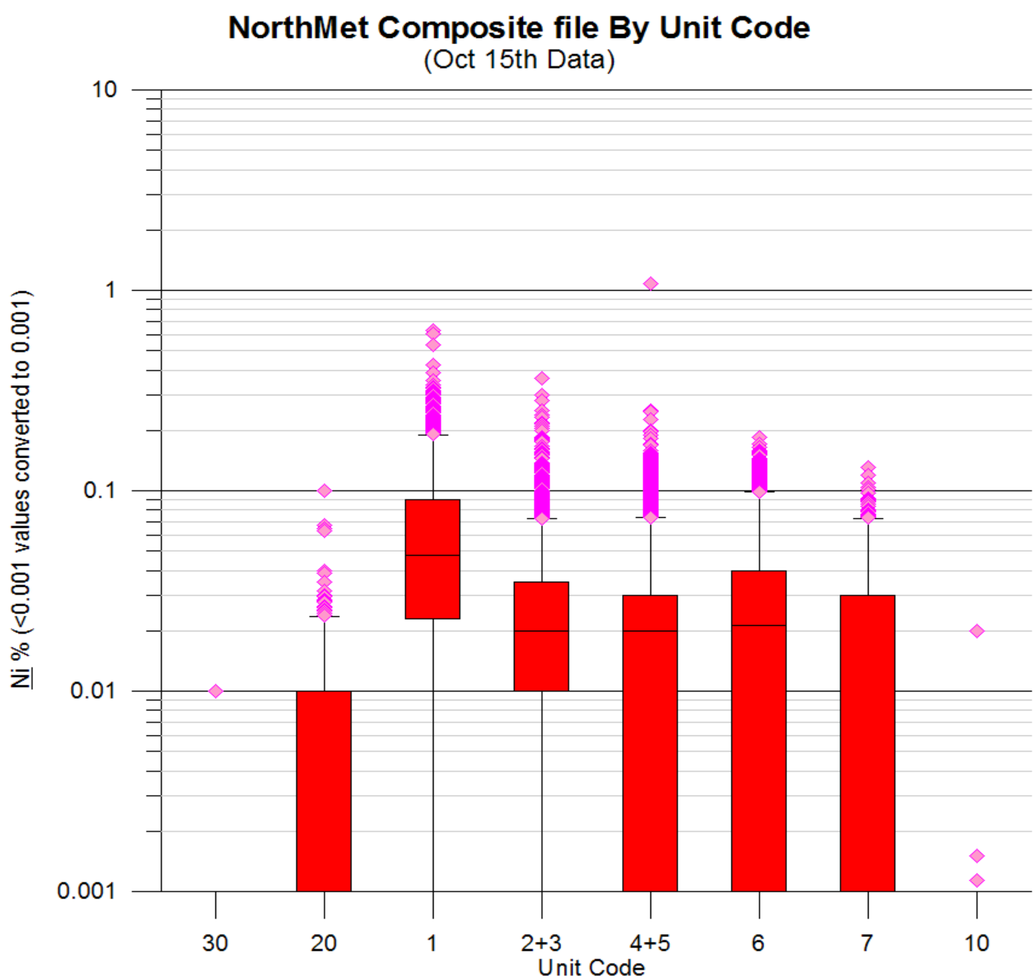
COMPOSITE STATISTICS

Final - Composite statistics by Unit code (Oct 2007 Model) Mean grade Compilation								
	1	2+3	4+5	6	7	20	30	10
Counts	11,481	6,813	4,054	2,184	847	2,241	374	522
Cu (%)	0.201	0.047	0.057	0.064	0.015	0.007	0.001	0.001
Ni (%)	0.062	0.026	0.022	0.026	0.019	0.006	0.001	0.001
Co (ppm)	60.5	40.9	31.6	34.6	31.3	10.1	0.2	0.2
Pt (ppb)	44	17	21	28	9	1	0.5	1
Pd (ppb)	167	53	54	68	18	3	0.5	1
Au (ppb)	23	10	11	12	4	2	0.5	1
S (%)	0.64	0.17	0.18	0.17	0.11	1.40	0.27	0.30

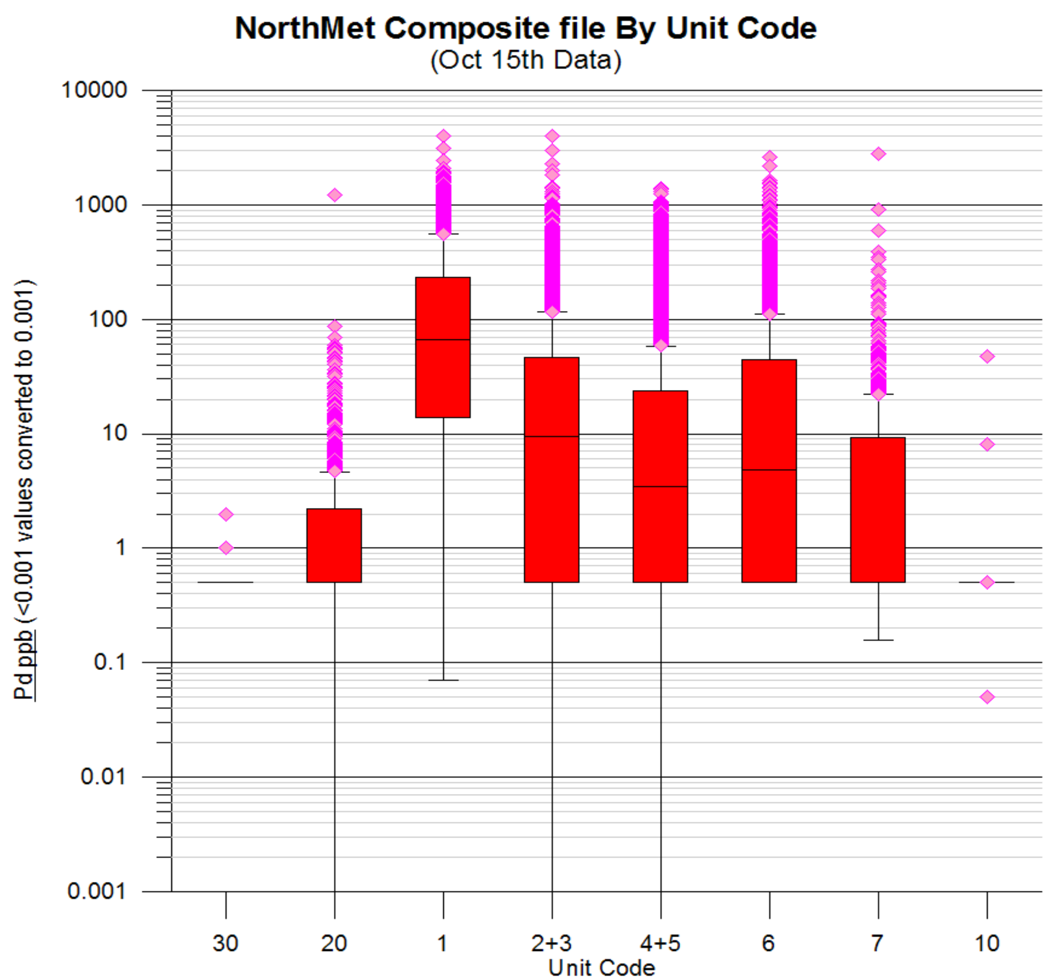
Final - Composite statistics by Unit code (Oct 2007 Model) Cu%								
	30	20	1	2+3	4+5	6	7	10
Number of values	374	2241	11481	6813	4054	2184	847	522
Sum	0	17	2,312	322	233	140	13	1
Minimum	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Maximum	0.010	0.260	1.949	2.280	1.210	1.321	0.913	0.020
Range	0.009	0.259	1.948	2.279	1.209	1.320	0.912	0.019
Mean	0.001	0.007	0.201	0.047	0.057	0.064	0.015	0.001
Median	0.001	0.001	0.132	0.019	0.010	0.010	0.001	0.001
First quartile	0.001	0.001	0.031	0.004	0.001	0.001	0.001	0.001
Third quartile	0.001	0.010	0.310	0.040	0.041	0.038	0.016	0.001
Standard error	0.000	0.000	0.002	0.001	0.002	0.003	0.002	0.000
95% confidence interval	0.000	0.001	0.004	0.002	0.004	0.006	0.003	0.000
99% confidence interval	0.000	0.001	0.005	0.003	0.005	0.008	0.004	0.000
Variance	0.000	0.000	0.044	0.010	0.015	0.021	0.002	0.000
Average deviation	0.000	0.008	0.165	0.052	0.075	0.087	0.018	0.000
Standard deviation	0.000	0.014	0.210	0.100	0.121	0.143	0.048	0.001
Coefficient of variation	0.454	1.933	1.045	2.120	2.110	2.232	3.183	0.825
Skew	19.339	7.577	1.476	7.087	3.306	3.382	10.488	20.793
Kurtosis	374.000	93.558	2.588	95.829	12.929	13.619	155.957	449.348



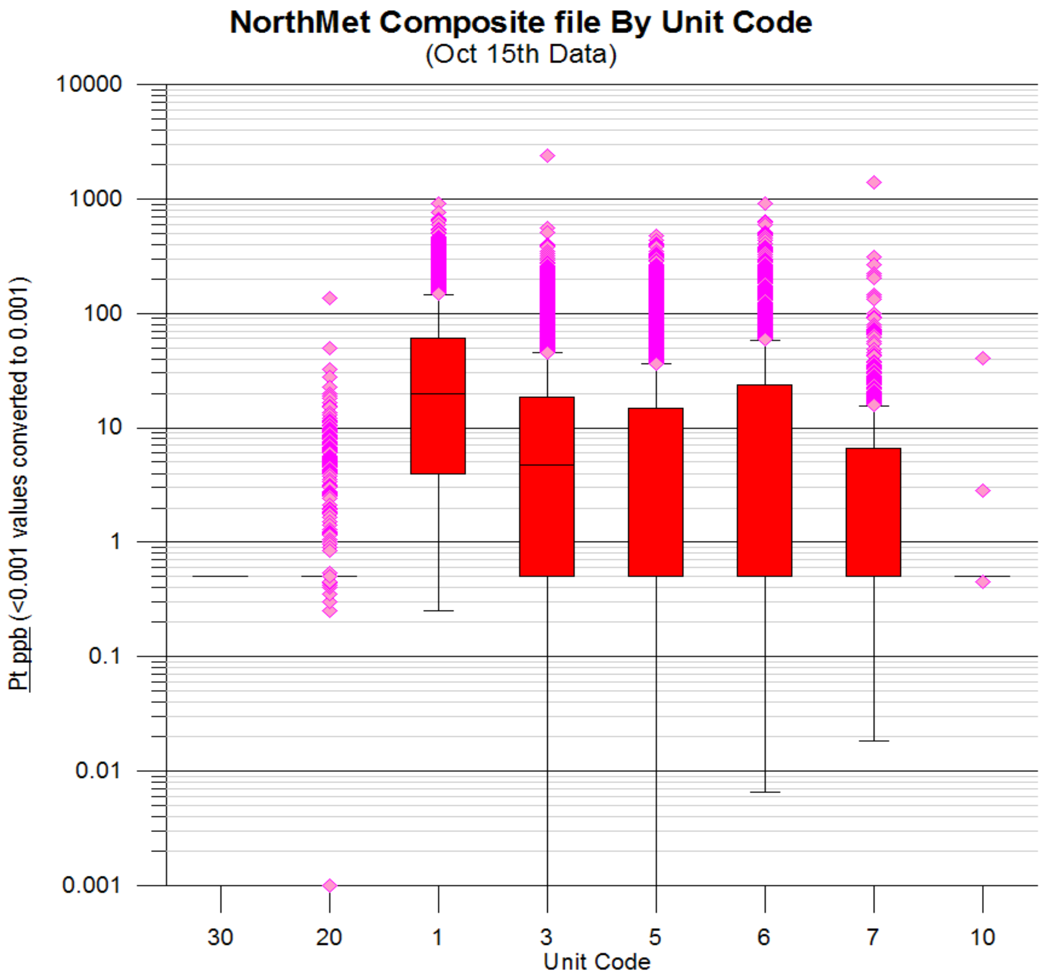
Final - Composite statistics by Unit code (Oct 2007 Model) Ni%								
	30	20	1	2+3	4+5	6	7	10
Number of values	374	2241	11481	6813	4054	2184	847	522
Sum	0	12	710	175	90	57	16	1
Minimum	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Maximum	0.010	0.100	0.630	0.363	1.076	0.185	0.130	0.020
Range	0.009	0.099	0.629	0.362	1.075	0.184	0.129	0.019
Mean	0.001	0.006	0.062	0.026	0.022	0.026	0.019	0.001
Median	0.001	0.001	0.047	0.020	0.020	0.021	0.001	0.001
First quartile	0.001	0.001	0.023	0.010	0.001	0.001	0.001	0.001
Third quartile	0.001	0.010	0.090	0.035	0.030	0.040	0.030	0.001
Standard error	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000
95% confidence interval	0.000	0.000	0.001	0.001	0.001	0.001	0.002	0.000
99% confidence interval	0.000	0.000	0.001	0.001	0.001	0.002	0.002	0.000
Variance	0.000	0.000	0.003	0.001	0.001	0.001	0.001	0.000
Average deviation	0.000	0.005	0.041	0.018	0.019	0.024	0.019	0.000
Standard deviation	0.000	0.007	0.052	0.026	0.032	0.032	0.024	0.001
Coefficient of variation	0.454	1.248	0.846	1.022	1.439	1.211	1.298	0.802
Skew	19.339	3.053	1.491	2.872	10.204	1.710	1.572	22.821
Kurtosis	374.000	24.139	4.509	16.281	289.070	3.419	2.546	521.190



Final - Composite statistics by Unit code (Oct 2007 Model) Pd (ppb)								
	30	20	1	2+3	4+5	6	7	10
Number of values	374	2241	11481	6813	4054	2184	847	522
Sum	189	6,404	1,921,108	362,591	218,512	148,748	15,447	316
Minimum	0.5	0.0	0.1	0.0	0.0	0.5	0.2	0.1
Maximum	2.0	1,227.0	4,013.5	3,987.5	1,380.5	2,615.0	2,791.4	48.0
Range	1.5	1,227.0	4,013.4	3,987.5	1,380.5	2,614.5	2,791.3	47.9
Mean	0.5	2.9	167.3	53.2	53.9	68.1	18.2	0.6
Median	0.5	0.5	66.2	9.4	3.5	4.8	0.5	0.5
First quartile	0.5	0.5	14.0	0.5	0.5	0.5	0.5	0.5
Third quartile	0.5	2.2	232.3	46.6	23.7	44.1	9.1	0.5
Standard error	0.0	0.6	2.2	1.7	2.2	3.8	3.8	0.1
95% confidence interval	0.0	1.1	4.3	3.2	4.3	7.5	7.4	0.2
99% confidence interval	0.0	1.4	5.7	4.3	5.6	9.9	9.8	0.2
Variance	0.0	700.5	56,296.2	18,563.9	19,299.7	32,218.8	12,084.7	4.4
Average deviation	0.0	3.3	167.9	65.9	77.5	93.3	25.9	0.2
Standard deviation	0.1	26.5	237.3	136.2	138.9	179.5	109.9	2.1
Coefficient of variation	0.2	9.3	1.4	2.6	2.6	2.6	6.0	3.5
Skew	17.1	44.3	2.8	9.3	4.1	5.5	20.2	22.1
Kurtosis	305.9	2,045.3	15.4	170.5	20.2	45.4	486.4	496.3

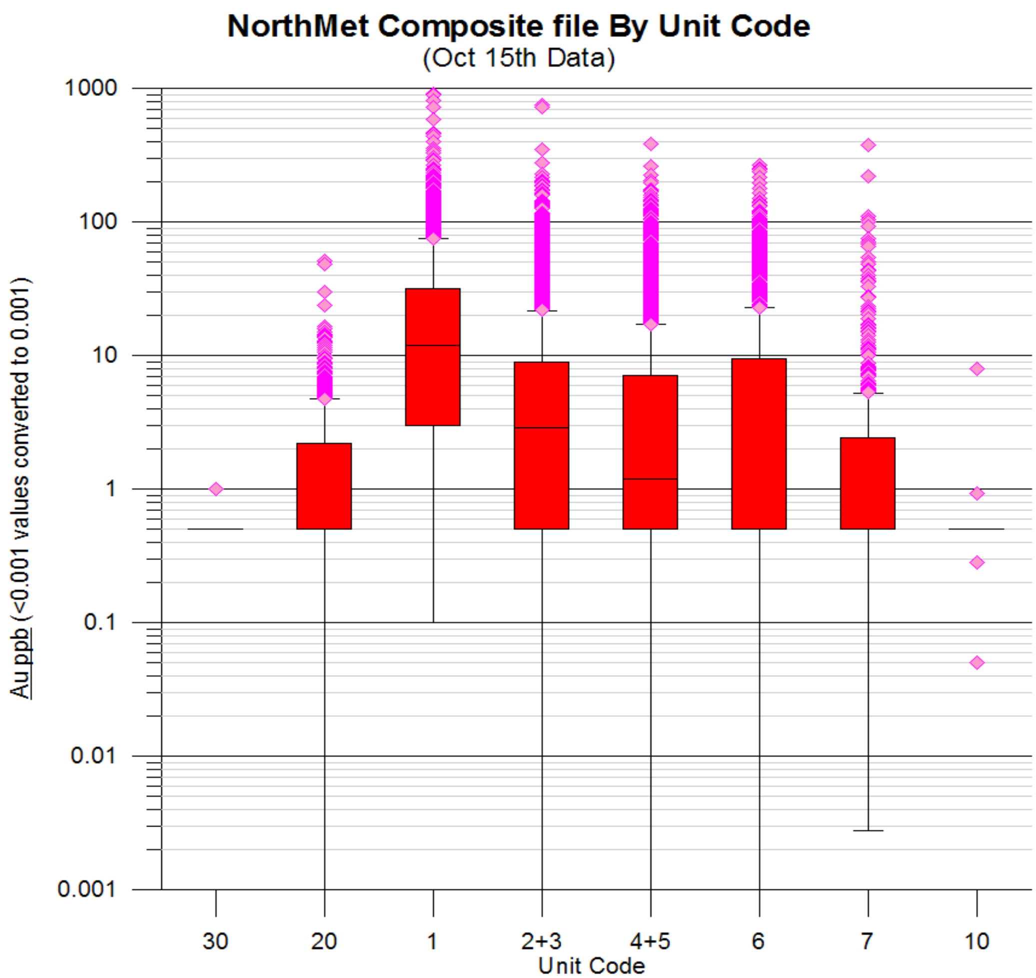


Final - Composite statistics by Unit code (Oct 2007 Model) Pt (ppb)								
	30	20	1	3	5	6	7	10
Number of values	374	2241	11481	6813	4054	2184	847	522
Sum	187	2,646	502,773	119,174	85,759	60,438	7,934	304
Minimum	0.5	0.0	0.3	0.0	0.0	0.0	0.0	0.5
Maximum	0.5	135.0	907.0	2,397.5	473.4	902.8	1,395.6	41.0
Range	-	135.0	906.8	2,397.5	473.4	902.8	1,395.6	40.5
Mean	0.5	1.2	43.8	17.5	21.2	27.7	9.4	0.6
Median	0.5	0.5	20.0	4.7	0.5	0.5	0.5	0.5
First quartile	0.5	0.5	4.0	0.5	0.5	0.5	0.5	0.5
Third quartile	0.5	0.5	61.2	18.5	14.7	23.7	6.5	0.5
Standard error	-	0.1	0.6	0.5	0.8	1.4	1.8	0.1
95% confidence interval	-	0.2	1.1	1.1	1.5	2.8	3.6	0.2
99% confidence interval	-	0.2	1.5	1.4	2.0	3.6	4.7	0.2
Variance	-	13.9	3,666.9	2,023.2	2,376.8	4,319.8	2,836.2	3.2
Average deviation	-	1.2	42.3	20.3	28.2	36.1	12.9	0.2
Standard deviation	-	3.7	60.6	45.0	48.8	65.7	53.3	1.8
Coefficient of variation	-	3.2	1.4	2.6	2.3	2.4	5.7	3.1
Skew		22.8	2.9	23.9	3.8	4.8	21.5	22.7
Kurtosis		759.6	15.5	1,162.4	17.6	34.4	546.3	518.5

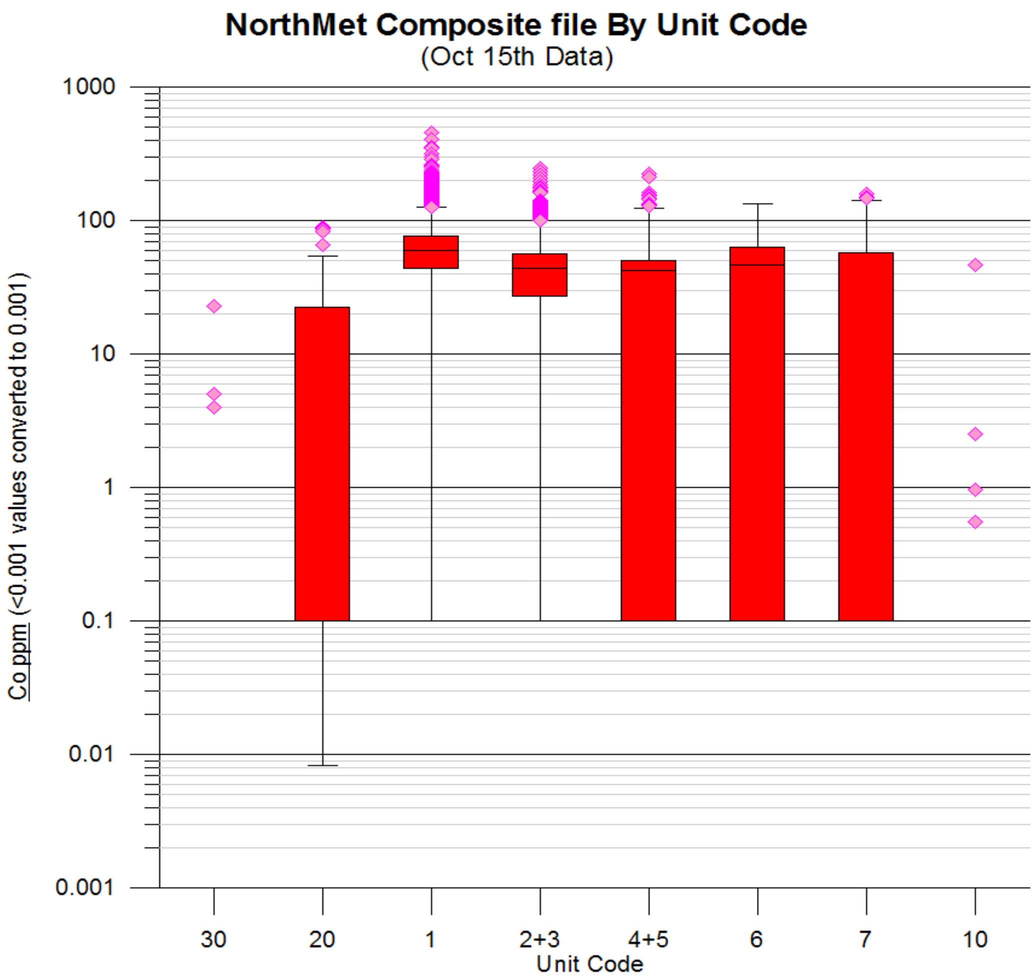


Final - Composite statistics by Unit code (Oct 2007 Model) Au (ppb)

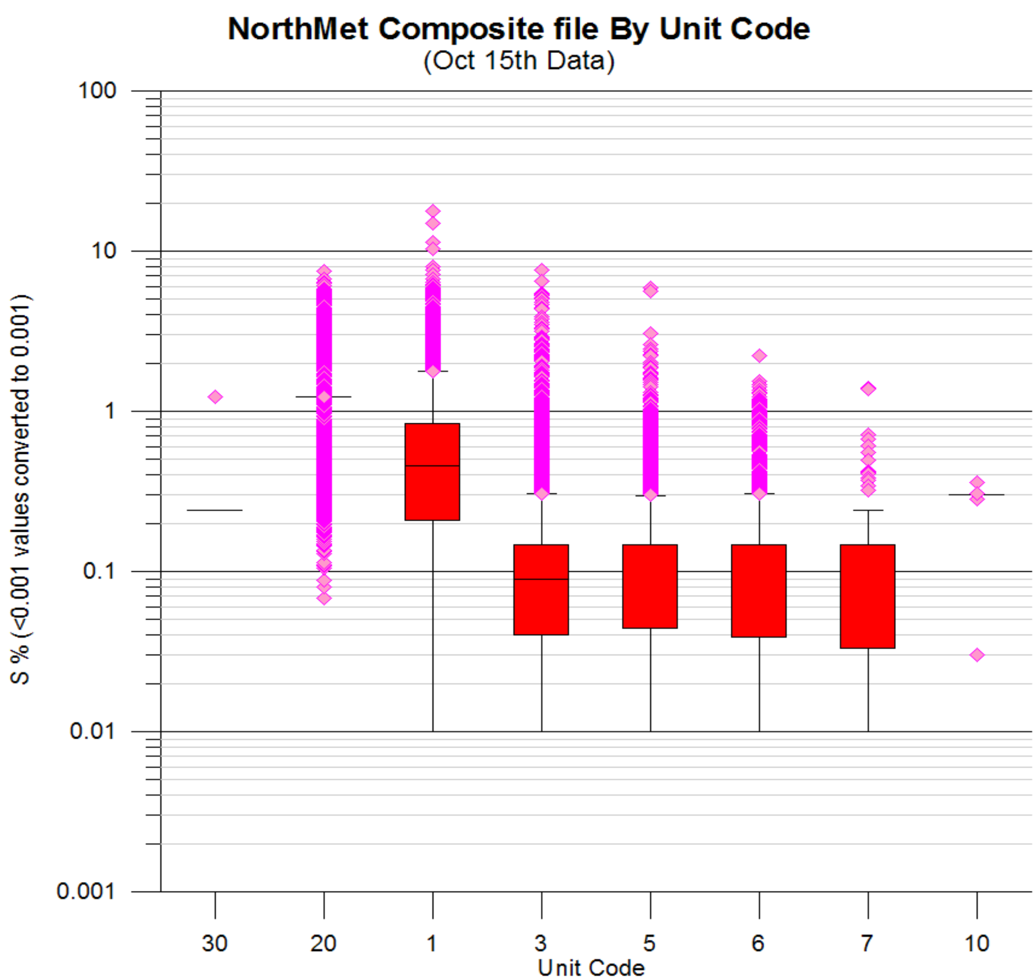
	30	20	1	2+3	4+5	6	7	10
Number of values	374	2241	11481	6813	4054	2184	847	522
Sum	188	3,761	269,273	65,608	42,878	25,248	3,444	268
Minimum	0.5	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Maximum	1.0	50.7	916.0	745.0	383.7	266.2	378.7	8.0
Range	0.5	50.7	915.9	745.0	383.7	266.2	378.7	7.9
Mean	0.5	1.7	23.5	9.6	10.6	11.6	4.1	0.5
Median	0.5	0.5	12.0	2.9	1.2	0.5	0.5	0.5
First quartile	0.5	0.5	3.0	0.5	0.5	0.5	0.5	0.5
Third quartile	0.5	2.2	31.9	9.0	7.1	9.3	2.4	0.5
Standard error	0.0	0.1	0.3	0.3	0.4	0.6	0.6	0.0
95% confidence interval	0.0	0.1	0.7	0.6	0.7	1.1	1.2	0.0
99% confidence interval	0.0	0.1	0.9	0.7	1.0	1.4	1.6	0.0
Variance	0.0	6.9	1,283.9	538.0	579.9	662.0	322.5	0.1
Average deviation	0.0	1.6	21.6	10.9	13.7	15.1	5.2	0.0
Standard deviation	0.0	2.6	35.8	23.2	24.1	25.7	18.0	0.3
Coefficient of variation	0.1	1.6	1.5	2.4	2.3	2.2	4.4	0.6
Skew	19.3	7.5	7.1	12.2	4.4	4.2	14.0	22.6
Kurtosis	374.0	109.9	116.0	302.9	29.9	25.0	252.8	514.0



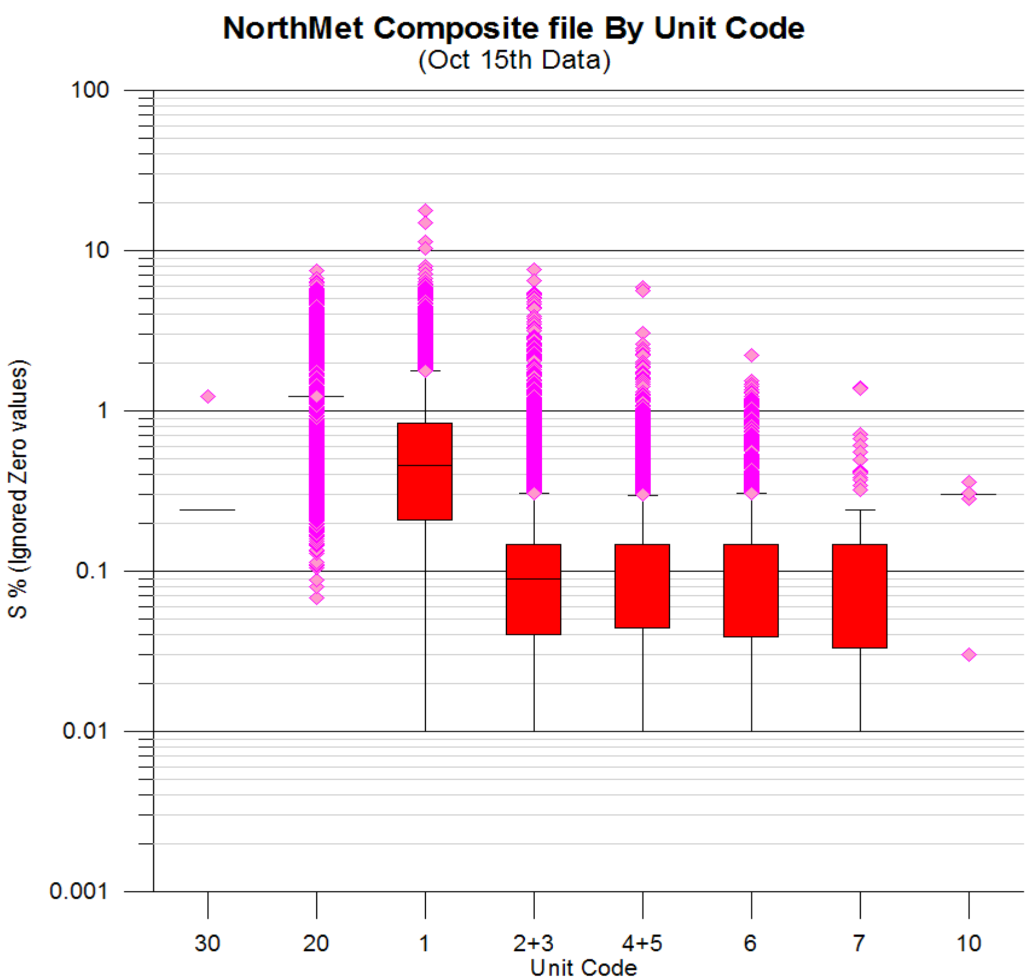
Final - Composite statistics by Unit code (Oct 2007 Model) Co ppm								
	30	20	1	3	5	6	7	10
Number of values	374	2241	11481	6813	4054	2184	847	522
Sum	69	22,741	694,462	278,419	128,222	75,572	26,514	102
Minimum	0.10	0.01	0.10	0.10	0.10	0.10	0.10	0.10
Maximum	23.00	90.00	457.00	245.40	223.20	132.79	158.90	46.00
Range	22.90	89.99	456.90	245.30	223.10	132.69	158.80	45.90
Mean	0.19	10.15	60.49	40.87	31.63	34.60	31.30	0.20
Median	0.10	0.10	59.00	43.60	42.40	46.00	0.10	0.10
First quartile	0.10	0.10	44.00	27.00	0.10	0.10	0.10	0.10
Third quartile	0.10	22.50	76.90	56.40	50.40	63.19	57.25	0.10
Standard error	0.06	0.28	0.31	0.33	0.45	0.71	1.33	0.09
95% confidence interval	0.13	0.55	0.61	0.65	0.87	1.40	2.62	0.17
99% confidence interval	0.16	0.72	0.80	0.85	1.15	1.84	3.44	0.23
Variance	1.50	176.63	1,098.81	750.29	804.91	1,115.97	1,504.94	4.05
Average deviation	0.17	12.09	23.75	20.70	25.39	31.66	34.03	0.19
Standard deviation	1.23	13.29	33.15	27.39	28.37	33.41	38.79	2.01
Coefficient of variation	6.64	1.31	0.55	0.67	0.90	0.97	1.24	10.32
Skew	17.60	1.02	0.98	0.29	0.35	0.15	0.93	22.74
Kurtosis	324.28	0.90	6.29	1.46	0.15	(1.53)	(0.19)	518.70



Final - Composite statistics by Unit code (Oct 2007 Model) S% - Zero values converted to 0.001								
	30	20	1	3	5	6	7	10
Number of values	374	2241	11481	6813	4054	2184	847	522
Sum	100	3,133	7,372	1,138	737	362	91	156
Minimum	0.24	0.07	0.01	0.01	0.01	0.01	0.01	0.03
Maximum	1.23	7.45	17.79	7.62	5.93	2.22	1.39	0.36
Range	0.99	7.39	17.78	7.61	5.92	2.21	1.38	0.33
Mean	0.27	1.40	0.64	0.17	0.18	0.17	0.11	0.30
Median	0.24	1.23	0.45	0.09	0.15	0.15	0.15	0.30
First quartile	0.24	1.23	0.21	0.04	0.04	0.04	0.03	0.30
Third quartile	0.24	1.23	0.84	0.15	0.15	0.15	0.15	0.30
Standard error	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00
95% confidence interval	0.02	0.04	0.01	0.01	0.01	0.01	0.01	0.00
99% confidence interval	0.02	0.06	0.02	0.01	0.01	0.01	0.01	0.00
Variance	0.03	1.02	0.49	0.13	0.07	0.04	0.01	0.00
Average deviation	0.05	0.61	0.44	0.14	0.13	0.11	0.06	0.00
Standard deviation	0.16	1.01	0.70	0.35	0.26	0.21	0.10	0.01
Coefficient of variation	0.60	0.72	1.09	2.12	1.44	1.24	0.91	0.04
Skew	5.89	2.32	5.17	9.27	7.77	3.32	6.33	(21.00)
Kurtosis	32.88	6.17	67.32	120.26	119.77	14.52	73.76	473.76



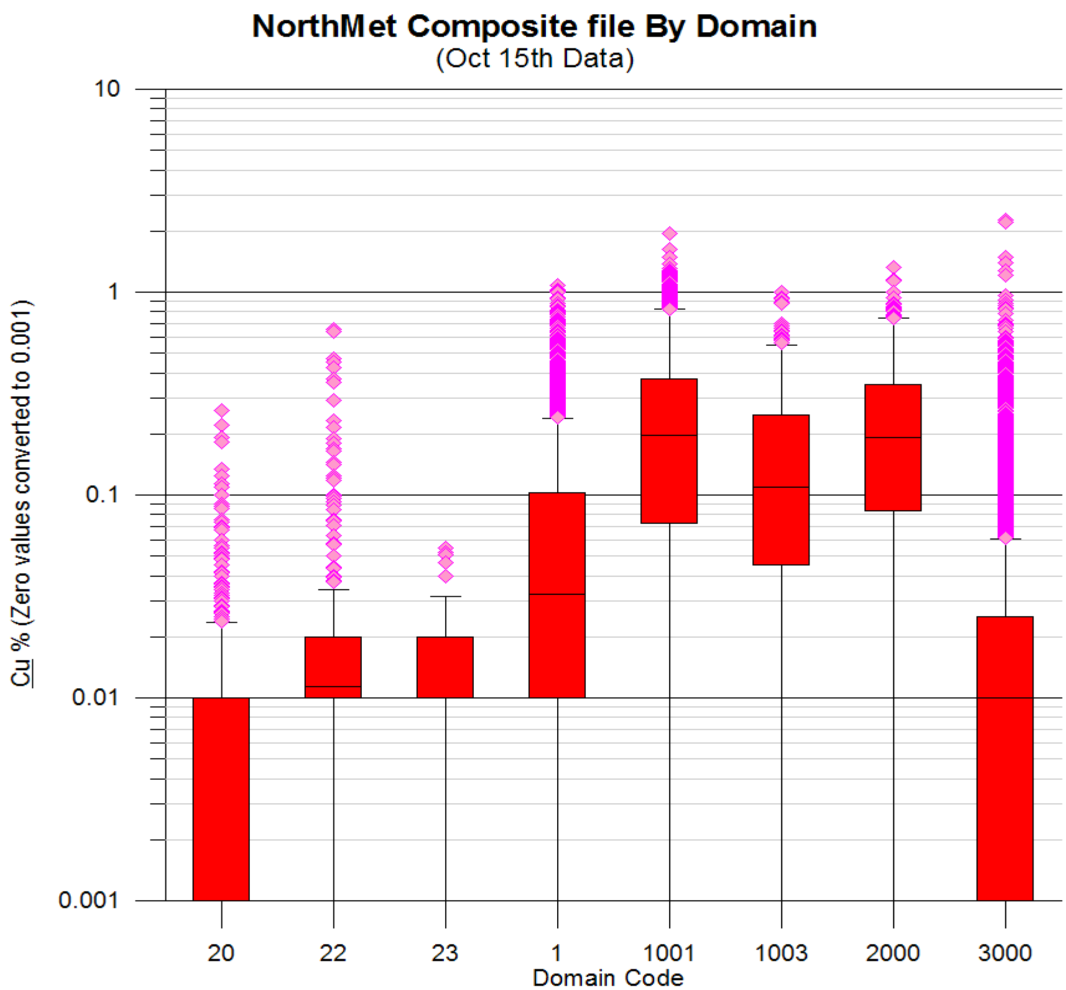
Final - Composite statistics by Unit code (Oct 2007 Model) S% - Ignored Zero values								
	30	20	1	3	5	6	7	10
Number of values	374	2241	11481	6813	4054	2184	847	522
Sum	100	3,133	7,372	1,138	737	362	91	156
Minimum	0.24	0.07	0.01	0.01	0.01	0.01	0.01	0.03
Maximum	1.23	7.45	17.79	7.62	5.93	2.22	1.39	0.36
Range	0.99	7.39	17.78	7.61	5.92	2.21	1.38	0.33
Mean	0.27	1.40	0.64	0.17	0.18	0.17	0.11	0.30
Median	0.24	1.23	0.45	0.09	0.15	0.15	0.15	0.30
First quartile	0.24	1.23	0.21	0.04	0.04	0.04	0.03	0.30
Third quartile	0.24	1.23	0.84	0.15	0.15	0.15	0.15	0.30
Standard error	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00
95% confidence interval	0.02	0.04	0.01	0.01	0.01	0.01	0.01	0.00
99% confidence interval	0.02	0.06	0.02	0.01	0.01	0.01	0.01	0.00
Variance	0.03	1.02	0.49	0.13	0.07	0.04	0.01	0.00
Average deviation	0.05	0.61	0.44	0.14	0.13	0.11	0.06	0.00
Standard deviation	0.16	1.01	0.70	0.35	0.26	0.21	0.10	0.01
Coefficient of variation	0.60	0.72	1.09	2.12	1.44	1.24	0.91	0.04
Skew	5.89	2.32	5.17	9.27	7.77	3.32	6.33	(21.00)
Kurtosis	32.88	6.17	67.32	120.26	119.77	14.52	73.76	473.76



PolyMet - Final Composites by Domain Oct 15, 2007 - Mean grade compilation								
	Unit 1 outside Dom1 zone	Unit 20 Virginia Formation	Code 22 Ramp Area	Code 23	Dom1 Bot (in Unit 1)	Dom1 Top (In Unit 3)	Magenta zone	Unit 3,4,5,6 and 7 outside magenta zone
Block model domain Code	1	20	22	23	1001	1003	2000	3000
Count	3,192	2,018	498	102	8,158	423	1,132	12,155
Cu %	0.081	0.007	0.028	0.015	0.250	0.176	0.241	0.029
Ni %	0.029	0.005	0.014	0.012	0.075	0.071	0.066	0.019
Co ppm	40.6	9.2	31.4	23.6	68.5	71.9	64.7	32.8
Pt ppb	14	1	6	3	56	60	95	11
Pd ppb	50	3	16	3	215	219	252	30
Au ppb	9	2	5	4	29	33	43	6
S %	0.47	1.41	0.67	2.29	0.70	0.37	0.40	0.14

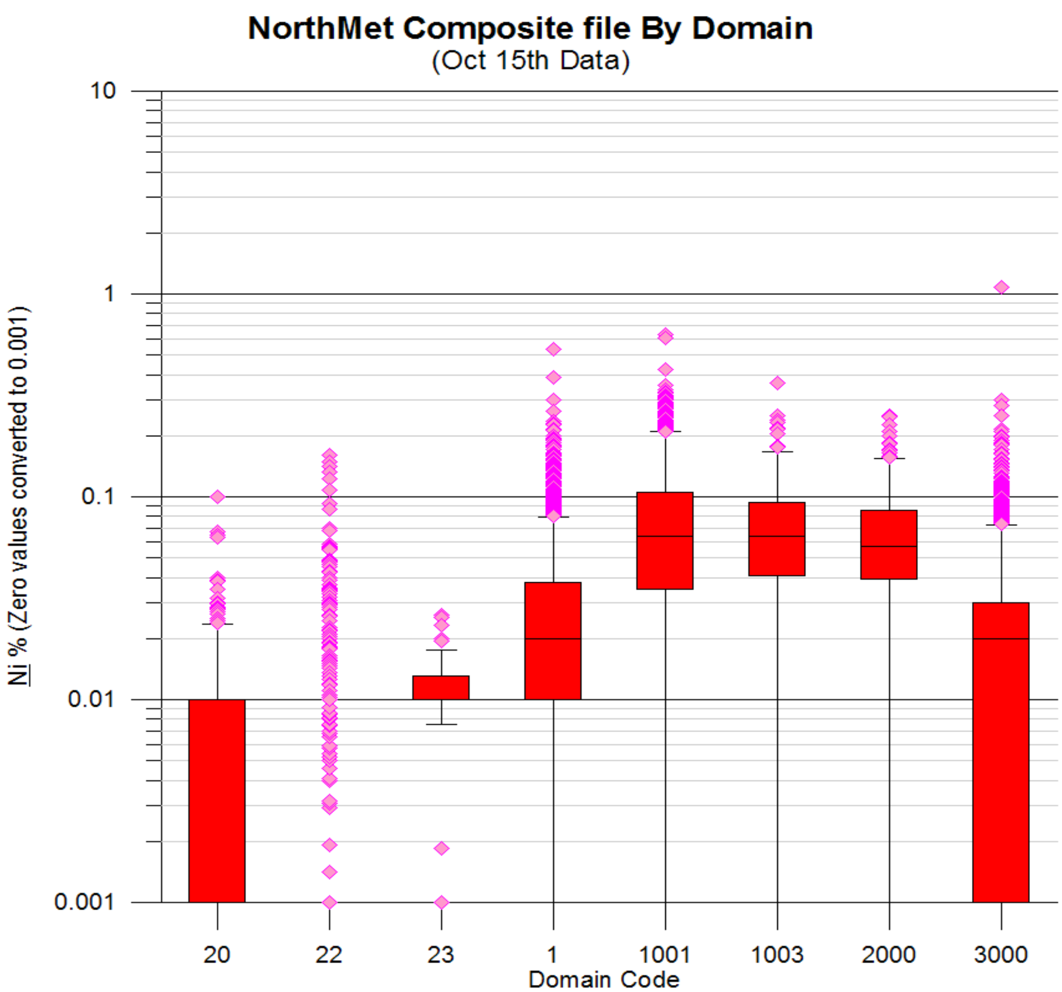
PolyMet - Final Composites by Domain Oct 15, 2007 file - Cu%	20	22	23	1	1001	1003	2000	3000
Number of values	2018	498	102	3192	8158	423	1132	12155
Sum	14.717	14.082	1.554	259.972	2,043.183	74.451	272.527	357.044
Minimum	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Maximum	0.260	0.655	0.055	1.084	1.949	0.998	1.321	2.280
Range	0.259	0.654	0.054	1.083	1.948	0.997	1.320	2.279
Mean	0.007	0.028	0.015	0.081	0.250	0.176	0.241	0.029
Median	0.001	0.011	0.010	0.032	0.197	0.110	0.193	0.010
First quartile	0.001	0.010	0.010	0.010	0.072	0.045	0.084	0.001
Third quartile	0.010	0.020	0.020	0.102	0.372	0.246	0.348	0.025
Standard error	0.000	0.003	0.001	0.002	0.002	0.009	0.006	0.001
95% confidence interval	0.001	0.006	0.002	0.004	0.005	0.017	0.012	0.001
99% confidence interval	0.001	0.008	0.003	0.006	0.006	0.022	0.015	0.002
Variance	0.000	0.005	0.000	0.015	0.048	0.032	0.040	0.005
Average deviation	0.008	0.027	0.007	0.081	0.174	0.136	0.157	0.033
Standard deviation	0.015	0.068	0.010	0.124	0.219	0.179	0.199	0.073
Coefficient of variation	2.095	2.405	0.668	1.522	0.873	1.015	0.827	2.483
Skew	7.357	6.096	1.813	3.147	1.222	1.654	1.203	10.053

Includes Oct 25th changes



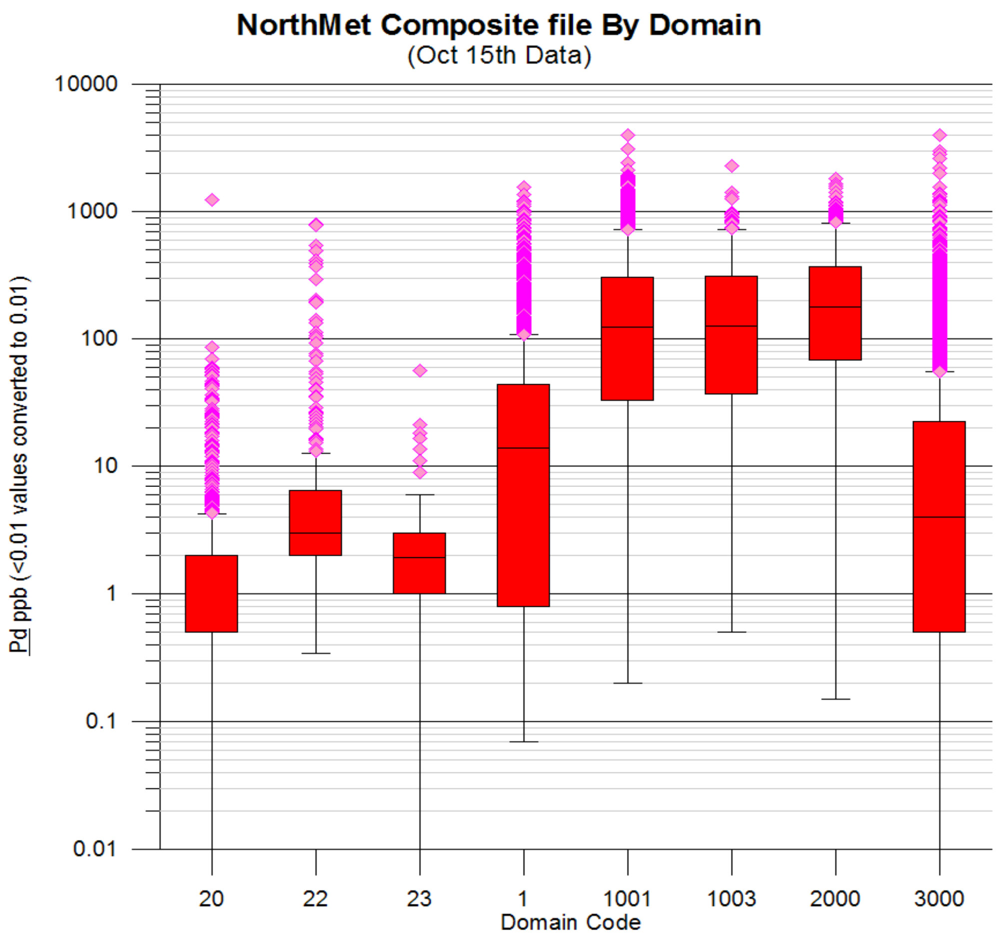
PolyMet - Final Composites by Domain Oct 15, 2007 file - Ni%	20	22	23	1	1001	1003	2000	3000
Number of values	2018	498	102	3192	8158	423	1132	12155
Sum	10.454	7.090	1.205	93.103	613.937	30.108	74.207	231.923
Minimum	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Maximum	0.100	0.161	0.026	0.537	0.630	0.363	0.252	1.076
Range	0.099	0.160	0.025	0.536	0.629	0.362	0.251	1.075
Mean	0.005	0.014	0.012	0.029	0.075	0.071	0.066	0.019
Median	0.001	0.010	0.010	0.020	0.064	0.064	0.057	0.020
First quartile	0.001	0.010	0.010	0.010	0.035	0.041	0.039	0.001
Third quartile	0.010	0.010	0.013	0.038	0.105	0.094	0.085	0.030
Standard error	0.000	0.001	0.001	0.001	0.001	0.002	0.001	0.000
95% confidence interval	0.000	0.002	0.001	0.001	0.001	0.004	0.002	0.000
99% confidence interval	0.000	0.002	0.001	0.002	0.002	0.006	0.003	0.001
Variance	0.000	0.000	0.000	0.001	0.003	0.002	0.001	0.001
Average deviation	0.005	0.009	0.004	0.022	0.041	0.033	0.028	0.015
Standard deviation	0.007	0.018	0.006	0.034	0.053	0.044	0.036	0.022
Coefficient of variation	1.347	1.281	0.475	1.152	0.701	0.619	0.548	1.178
Skew	3.325	4.759	0.386	3.510	1.317	1.582	1.085	10.343

Includes Oct 25th changes



PolyMet - Final Composites by Domain Oct 15, 2007 - Pd (ppb)								
	20	22	23	1	1001	1003	2000	3000
Number of values	2018	498	102	3192	8158	423	1132	12155
Sum	5,856	8,167	327	158,391	1,756,466	92,498	284,944	366,394
Minimum	0.0	0.3	0.0	0.1	0.2	0.5	0.2	0.0
Maximum	1,227.0	795.2	56.1	1,565.5	4,013.5	2,295.0	1,824.7	3,987.5
Range	1,227.0	794.9	56.1	1,565.4	4,013.3	2,294.5	1,824.6	3,987.5
Mean	2.9	16.4	3.2	49.6	215.3	218.7	251.7	30.1
Median	0.5	3.0	1.9	13.8	123.0	125.5	176.0	4.0
First quartile	0.5	2.0	1.0	0.8	32.6	37.2	68.3	0.5
Third quartile	2.0	6.4	3.0	44.0	306.7	311.9	366.6	22.2
Standard error	0.6	3.1	0.6	2.1	2.8	12.9	7.4	0.9
95% confidence interval	1.2	6.2	1.3	4.1	5.6	25.5	14.4	1.8
99% confidence interval	1.6	8.1	1.7	5.3	7.3	33.5	19.0	2.4
Variance	777.8	4,933.3	40.6	13,683.0	65,649.5	70,907.1	61,520.0	10,217.0
Average deviation	3.5	22.9	2.8	57.9	186.5	190.6	186.4	39.4
Standard deviation	27.9	70.2	6.4	117.0	256.2	266.3	248.0	101.1
Coefficient of variation	9.6	4.3	2.0	2.4	1.2	1.2	1.0	3.4
Skew	42.0	8.0	6.3	5.6	2.5	2.6	1.8	15.2

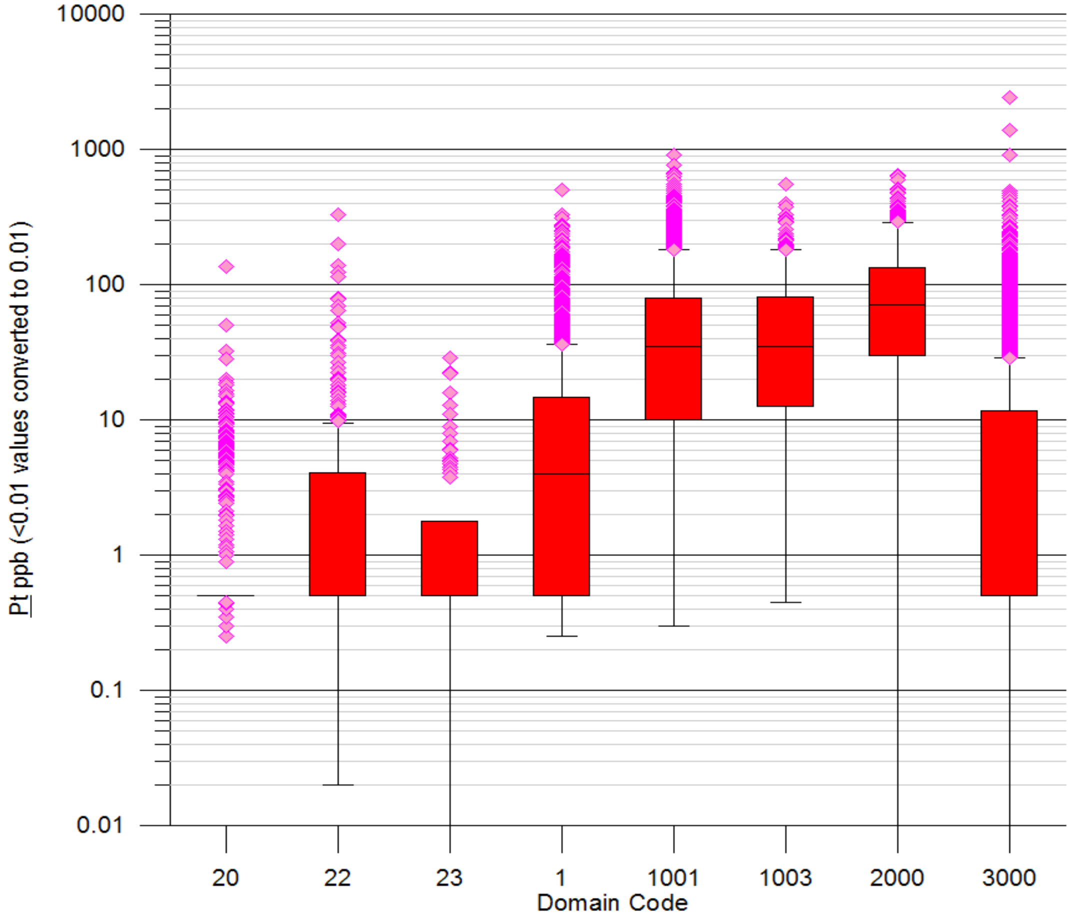
Includes Oct 25th changes



PolyMet - Final Composites by Domain Oct 15, 2007 - Pt (ppb)								
	20	22	23	1	1001	1003	2000	3000
Number of values	2018	498	102	3192	8158	423	1132	12155
Sum	2,355	2,770	270	44,284	456,515	25,471	107,328	139,776
Minimum	0.3	0.0	0.0	0.3	0.3	0.5	0.0	0.0
Maximum	135.0	331.0	29.0	505.0	907.0	555.0	639.4	2,397.5
Range	134.8	331.0	29.0	504.8	906.7	554.6	639.4	2,397.5
Mean	1.2	5.6	2.7	13.9	56.0	60.2	94.8	11.5
Median	0.5	0.5	0.5	4.0	35.0	34.5	70.9	0.5
First quartile	0.5	0.5	0.5	0.5	10.0	12.5	30.0	0.5
Third quartile	0.5	4.1	1.8	14.8	78.9	80.3	133.4	11.8
Standard error	0.1	1.0	0.5	0.5	0.7	3.4	2.6	0.3
95% confidence interval	0.2	1.9	1.0	1.0	1.4	6.8	5.2	0.7
99% confidence interval	0.2	2.5	1.3	1.3	1.9	8.9	6.8	0.9
Variance	14.8	460.4	25.3	876.8	4,281.2	5,004.8	7,917.0	1,357.1
Average deviation	1.2	7.4	3.2	15.7	46.8	50.5	67.2	14.1
Standard deviation	3.8	21.5	5.0	29.6	65.4	70.7	89.0	36.8
Coefficient of variation	3.3	3.9	1.9	2.1	1.2	1.2	0.9	3.2
Skew	23.0	10.0	3.2	5.7	2.6	2.3	1.8	30.2

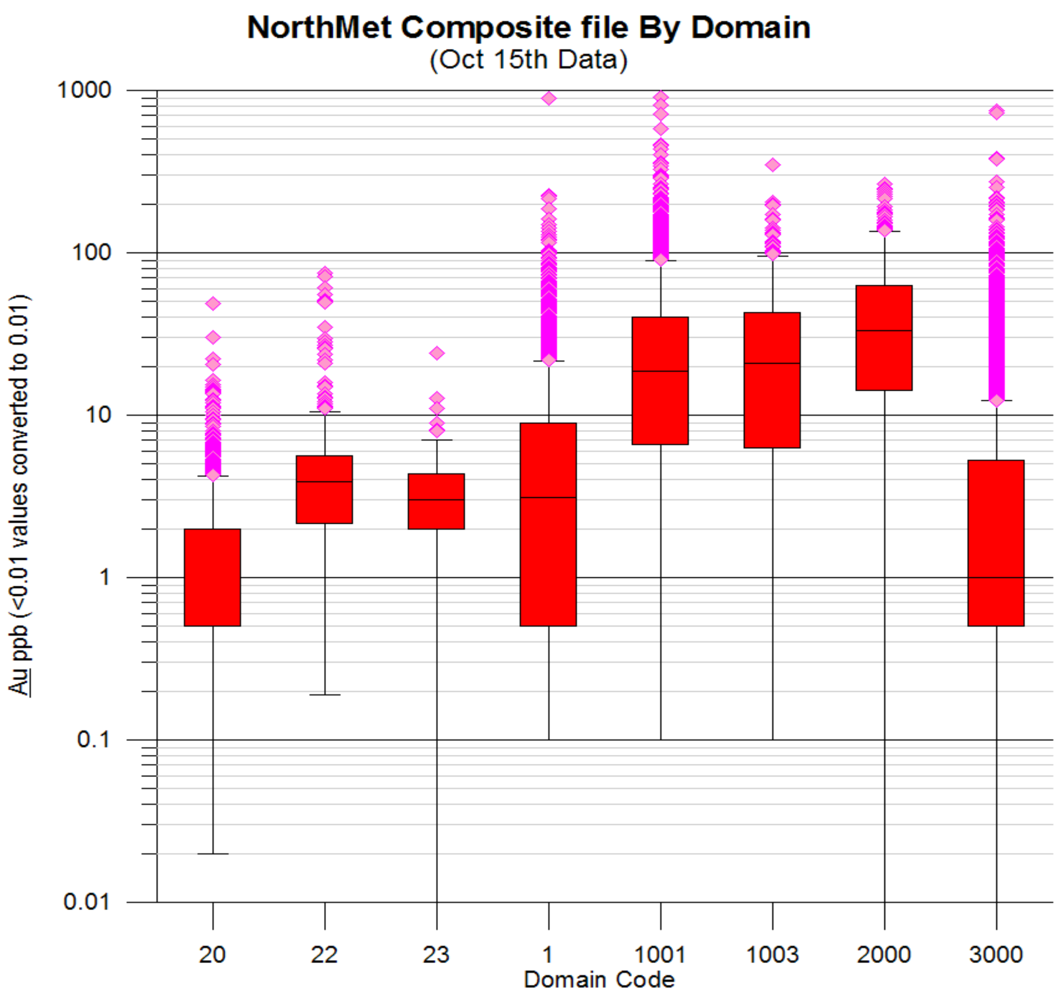
Includes Oct 25th changes

NorthMet Composite file By Domain
(Oct 15th Data)



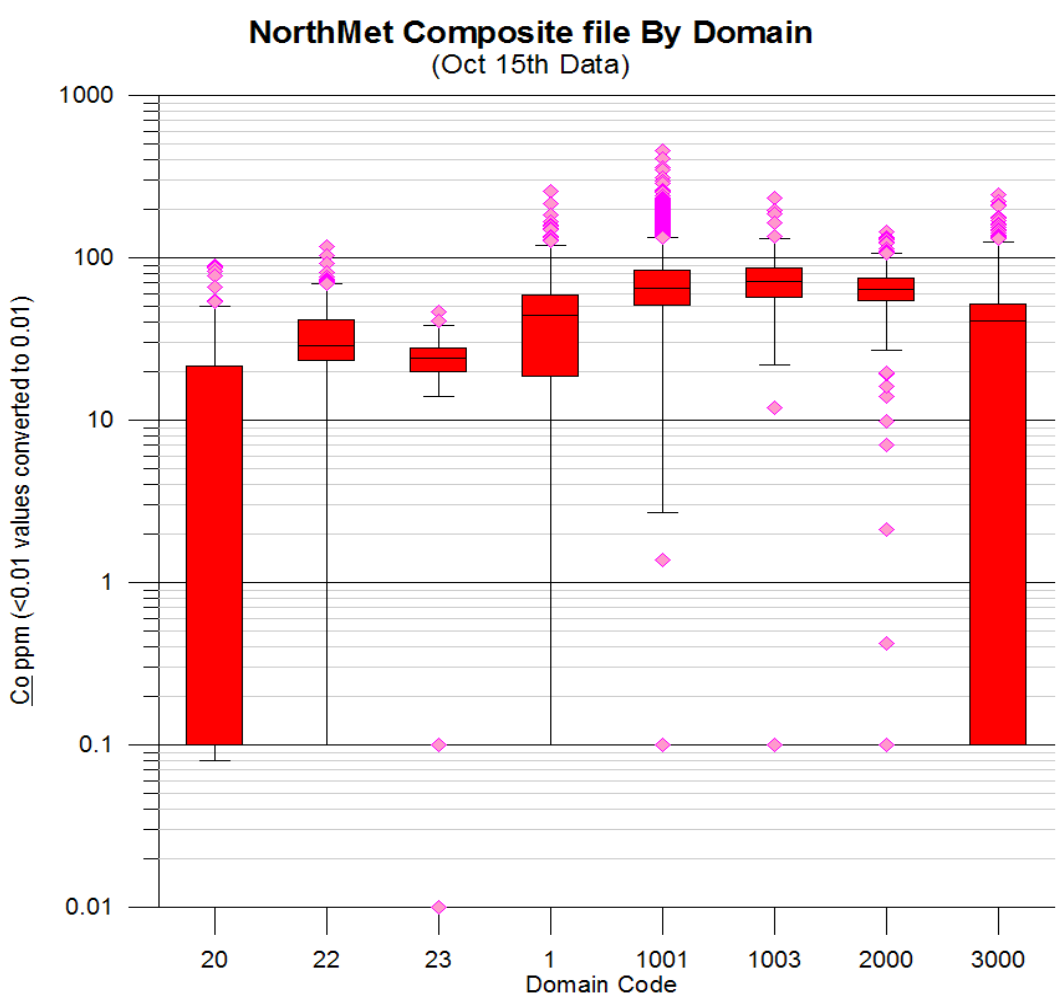
PolyMet - Final Composites by Domain Oct 15 2007 file - Au (ppb)								
	20	22	23	1	1001	1003	2000	3000
Number of values	2018	498	102	3192	8158	423	1132	12155
Sum	3,195	2,698	357	28,027	239,991	13,839	49,062	73,392
Minimum	0.0	0.2	0.0	0.1	0.1	0.1	0.0	0.0
Maximum	48.6	75.0	24.0	895.0	916.0	347.0	266.2	745.0
Range	48.6	74.8	24.0	894.9	915.9	346.9	266.2	745.0
Mean	1.6	5.4	3.5	8.8	29.4	32.7	43.3	6.0
Median	0.5	3.9	3.0	3.1	18.6	21.0	33.1	1.0
First quartile	0.5	2.2	2.0	0.5	6.6	6.3	14.3	0.5
Third quartile	2.0	5.7	4.4	9.0	39.9	42.8	62.7	5.2
Standard error	0.1	0.4	0.3	0.4	0.4	1.9	1.2	0.2
95% confidence interval	0.1	0.7	0.6	0.8	0.8	3.8	2.3	0.3
99% confidence interval	0.1	1.0	0.8	1.1	1.1	5.0	3.0	0.4
Variance	6.4	69.5	9.6	540.1	1,469.5	1,549.4	1,529.6	305.4
Average deviation	1.6	3.7	2.0	9.4	23.6	27.2	29.6	7.1
Standard deviation	2.5	8.3	3.1	23.2	38.3	39.4	39.1	17.5
Coefficient of variation	1.6	1.5	0.9	2.6	1.3	1.2	0.9	2.9
Skew	6.1	5.6	3.3	19.6	6.1	2.7	1.7	17.1

Includes Oct 25th changes



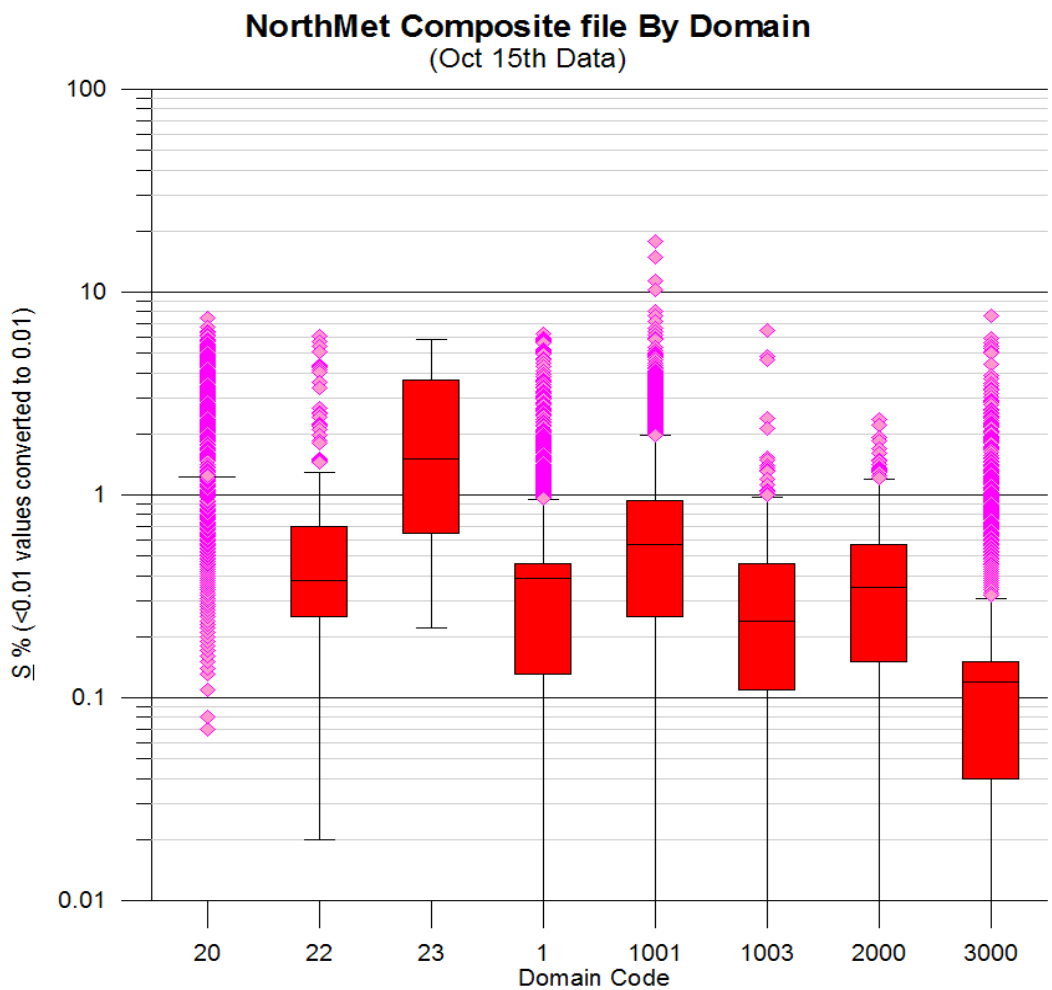
PolyMet - Final Composites by Domain June 2007 - Co (ppm)								
	20	22	23	1	1001	1003	2000	3000
Number of values	2018	498	102	3192	8158	423	1132	12155
Sum	18,467	15,633	2,412	129,711	559,195	30,395	73,194	398,585
Minimum	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1
Maximum	90.0	116.6	46.3	256.4	457.0	234.0	143.8	245.4
Range	89.9	116.5	46.3	256.3	456.9	233.9	143.7	245.3
Mean	9.2	31.4	23.6	40.6	68.5	71.9	64.7	32.8
Median	0.1	28.9	24.0	44.3	65.0	71.8	64.2	41.0
First quartile	0.1	23.3	20.0	18.5	51.0	57.2	54.1	0.1
Third quartile	21.4	41.5	28.0	59.1	83.5	87.3	74.9	51.9
Standard error	0.3	0.8	0.9	0.5	0.4	1.5	0.5	0.3
95% confidence interval	0.6	1.5	1.7	1.0	0.7	2.9	1.0	0.5
99% confidence interval	0.8	2.0	2.3	1.3	0.9	3.8	1.3	0.7
Variance	171.9	286.7	77.2	811.8	999.4	915.9	311.2	821.0
Average deviation	11.6	12.4	6.2	22.9	22.3	21.6	13.1	24.8
Standard deviation	13.1	16.9	8.8	28.5	31.6	30.3	17.6	28.7
Coefficient of variation	1.4	0.5	0.4	0.7	0.5	0.4	0.3	0.9
Skew	1.3	0.6	(0.8)	0.3	1.4	0.2	(0.0)	0.4

Includes Oct 25th changes



PolyMet - Final Composites by Domain Oct 15, 2007 file - S%								
	20	22	23	1	1001	1003	2000	3000
Number of values	2018	498	102	3192	8158	423	1132	12155
Sum	2,835.4	333.3	233.5	1,499.3	5,725.4	157.2	452.5	1,645.7
Minimum	0.070	0.020	0.220	0.010	0.010	0.010	0.010	0.010
Maximum	7.450	6.080	5.830	6.240	17.790	6.450	2.350	7.620
Range	7.380	6.060	5.610	6.230	17.780	6.440	2.340	7.610
Mean	1.405	0.669	2.290	0.470	0.702	0.372	0.400	0.135
Median	1.230	0.380	1.510	0.390	0.570	0.240	0.350	0.120
First quartile	1.230	0.250	0.650	0.130	0.250	0.110	0.150	0.040
Third quartile	1.230	0.700	3.690	0.460	0.940	0.460	0.570	0.150
Standard error	0.021	0.040	0.173	0.011	0.008	0.026	0.009	0.002
95% confidence interval	0.042	0.078	0.344	0.021	0.015	0.050	0.018	0.005
99% confidence interval	0.055	0.103	0.455	0.027	0.020	0.066	0.024	0.006
Variance	0.922	0.793	3.066	0.363	0.493	0.276	0.101	0.066
Average deviation	0.565	0.526	1.537	0.327	0.448	0.276	0.245	0.093
Standard deviation	0.960	0.891	1.751	0.602	0.702	0.526	0.317	0.256
Coefficient of variation	0.683	1.331	0.765	1.282	1.000	1.414	0.793	1.892
Skew	2.469	3.637	0.570	4.457	5.614	6.770	1.437	11.770

Includes Oct 25th changes



APPENDIX F

VARIOGRAPHY

Downhole 1001 - Au

User Defined Rotation Conventions

Nugget ==> 0.036
C1 ==> 0.748
C2 ==> 0.216

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -49
RH Rotation about the Y' axis ==> -72
RH Rotation about the Z' axis ==> 45

Range along the Z' axis ==> 10.2	Azimuth ==> 319	Dip ==> 18
Range along the Y' axis ==> 182.4	Azimuth ==> 32	Dip ==> -43
Range along the X' axis ==> 42.9	Azimuth ==> 66	Dip ==> 42

Second Structure -- Exponential with Practical Range

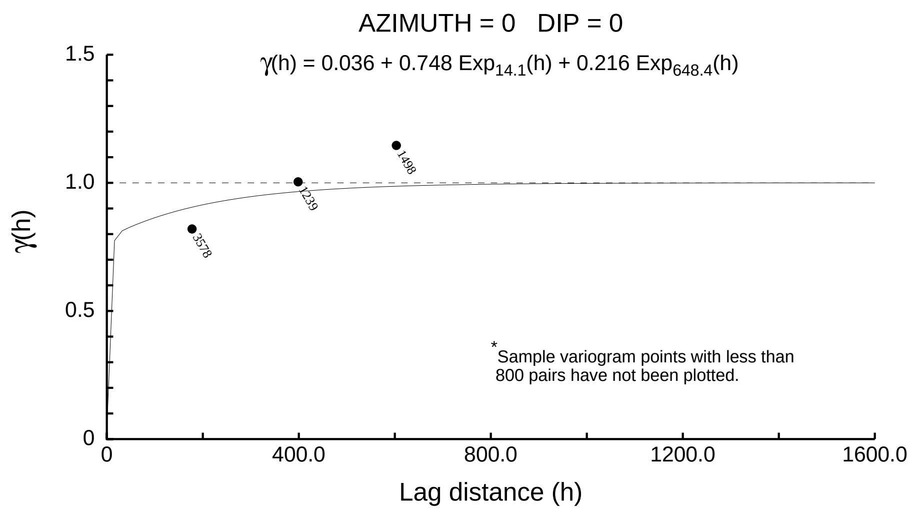
RH Rotation about the Z axis ==> -68
RH Rotation about the Y' axis ==> -53
RH Rotation about the Z' axis ==> 11

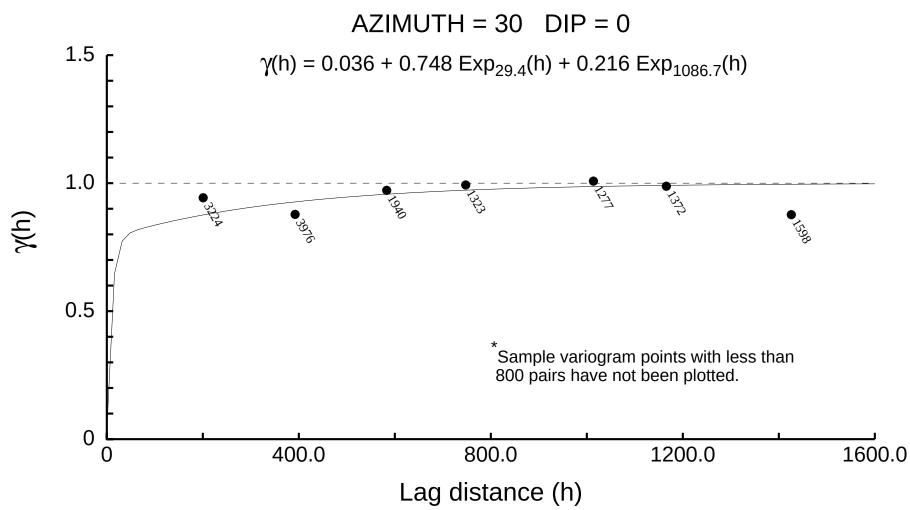
Range along the Z' axis ==> 1682.3	Azimuth ==> 338	Dip ==> 37
Range along the Y' axis ==> 1398.4	Azimuth ==> 61	Dip ==> -9
Range along the X' axis ==> 326.0	Azimuth ==> 139	Dip ==> 52

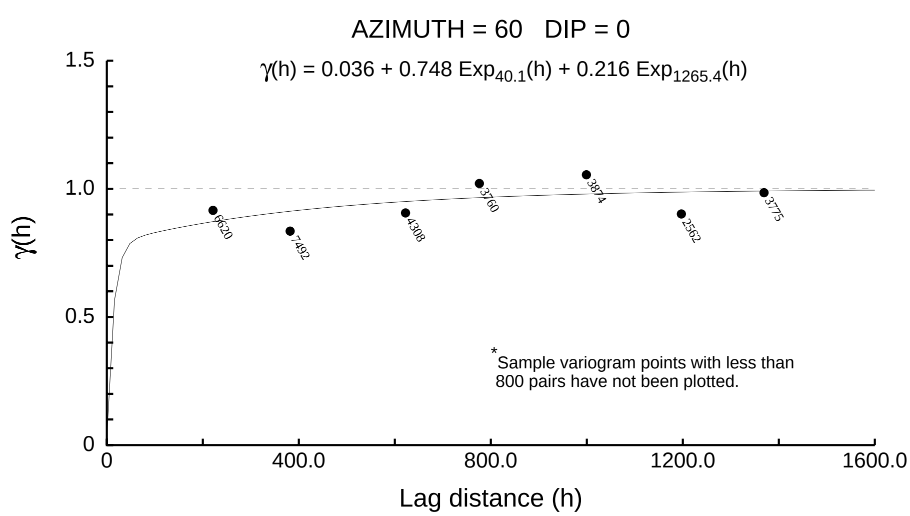
Modeling Criteria

Minimum number pairs req'd ==> 800
Sample variogram points weighted by # pairs

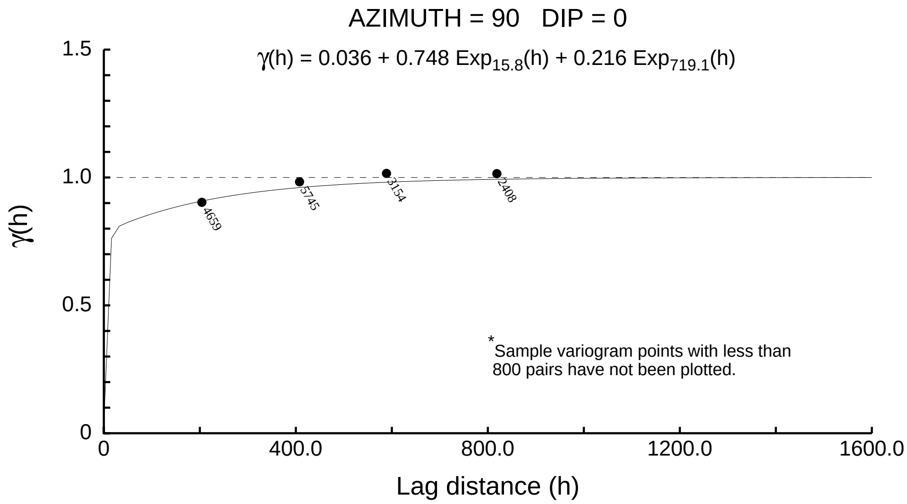
Downhole 1001 - Au

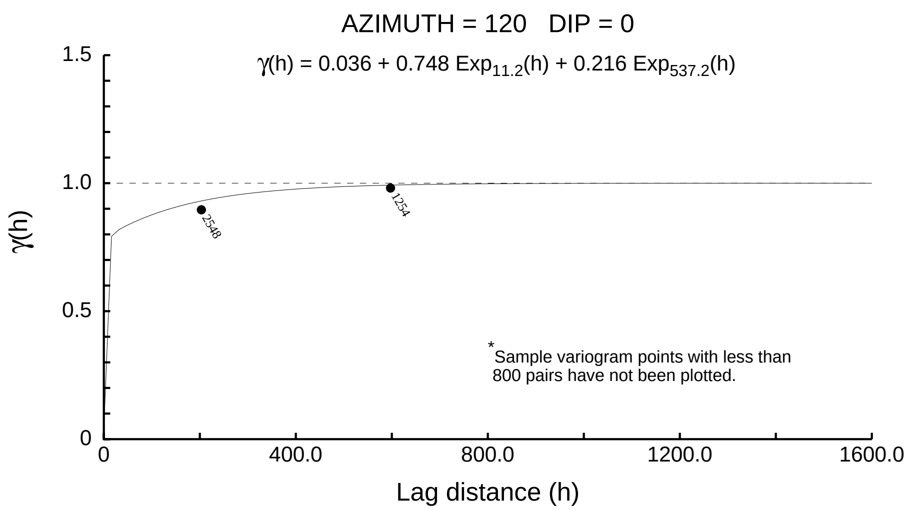


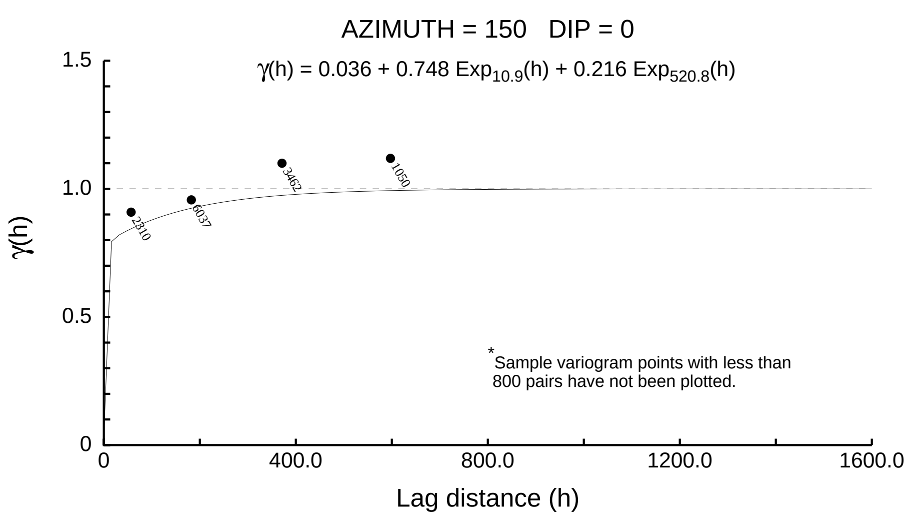




Downhole 1001 - Au







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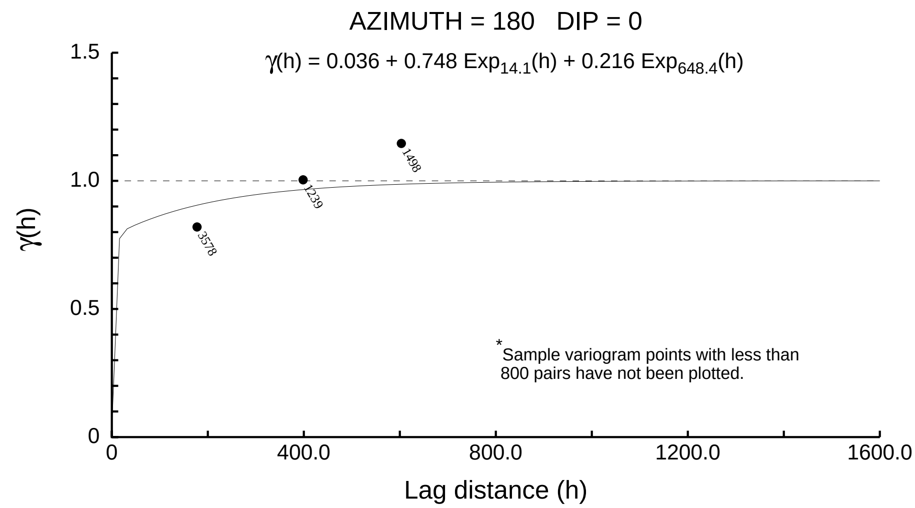

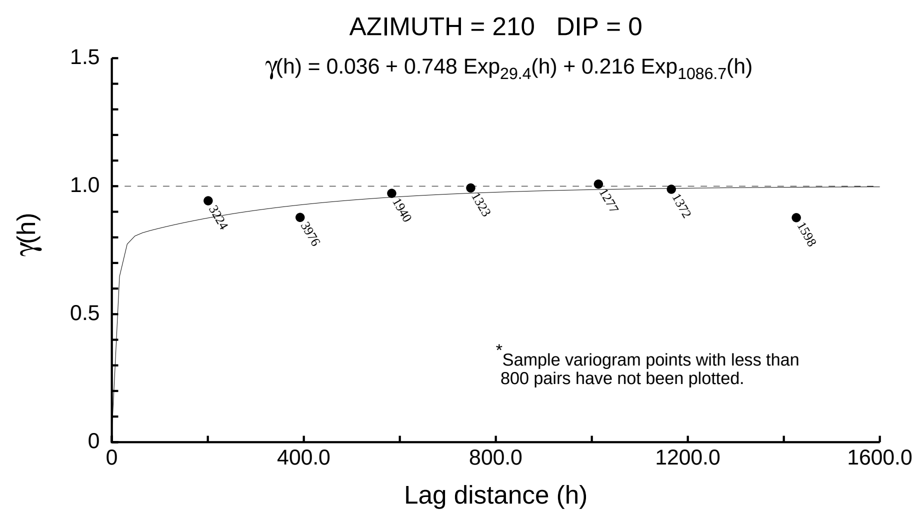

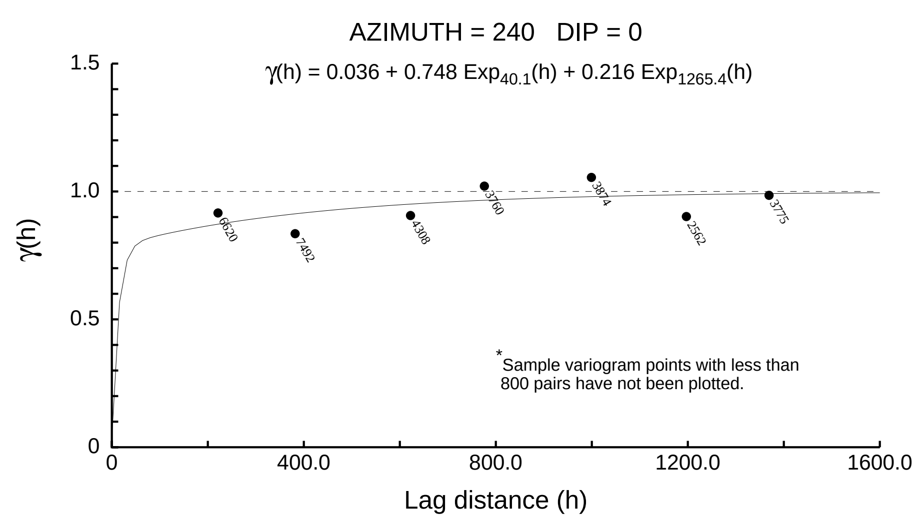

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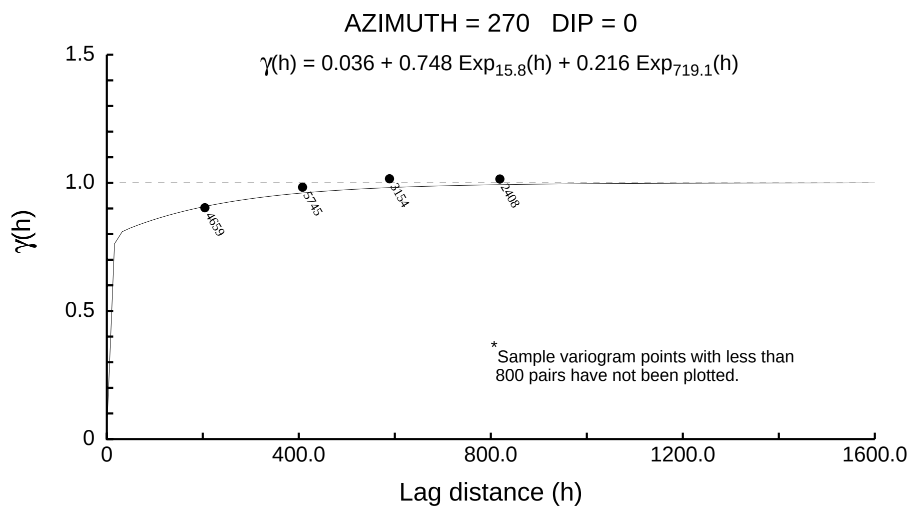

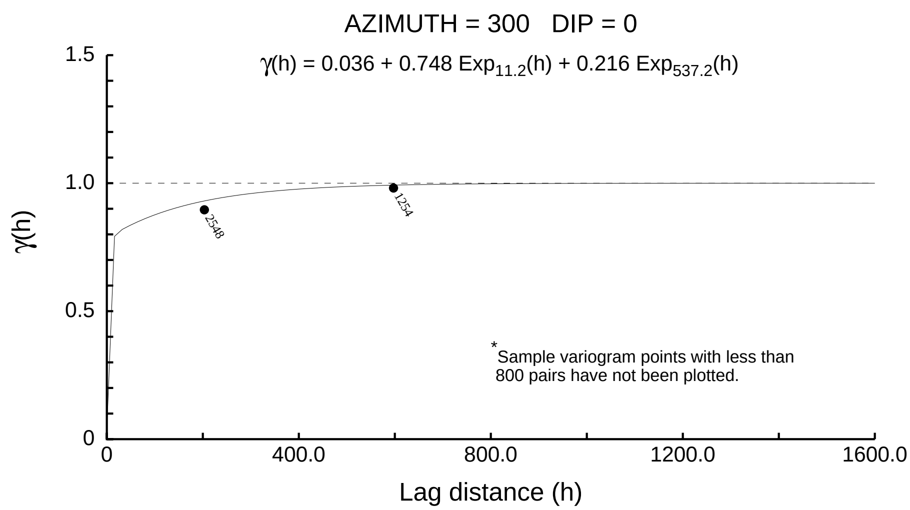

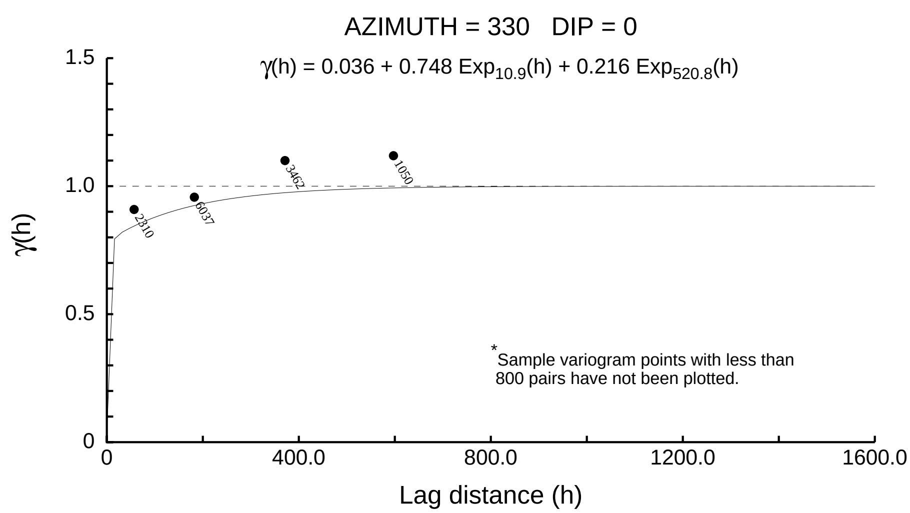

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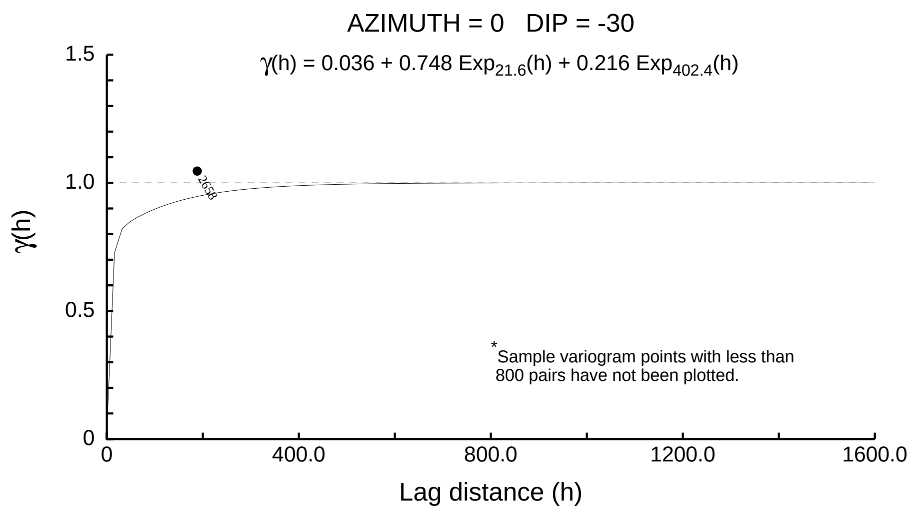

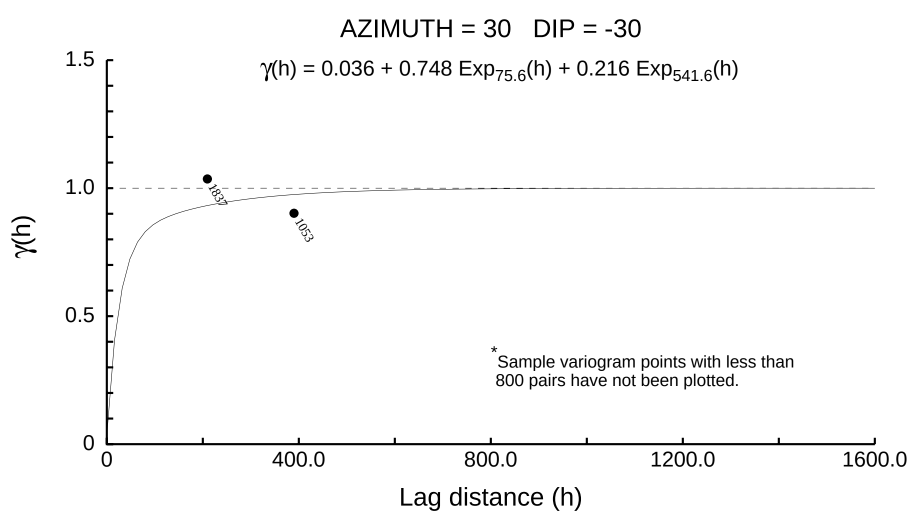

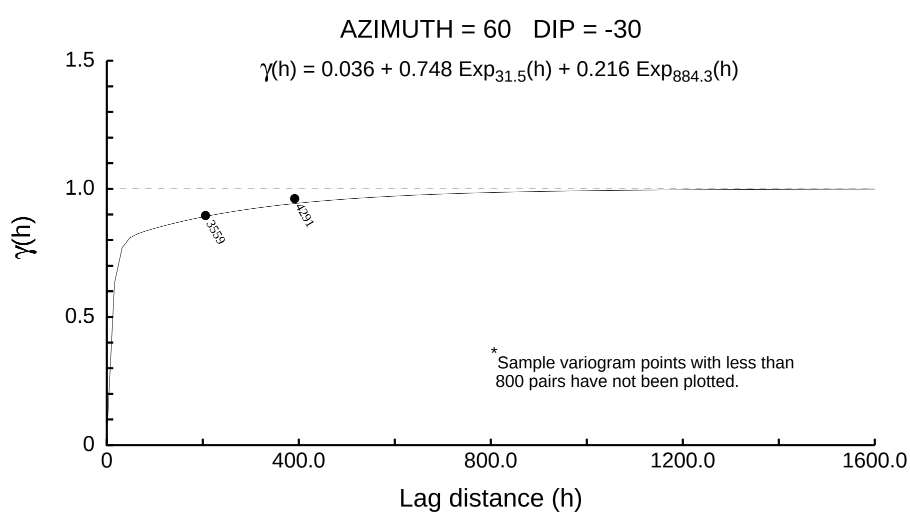

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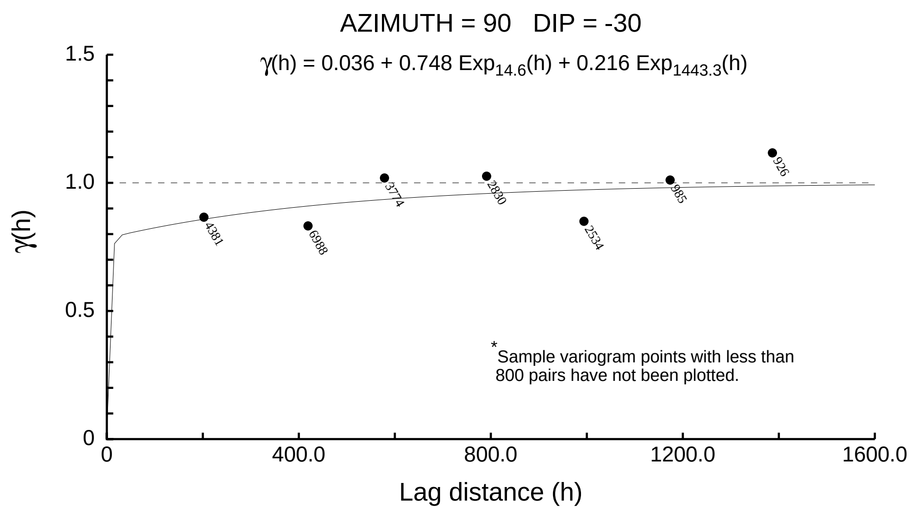

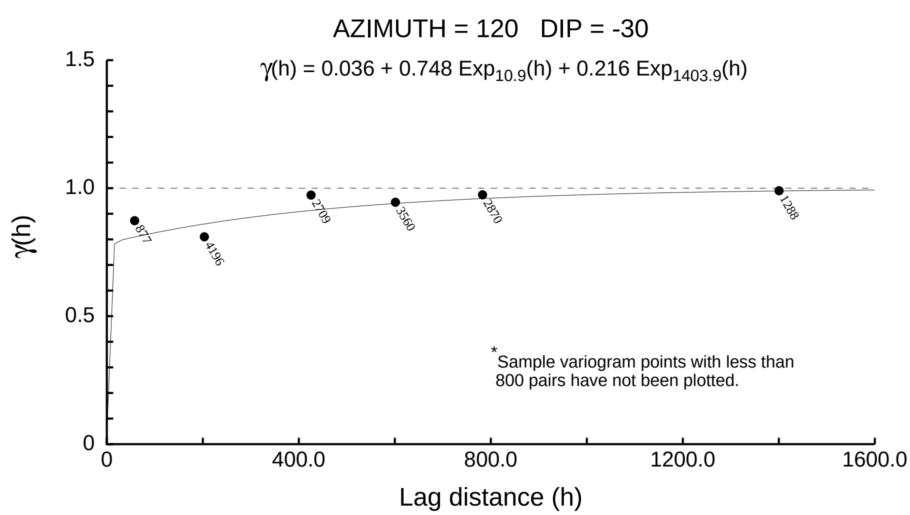

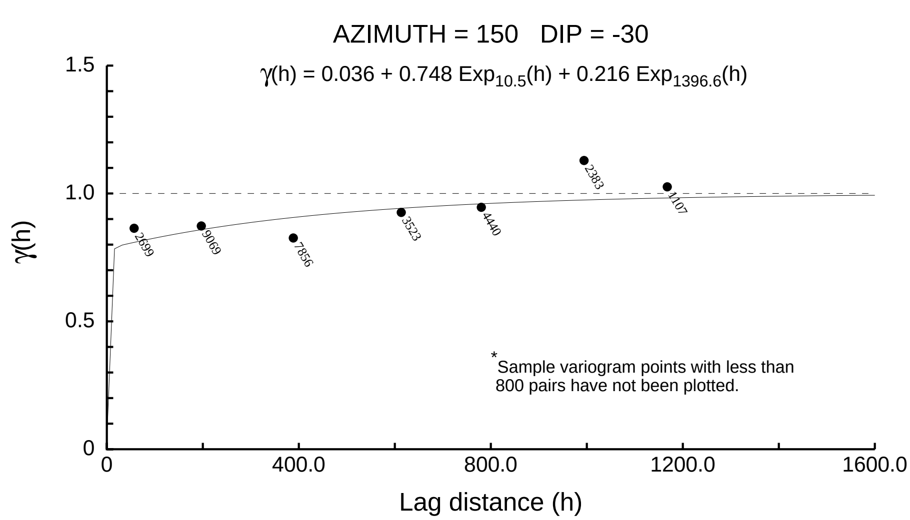

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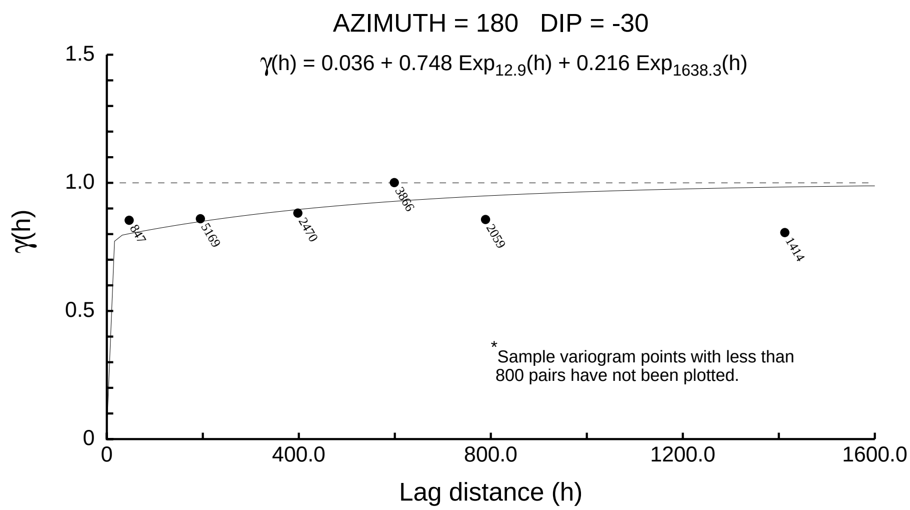

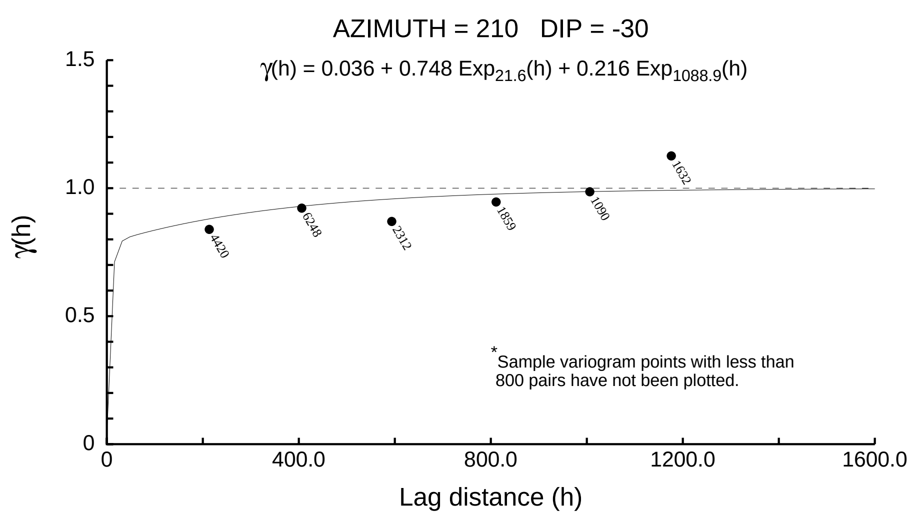

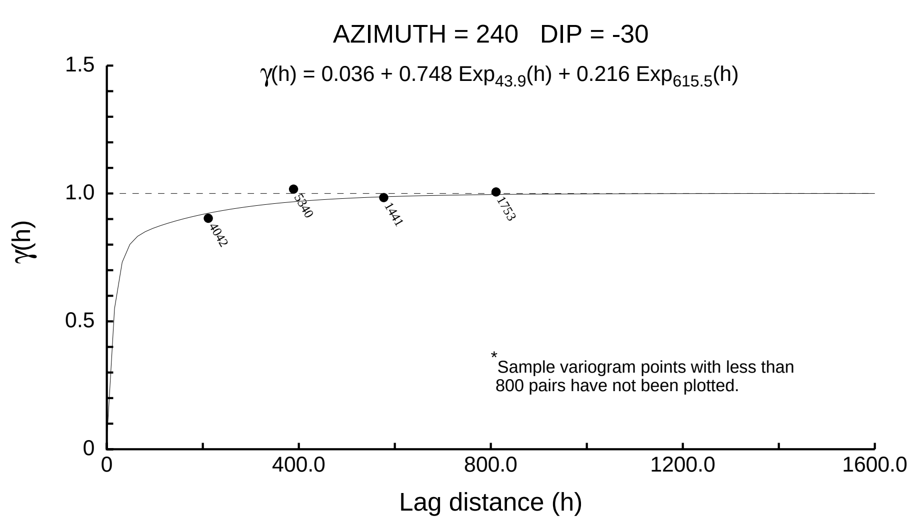

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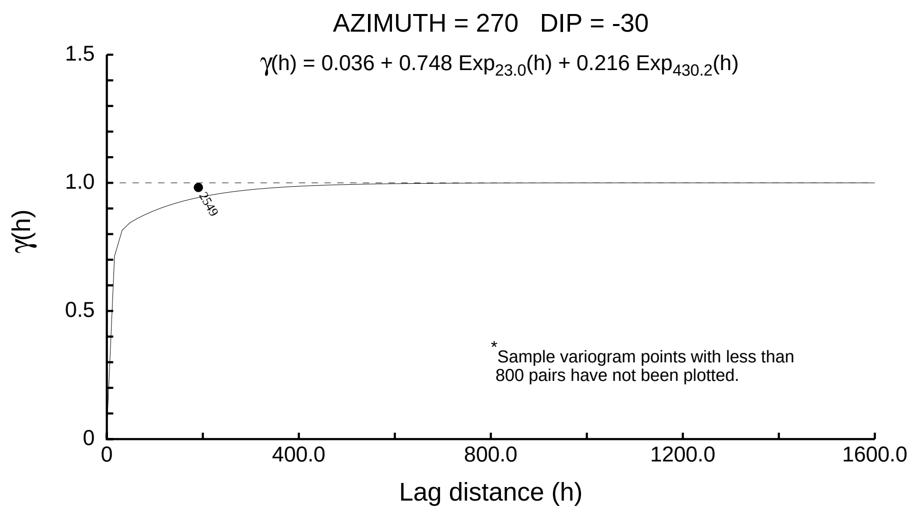

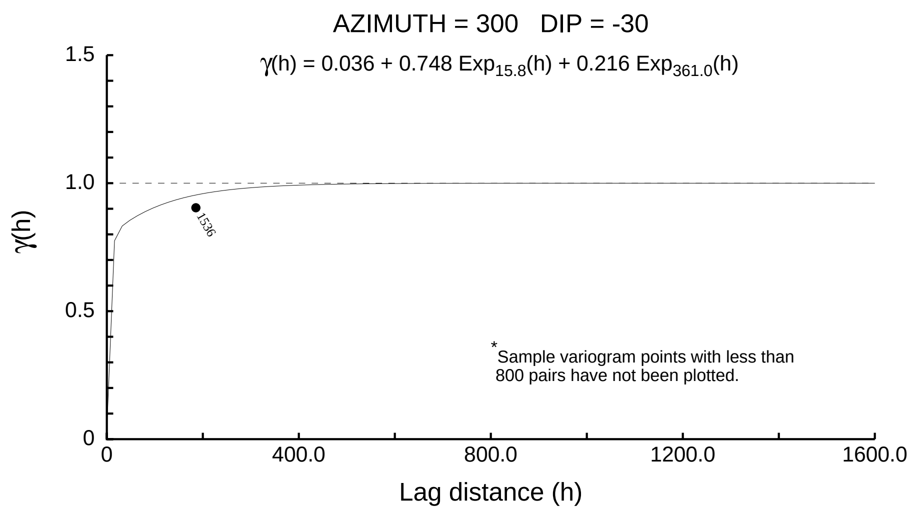

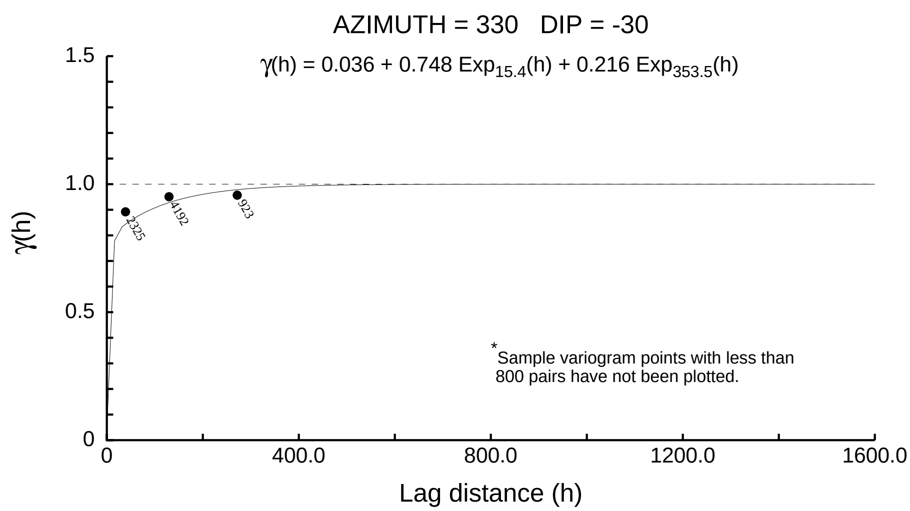

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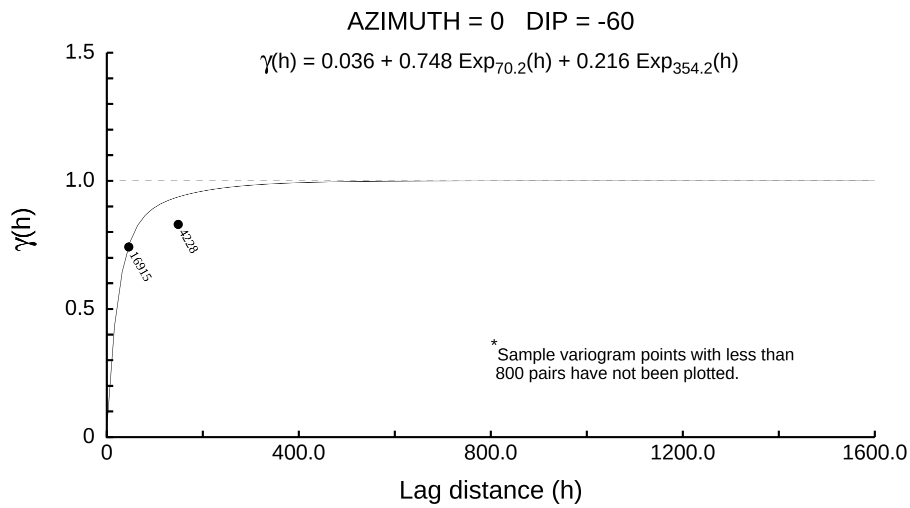

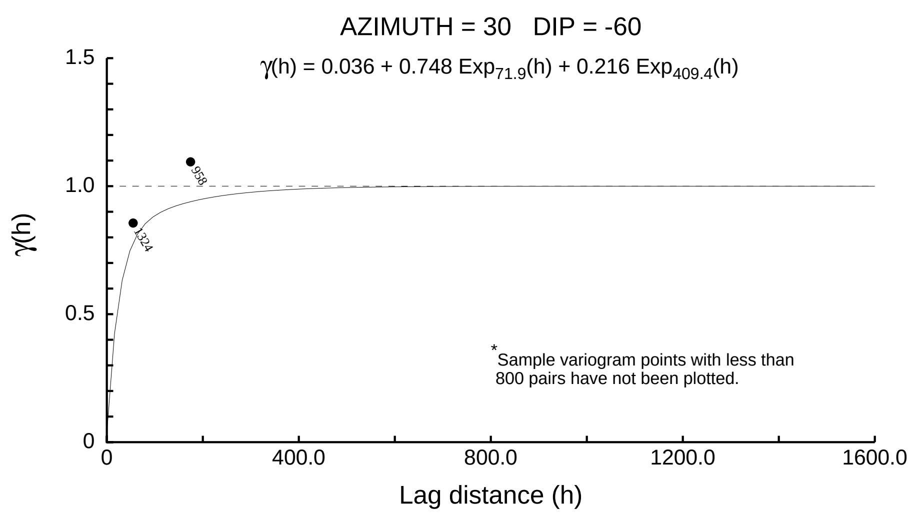

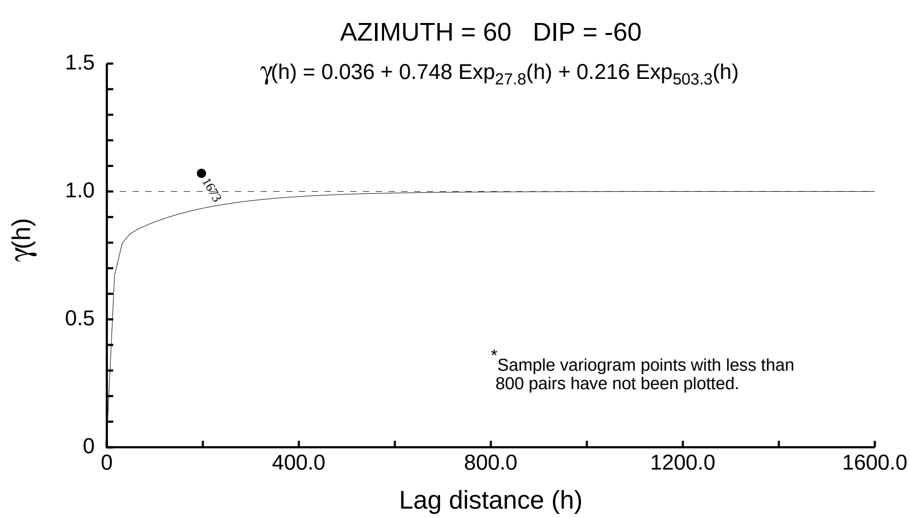

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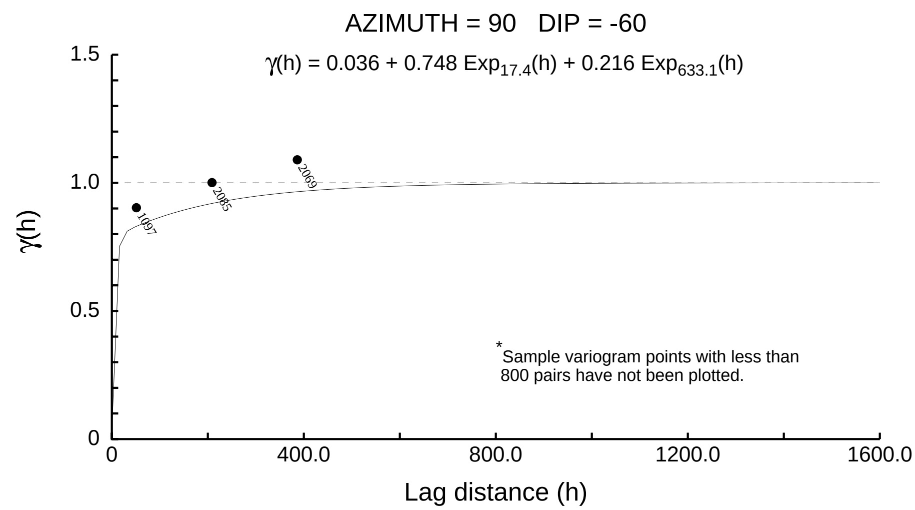

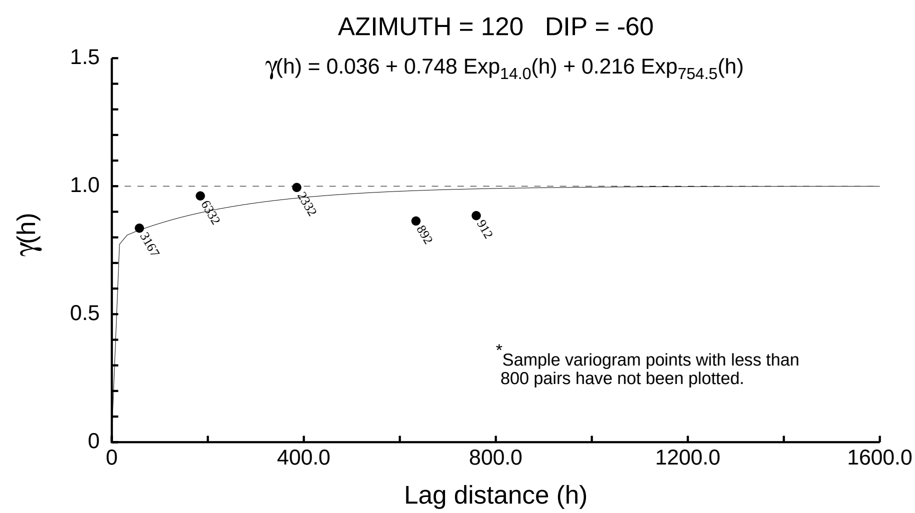

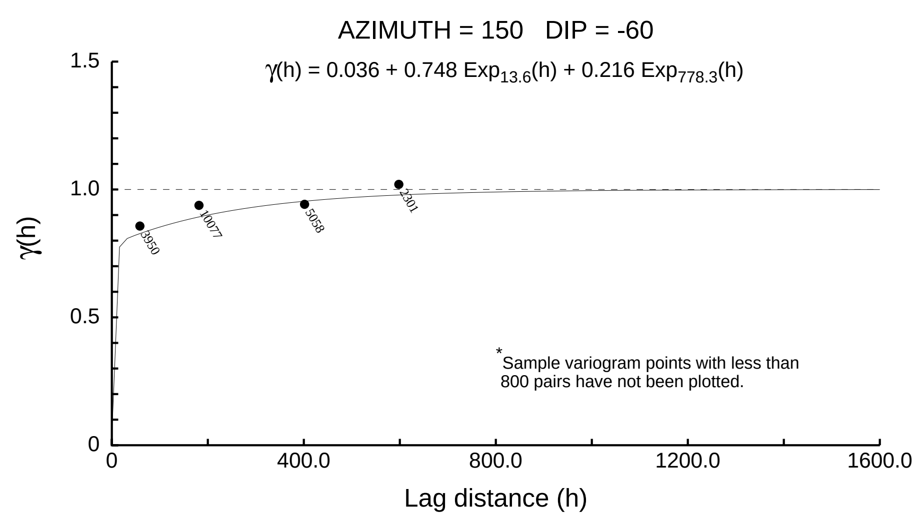

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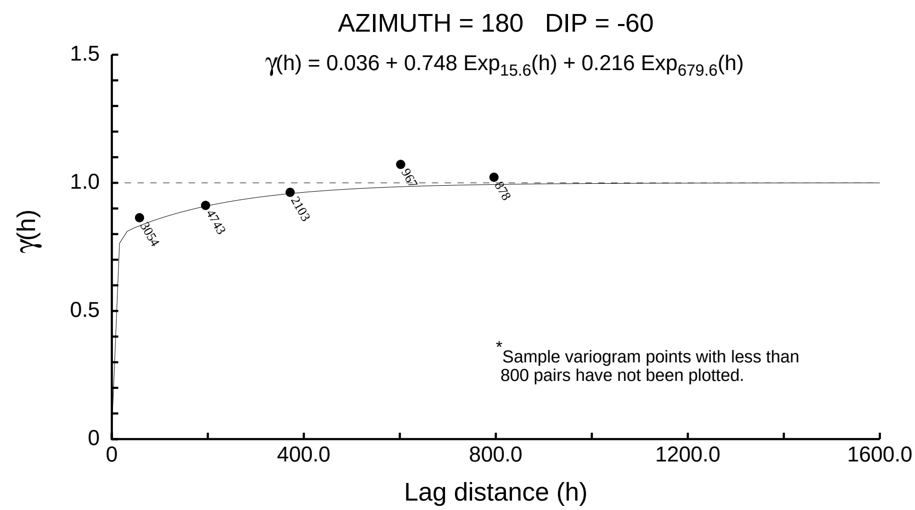

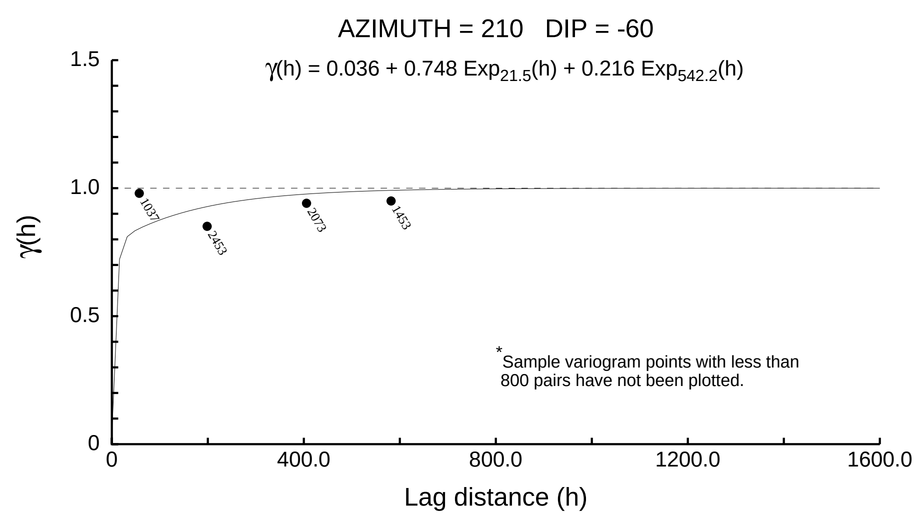

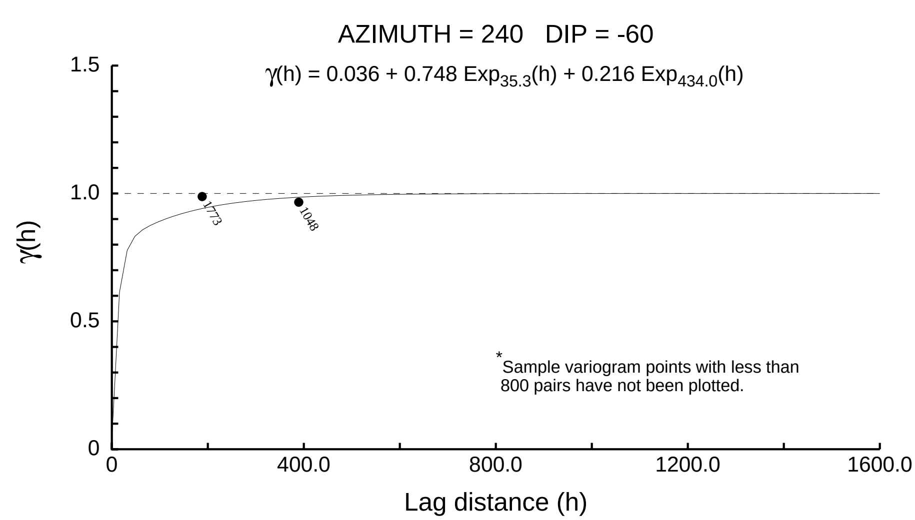

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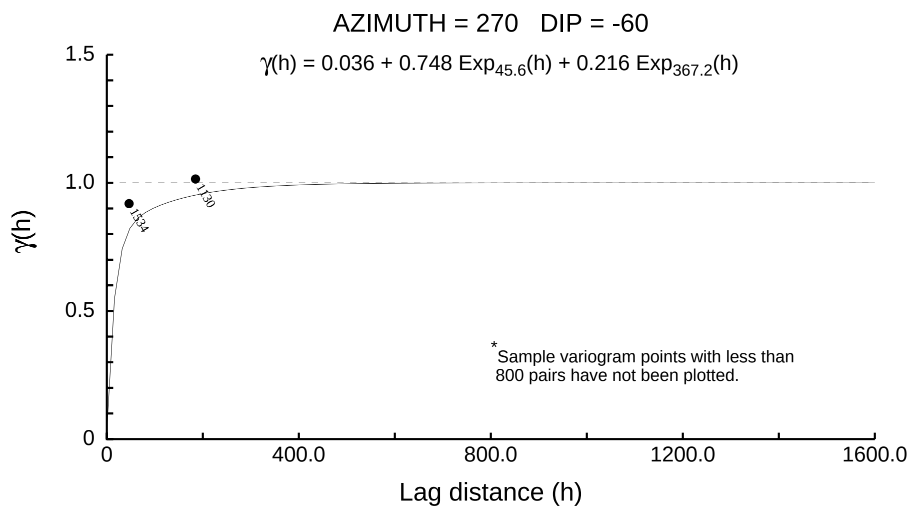

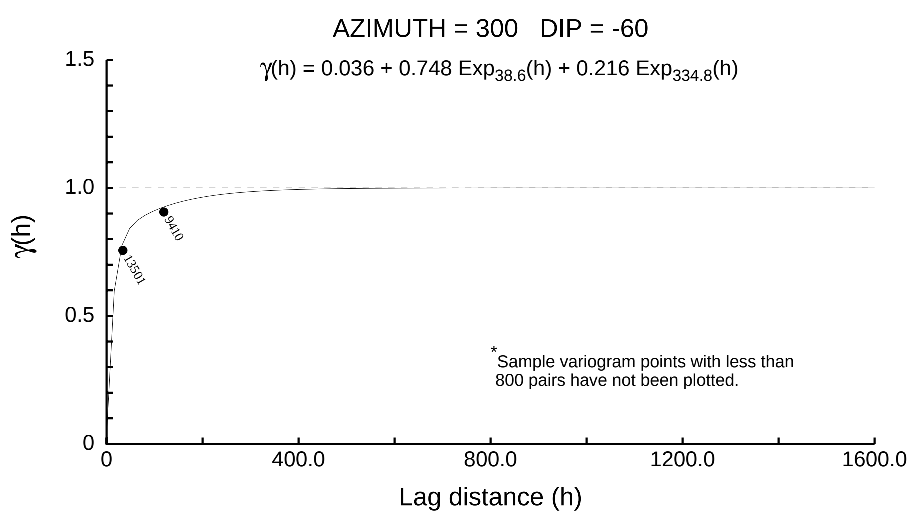

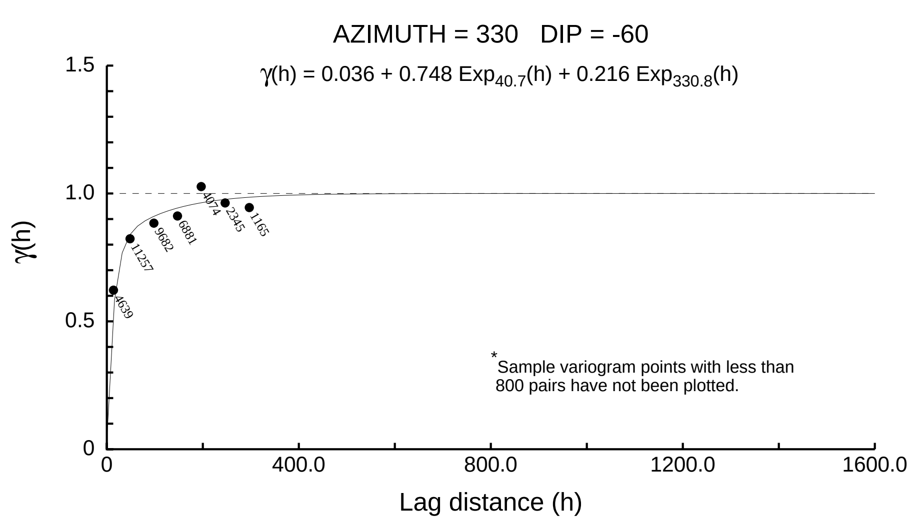

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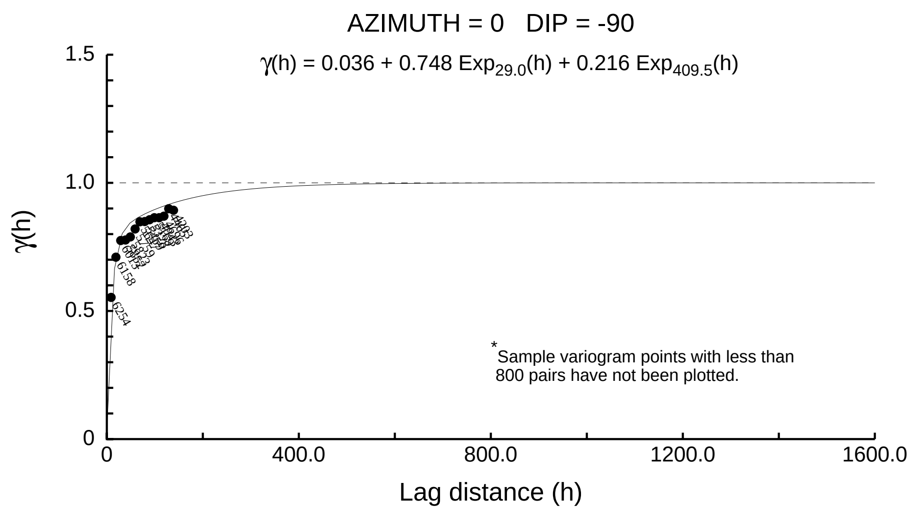


Downhole 1001 - Co

User Defined Rotation Conventions

Nugget ==> 0.044
C1 ==> 0.697
C2 ==> 0.259

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -66
RH Rotation about the Y’ axis ==> 58
RH Rotation about the Z’ axis ==> 4
Range along the Z’ axis ==> 72.1 Azimuth ==> 156 Dip ==> 32
Range along the Y’ axis ==> 663.4 Azimuth ==> 64 Dip ==> 3
Range along the X’ axis ==> 317.8 Azimuth ==> 149 Dip ==> -58

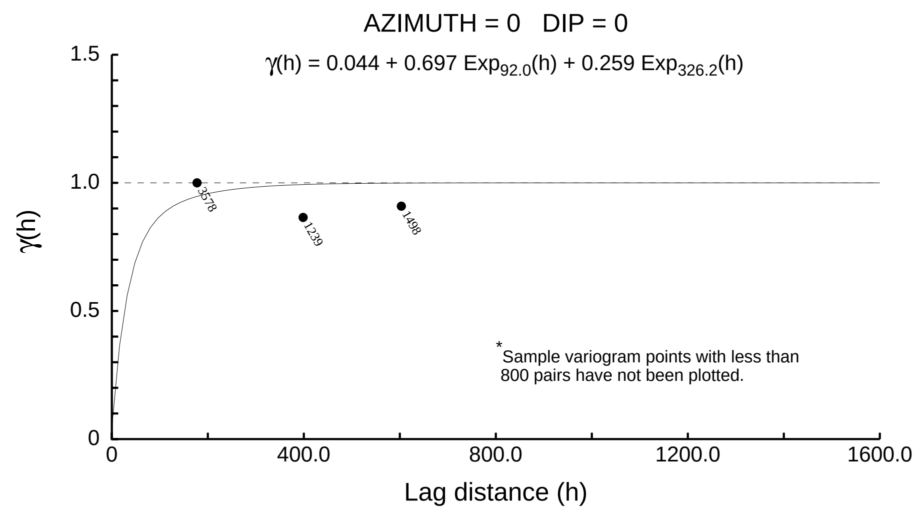
Second Structure -- Exponential with Practical Range

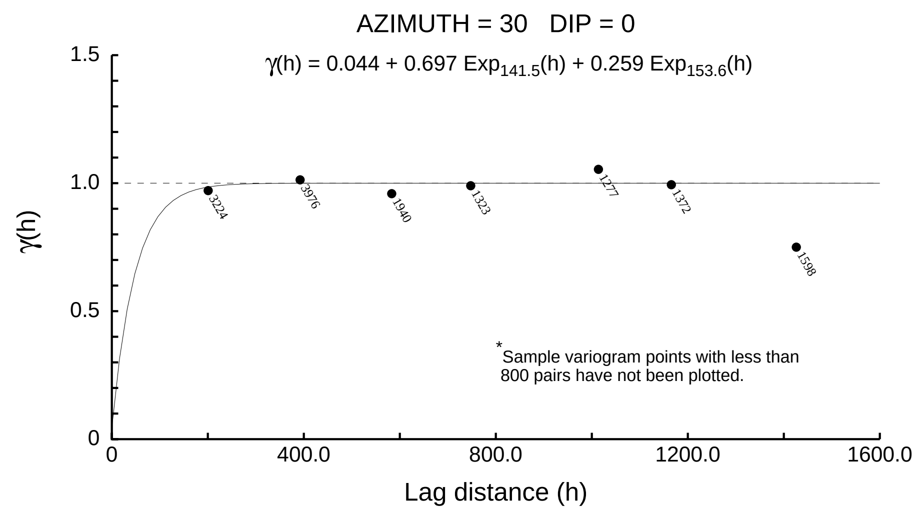
RH Rotation about the Z axis ==> -102
RH Rotation about the Y’ axis ==> 23
RH Rotation about the Z’ axis ==> 93
Range along the Z’ axis ==> 2319.5 Azimuth ==> 192 Dip ==> 67
Range along the Y’ axis ==> 1860.7 Azimuth ==> 9 Dip ==> 23
Range along the X’ axis ==> 54.1 Azimuth ==> 99 Dip ==> 1

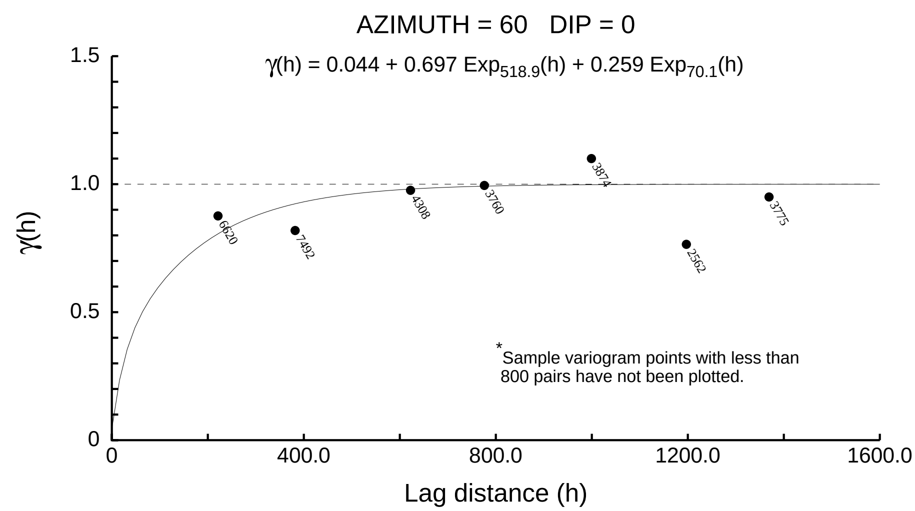
Modeling Criteria

Minimum number pairs req’d ==> 800
Sample variogram points weighted by # pairs

Downhole 1001 - Co







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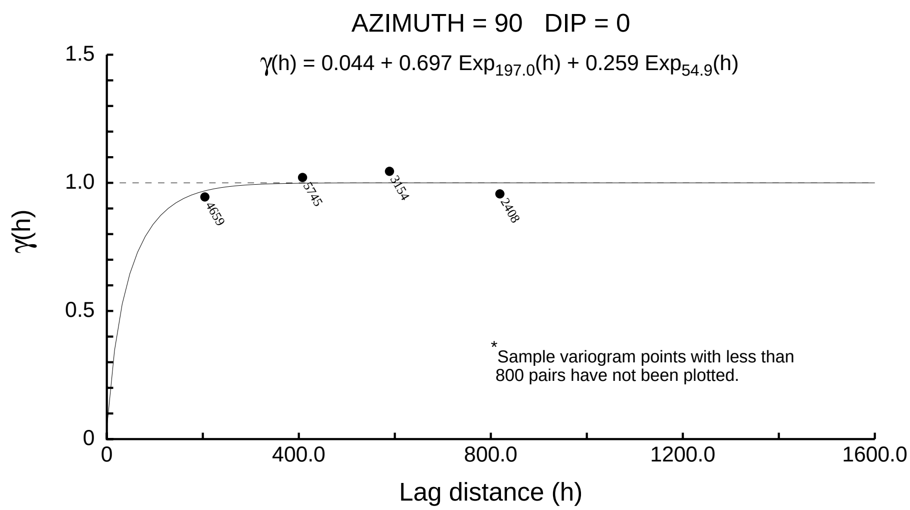
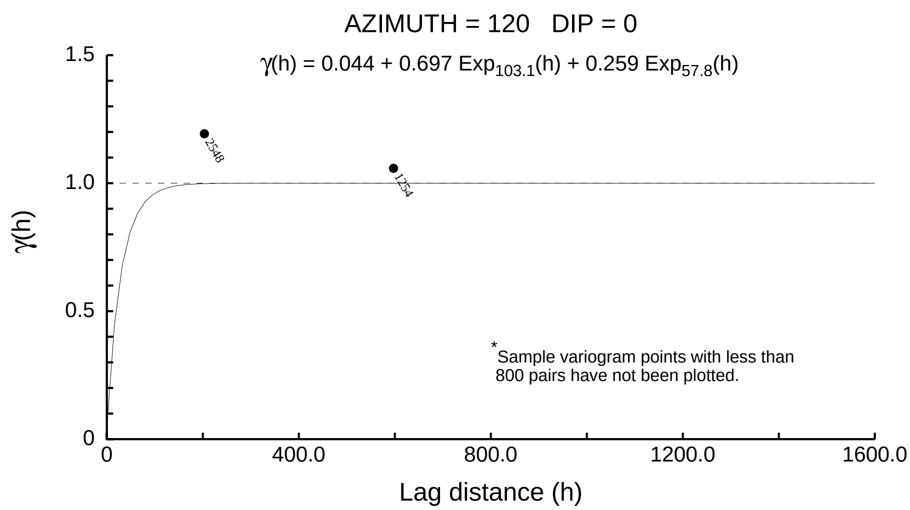
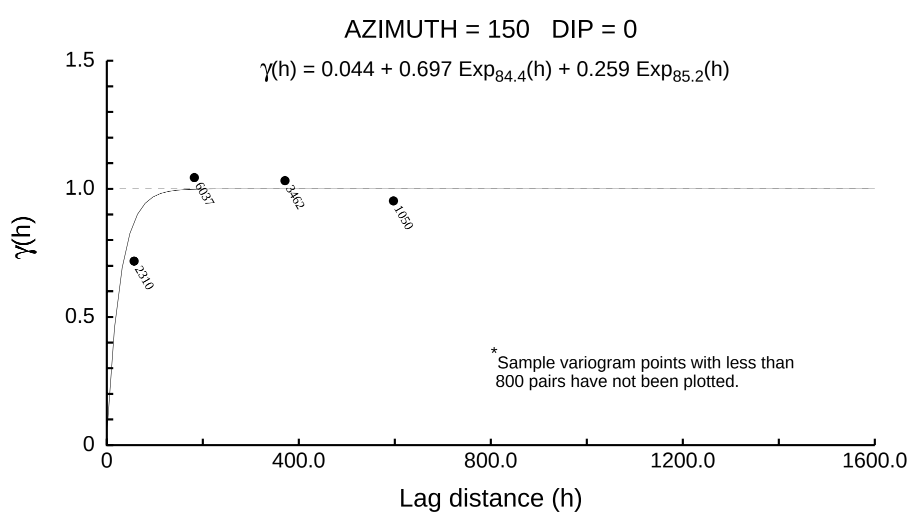
Downhole 1001 - Co







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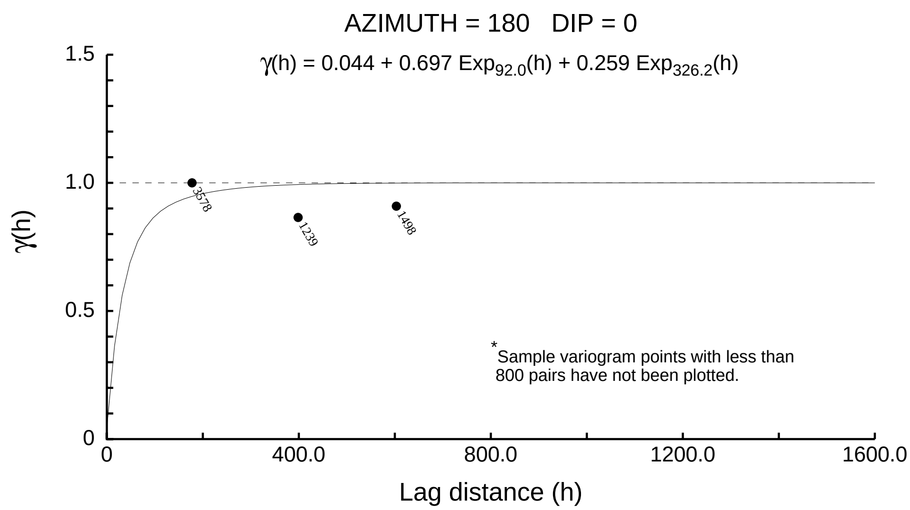

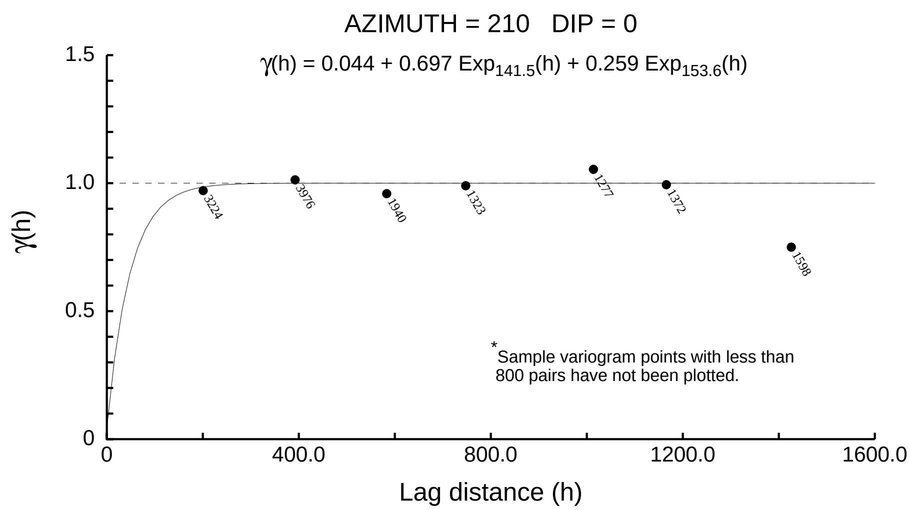

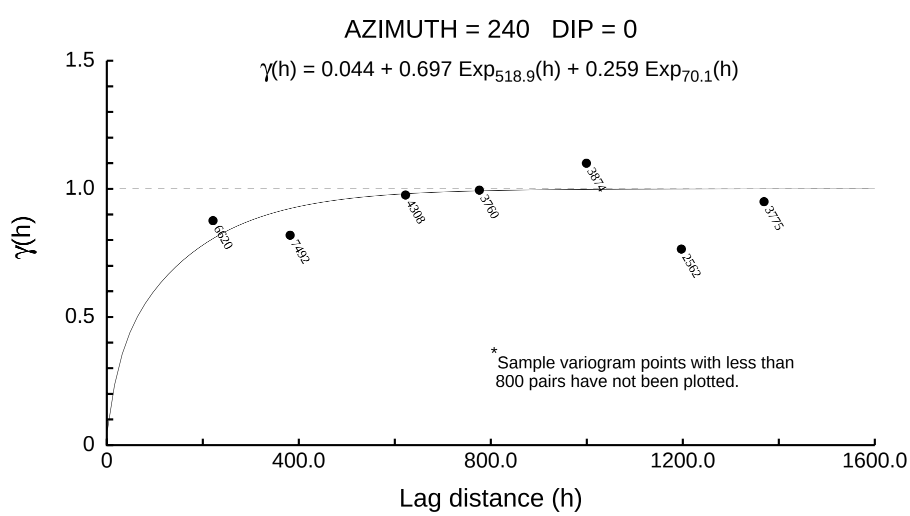

Downhole 1001 - Co

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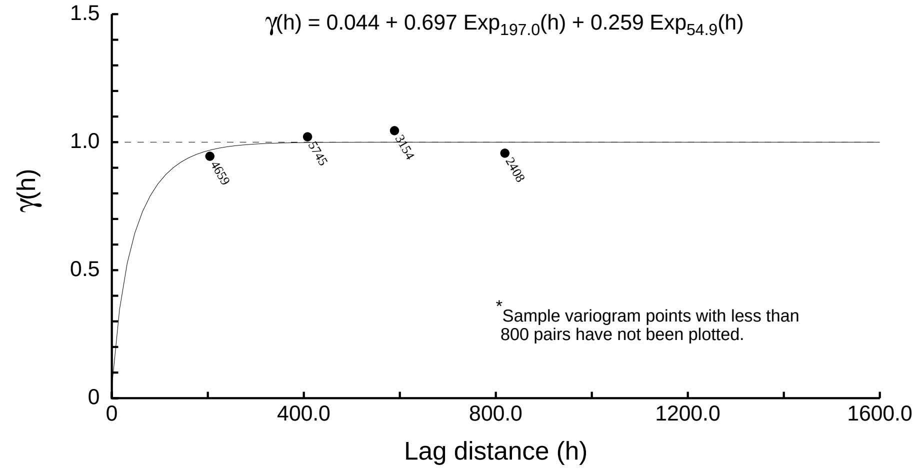

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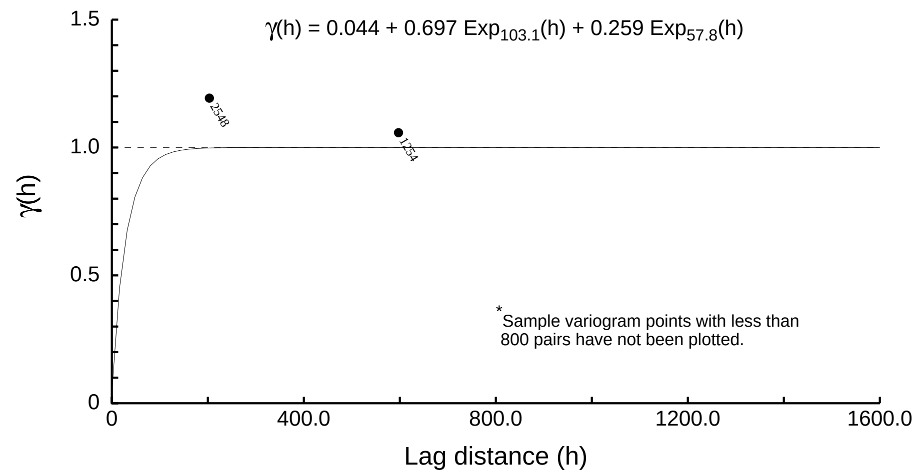

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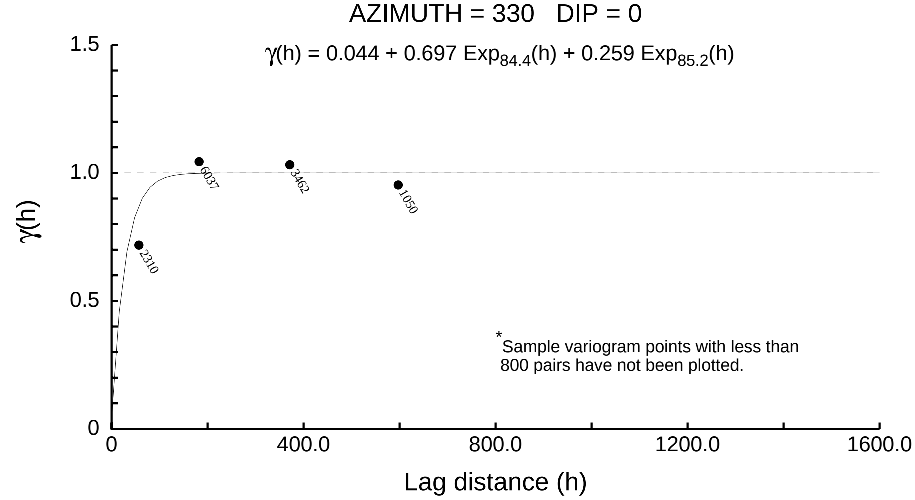

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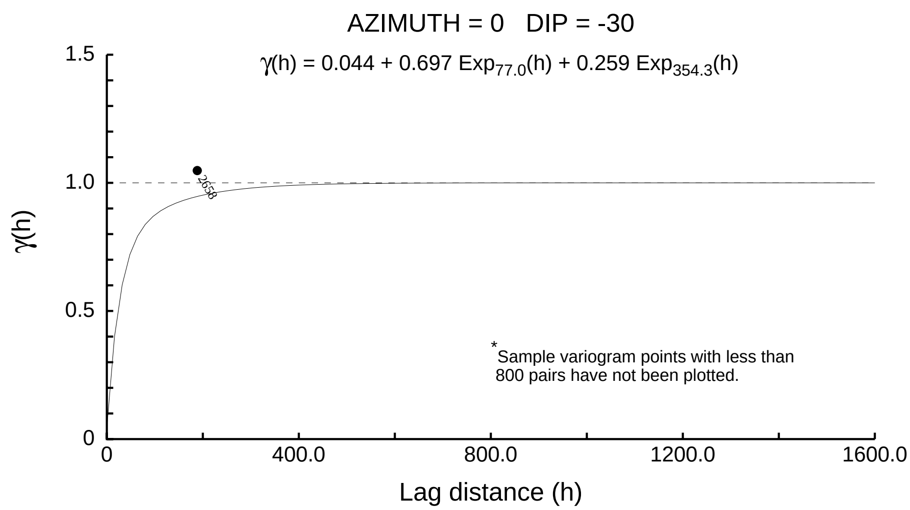
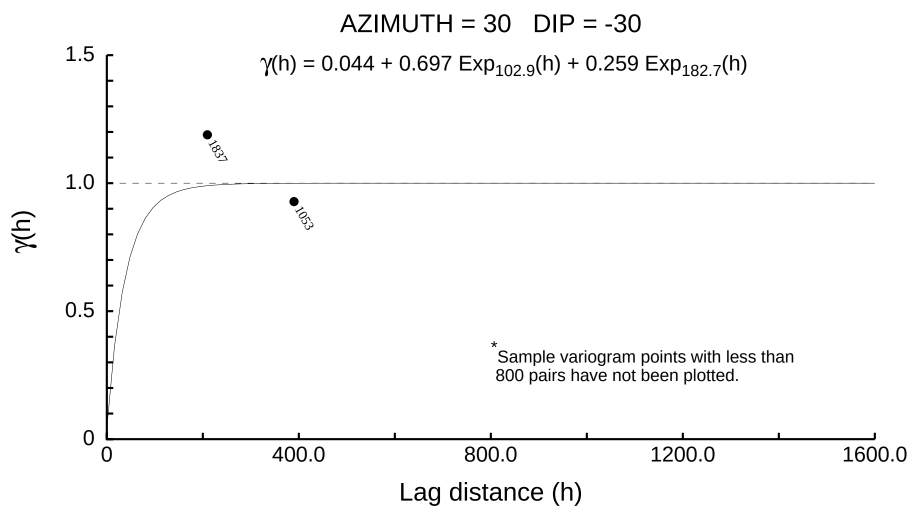
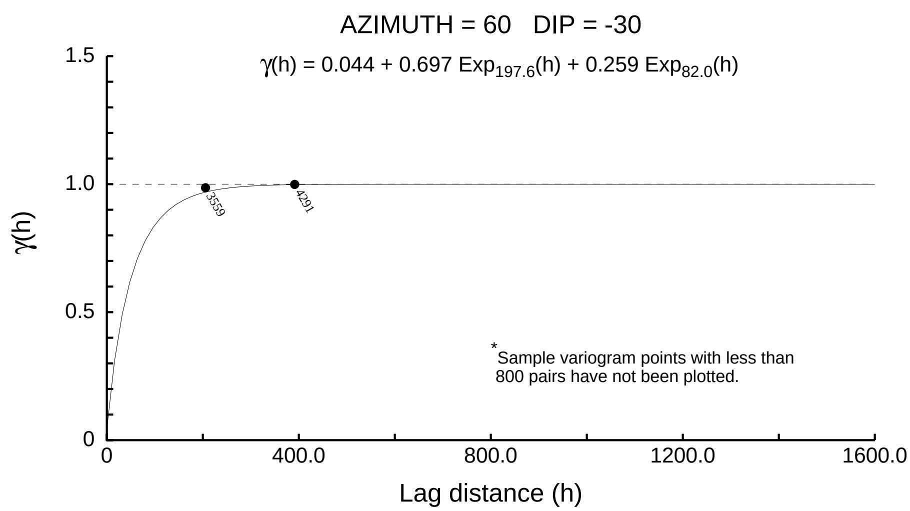
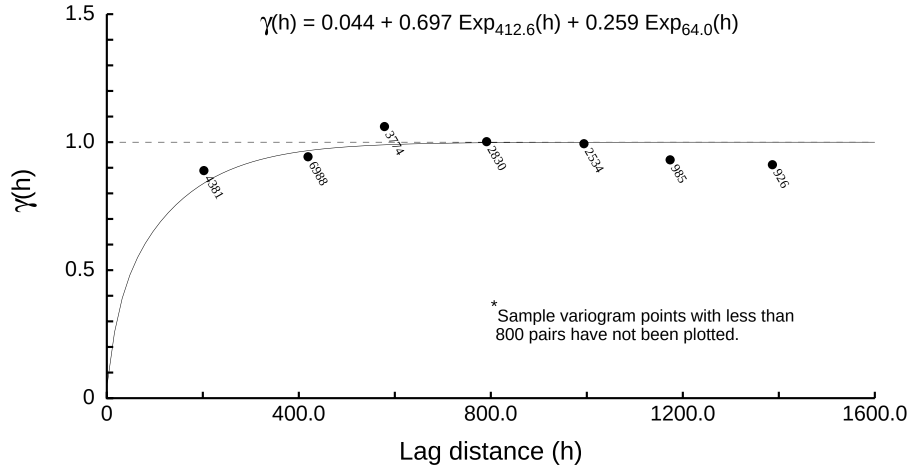




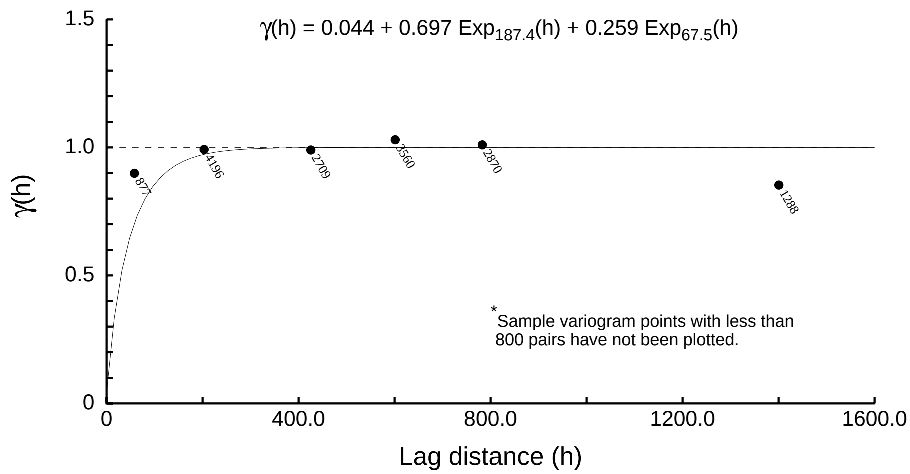


Downhole 1001 - Co

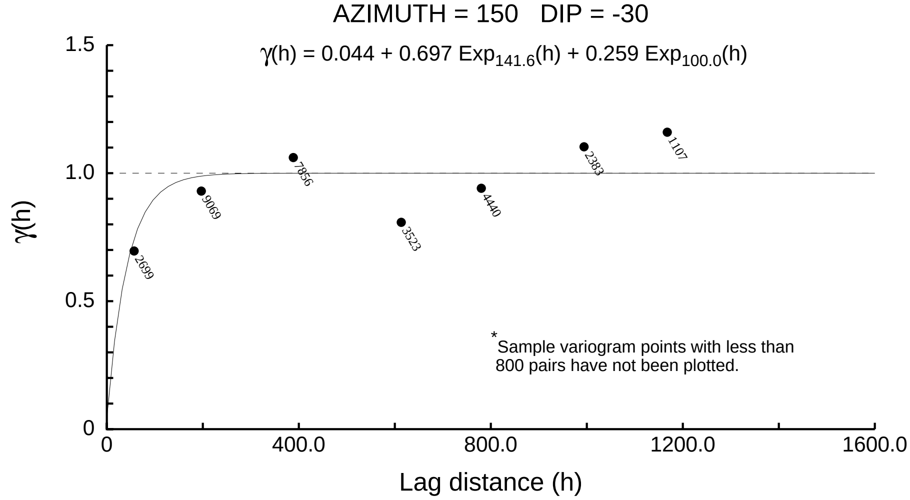
AZIMUTH = 90 DIP = -30



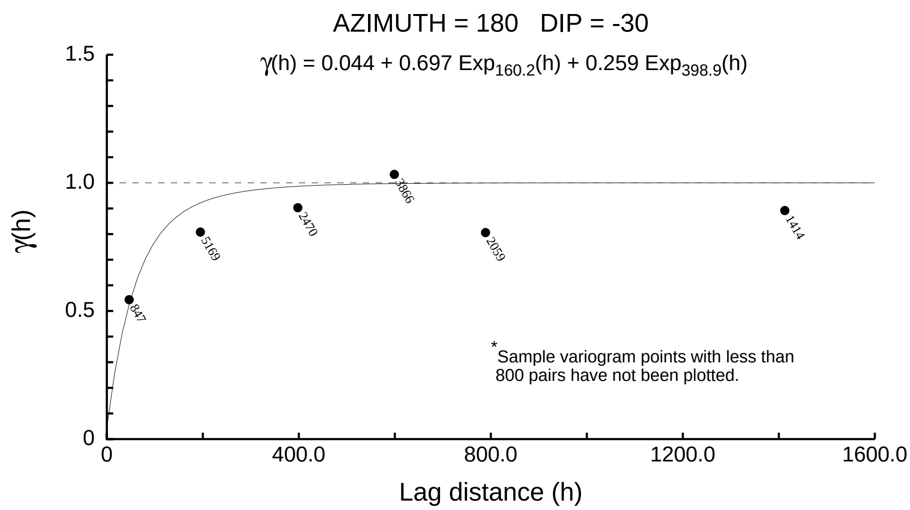
AZIMUTH = 120 DIP = -30

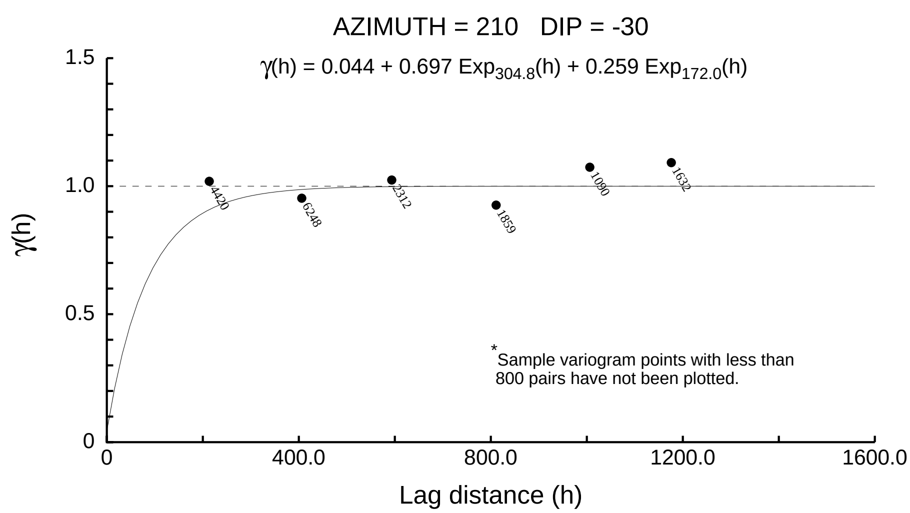


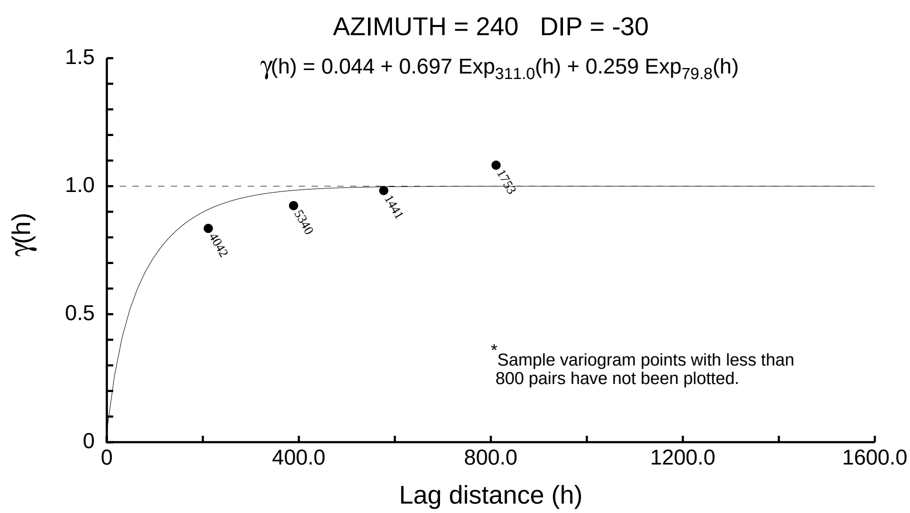
AZIMUTH = 150 DIP = -30



Downhole 1001 - Co



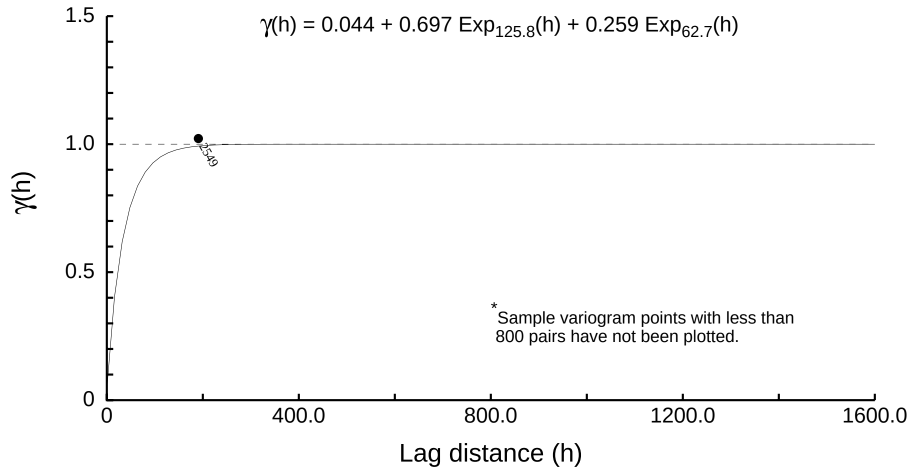




Downhole 1001 - Co

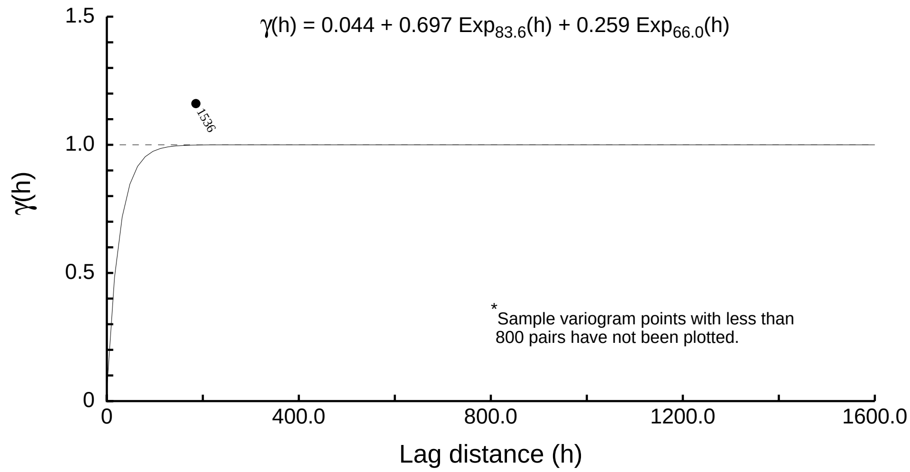
AZIMUTH = 270   DIP = -30

$\gamma(h) = 0.044 + 0.697\ Exp_{125.8}(h) + 0.259\ Exp_{62.7}(h)$



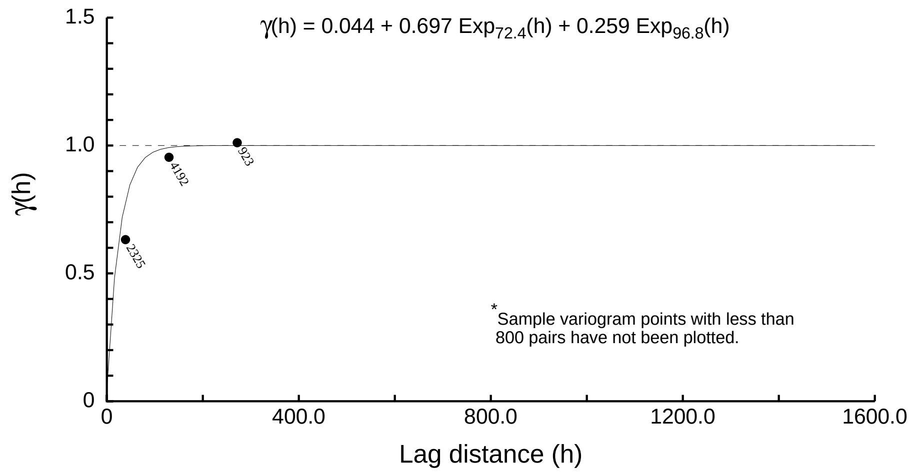
AZIMUTH = 300   DIP = -30

$\gamma(h) = 0.044 + 0.697\ Exp_{83.6}(h) + 0.259\ Exp_{66.0}(h)$



AZIMUTH = 330   DIP = -30

$\gamma(h) = 0.044 + 0.697\ Exp_{72.4}(h) + 0.259\ Exp_{96.8}(h)$



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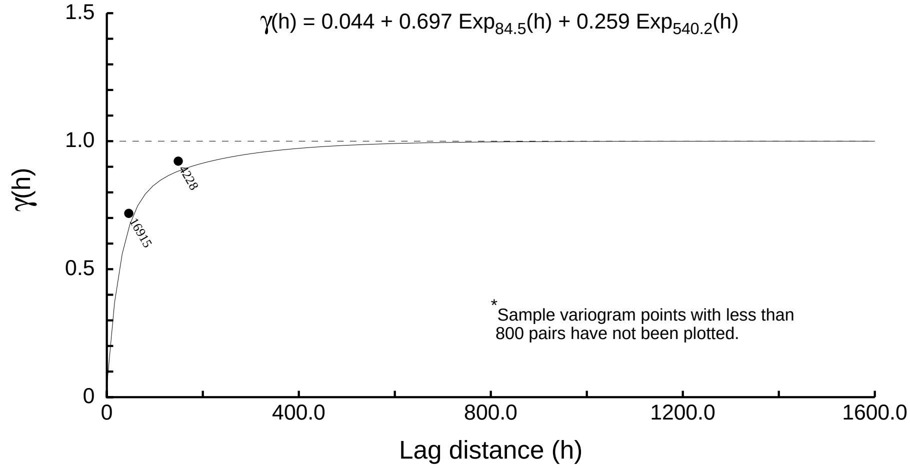
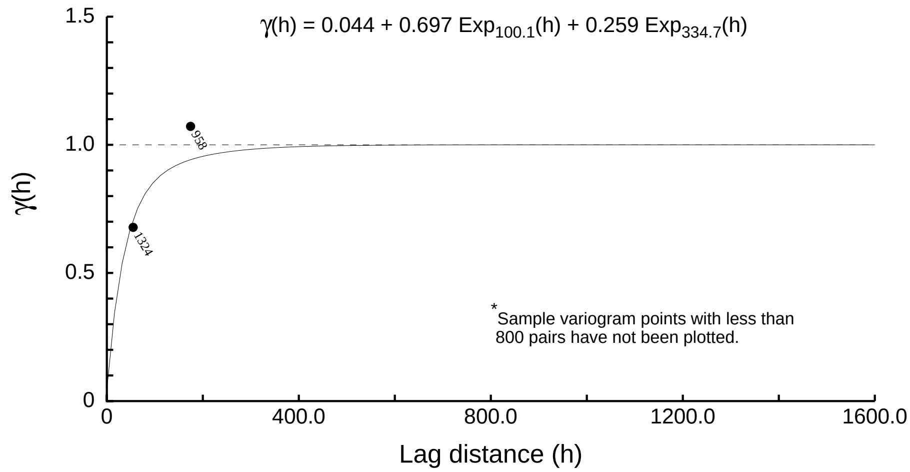
Downhole 1001 - Co

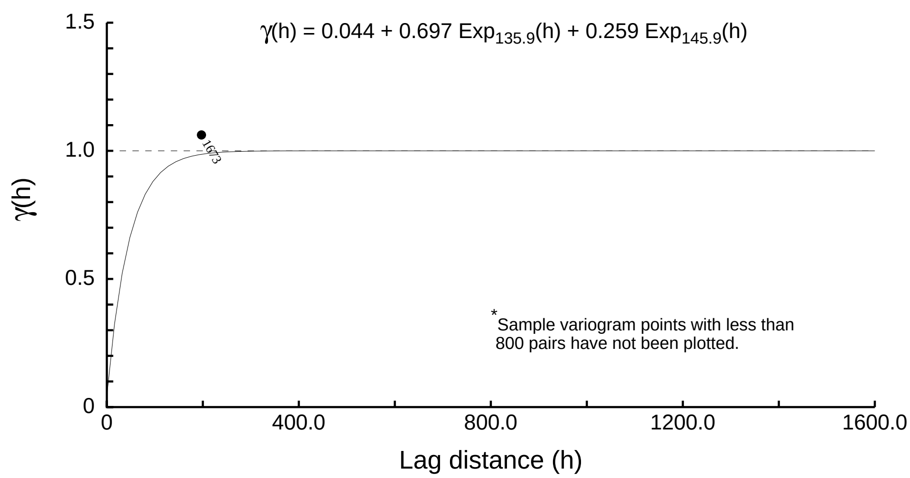
AZIMUTH = 0   DIP = -60



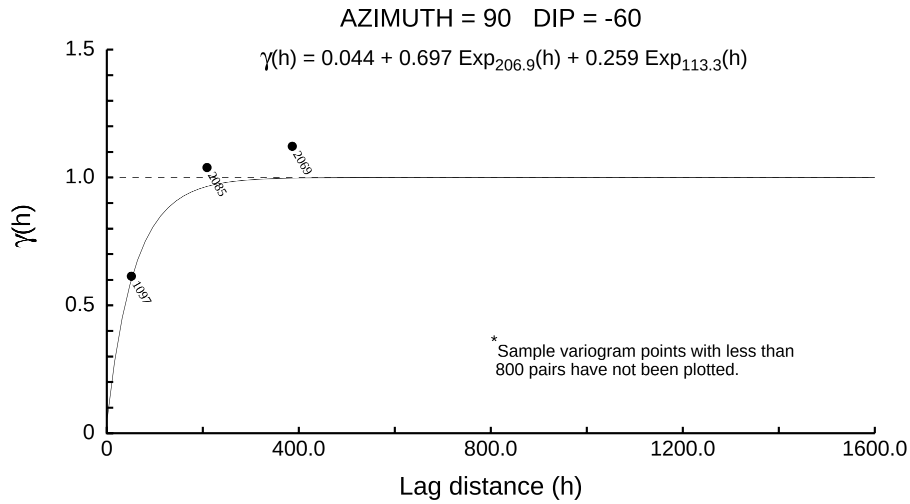
AZIMUTH = 30   DIP = -60

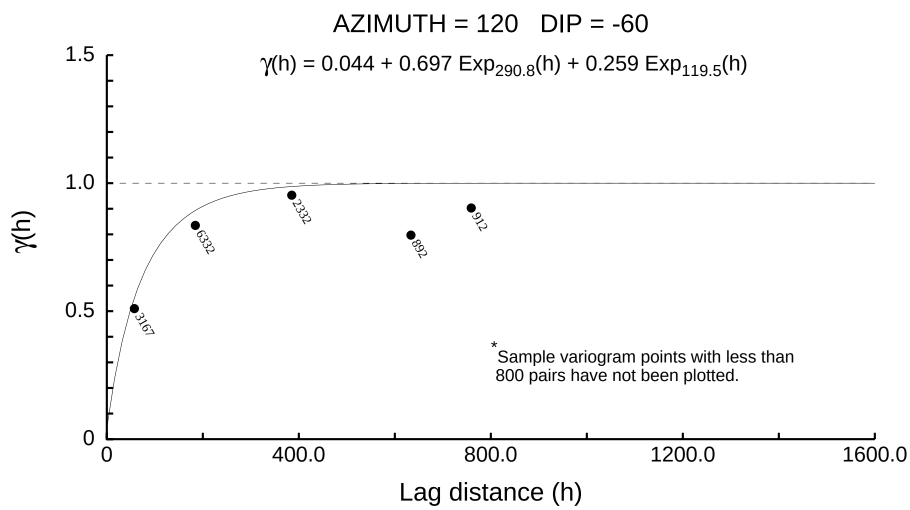


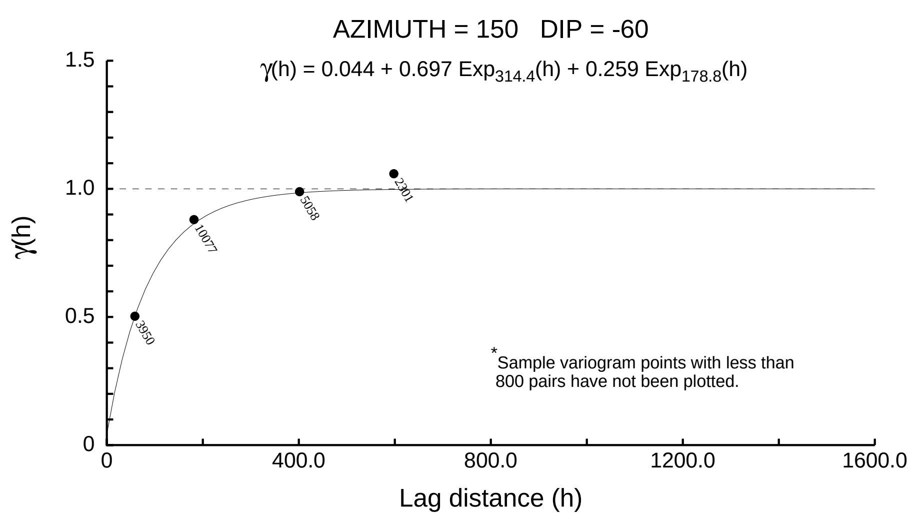
AZIMUTH = 60   DIP = -60



Downhole 1001 - Co



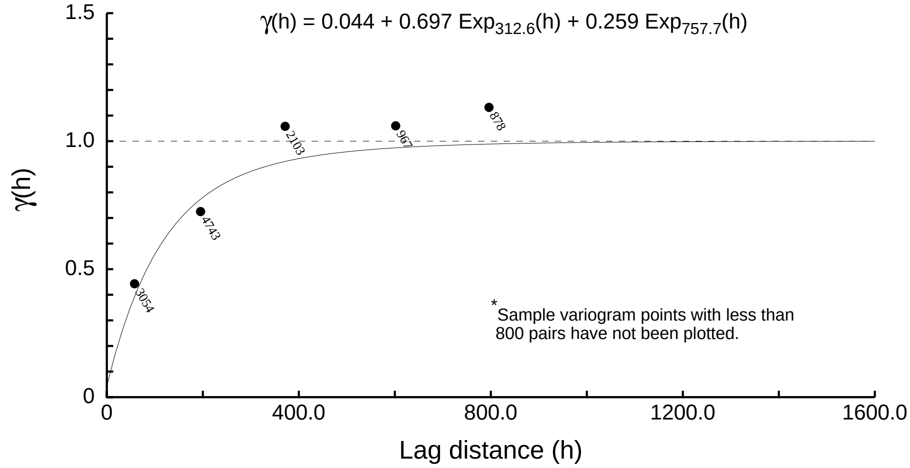




Downhole 1001 - Co

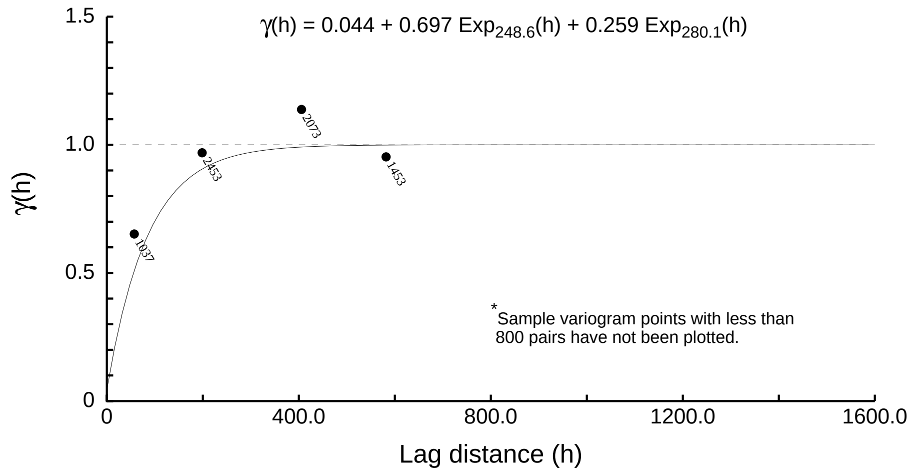
AZIMUTH = 180   DIP = -60

$\gamma(h) = 0.044 + 0.697\ Exp_{312.6}(h) + 0.259\ Exp_{757.7}(h)$



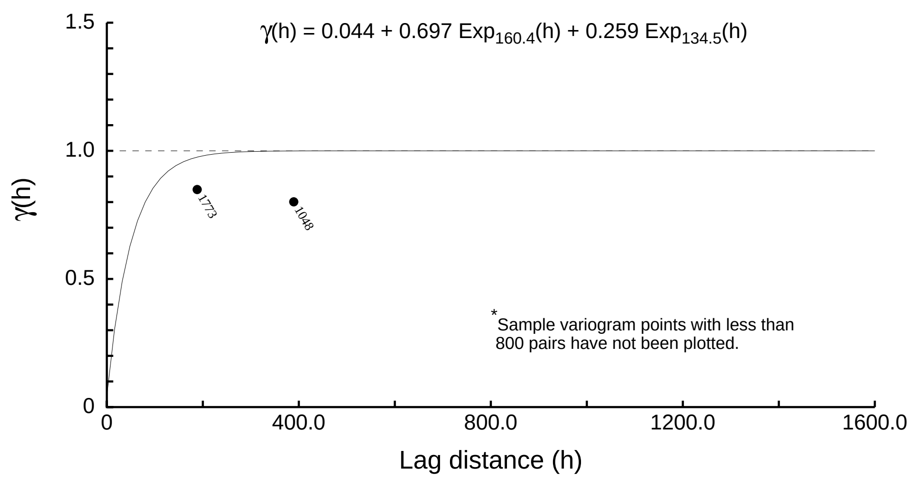
AZIMUTH = 210   DIP = -60

$\gamma(h) = 0.044 + 0.697\ Exp_{248.6}(h) + 0.259\ Exp_{280.1}(h)$



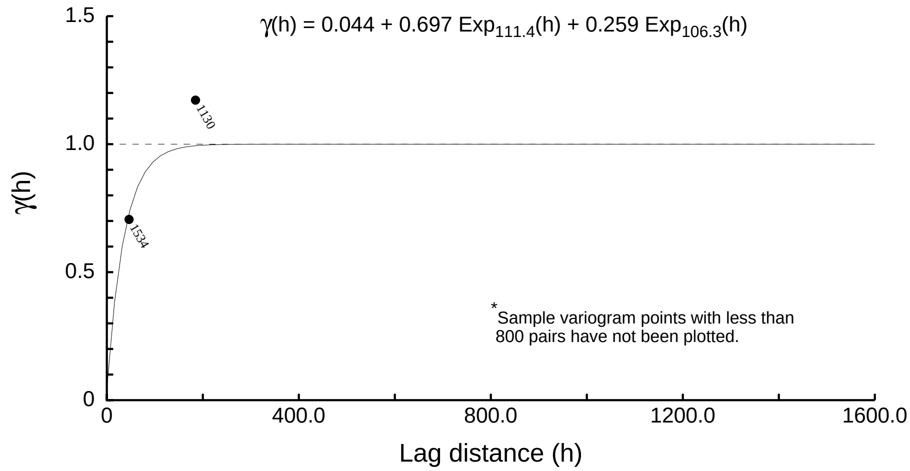
AZIMUTH = 240   DIP = -60

$\gamma(h) = 0.044 + 0.697\ Exp_{160.4}(h) + 0.259\ Exp_{134.5}(h)$

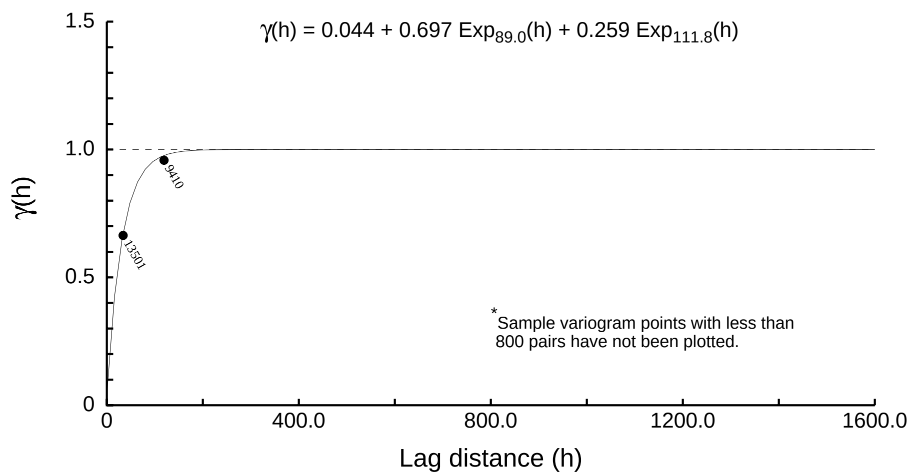


Downhole 1001 - Co

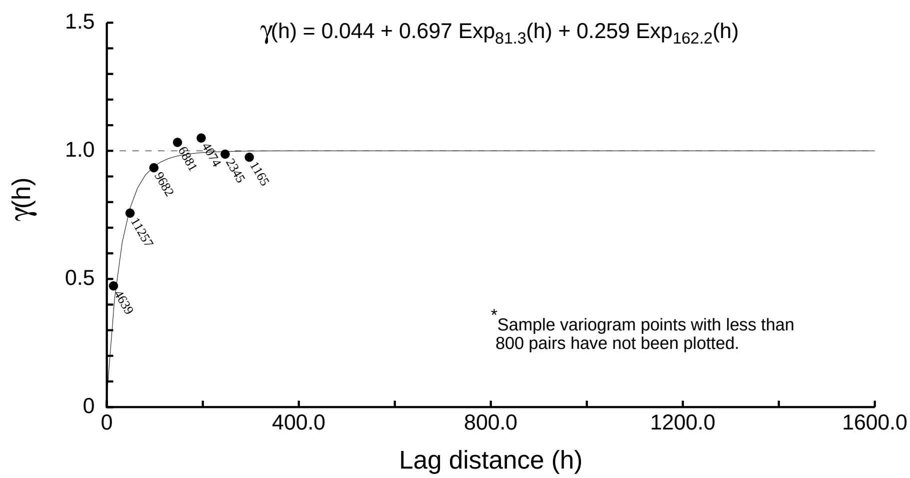
AZIMUTH = 270   DIP = -60



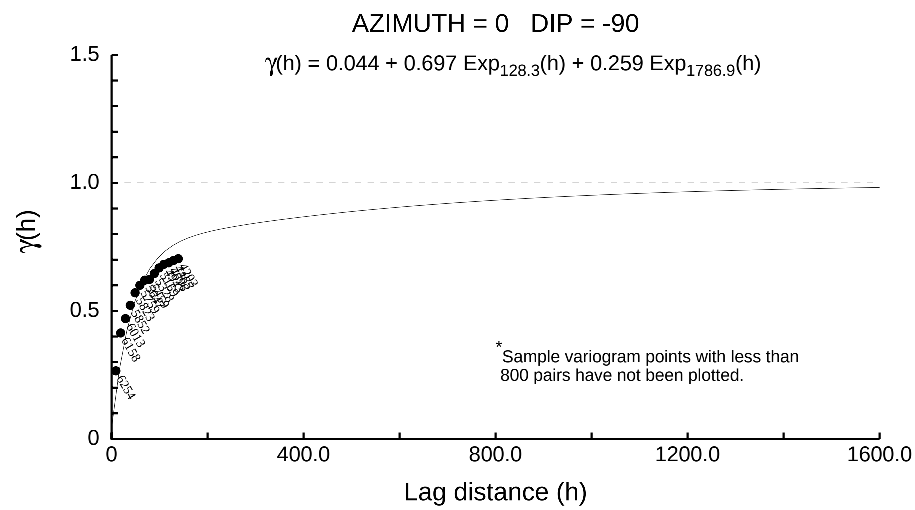
AZIMUTH = 300   DIP = -60



AZIMUTH = 330   DIP = -60



Downhole 1001 - Co



Downhole 1001 - Cu

User Defined Rotation Conventions

Nugget ==> 0.005
C1 ==> 0.605
C2 ==> 0.390

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -52
RH Rotation about the Y’ axis ==> 105
RH Rotation about the Z’ axis ==> -4
Range along the Z’ axis ==> 23.8 Azimuth ==> 142 Dip ==> -15
Range along the Y’ axis ==> 224.8 Azimuth ==> 51 Dip ==> -4
Range along the X’ axis ==> 78.2 Azimuth ==> 305 Dip ==> -75

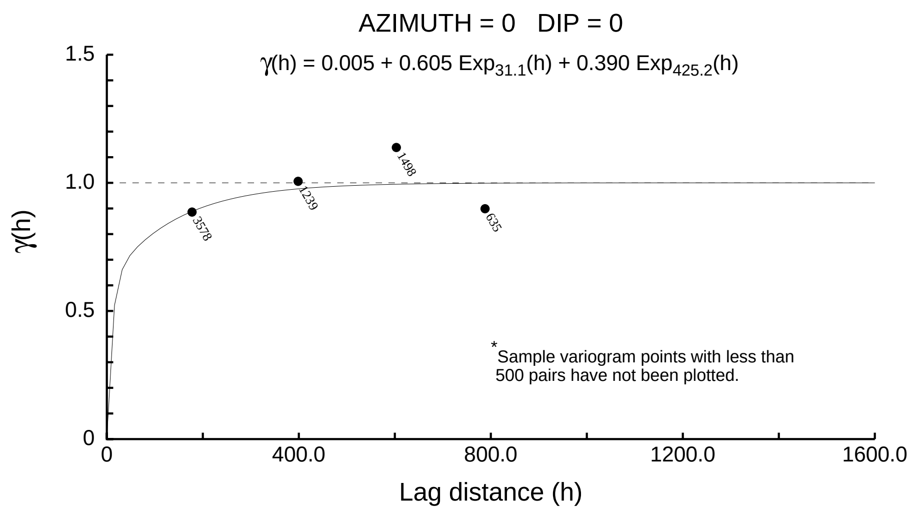
Second Structure -- Exponential with Practical Range

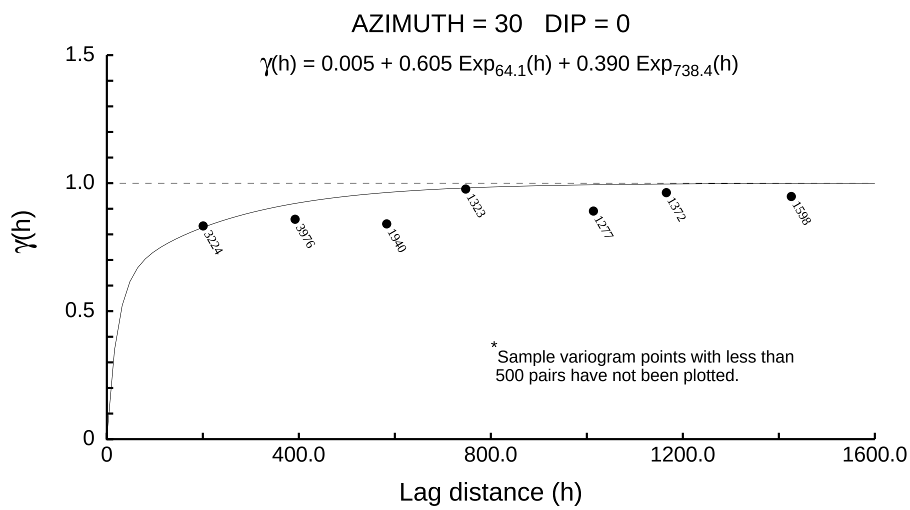
RH Rotation about the Z axis ==> -169
RH Rotation about the Y’ axis ==> -108
RH Rotation about the Z’ axis ==> 36
Range along the Z’ axis ==> 1421.1 Azimuth ==> 79 Dip ==> -18
Range along the Y’ axis ==> 1835.0 Azimuth ==> 181 Dip ==> -34
Range along the X’ axis ==> 228.4 Azimuth ==> 146 Dip ==> 51

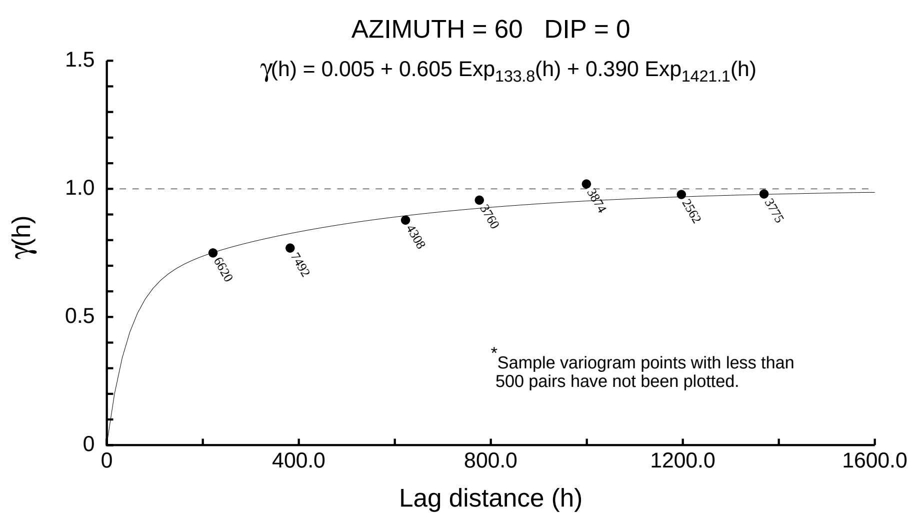
Modeling Criteria

Minimum number pairs req’d ==> 500
Sample variogram points weighted by # pairs

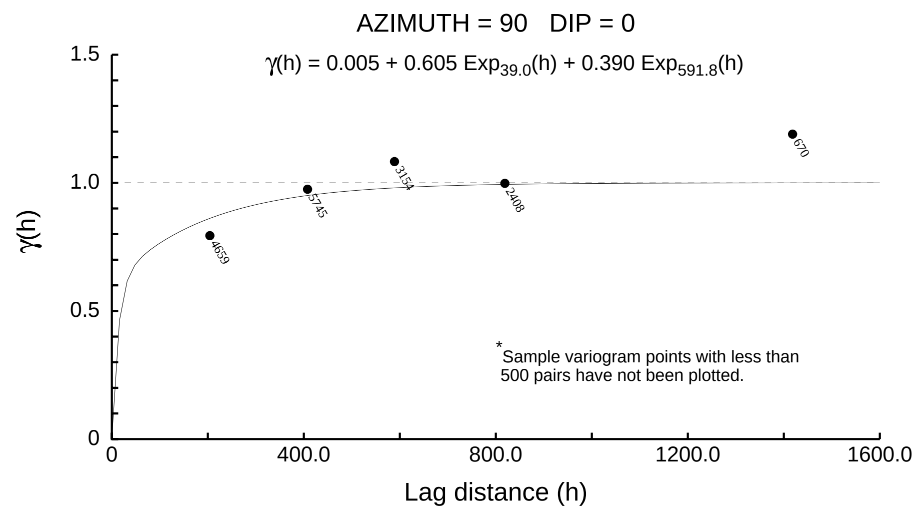
Downhole 1001 - Cu

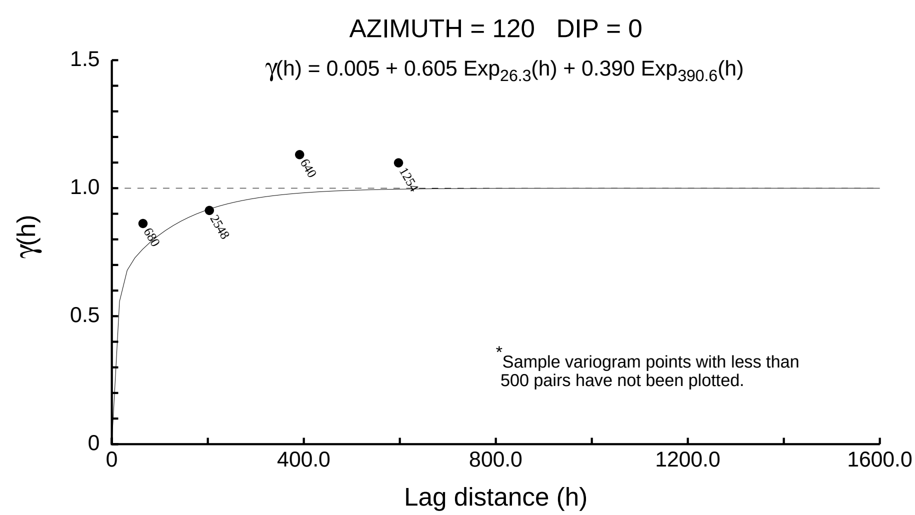


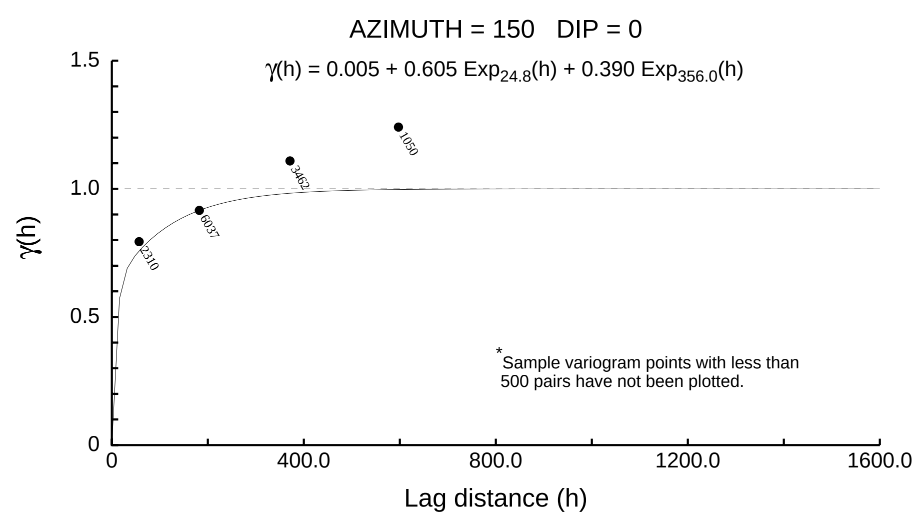




Downhole 1001 - Cu







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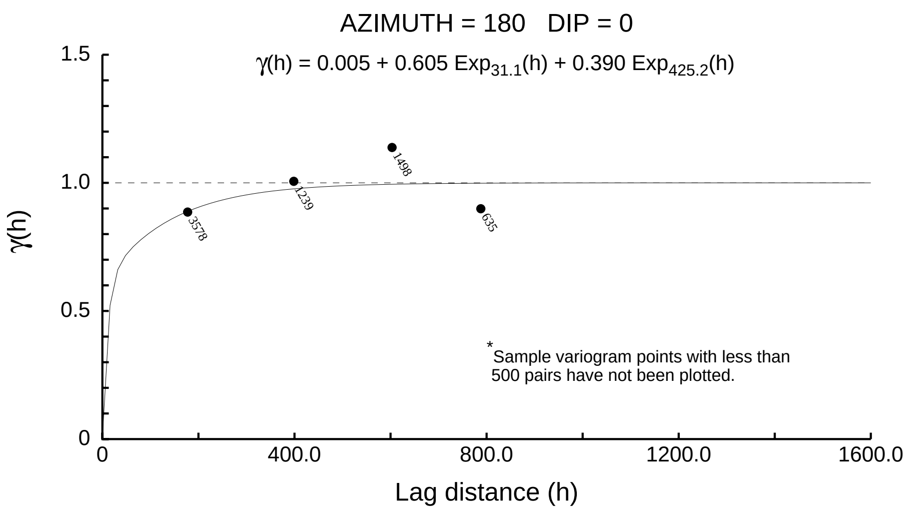
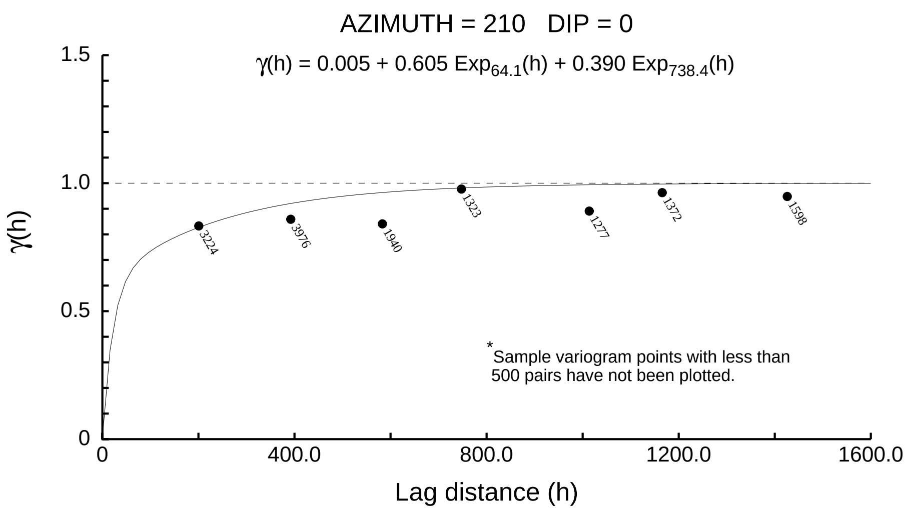
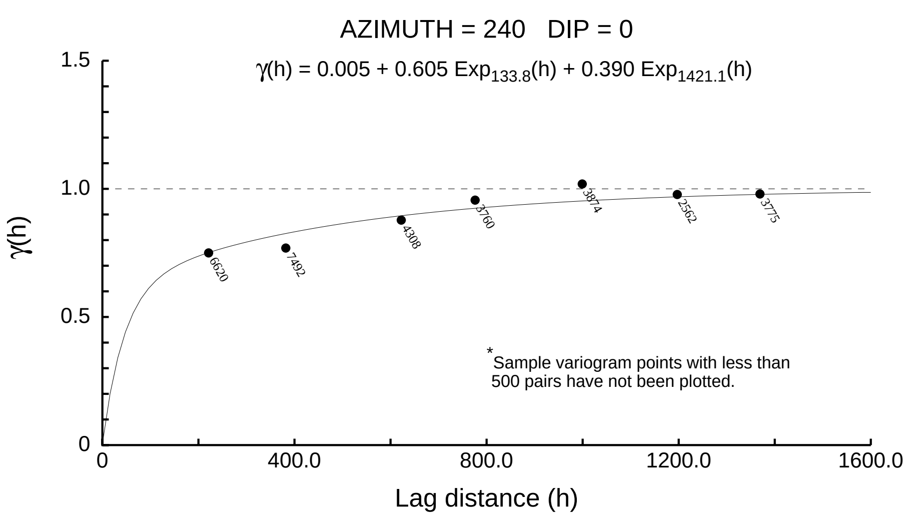
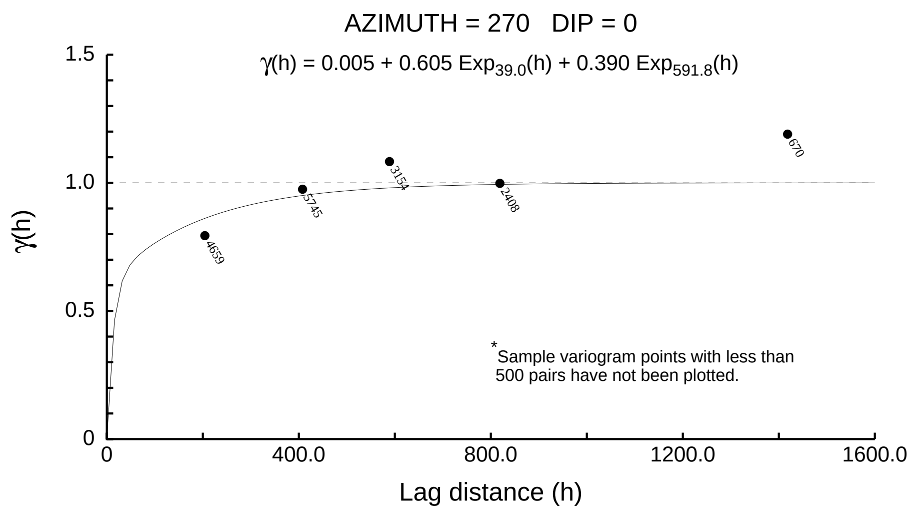
Downhole 1001 - Cu

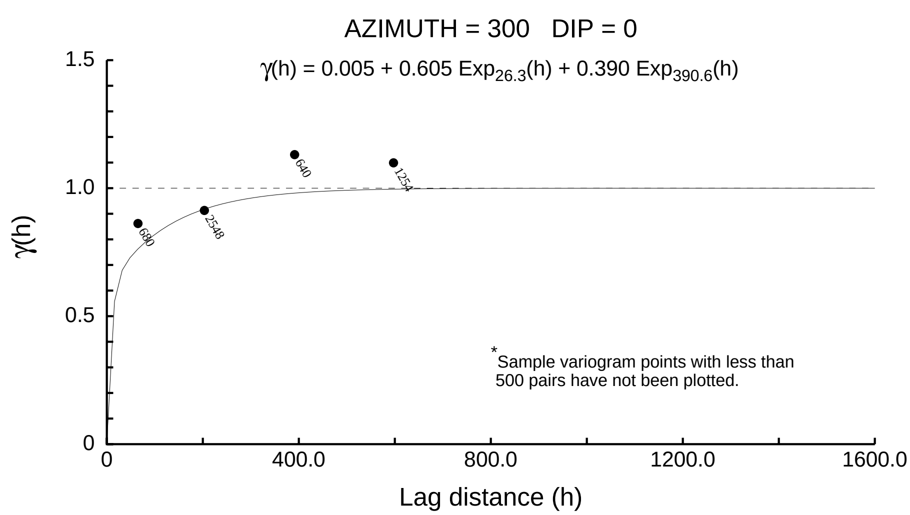


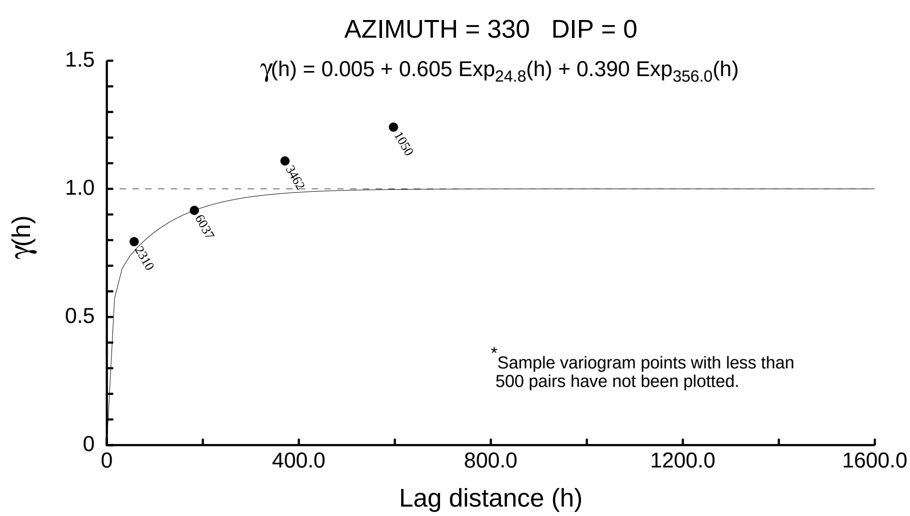




Downhole 1001 - Cu



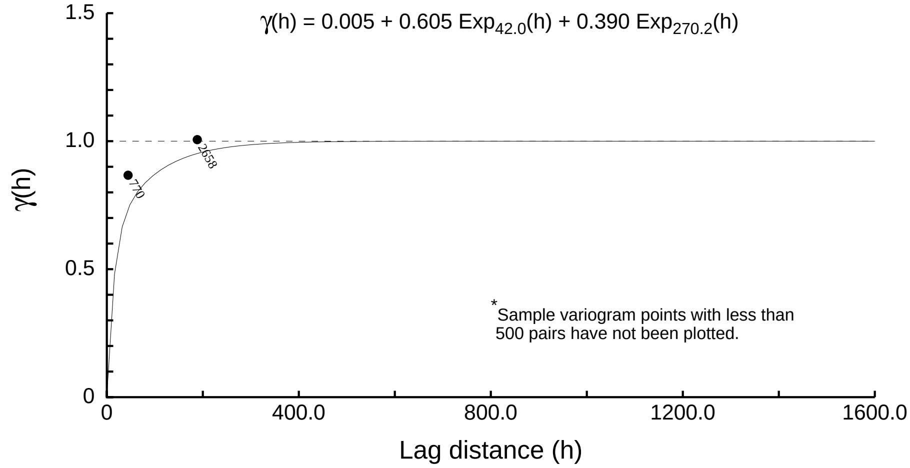




Downhole 1001 - Cu

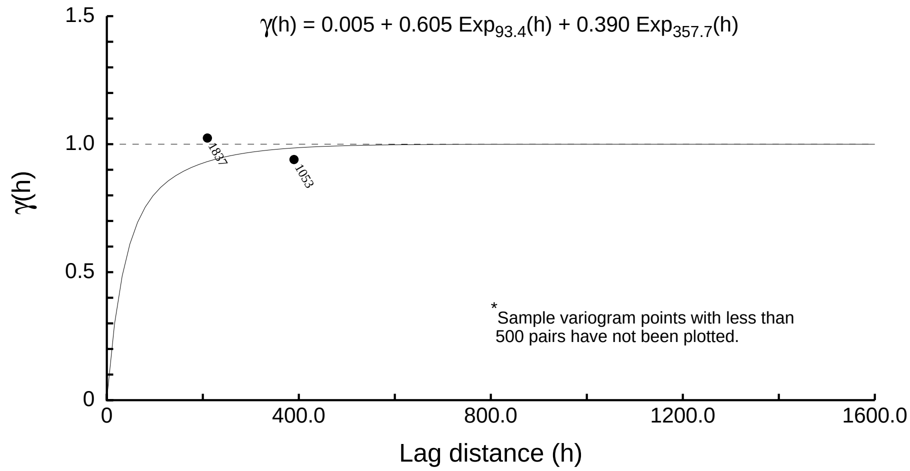
AZIMUTH = 0   DIP = -30

$\gamma(h) = 0.005 + 0.605\ Exp_{42.0}(h) + 0.390\ Exp_{270.2}(h)$



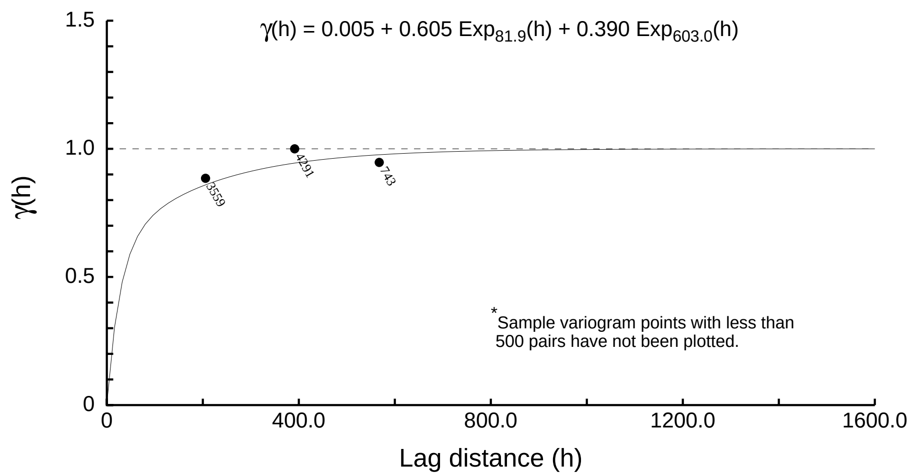
AZIMUTH = 30   DIP = -30

$\gamma(h) = 0.005 + 0.605\ Exp_{93.4}(h) + 0.390\ Exp_{357.7}(h)$

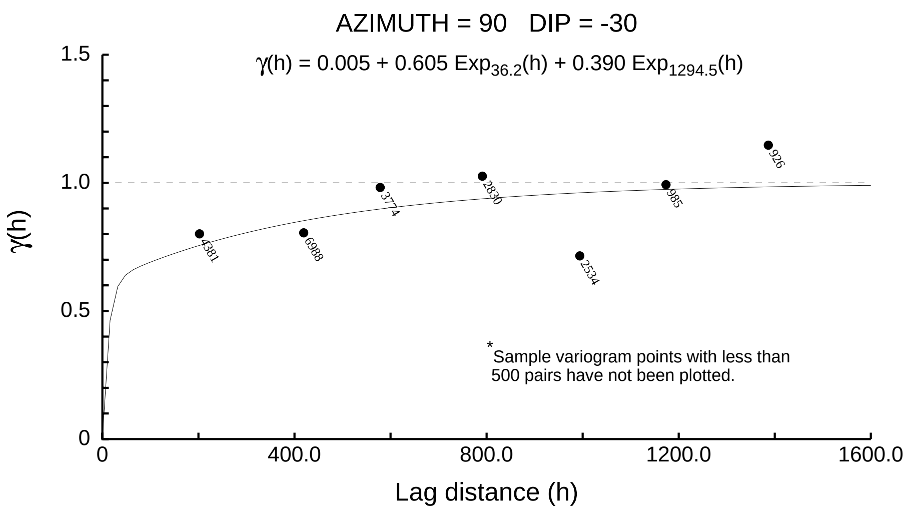


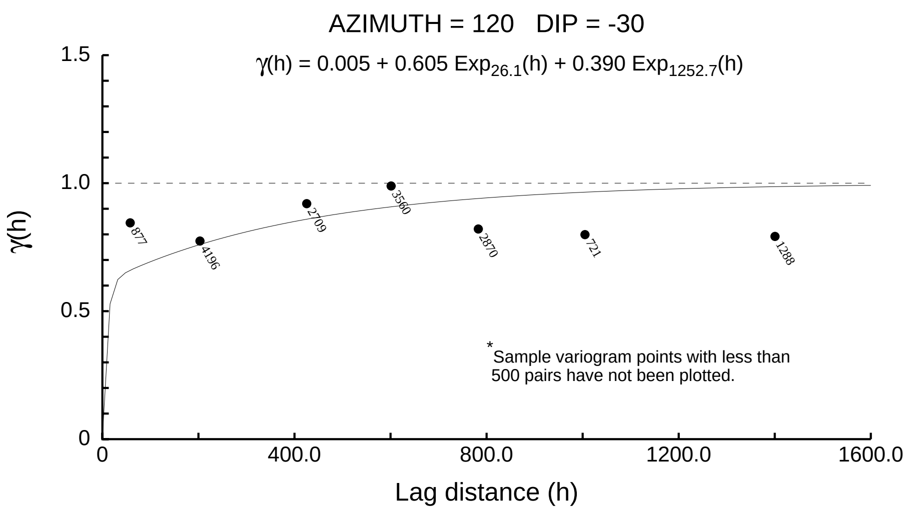
AZIMUTH = 60   DIP = -30

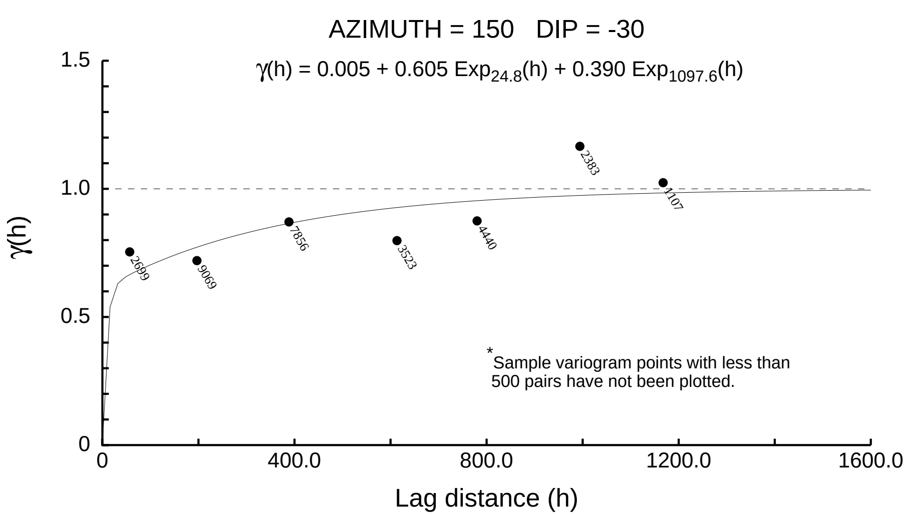
$\gamma(h) = 0.005 + 0.605\ Exp_{81.9}(h) + 0.390\ Exp_{603.0}(h)$



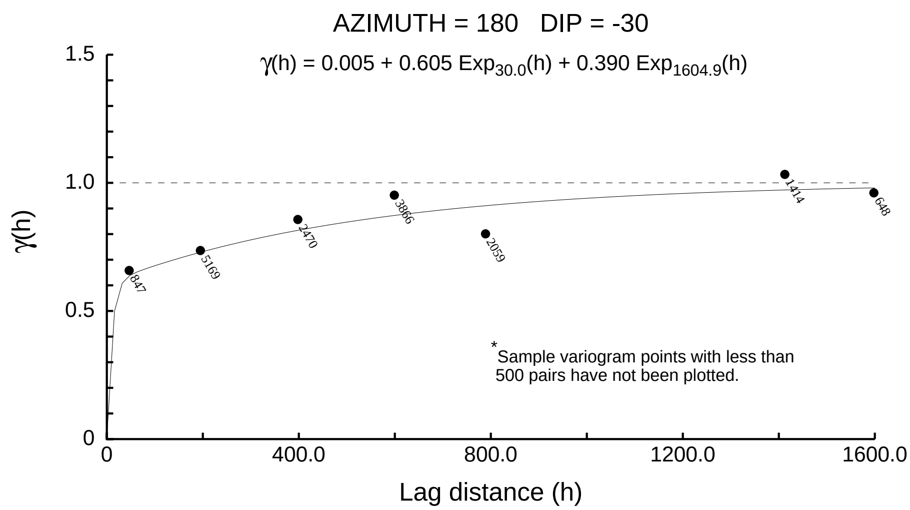
Downhole 1001 - Cu

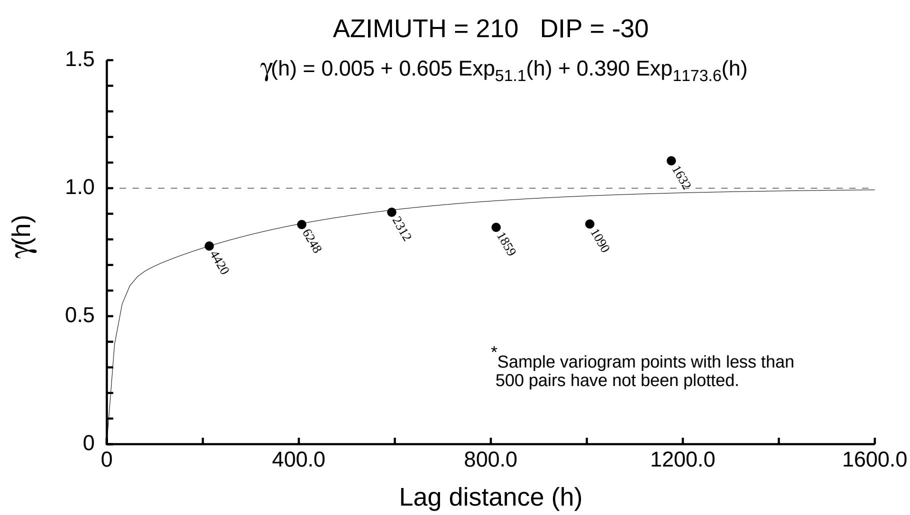


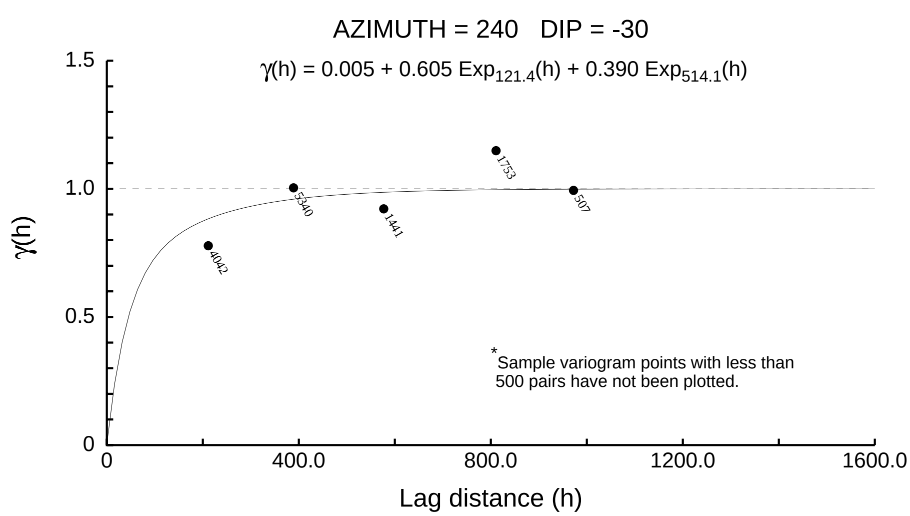




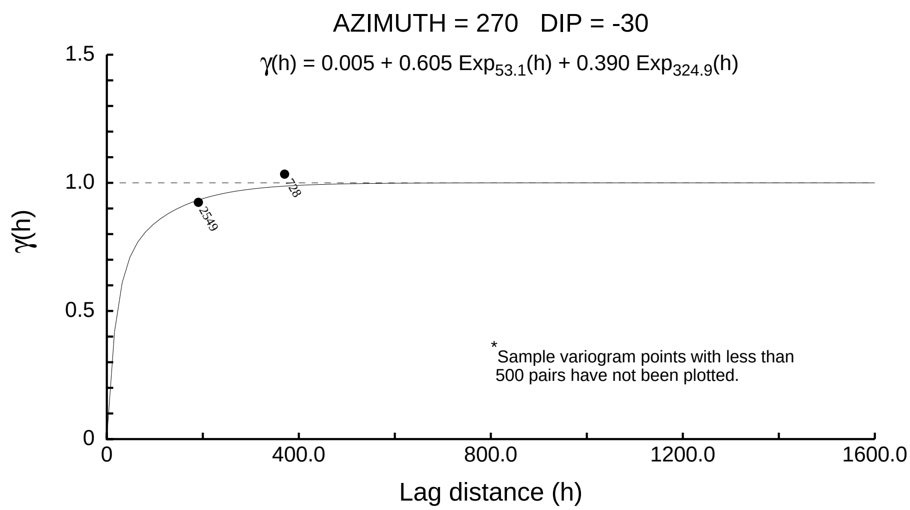
Downhole 1001 - Cu

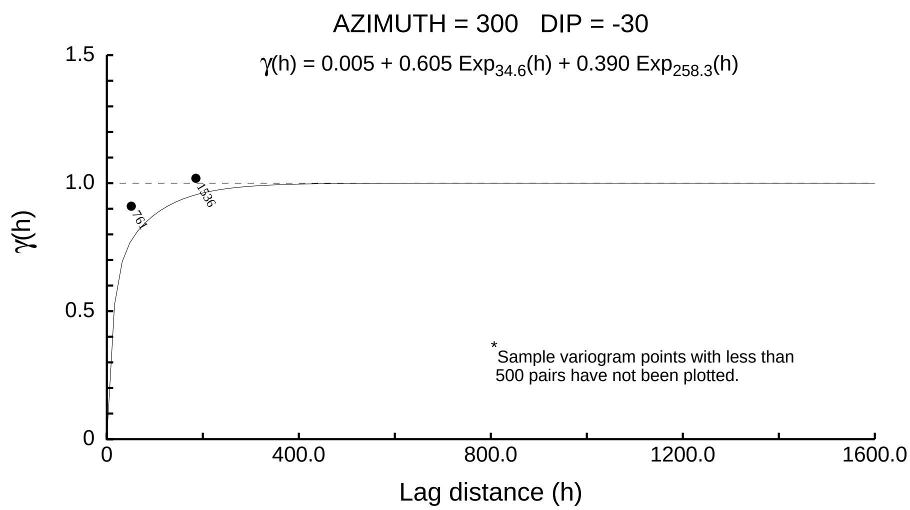


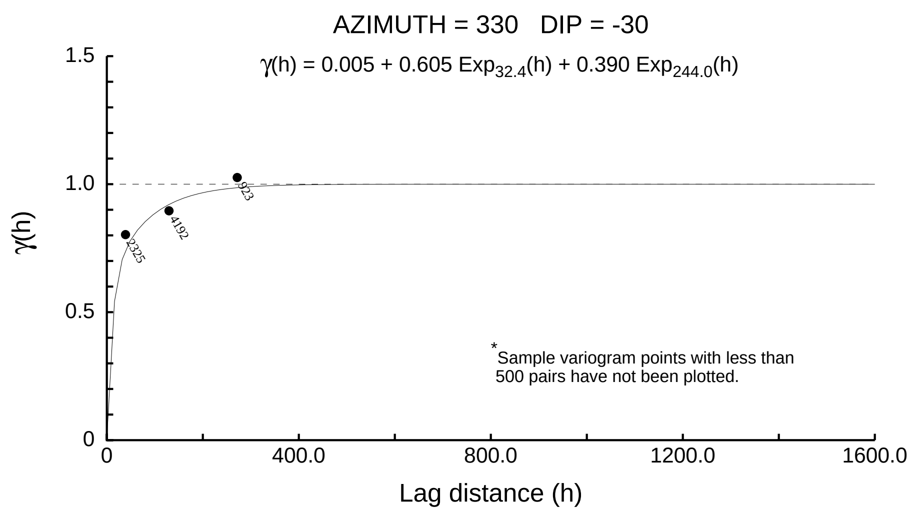




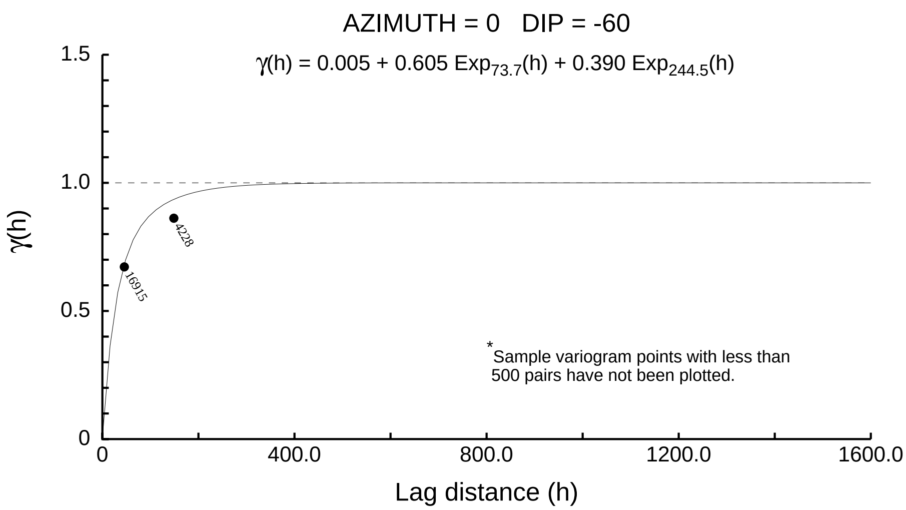
Downhole 1001 - Cu

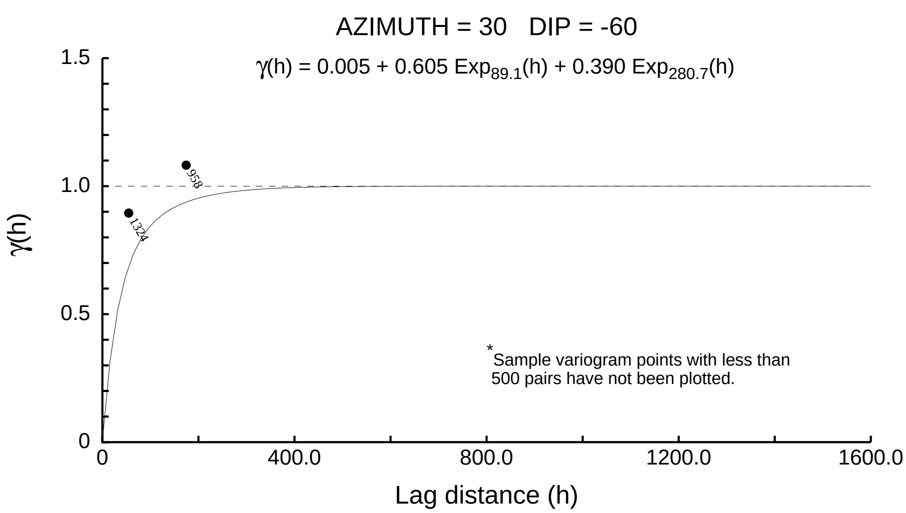


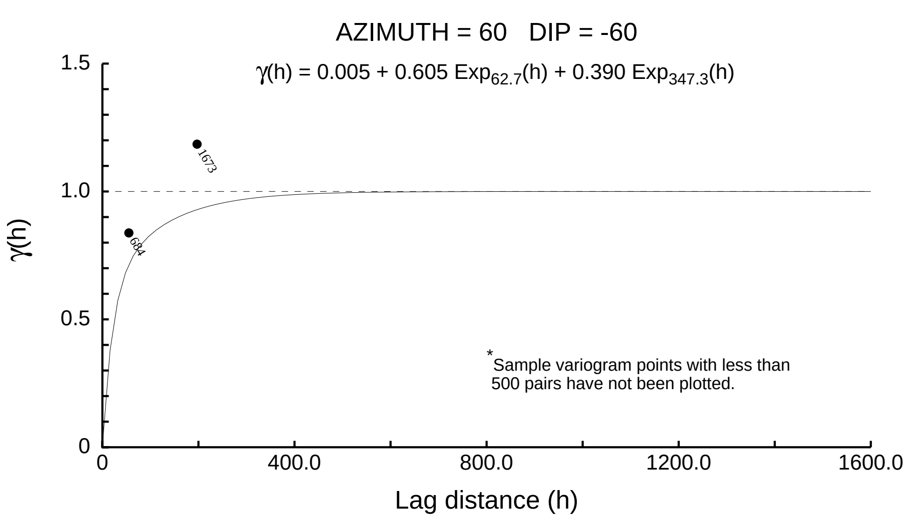




Downhole 1001 - Cu

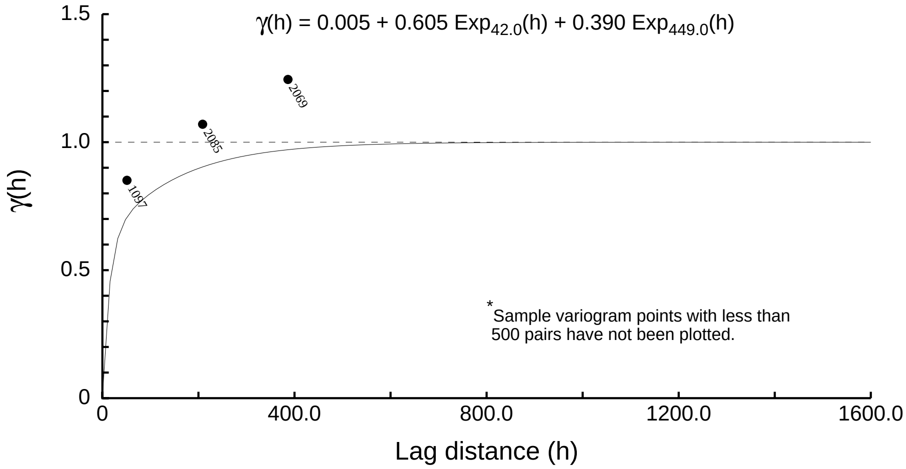




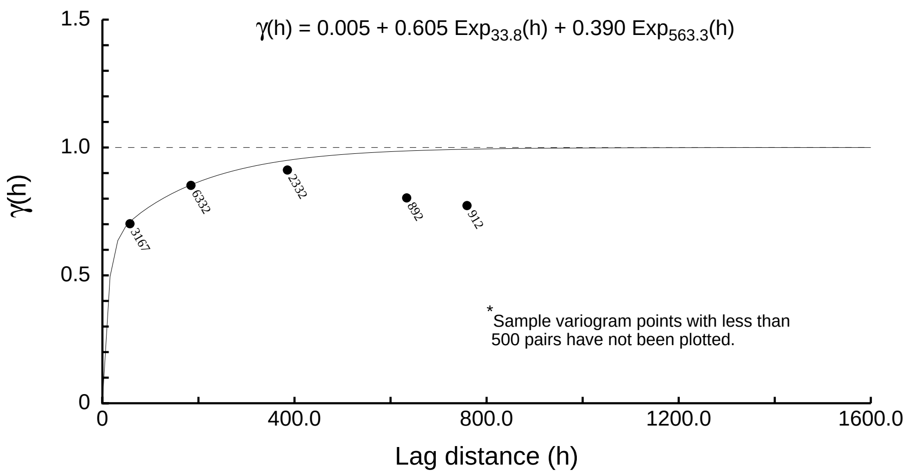


Downhole 1001 - Cu

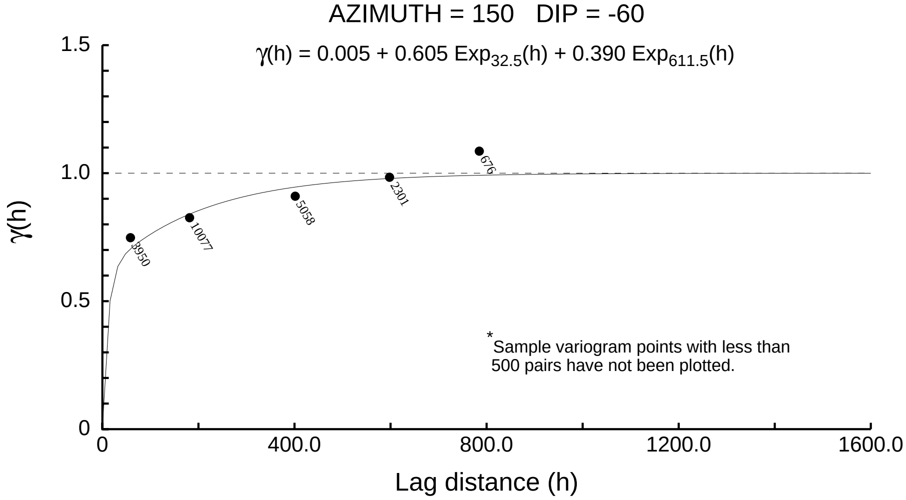
AZIMUTH = 90 DIP = -60



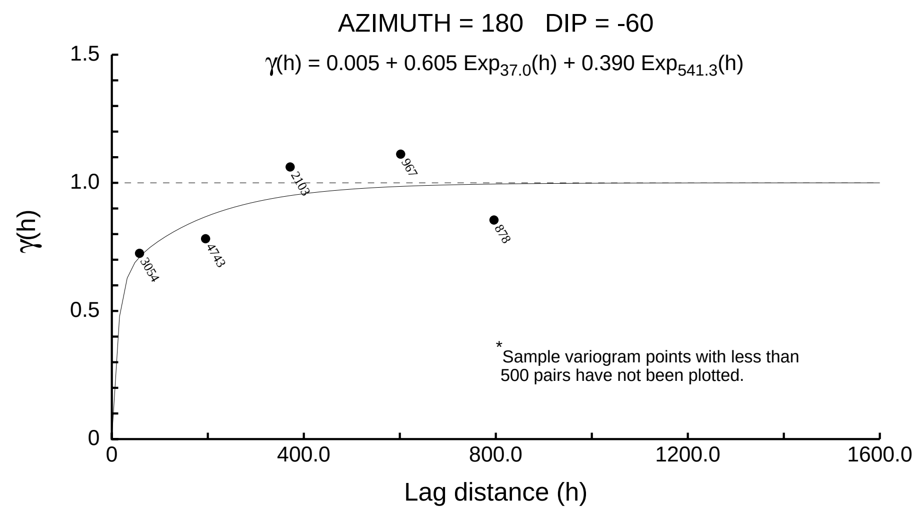
AZIMUTH = 120 DIP = -60

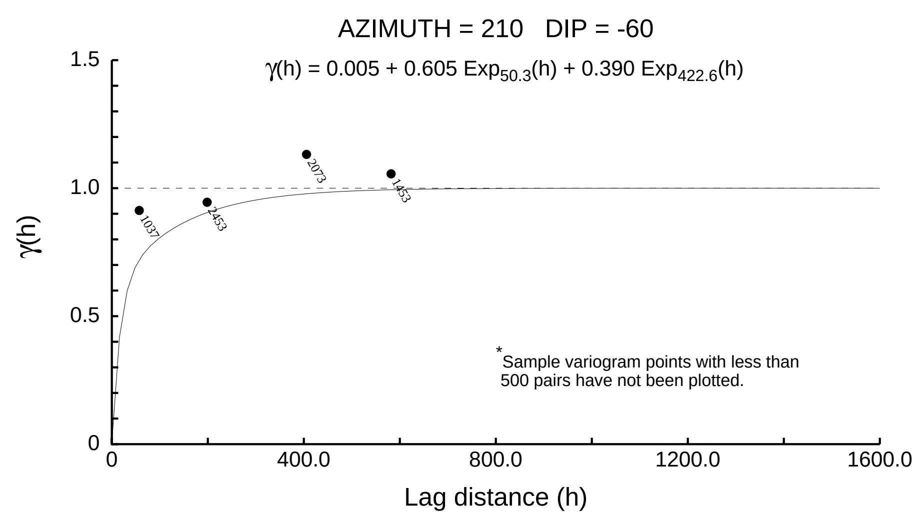


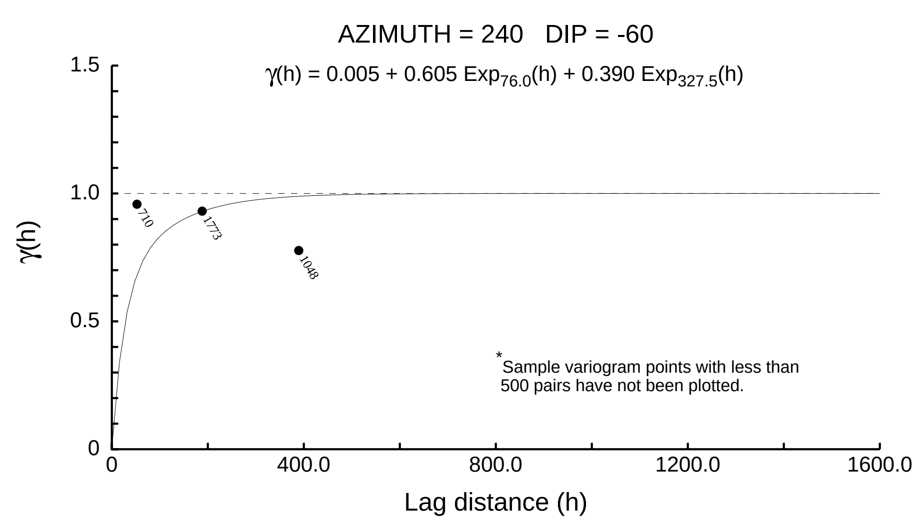
AZIMUTH = 150 DIP = -60



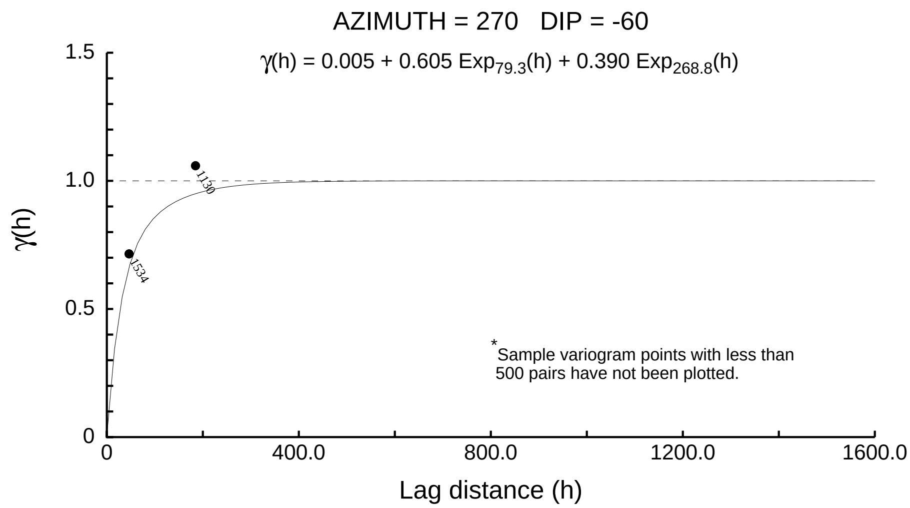
Downhole 1001 - Cu

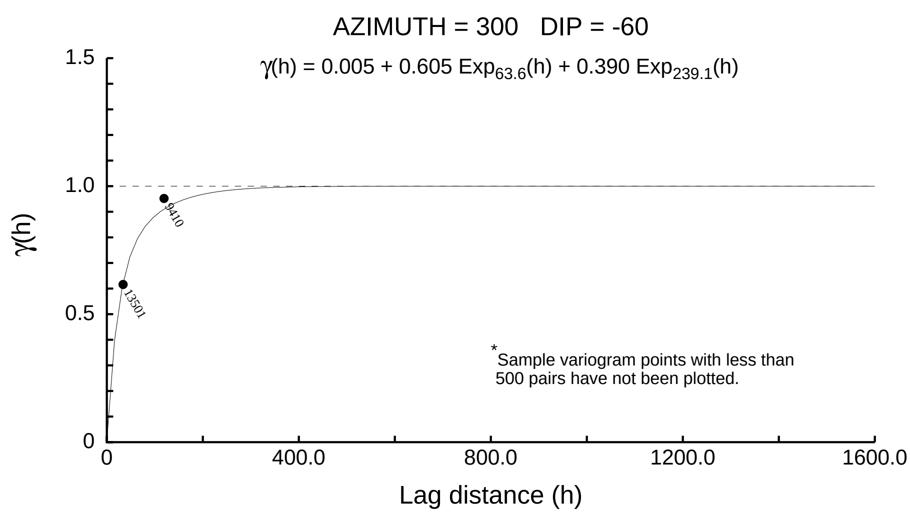


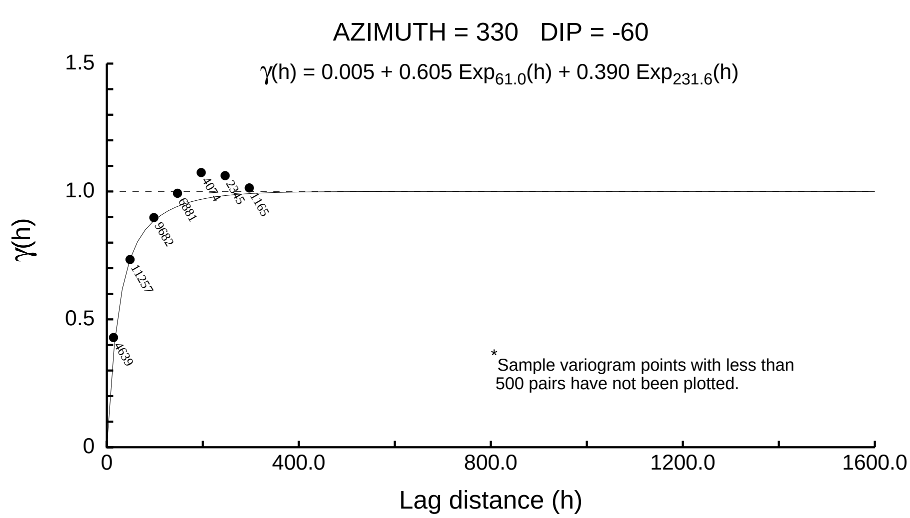




Downhole 1001 - Cu







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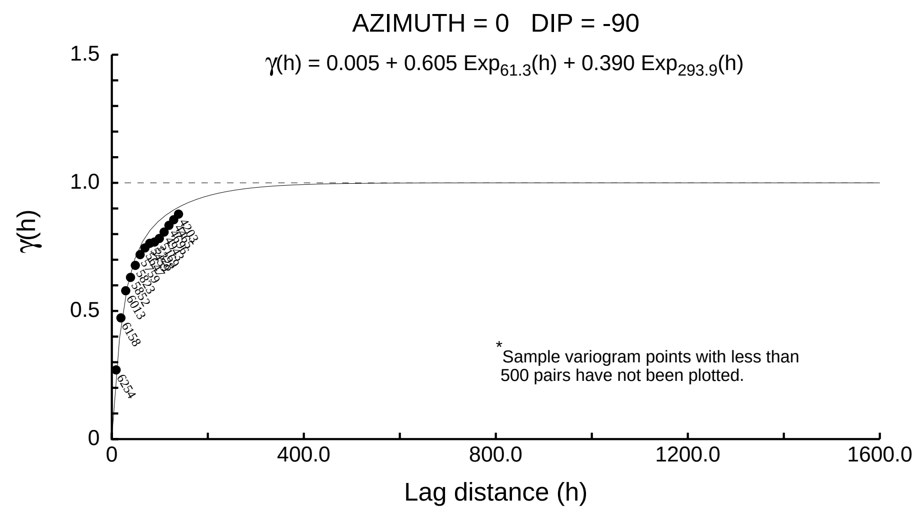
Downhole 1001 - Cu



Downhole 1001 - Ni

User Defined Rotation Conventions

Nugget ==> 0.006
C1 ==> 0.600
C2 ==> 0.394

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -8
RH Rotation about the Y’ axis ==> 21
RH Rotation about the Z’ axis ==> 42

Range along the Z’ axis	==> 66.6	Azimuth ==> 98	Dip ==> 69
Range along the Y’ axis	==> 32.9	Azimuth ==> 328	Dip ==> 14
Range along the X’ axis	==> 174.8	Azimuth ==> 54	Dip ==> -16

Second Structure -- Exponential with Practical Range

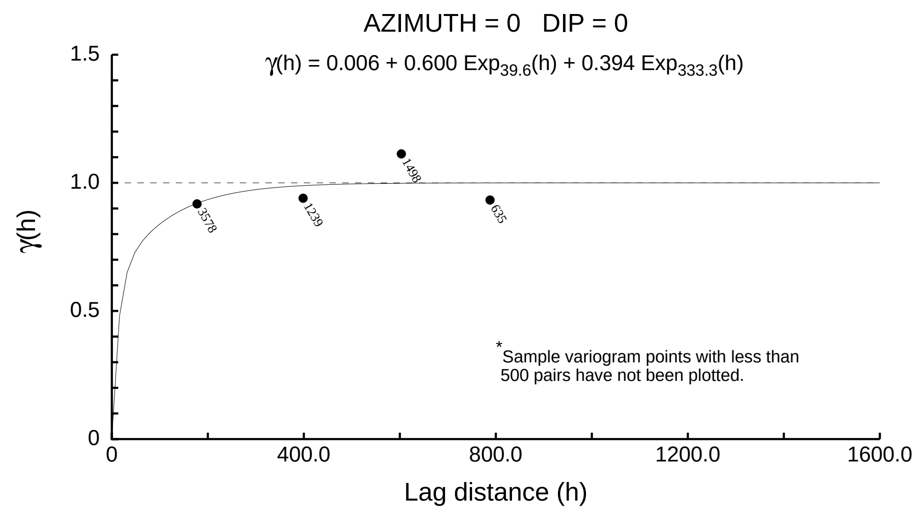
RH Rotation about the Z axis ==> -51
RH Rotation about the Y’ axis ==> -46
RH Rotation about the Z’ axis ==> -5

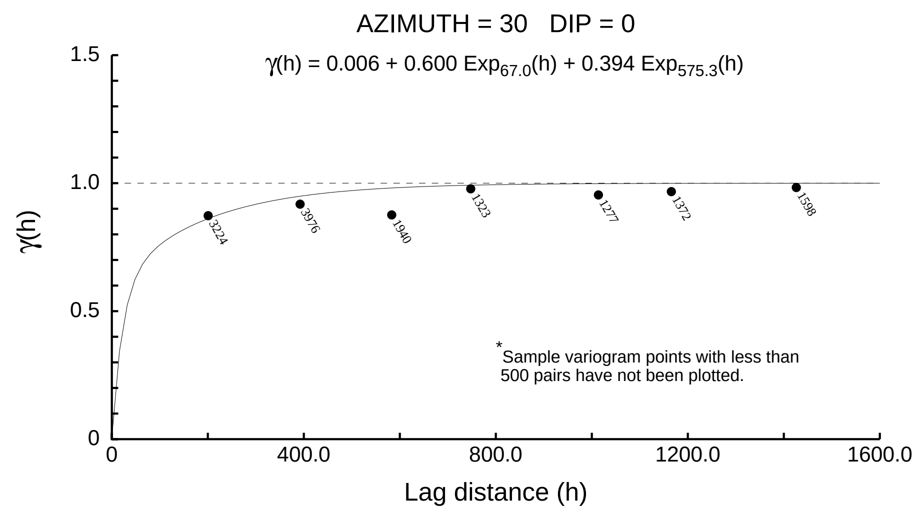
Range along the Z’ axis	==> 1107.8	Azimuth ==> 321	Dip ==> 44
Range along the Y’ axis	==> 1465.2	Azimuth ==> 54	Dip ==> 3
Range along the X’ axis	==> 202.3	Azimuth ==> 148	Dip ==> 45

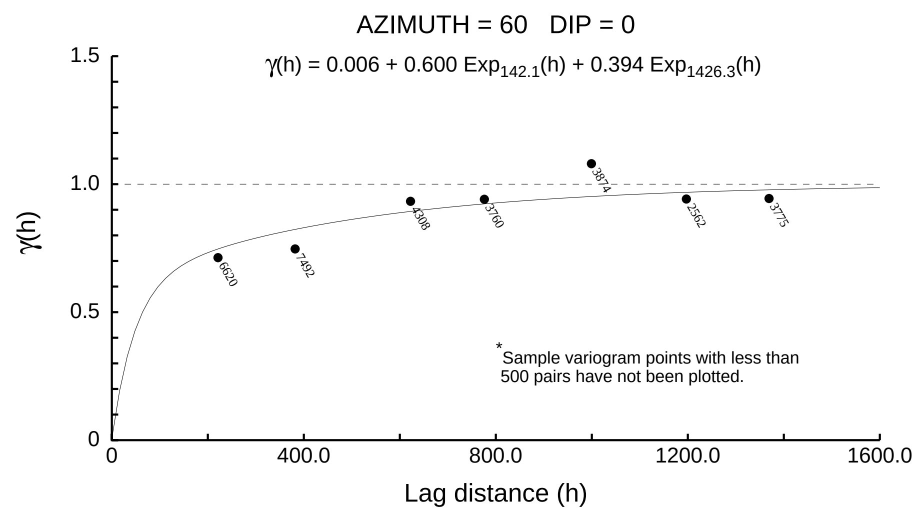
Modeling Criteria

Minimum number pairs req’d ==> 500
Sample variogram points weighted by # pairs

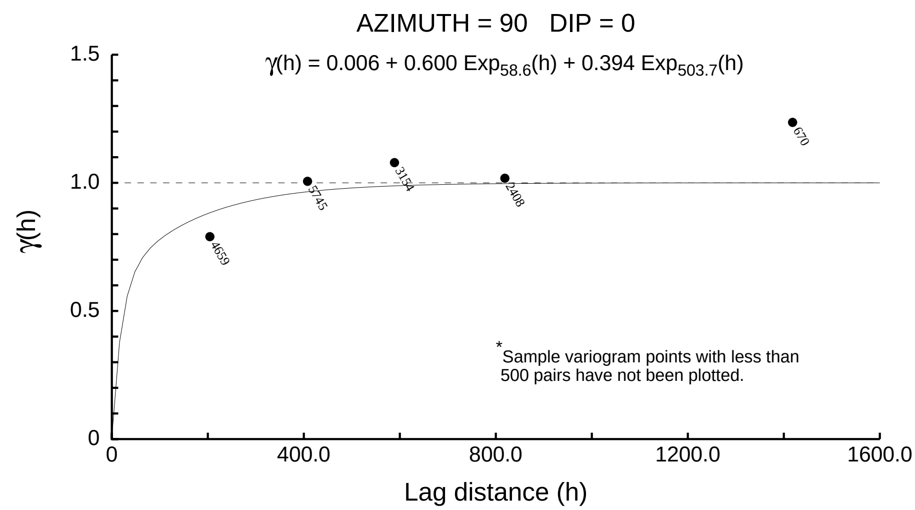
Downhole 1001 - Ni

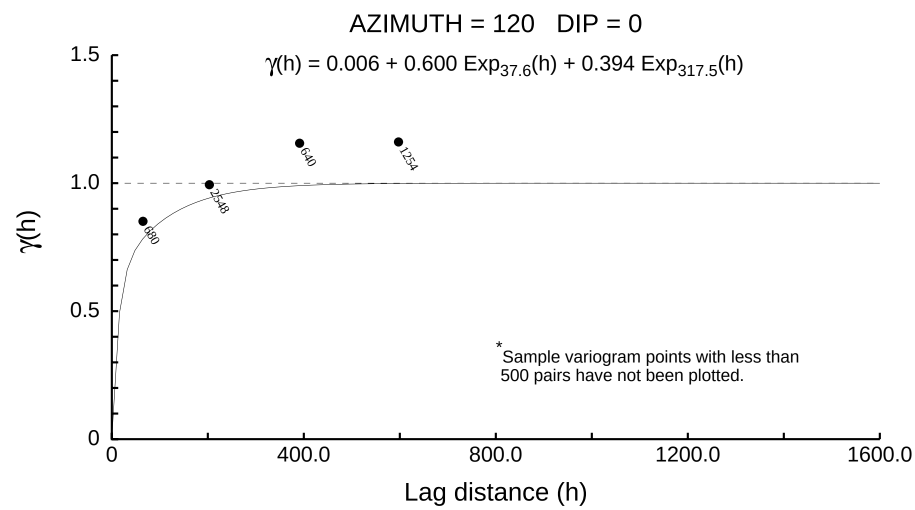


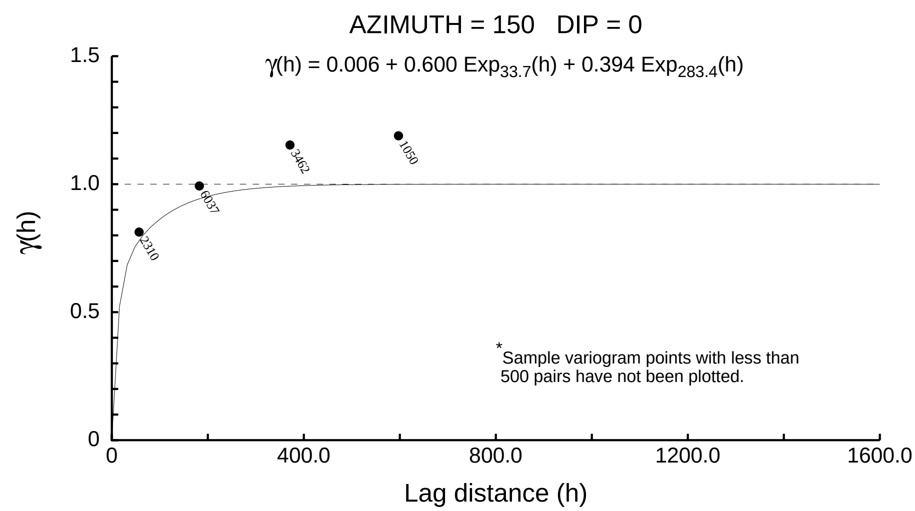




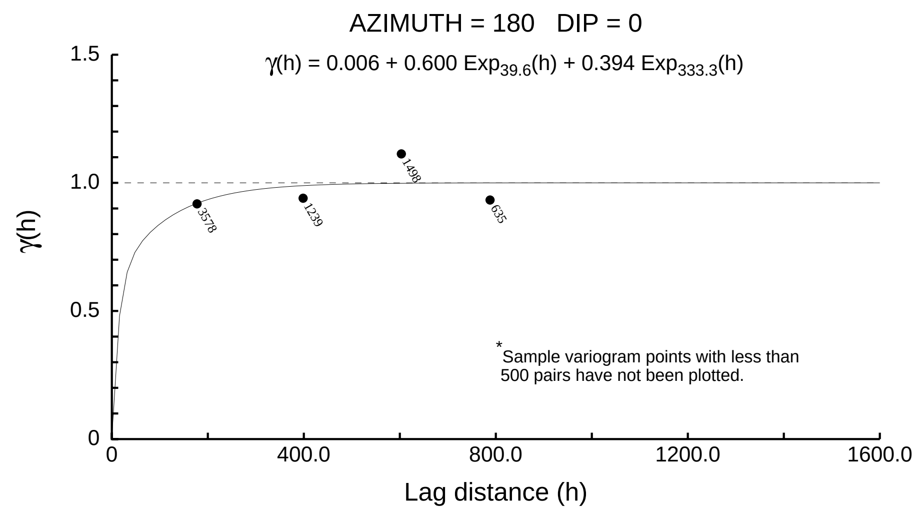
Downhole 1001 - Ni

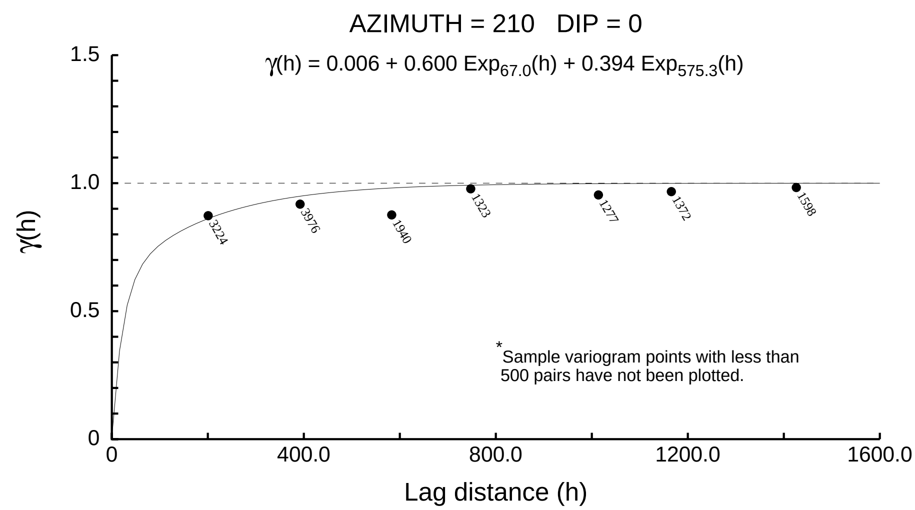


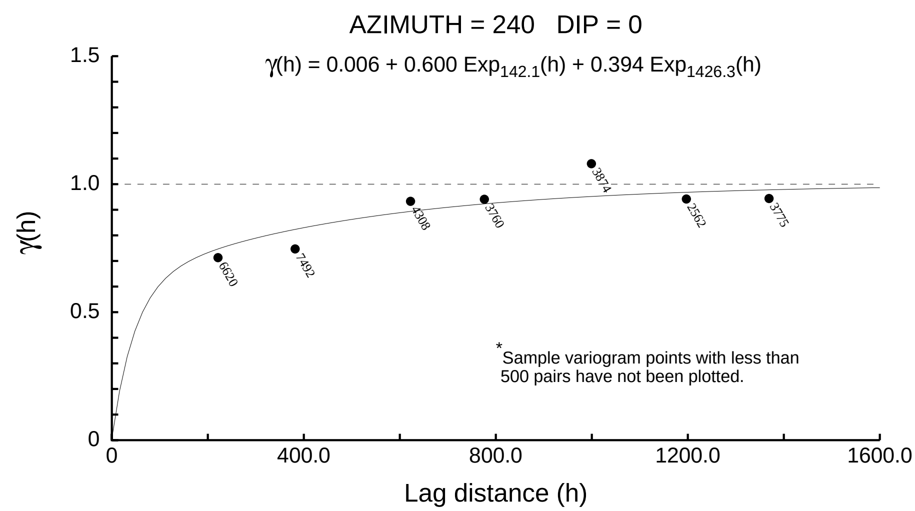




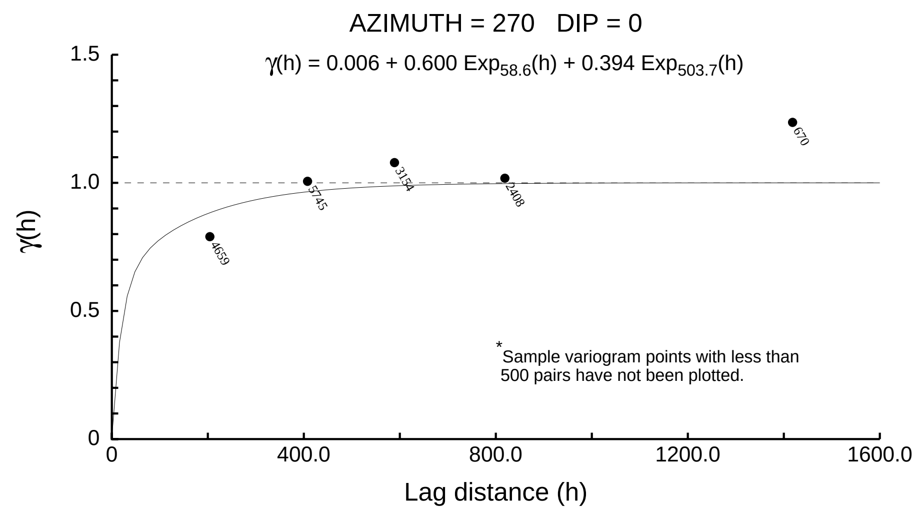
Downhole 1001 - Ni

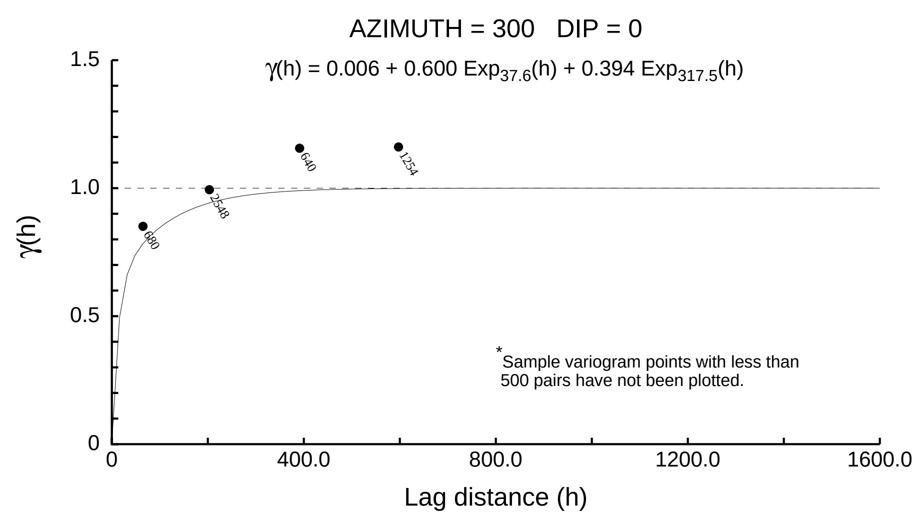


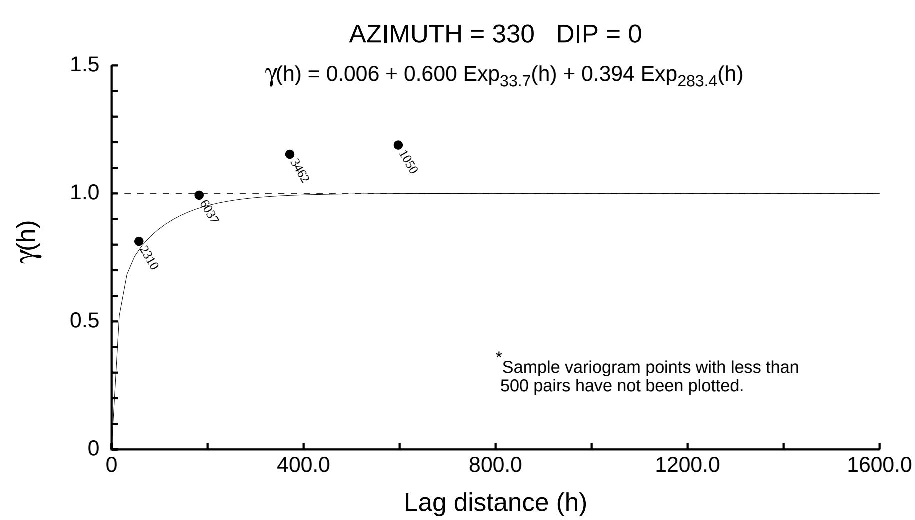




Downhole 1001 - Ni







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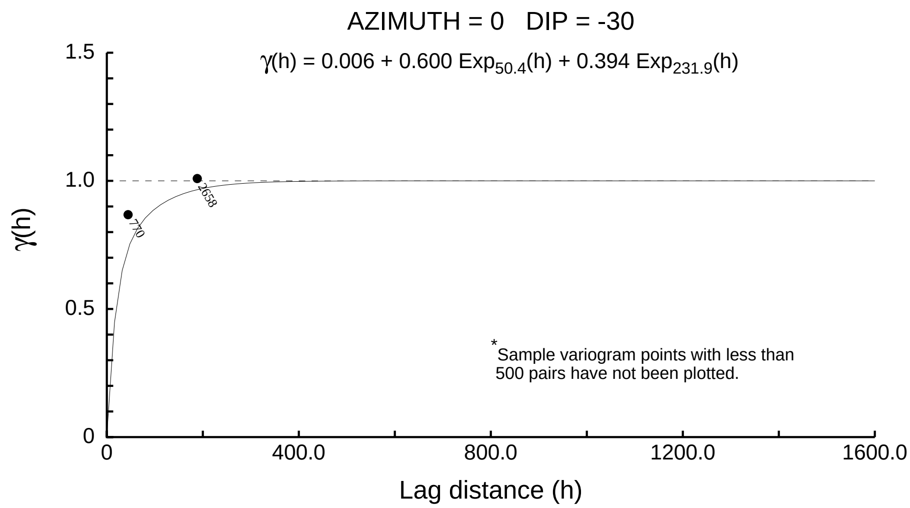
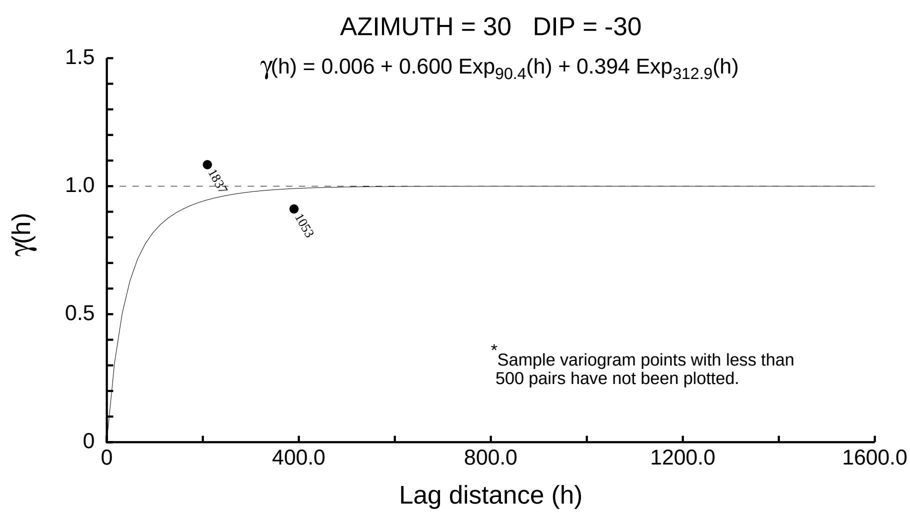
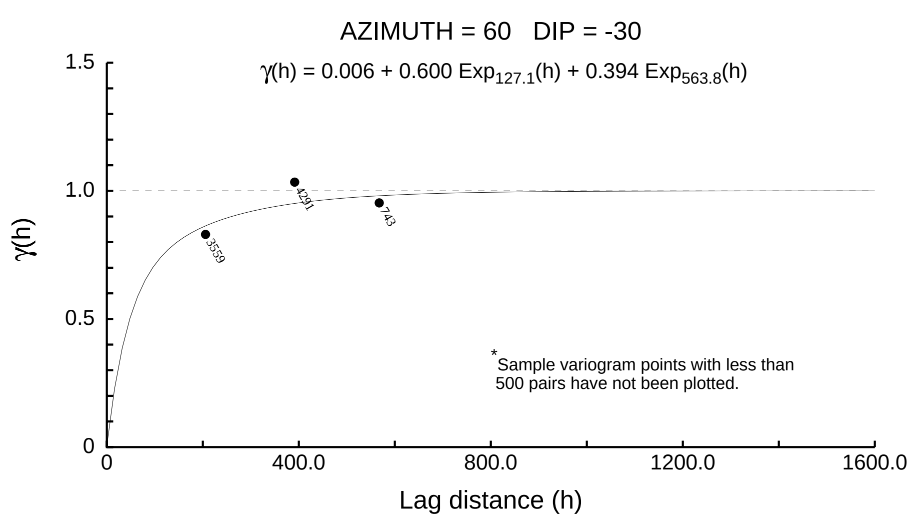
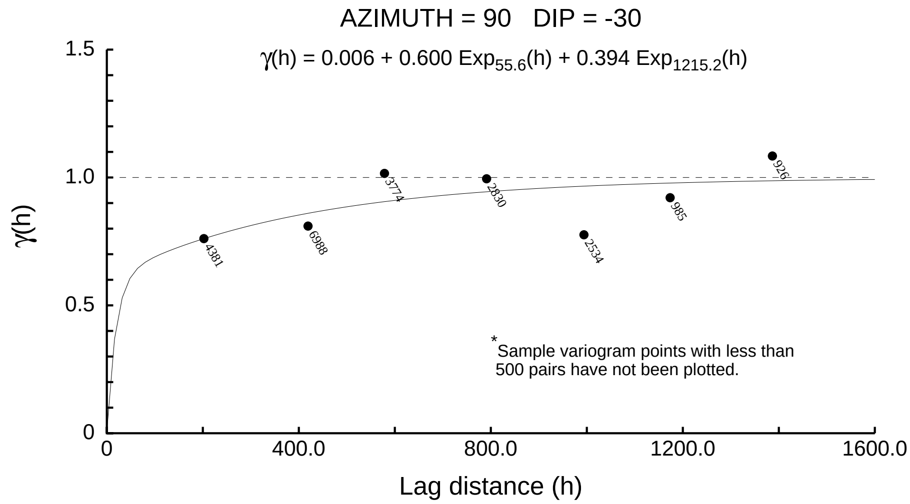
Downhole 1001 - Ni

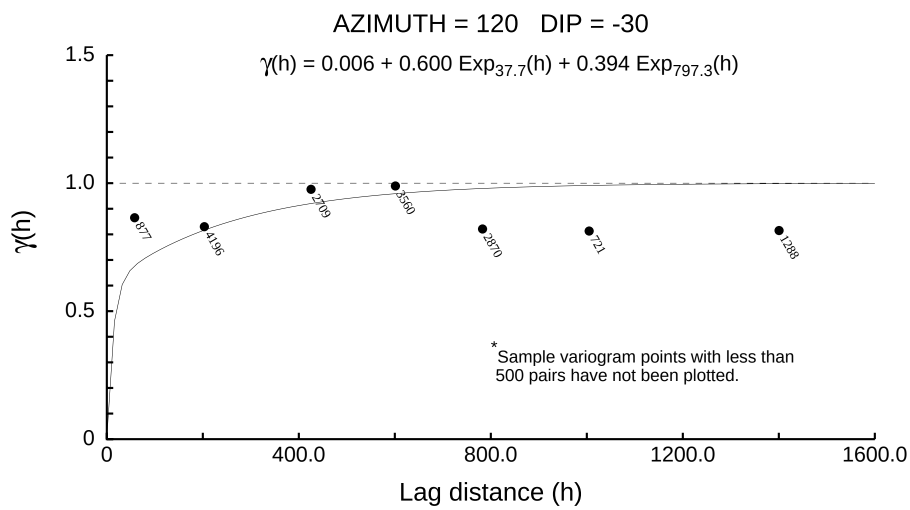


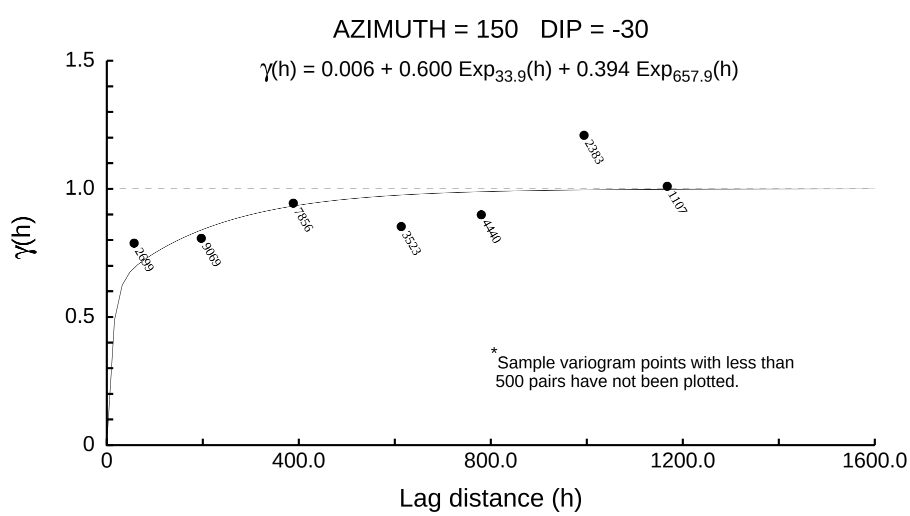




Downhole 1001 - Ni

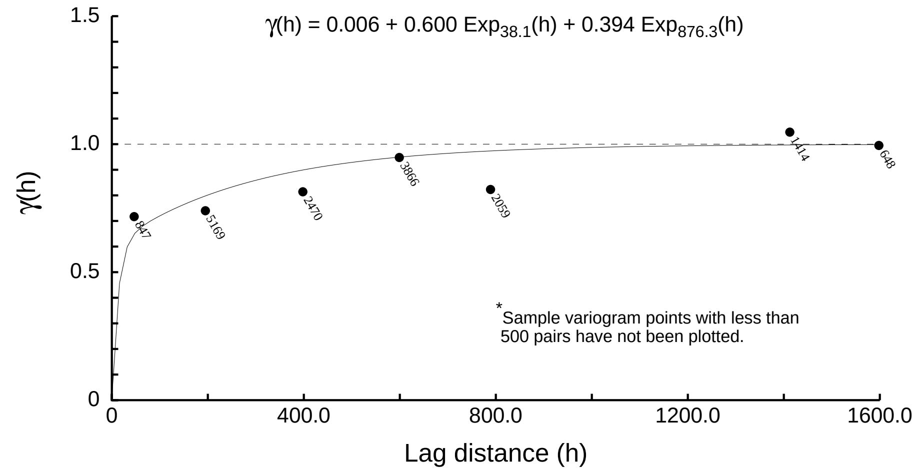




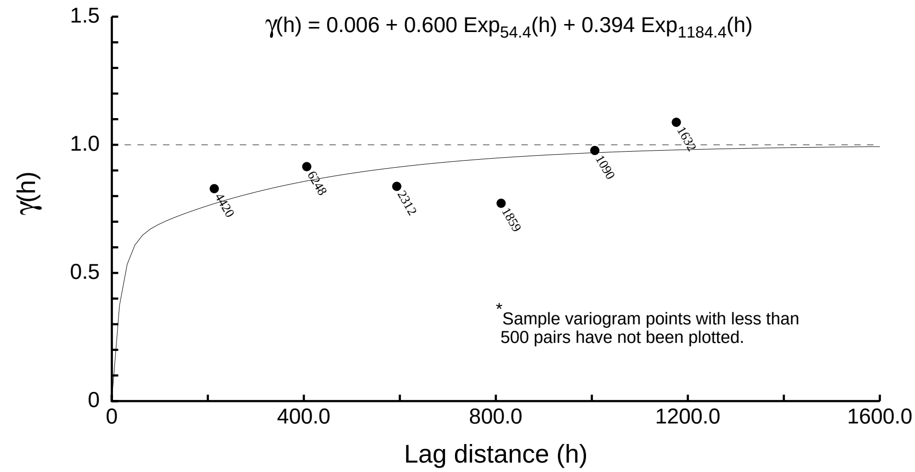


Downhole 1001 - Ni

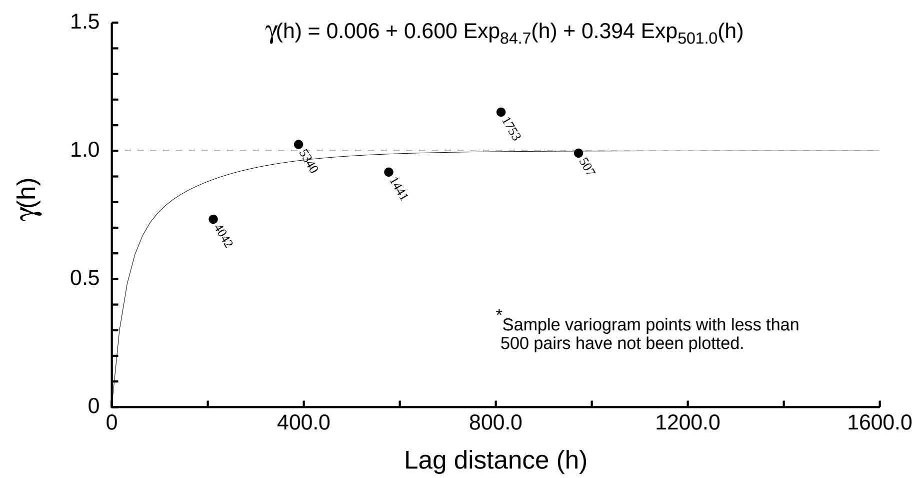
AZIMUTH = 180   DIP = -30



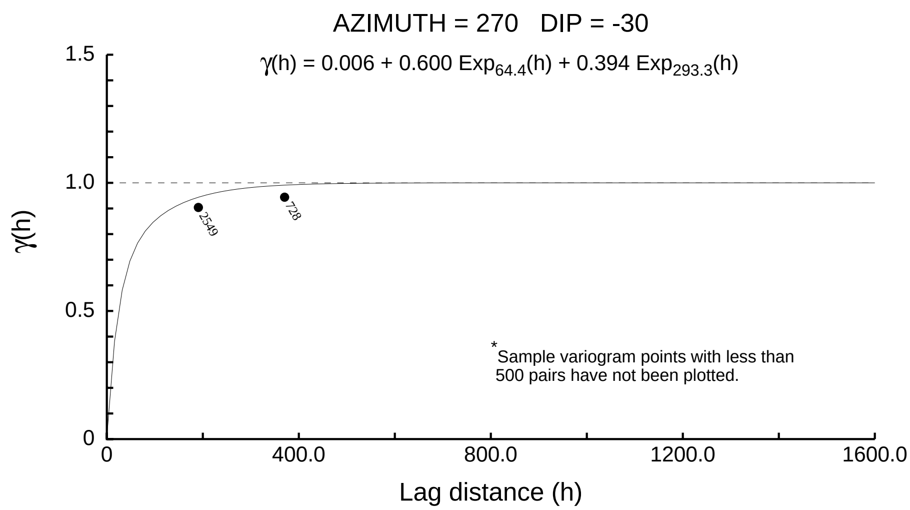
AZIMUTH = 210   DIP = -30

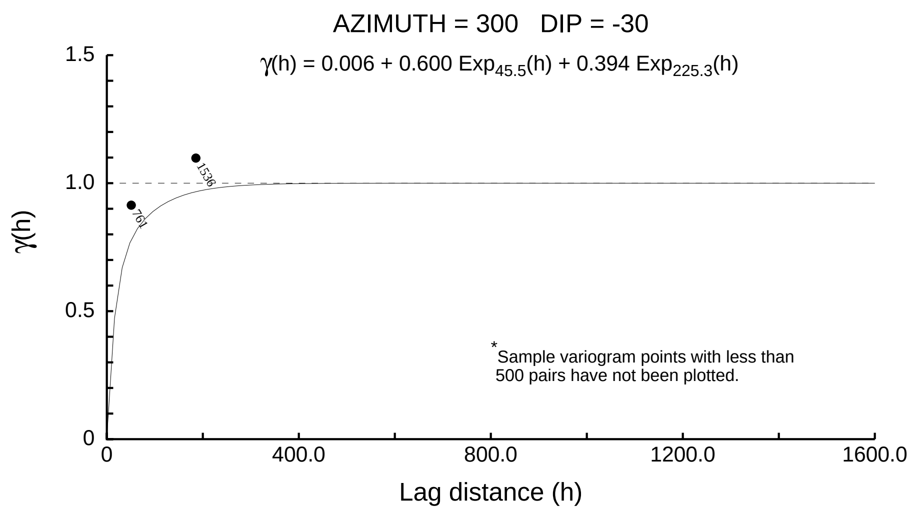


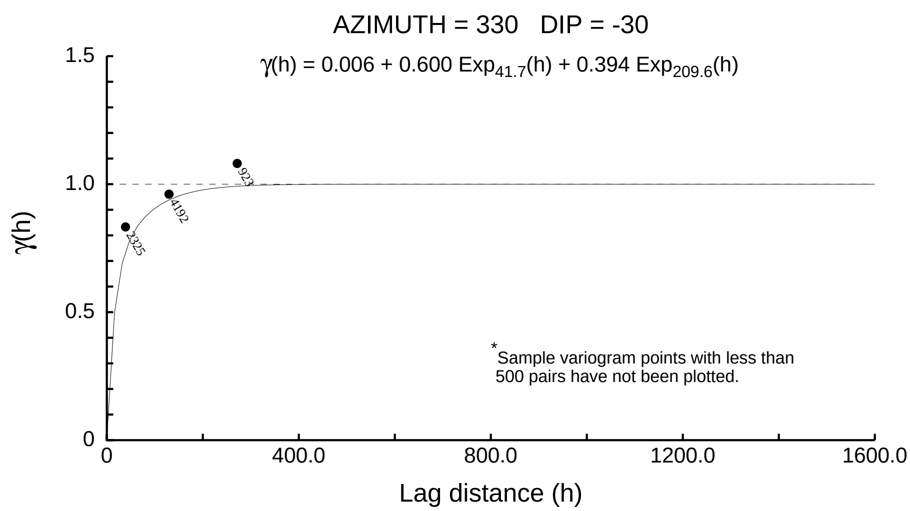
AZIMUTH = 240   DIP = -30



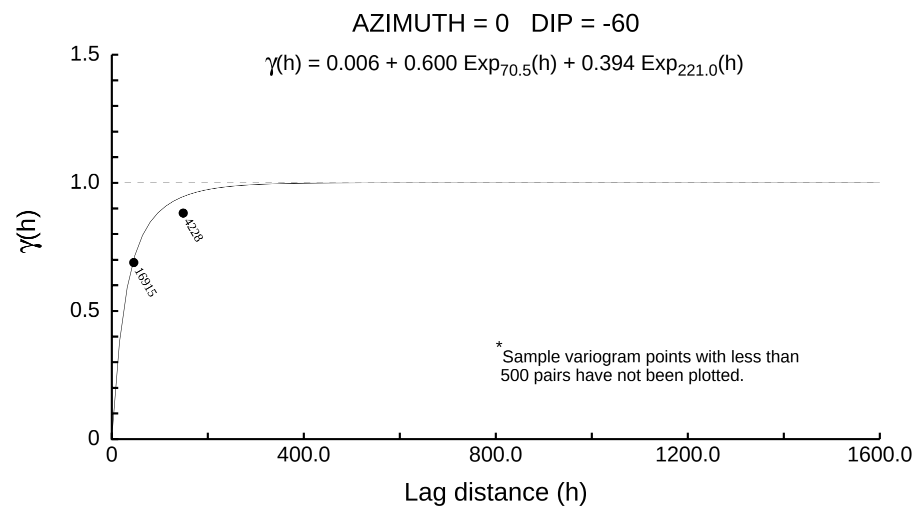
Downhole 1001 - Ni

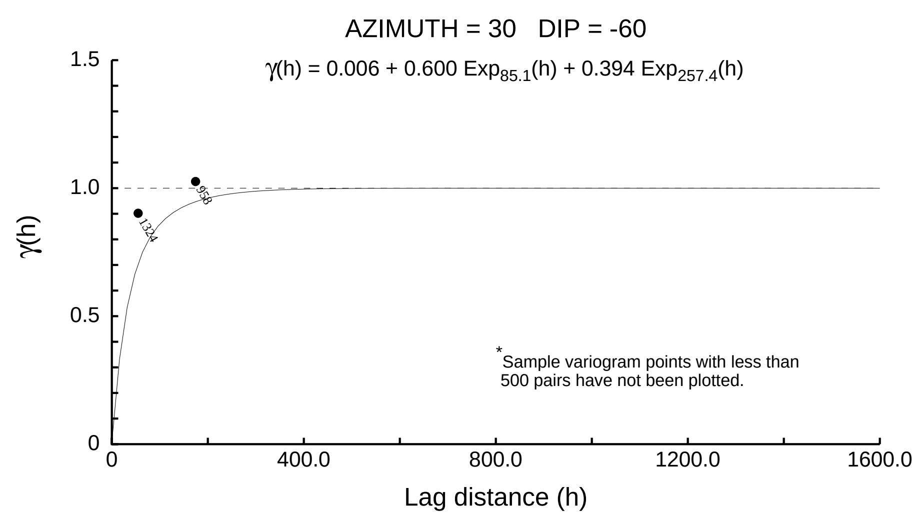


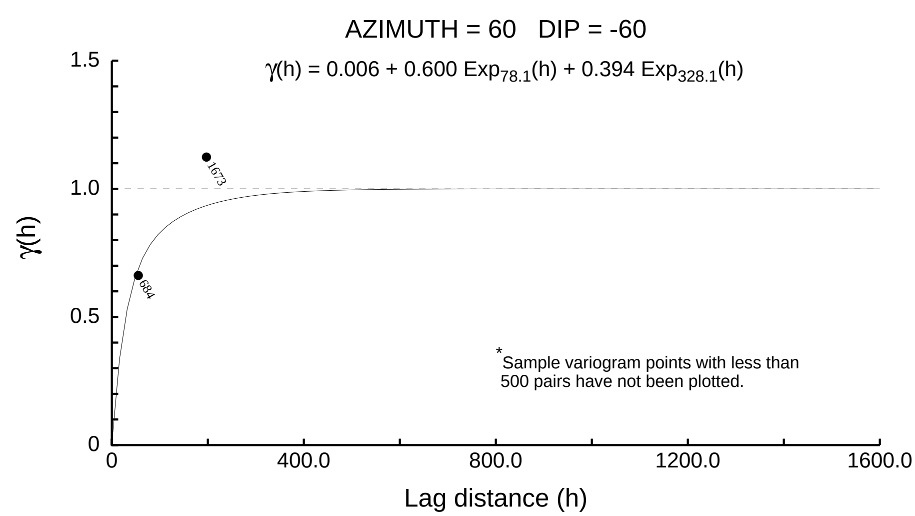




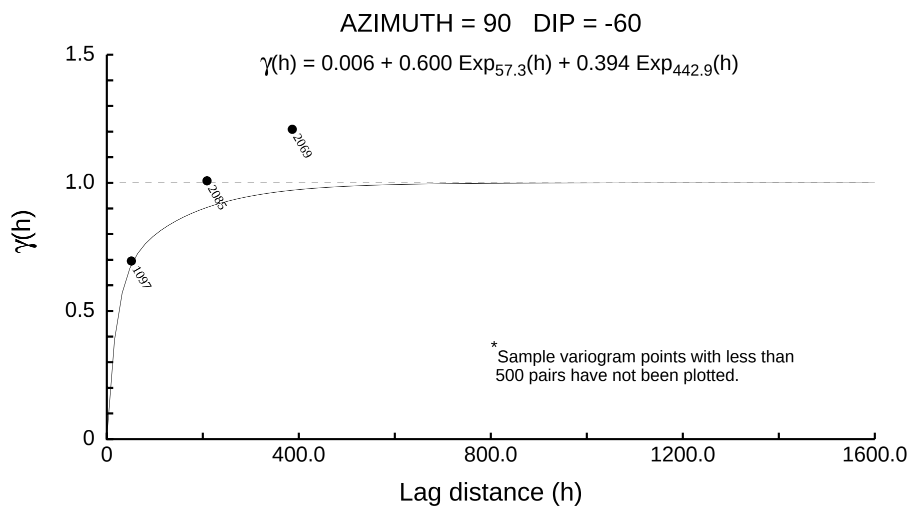
Downhole 1001 - Ni

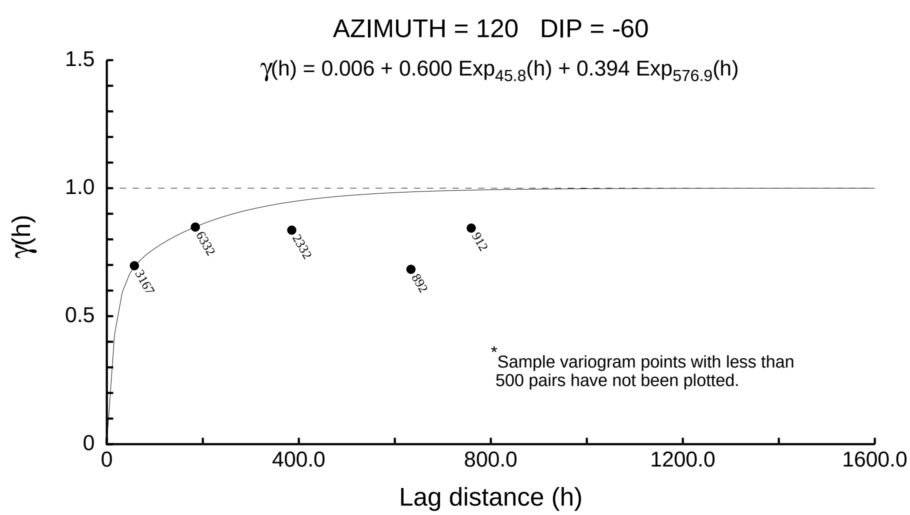


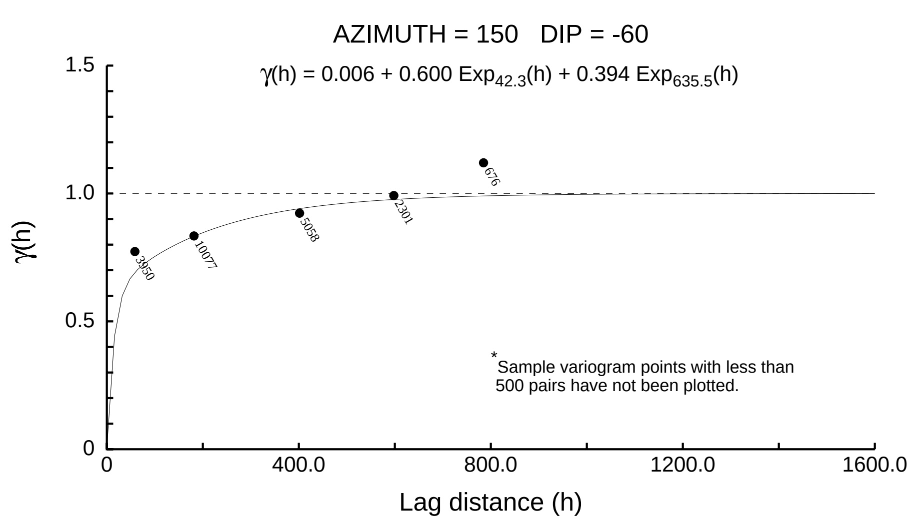




Downhole 1001 - Ni







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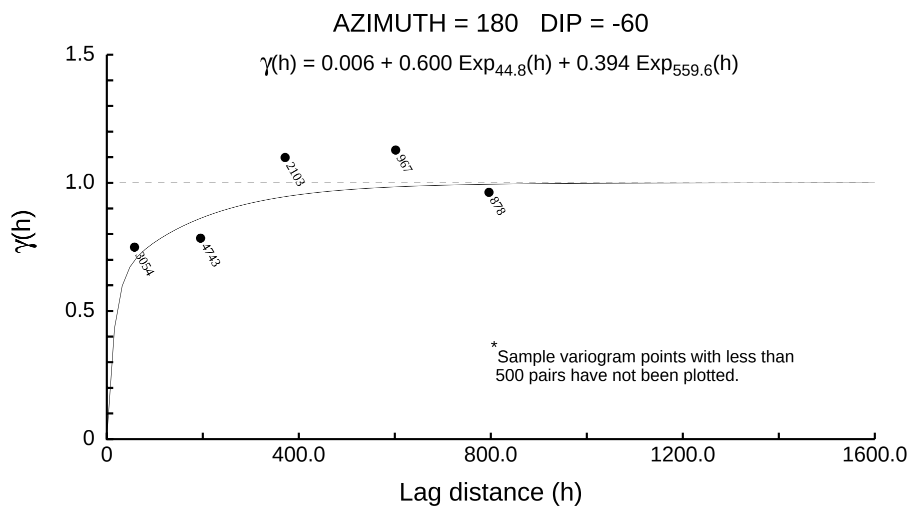
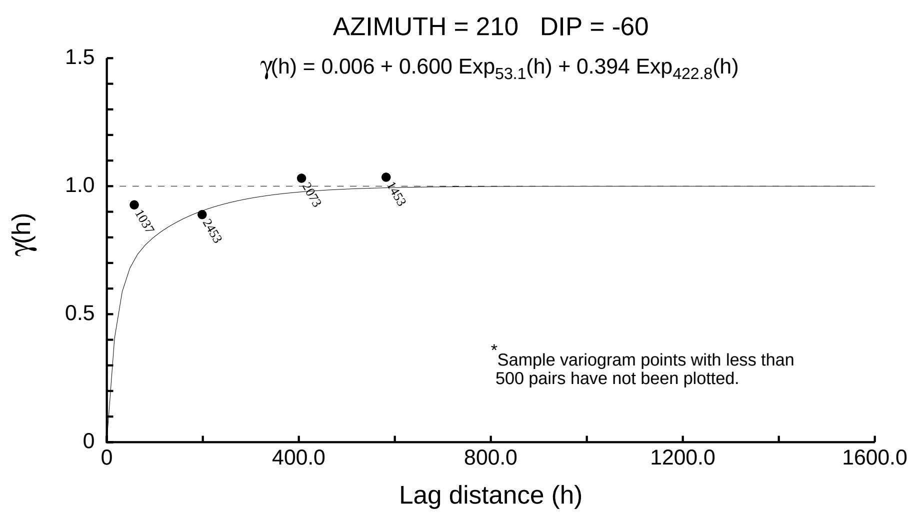
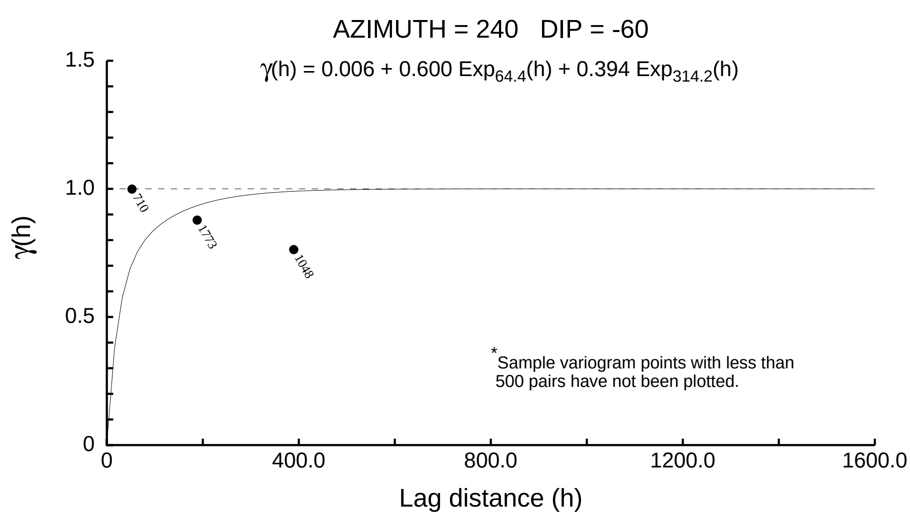
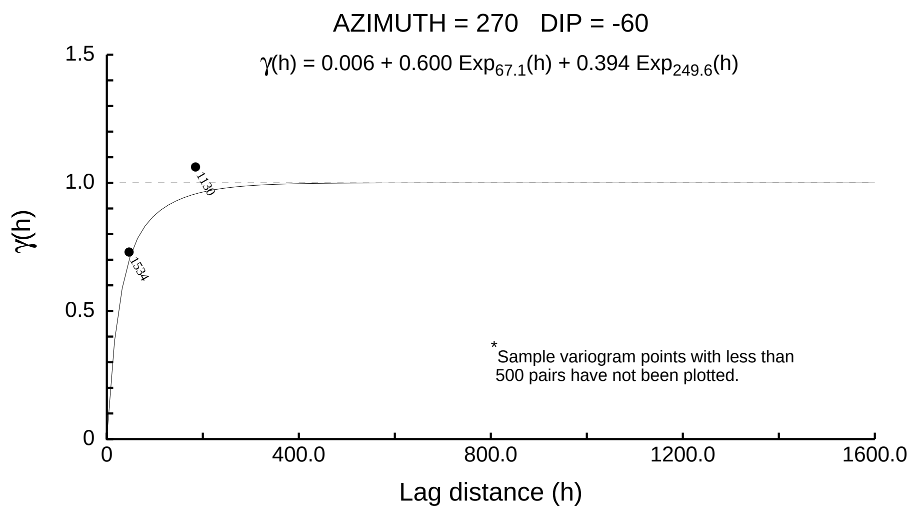
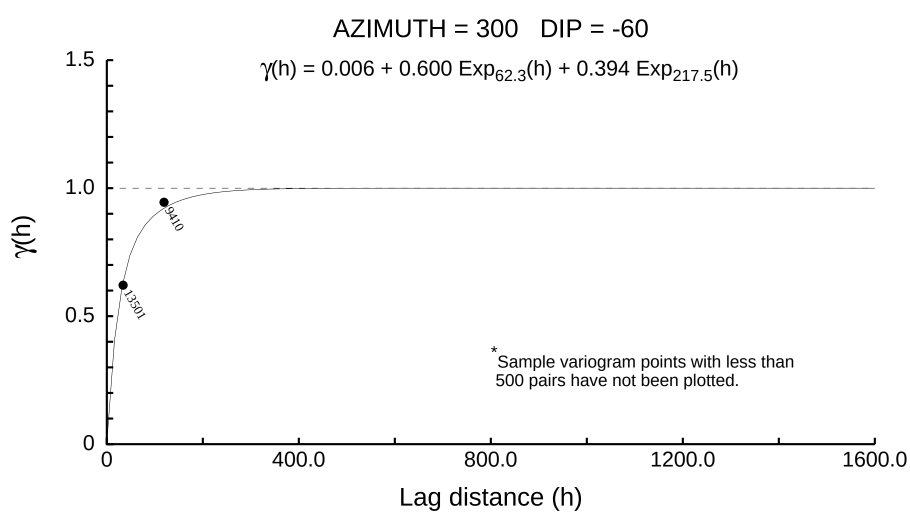


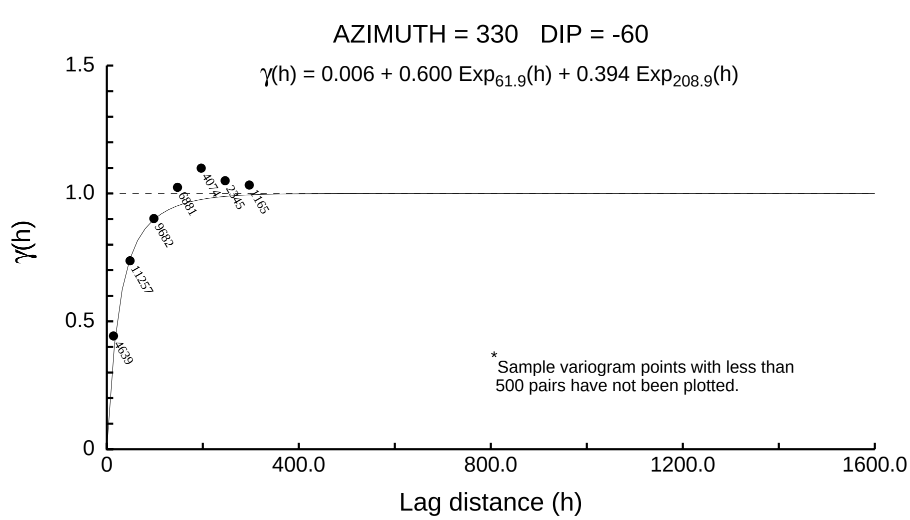




Downhole 1001 - Ni







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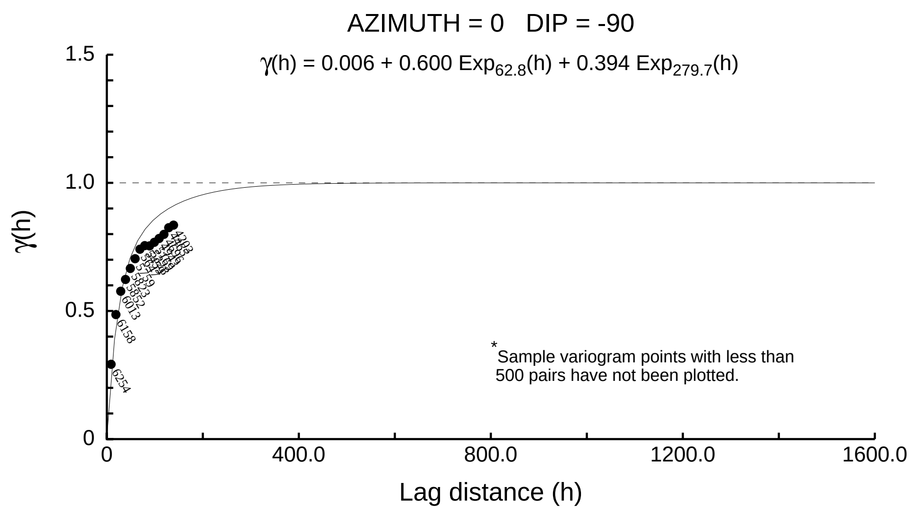


Downhole 1001 - Pd

User Defined Rotation Conventions

Nugget ==> 0.008
C1 ==> 0.671
C2 ==> 0.321

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -19
RH Rotation about the Y' axis ==> 15
RH Rotation about the Z' axis ==> -16
Range along the Z' axis ==> 67.0 Azimuth ==> 109 Dip ==> 75
Range along the Y' axis ==> 130.9 Azimuth ==> 35 Dip ==> -4
Range along the X' axis ==> 24.7 Azimuth ==> 126 Dip ==> -14

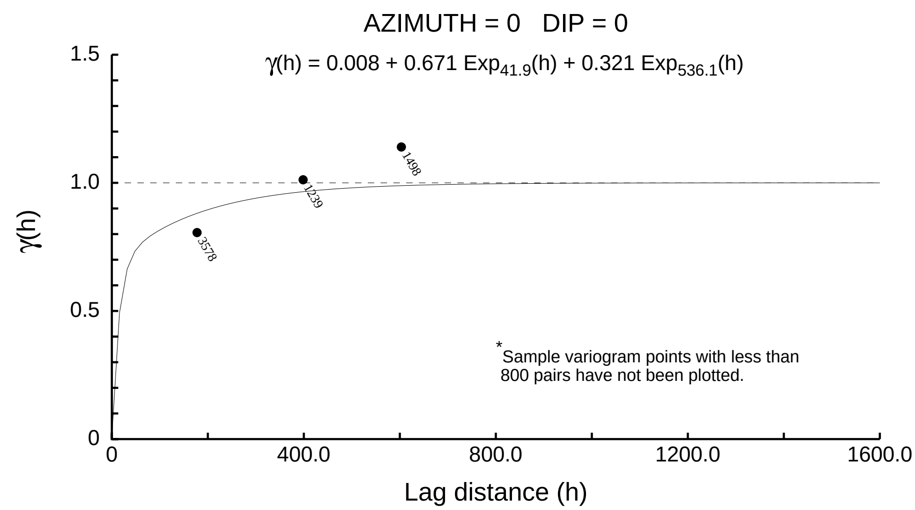
Second Structure -- Exponential with Practical Range

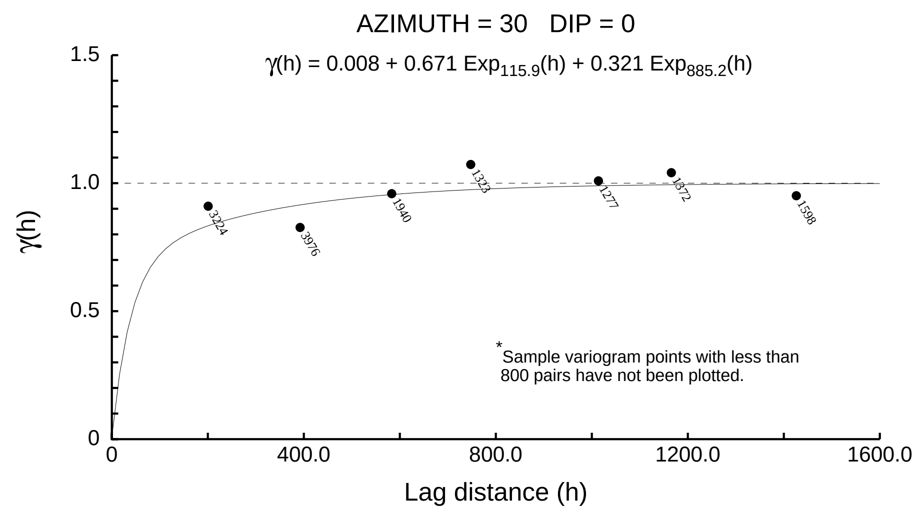
RH Rotation about the Z axis ==> -77
RH Rotation about the Y' axis ==> -51
RH Rotation about the Z' axis ==> 12
Range along the Z' axis ==> 1325.5 Azimuth ==> 347 Dip ==> 39
Range along the Y' axis ==> 2099.6 Azimuth ==> 69 Dip ==> -9
Range along the X' axis ==> 311.6 Azimuth ==> 148 Dip ==> 50

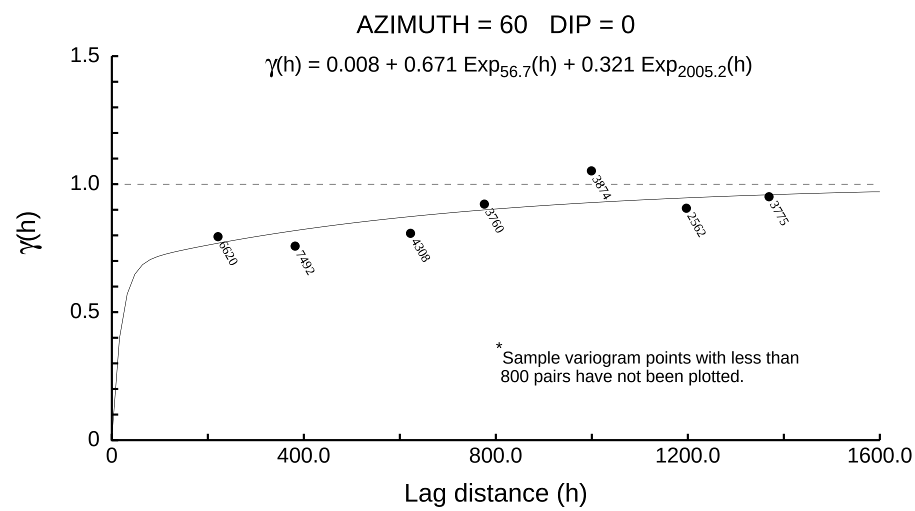
Modeling Criteria

Minimum number pairs req'd ==> 800
Sample variogram points weighted by # pairs

Downhole 1001 - Pd







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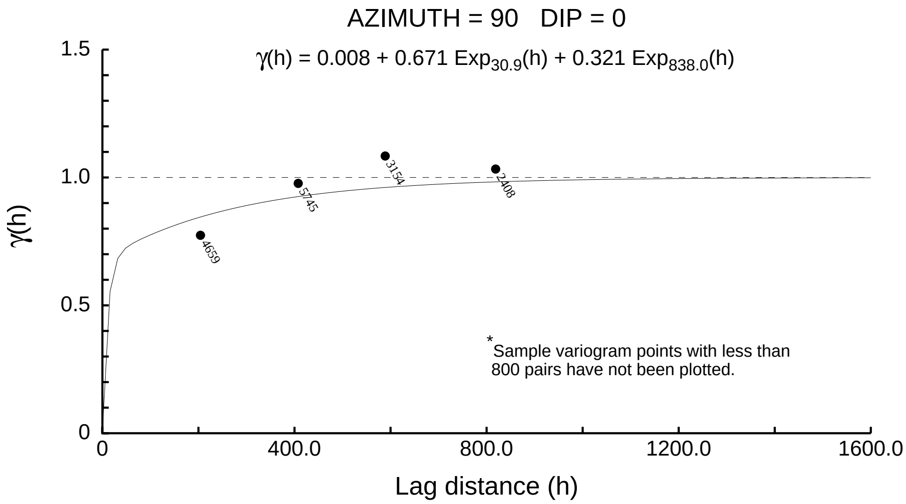
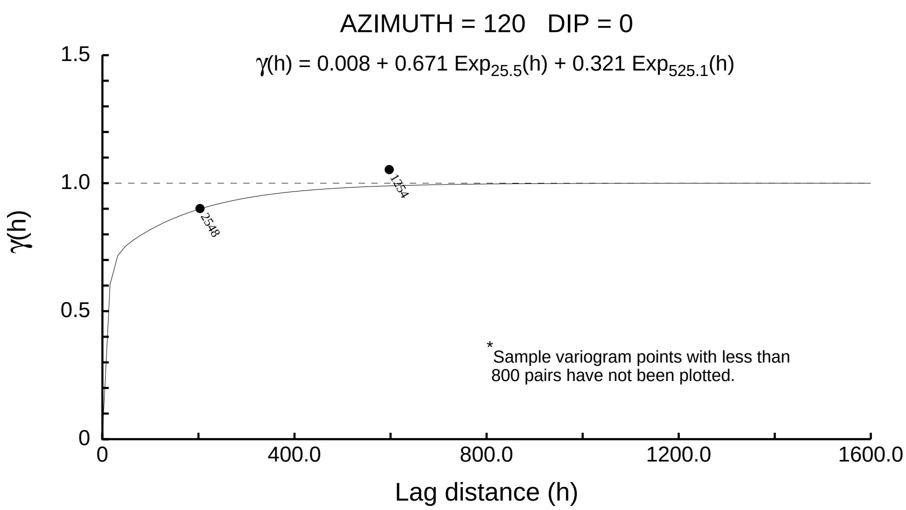
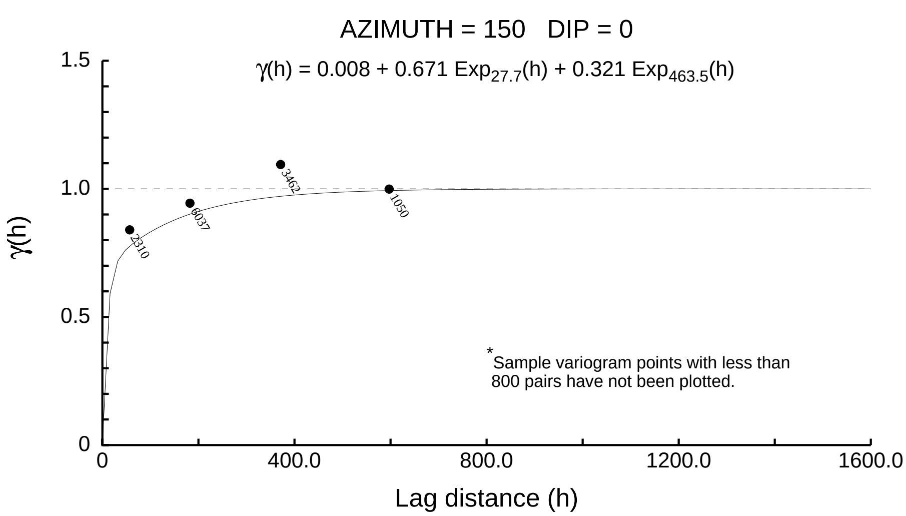
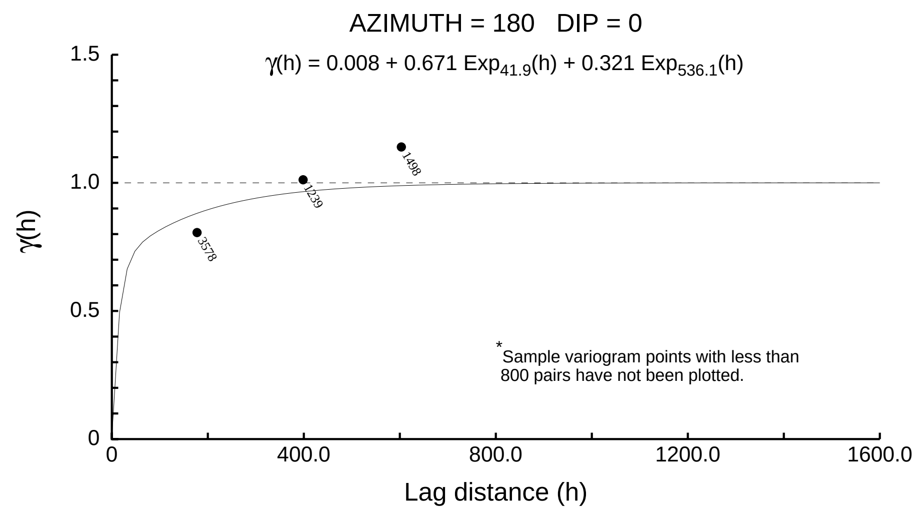
Downhole 1001 - Pd

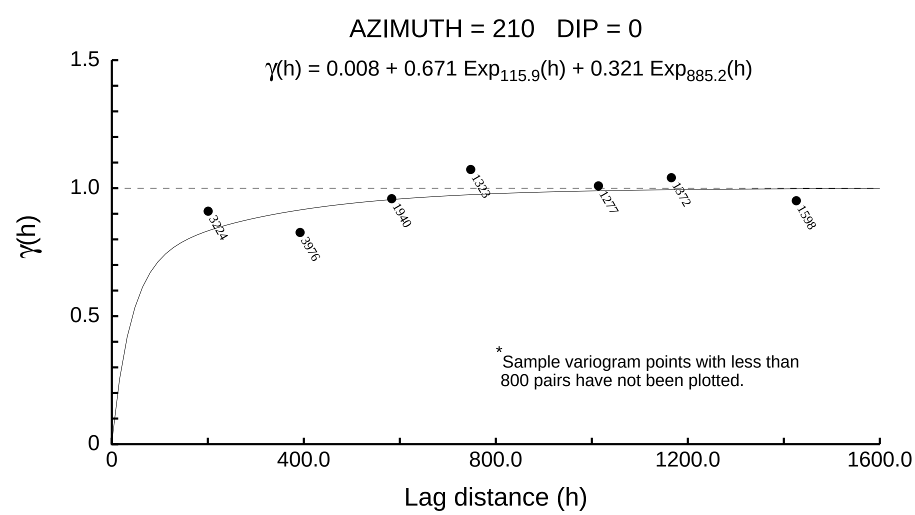


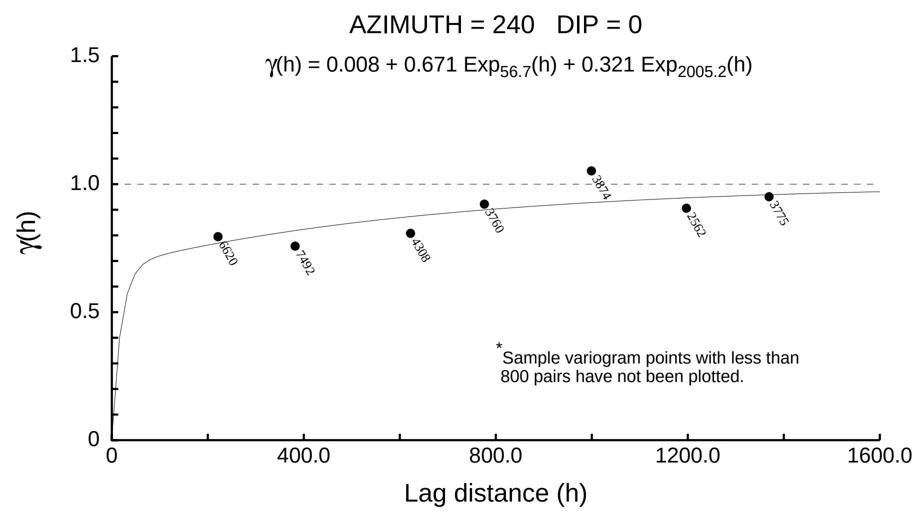




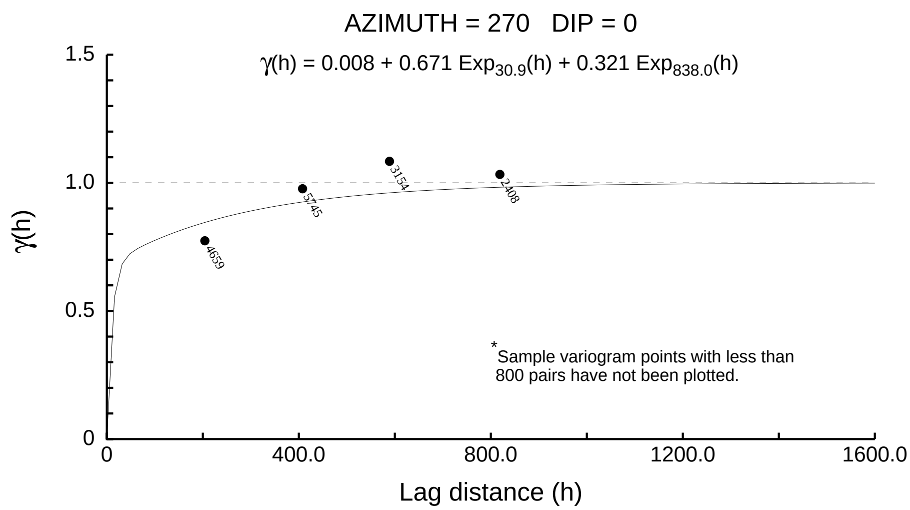
Downhole 1001 - Pd

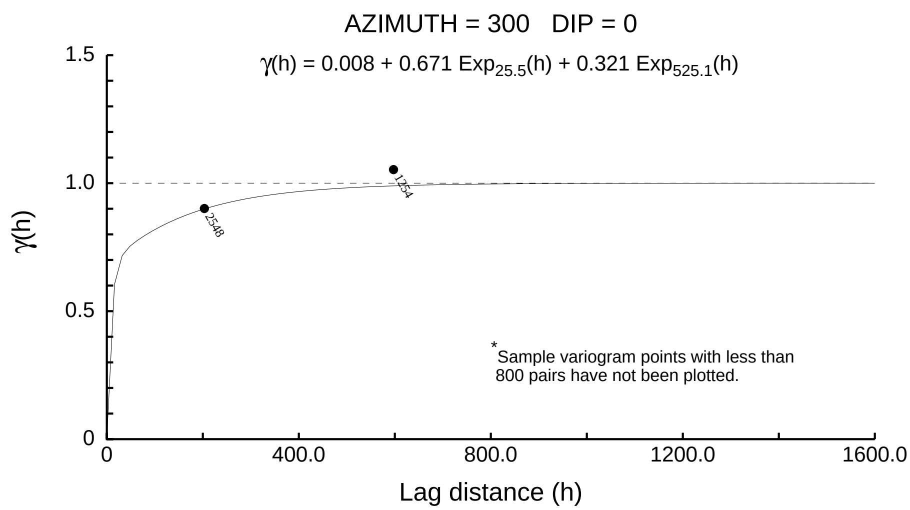


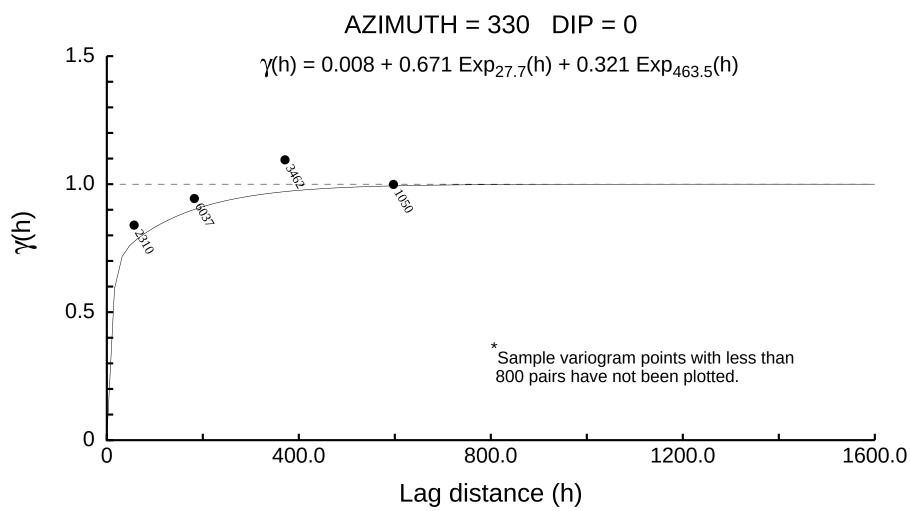




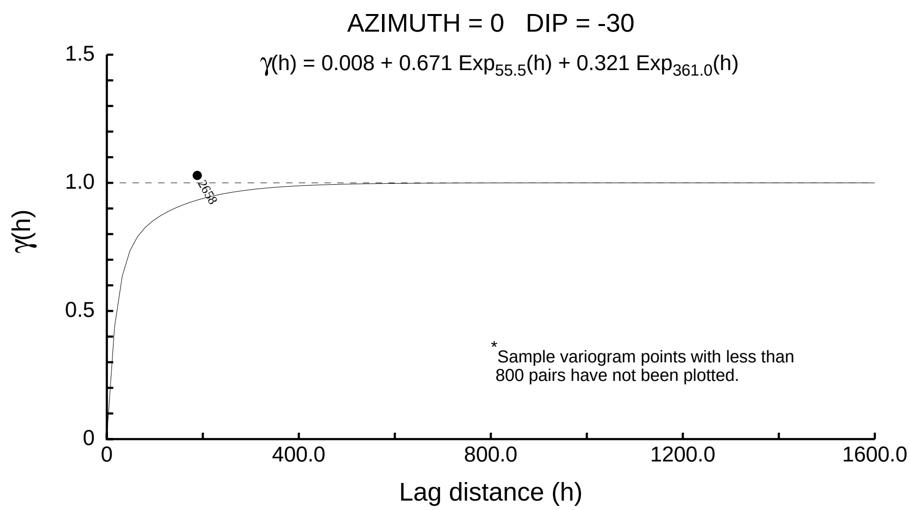
Downhole 1001 - Pd

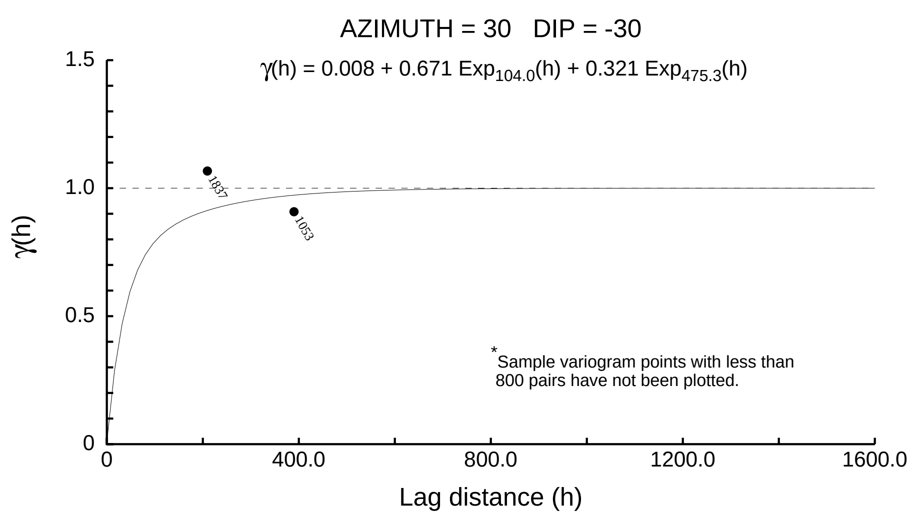


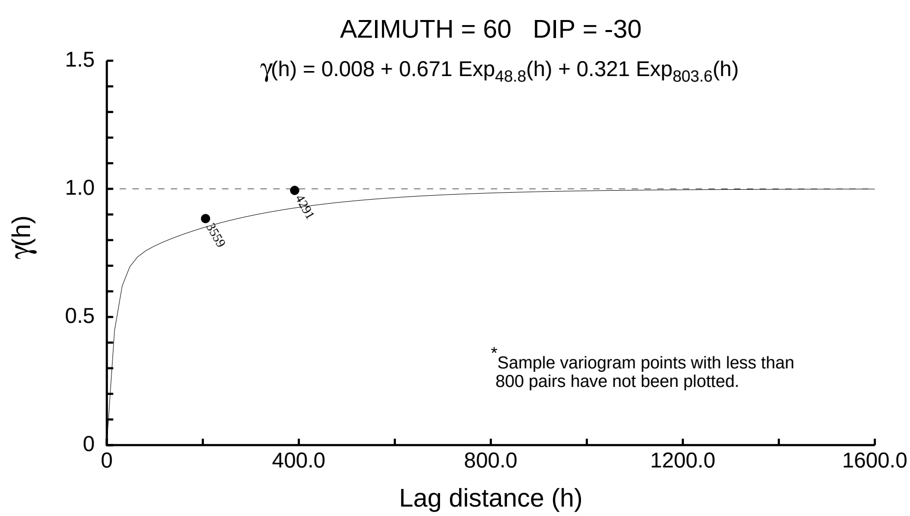




Downhole 1001 - Pd

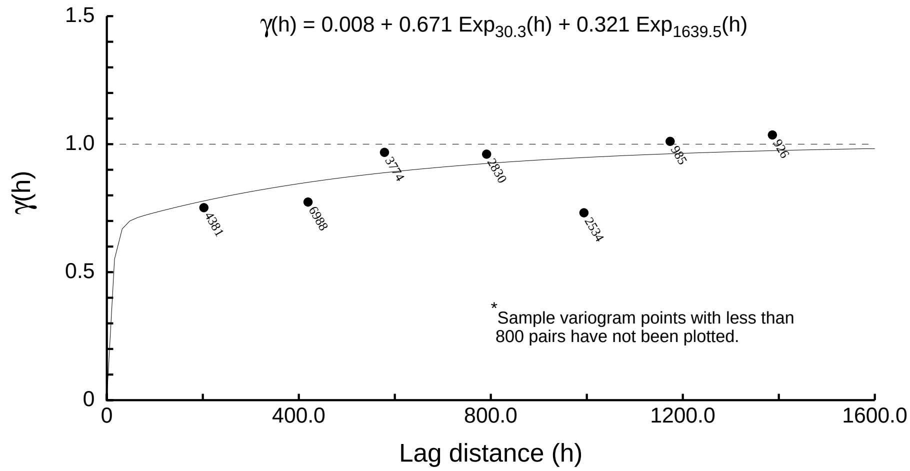




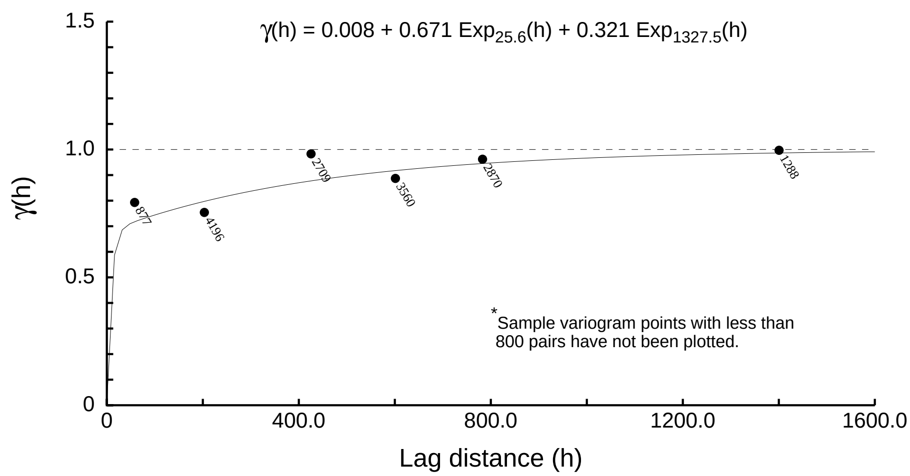


Downhole 1001 - Pd

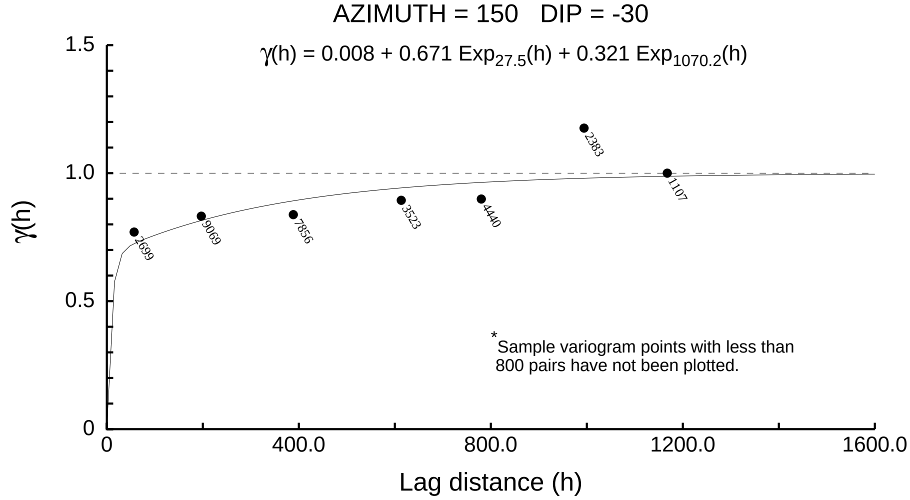
AZIMUTH = 90   DIP = -30



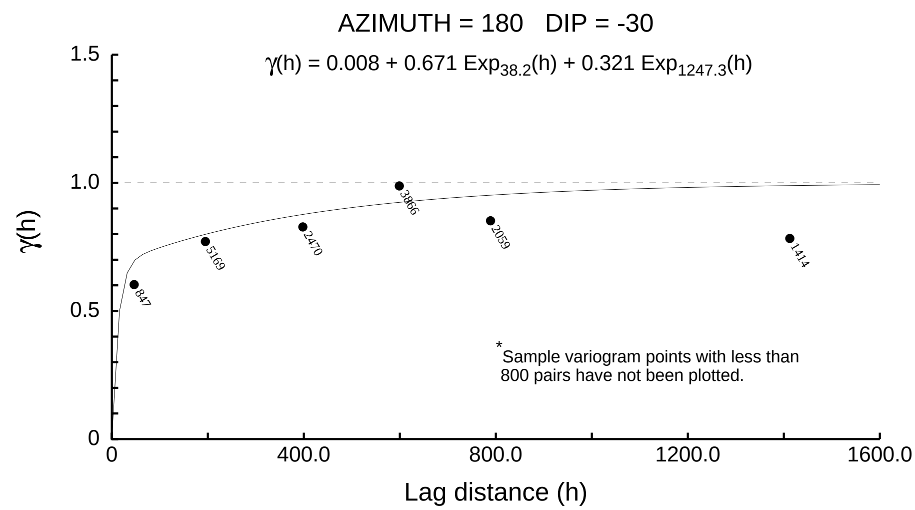
AZIMUTH = 120   DIP = -30

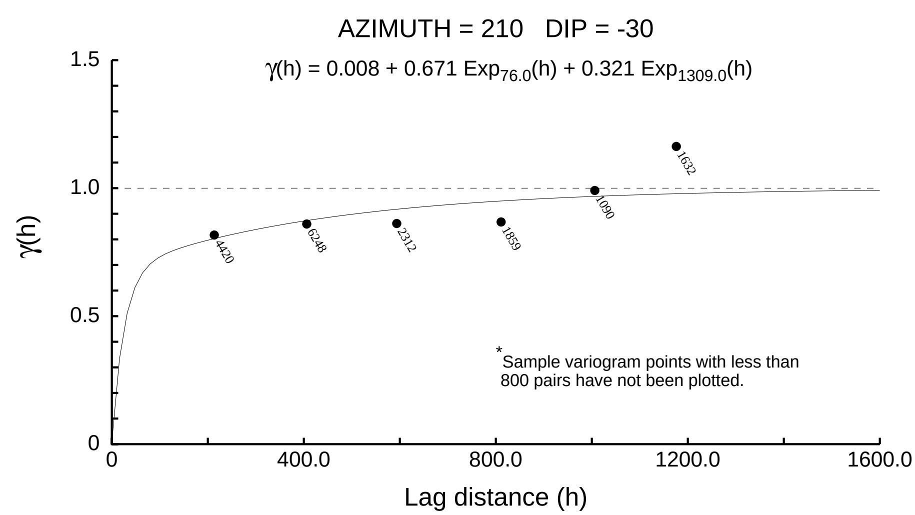


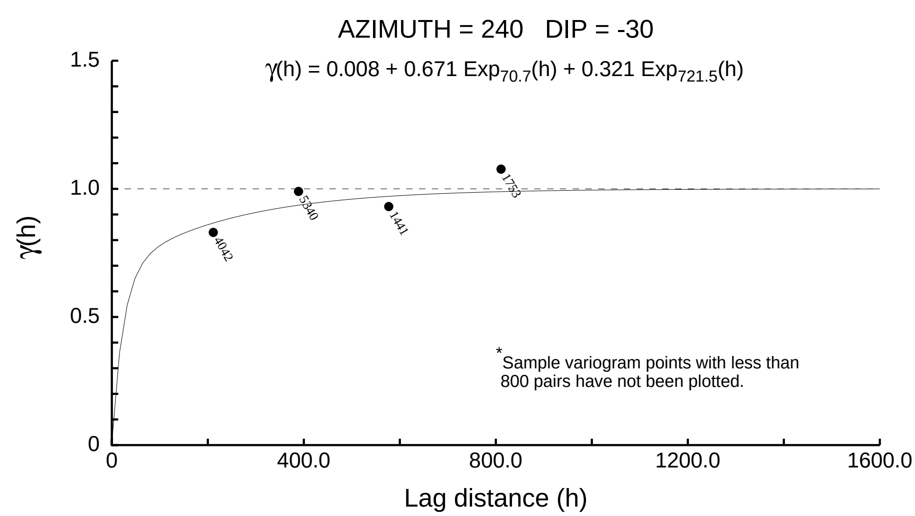
AZIMUTH = 150   DIP = -30



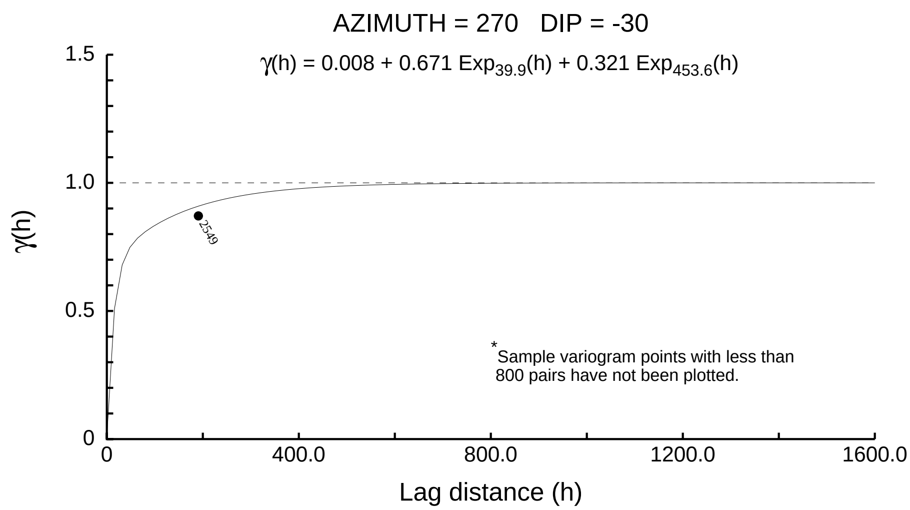
Downhole 1001 - Pd

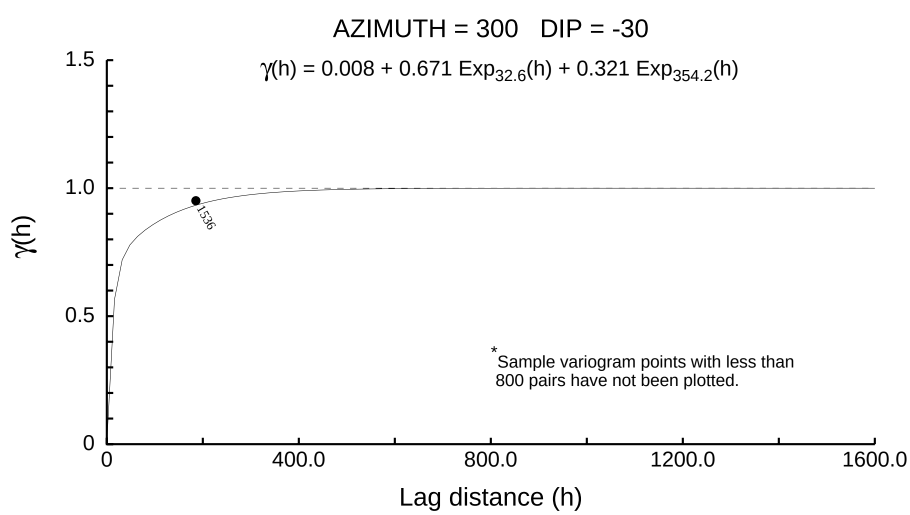


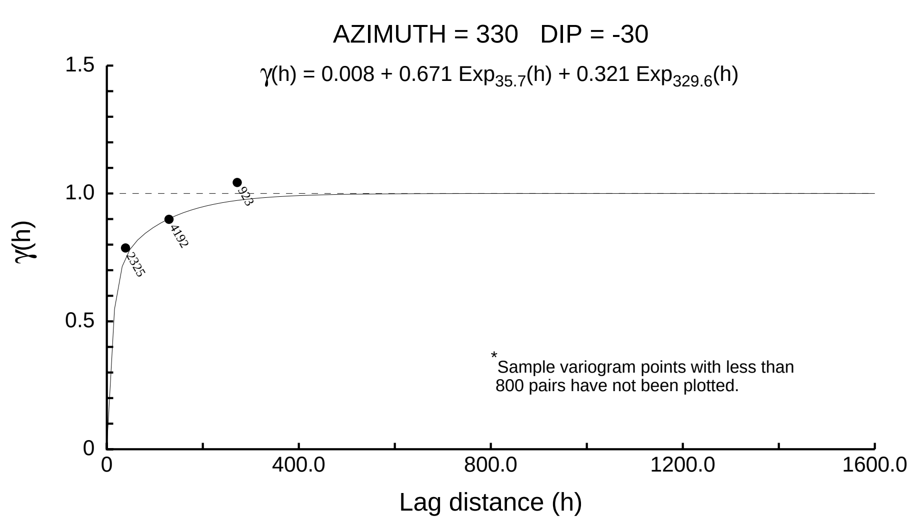




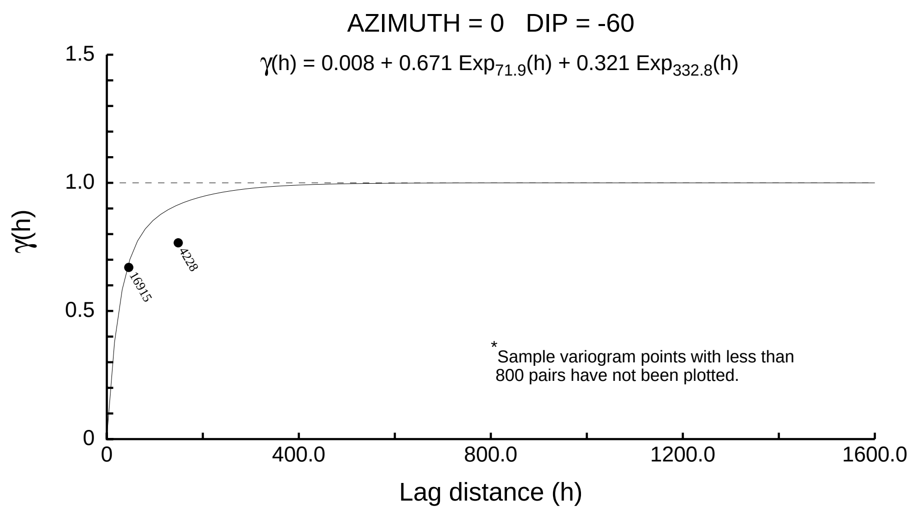
Downhole 1001 - Pd

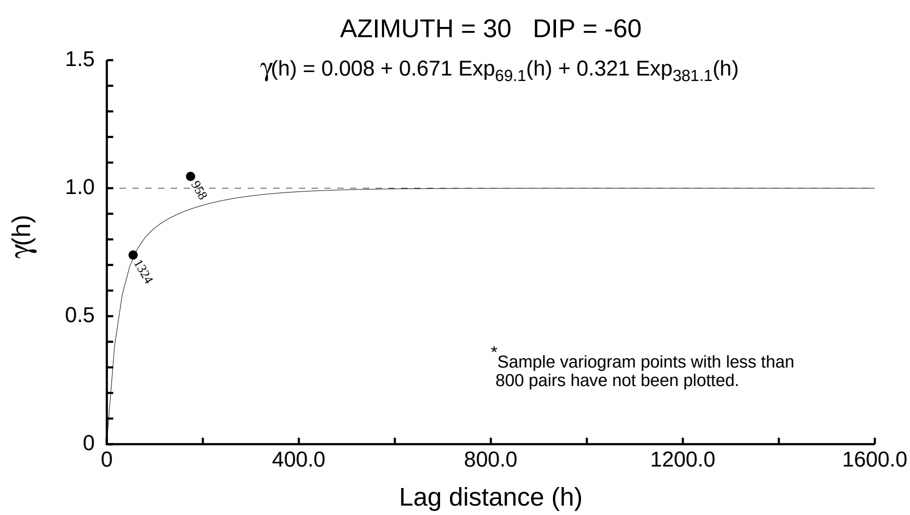


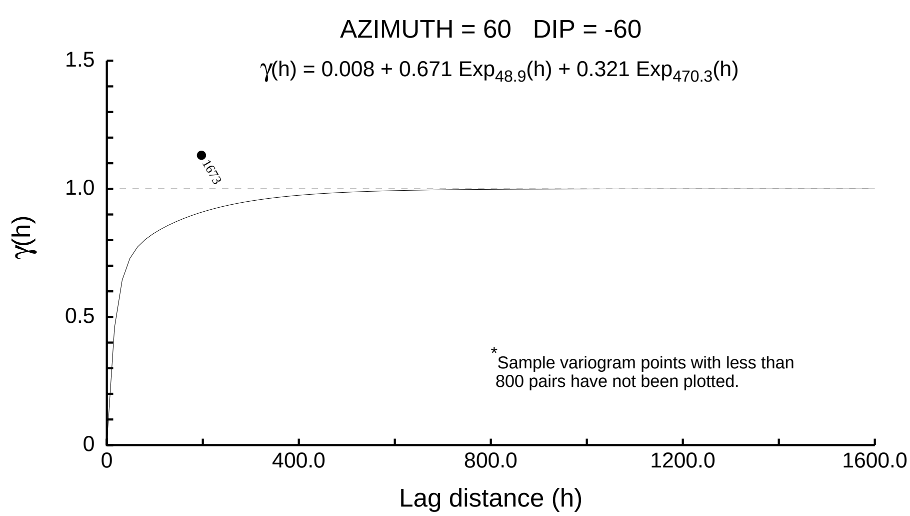




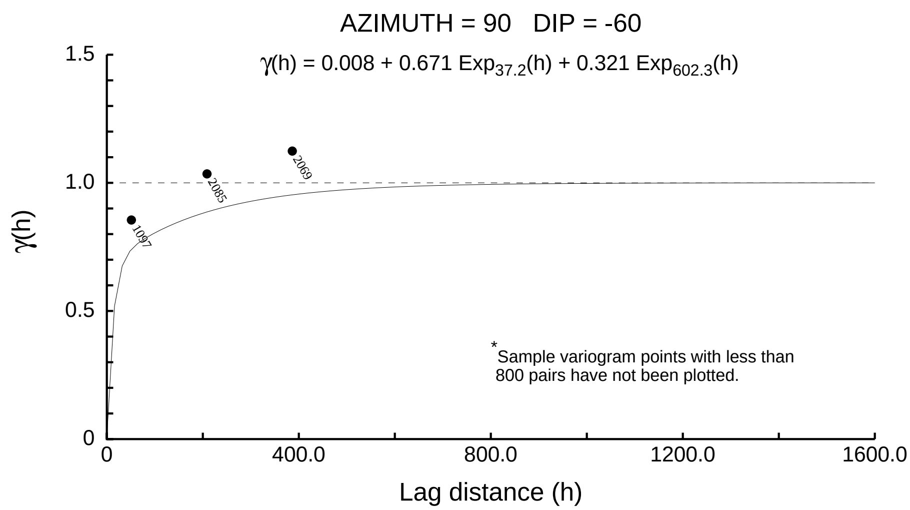
Downhole 1001 - Pd

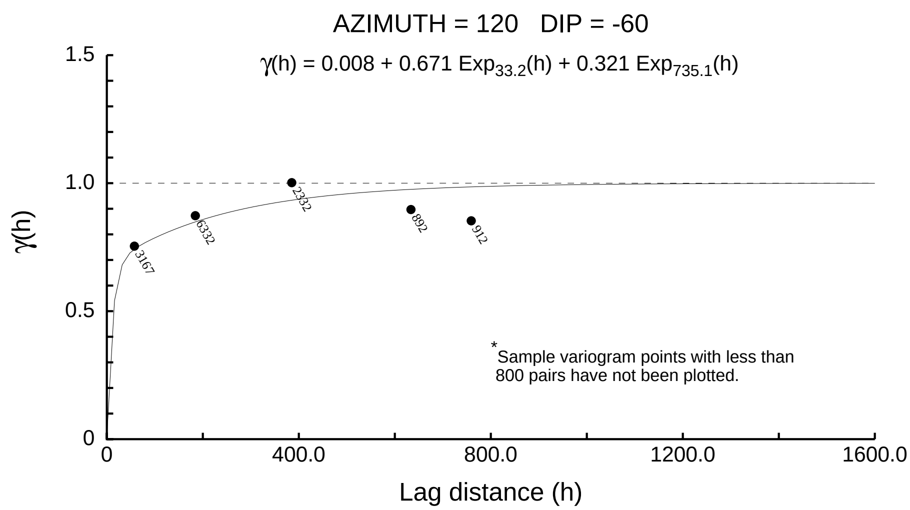


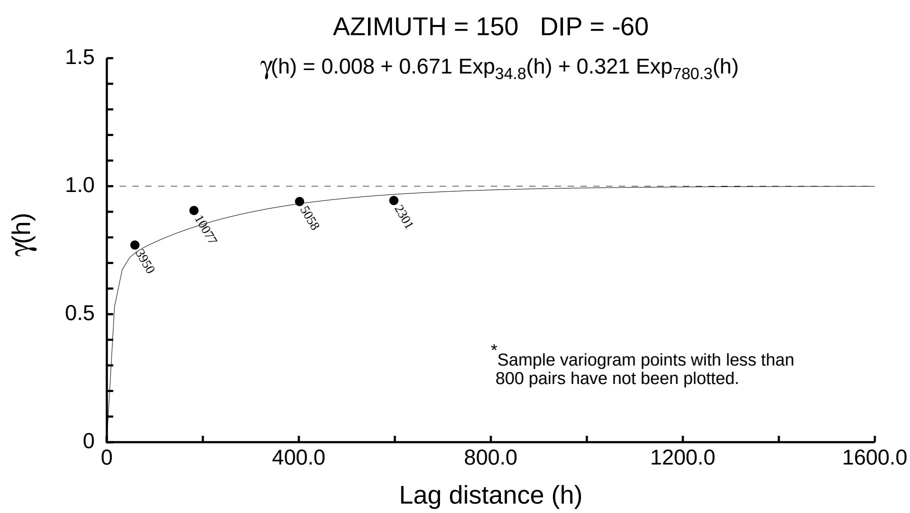




Downhole 1001 - Pd



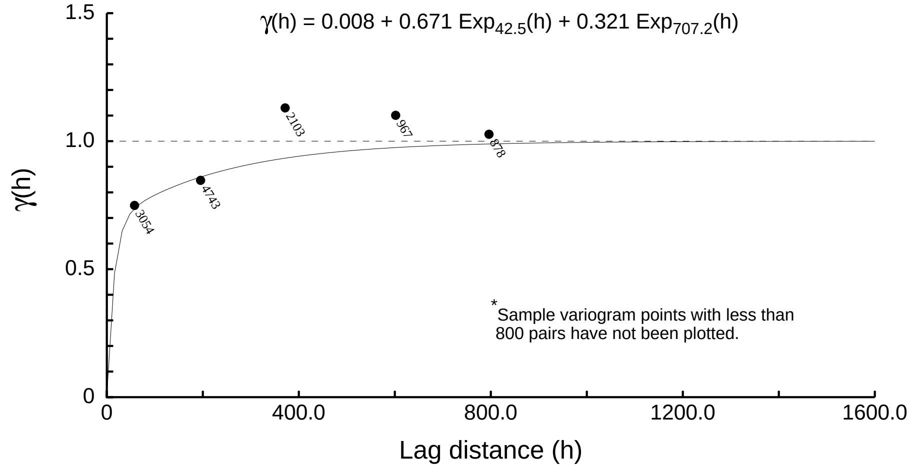




Downhole 1001 - Pd

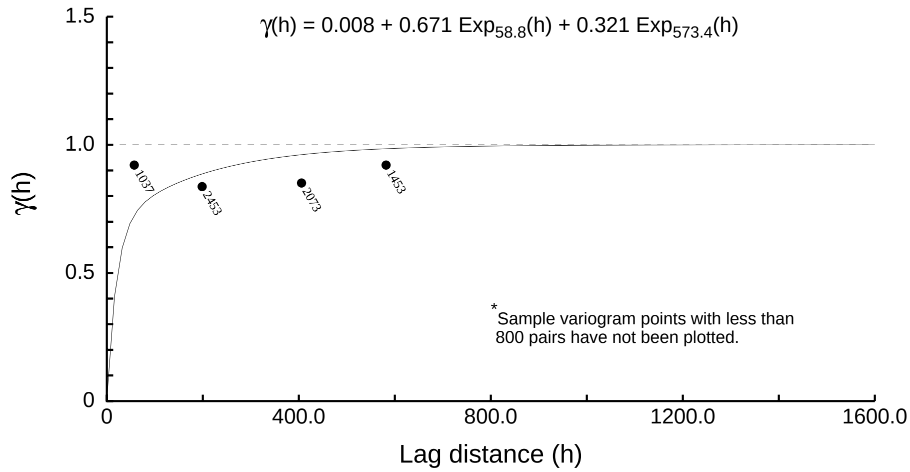
AZIMUTH = 180   DIP = -60

$\gamma(h) = 0.008 + 0.671\ Exp_{42.5}(h) + 0.321\ Exp_{707.2}(h)$



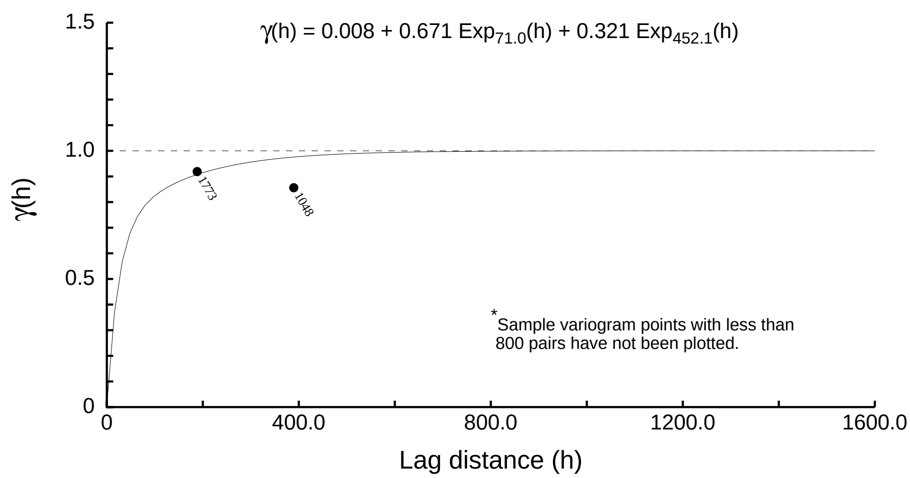
AZIMUTH = 210   DIP = -60

$\gamma(h) = 0.008 + 0.671\ Exp_{58.8}(h) + 0.321\ Exp_{573.4}(h)$

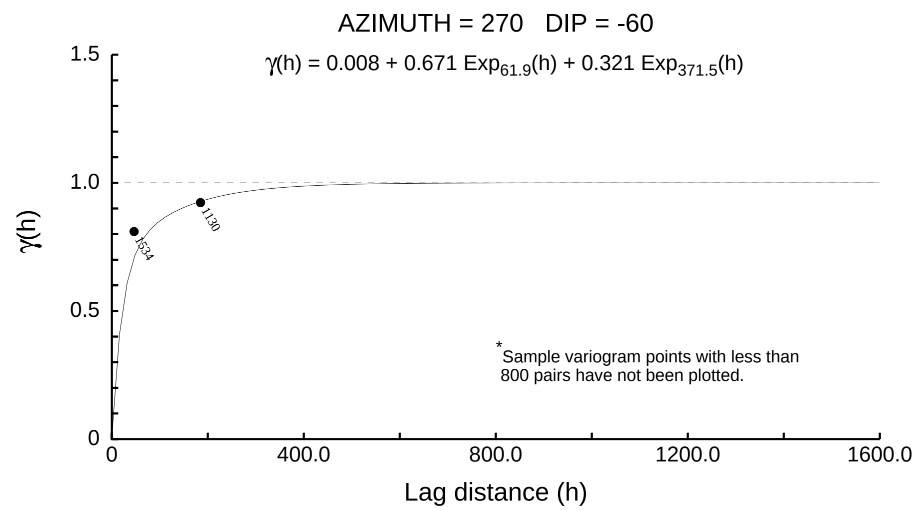


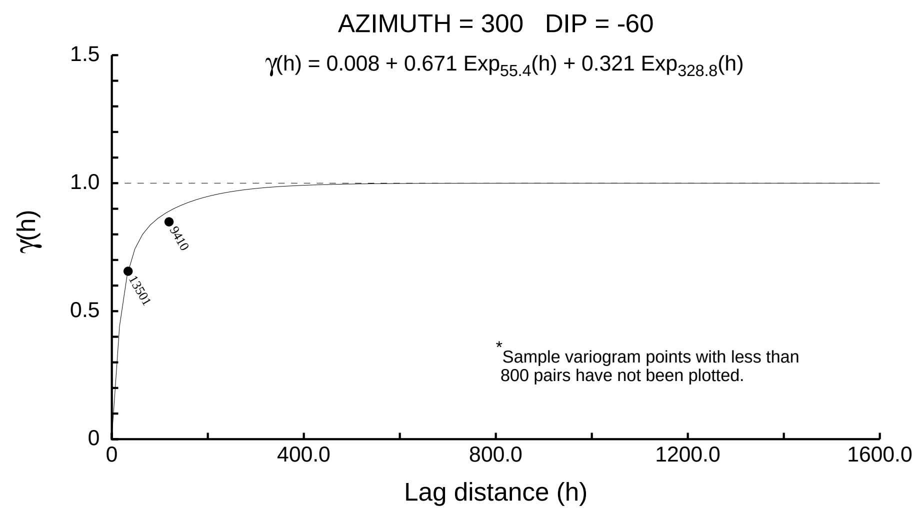
AZIMUTH = 240   DIP = -60

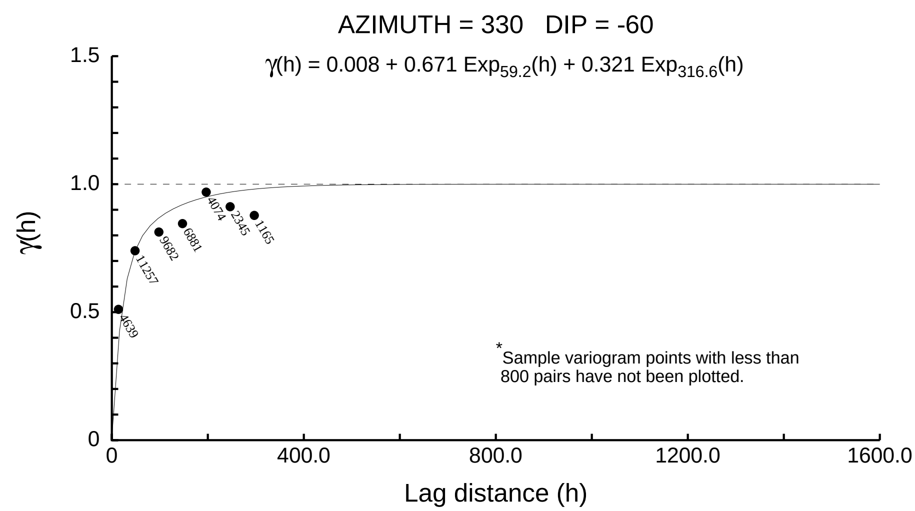
$\gamma(h) = 0.008 + 0.671\ Exp_{71.0}(h) + 0.321\ Exp_{452.1}(h)$



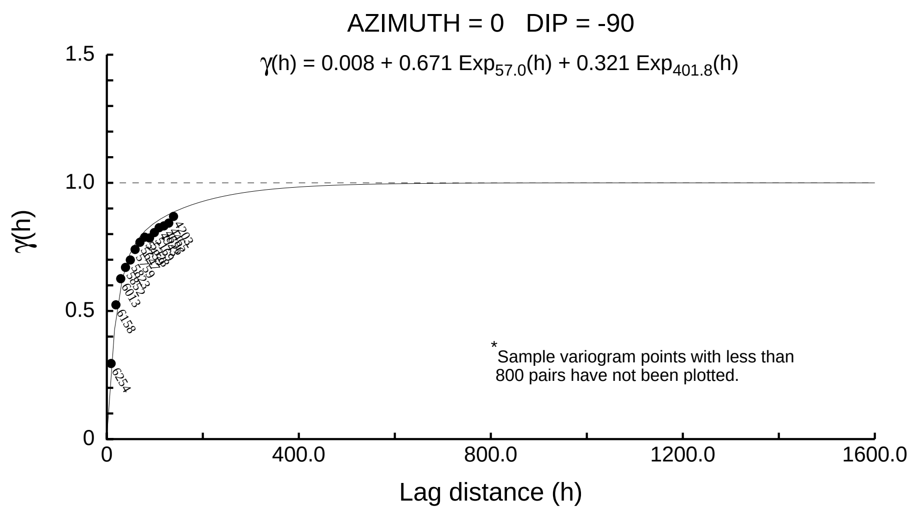
Downhole 1001 - Pd







Downhole 1001 - Pd



Downhole 1001 - Pt

User Defined Rotation Conventions

Nugget ==> 0.014
C1 ==> 0.745
C2 ==> 0.241

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -75
RH Rotation about the Y’ axis ==> 21
RH Rotation about the Z’ axis ==> 21

Range along the Z’ axis	==> 72.4	Azimuth ==> 165	Dip ==> 69
Range along the Y’ axis	==> 100.3	Azimuth ==> 55	Dip ==> 8
Range along the X’ axis	==> 19.6	Azimuth ==> 142	Dip ==> -20

Second Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -117
RH Rotation about the Y’ axis ==> -71
RH Rotation about the Z’ axis ==> 31

Range along the Z’ axis	==> 2685.0	Azimuth ==> 27	Dip ==> 19
Range along the Y’ axis	==> 1483.8	Azimuth ==> 106	Dip ==> -29
Range along the X’ axis	==> 324.8	Azimuth ==> 145	Dip ==> 54

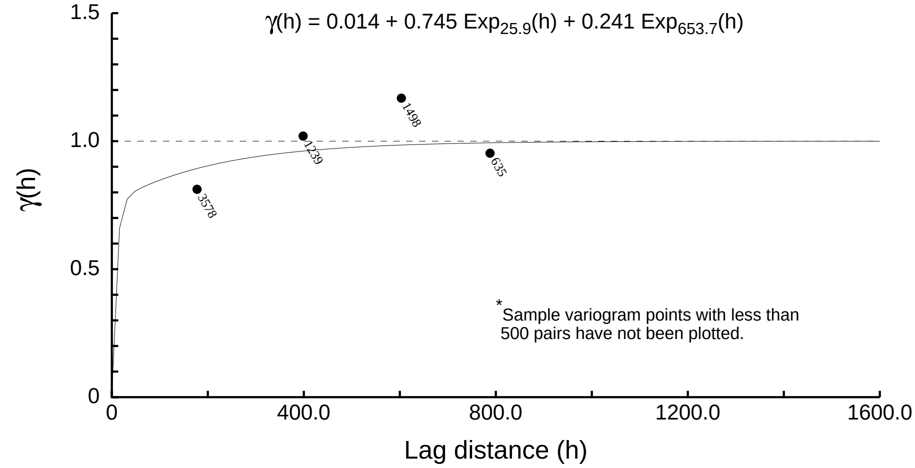
Modeling Criteria

Minimum number pairs req’d ==> 500
Sample variogram points weighted by # pairs

Downhole 1001 - Pt

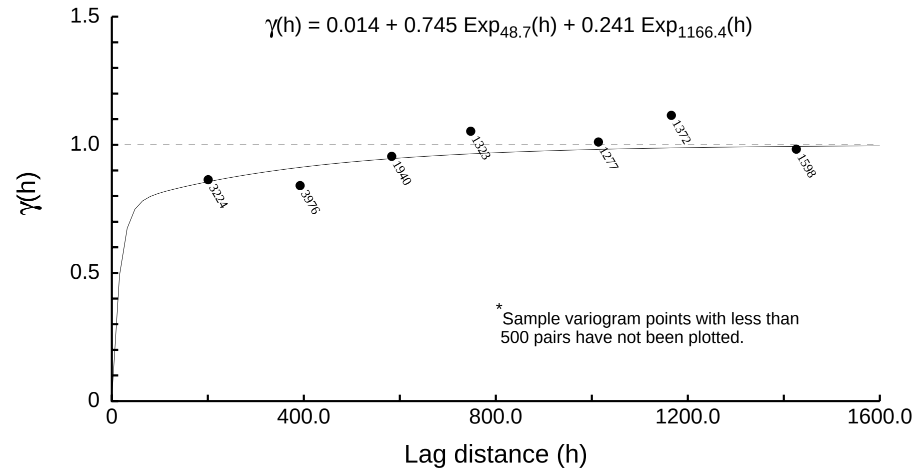
AZIMUTH = 0   DIP = 0

$\gamma(h) = 0.014 + 0.745\ Exp_{25.9}(h) + 0.241\ Exp_{653.7}(h)$



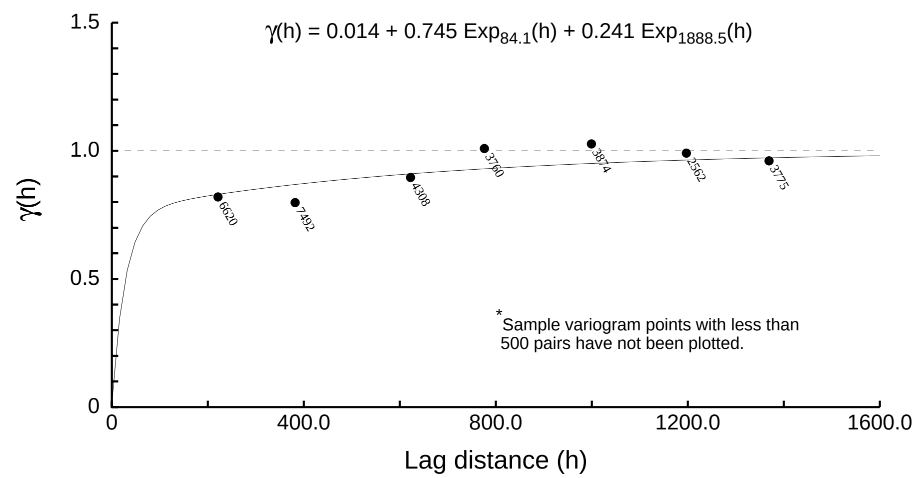
AZIMUTH = 30   DIP = 0

$\gamma(h) = 0.014 + 0.745\ Exp_{48.7}(h) + 0.241\ Exp_{1166.4}(h)$

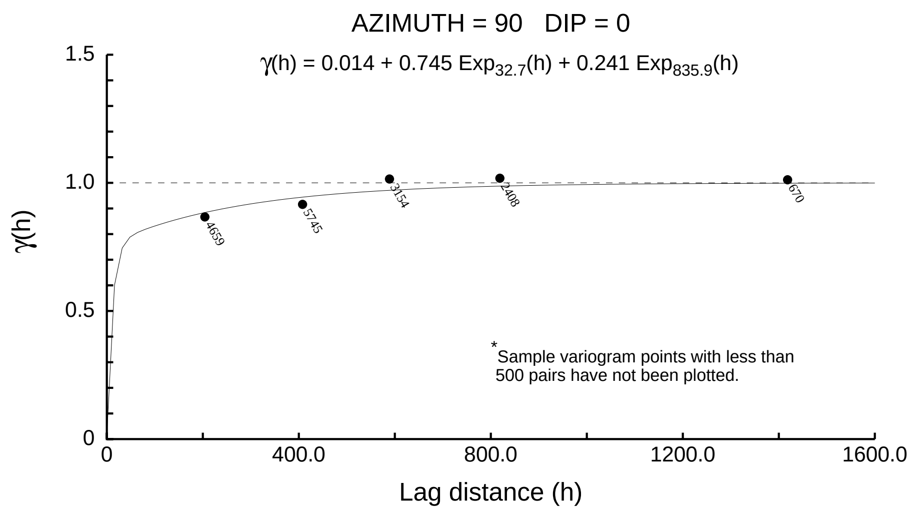


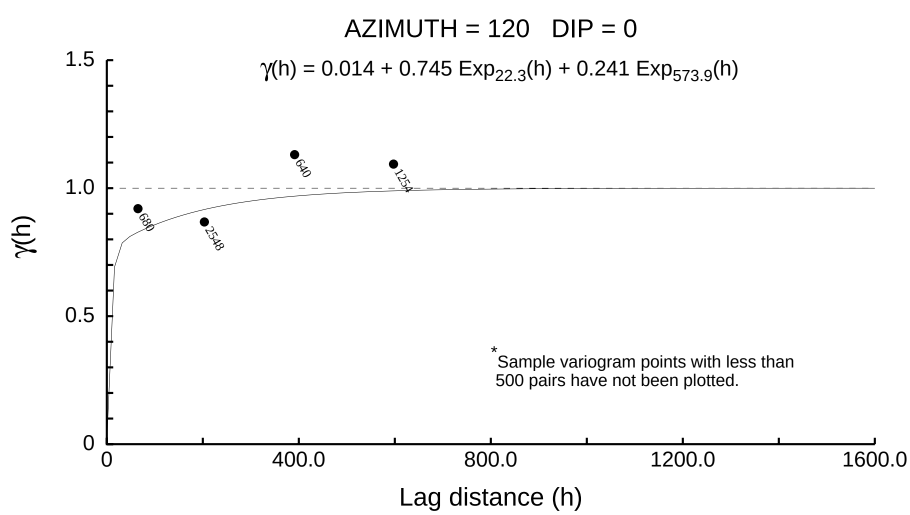
AZIMUTH = 60   DIP = 0

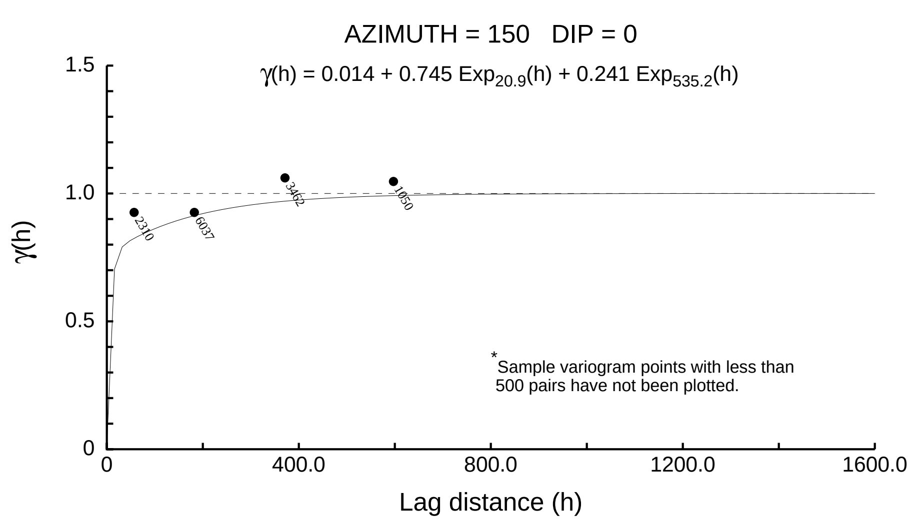
$\gamma(h) = 0.014 + 0.745\ Exp_{84.1}(h) + 0.241\ Exp_{1888.5}(h)$



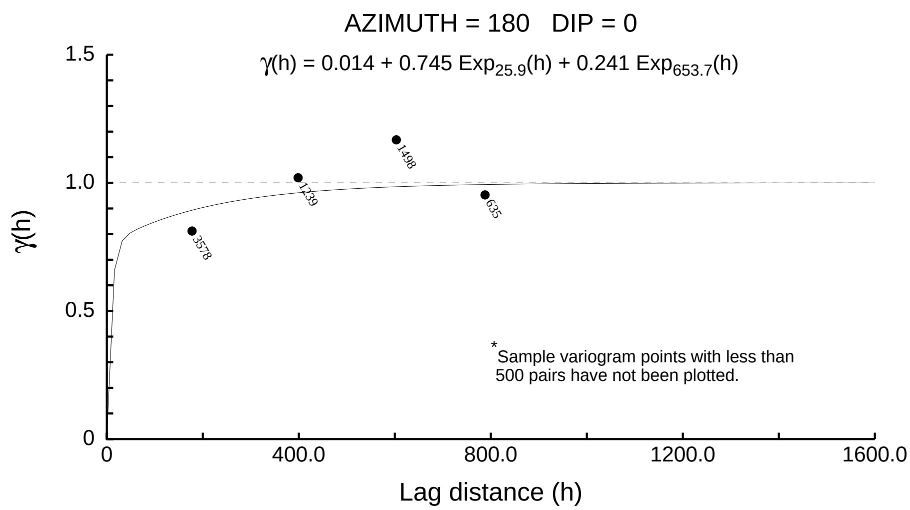
Downhole 1001 - Pt

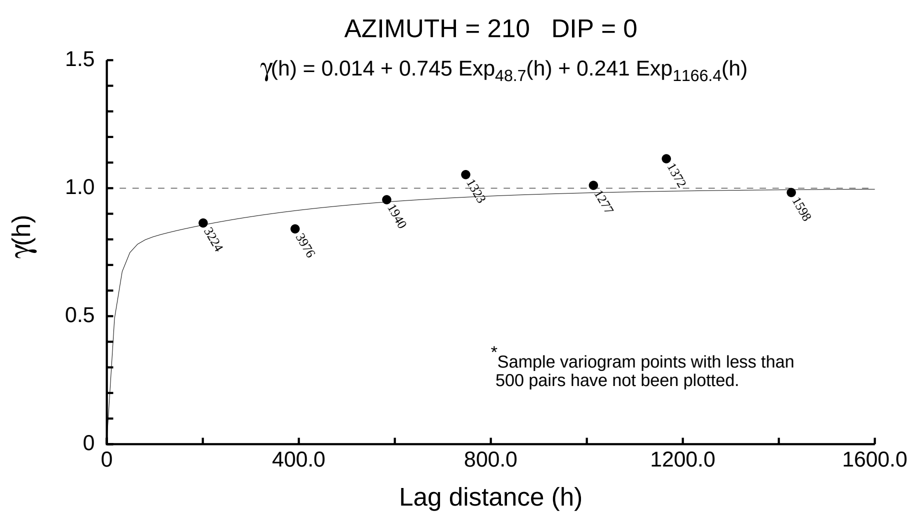


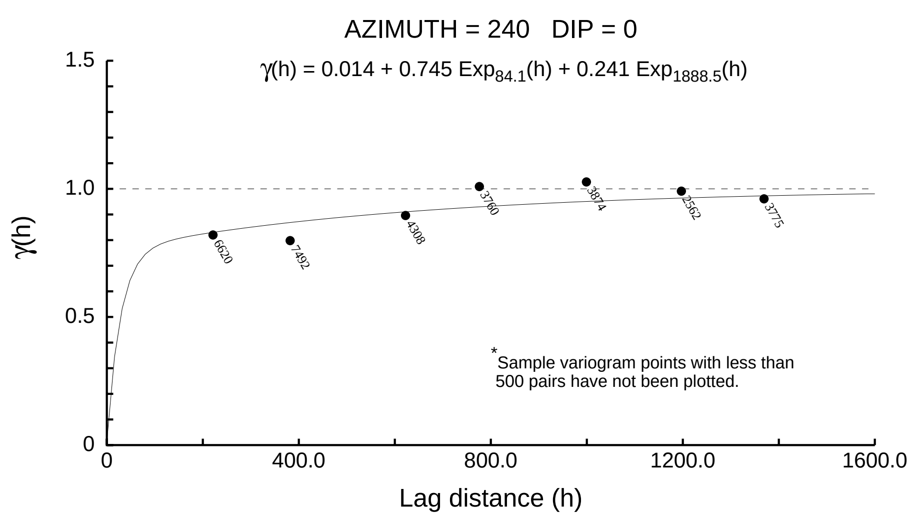




Downhole 1001 - Pt



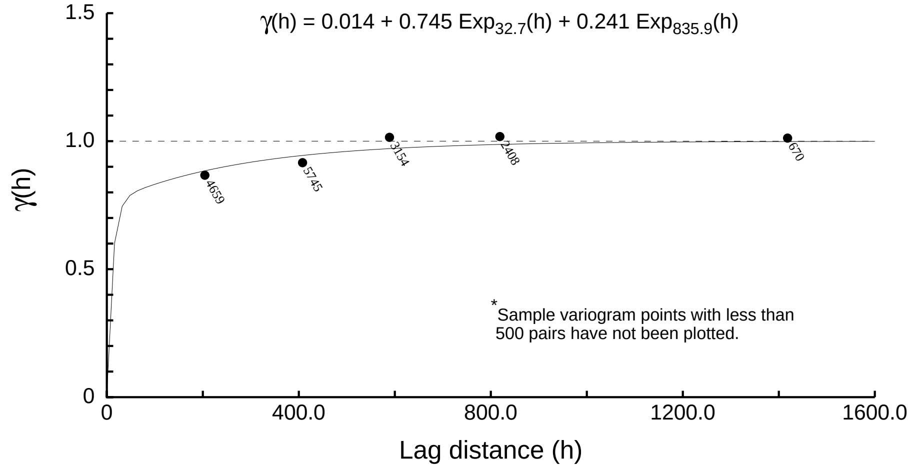




Downhole 1001 - Pt

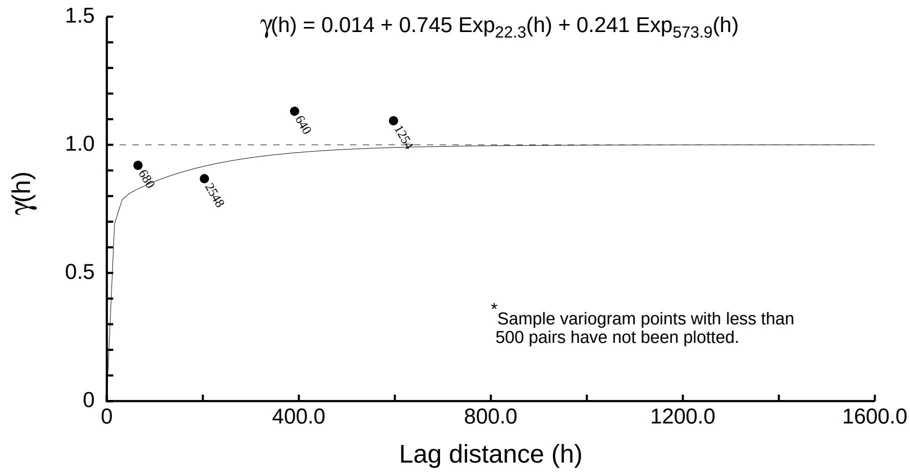
AZIMUTH = 270   DIP = 0

$\gamma(h) = 0.014 + 0.745\ \mathrm{Exp}_{32.7}(h) + 0.241\ \mathrm{Exp}_{835.9}(h)$



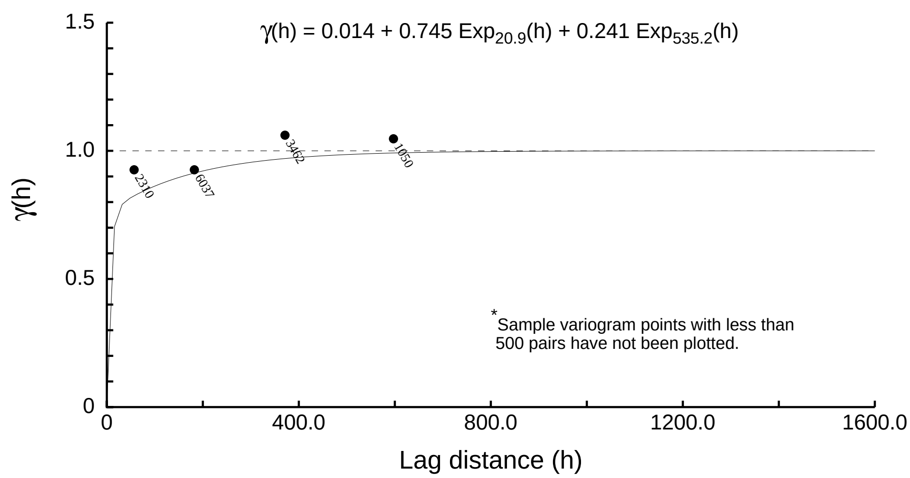
AZIMUTH = 300   DIP = 0

$\gamma(h) = 0.014 + 0.745\ \mathrm{Exp}_{22.3}(h) + 0.241\ \mathrm{Exp}_{573.9}(h)$

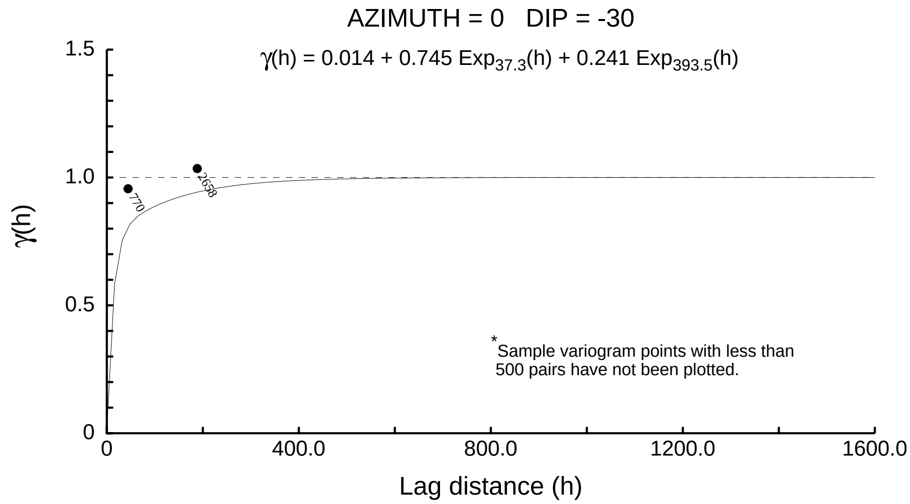


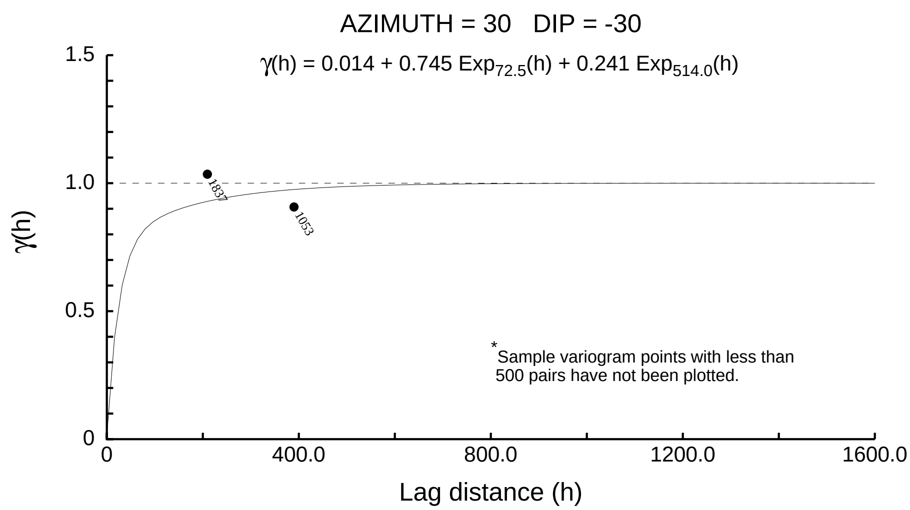
AZIMUTH = 330   DIP = 0

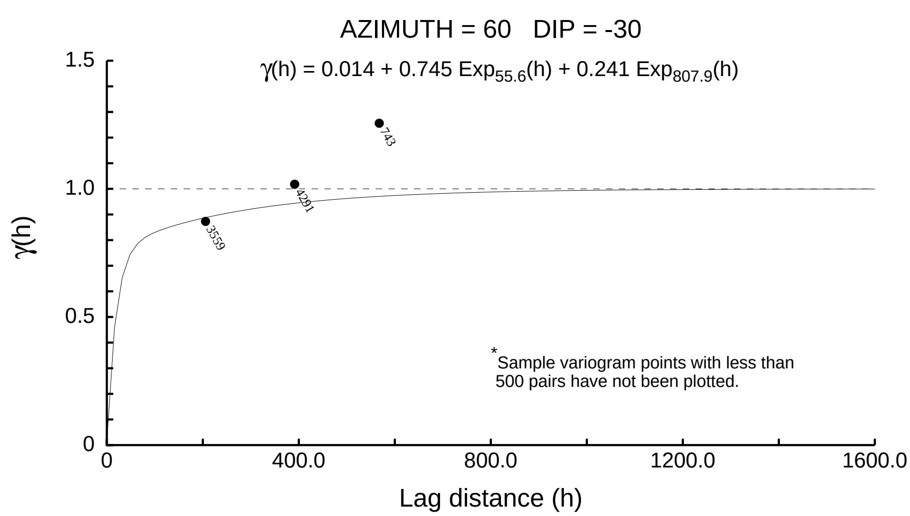
$\gamma(h) = 0.014 + 0.745\ \mathrm{Exp}_{20.9}(h) + 0.241\ \mathrm{Exp}_{535.2}(h)$



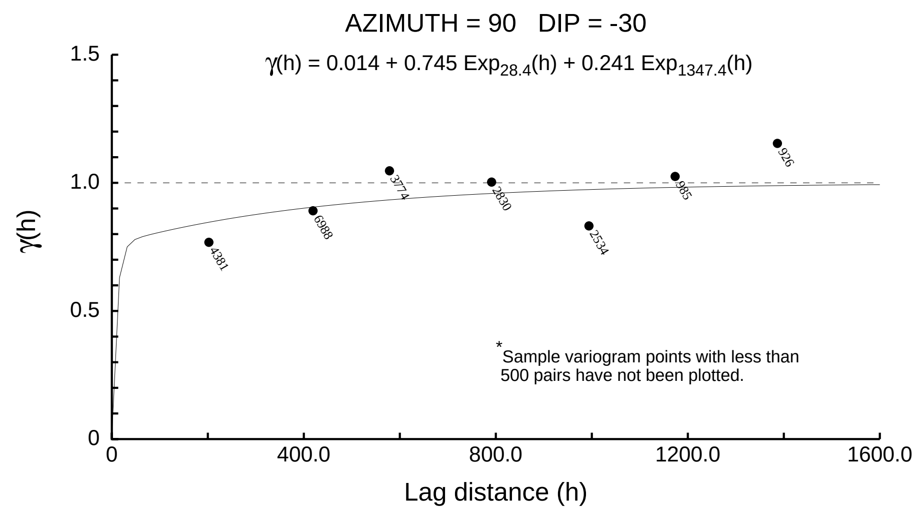
Downhole 1001 - Pt

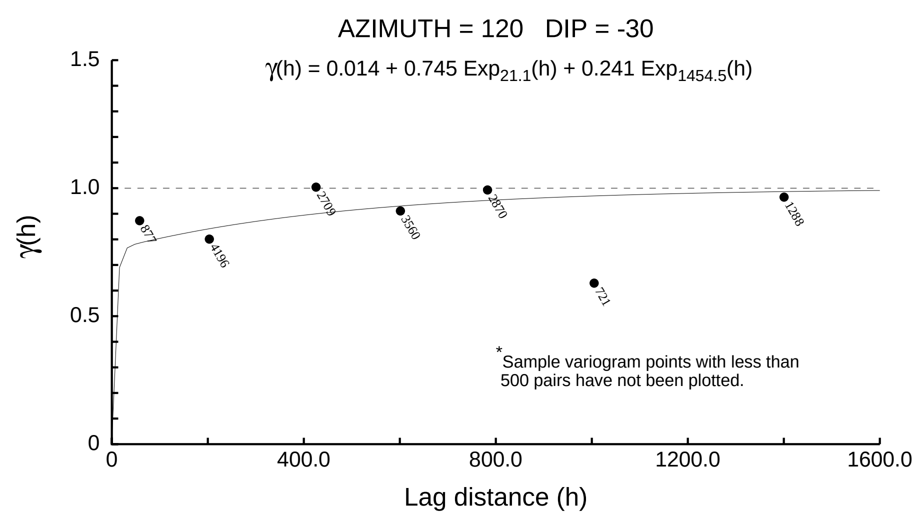


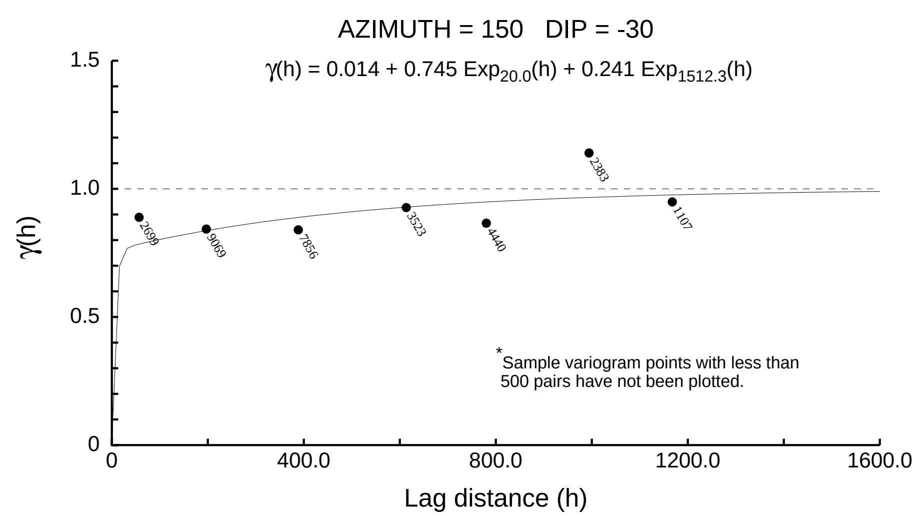




Downhole 1001 - Pt







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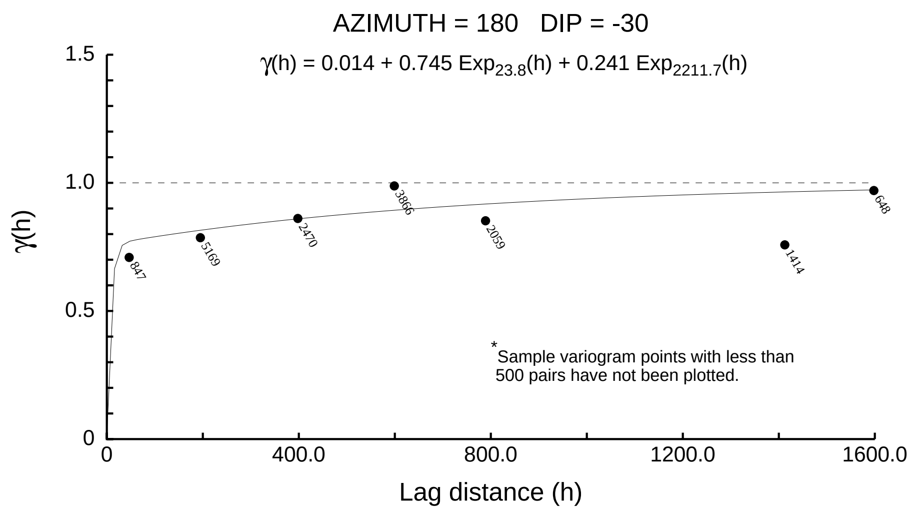

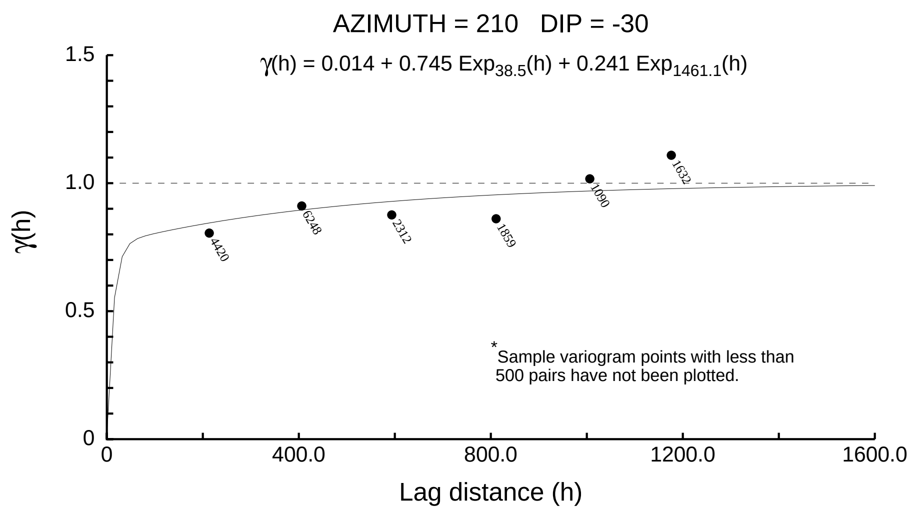

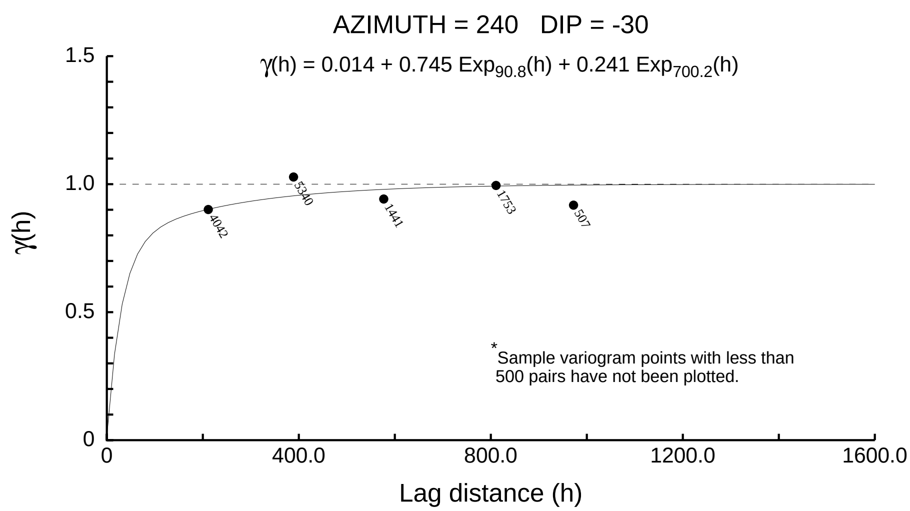

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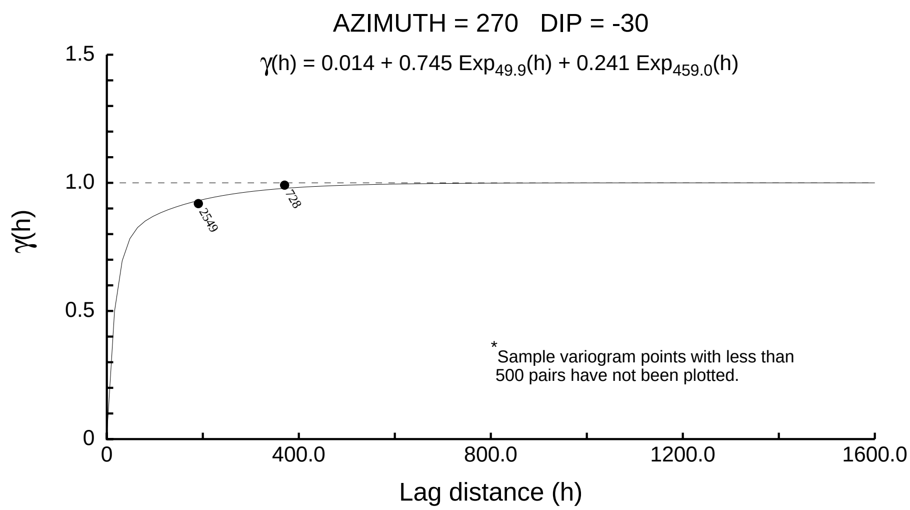

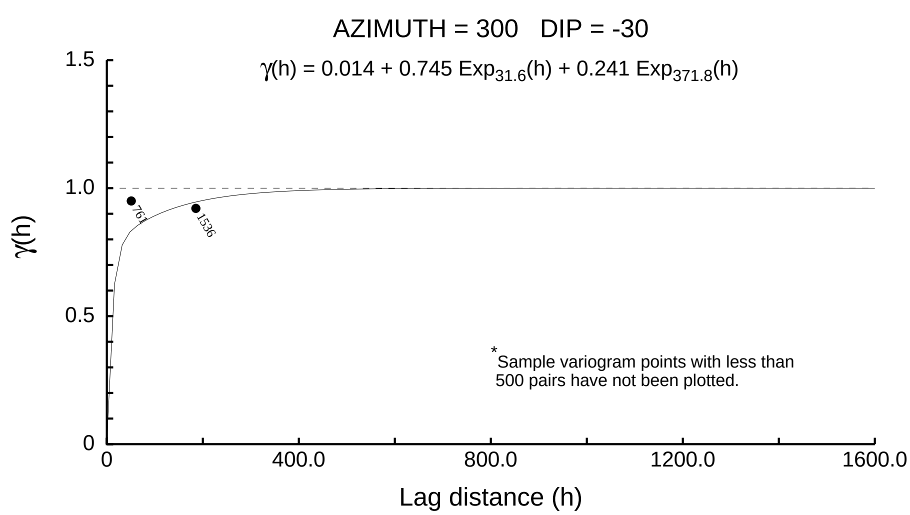

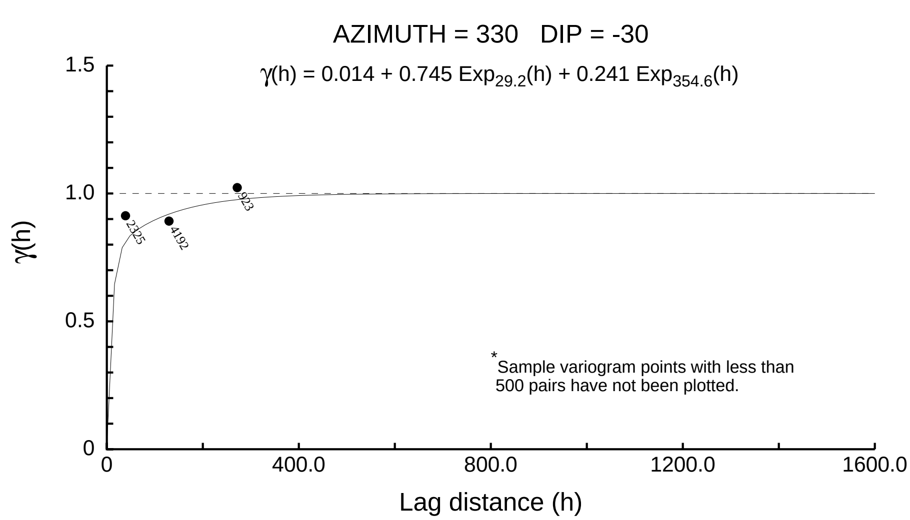

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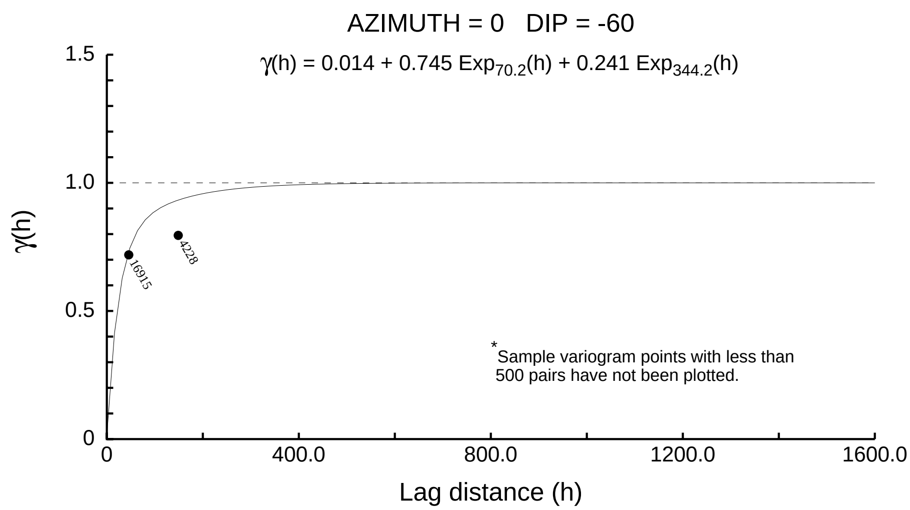

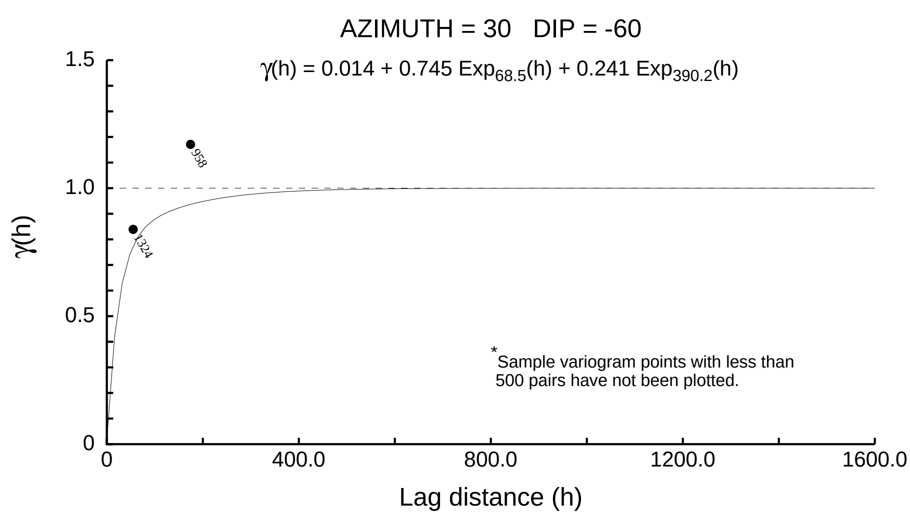

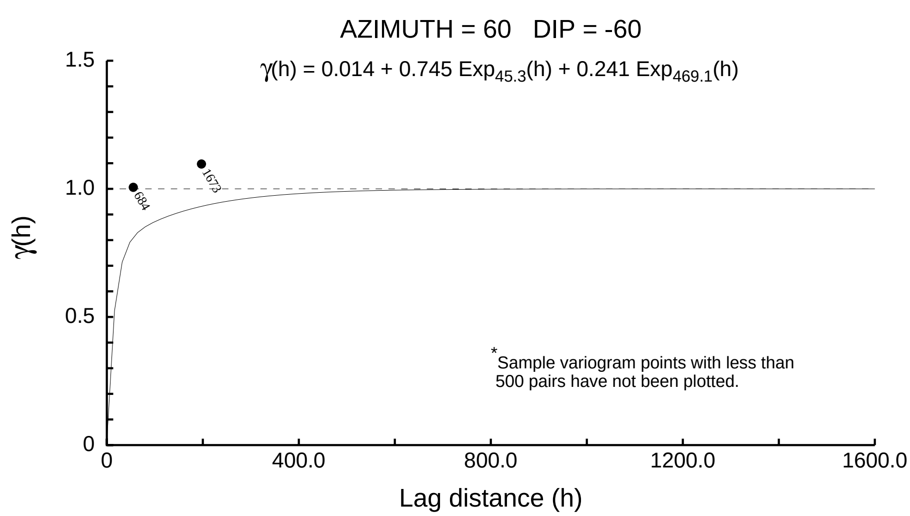

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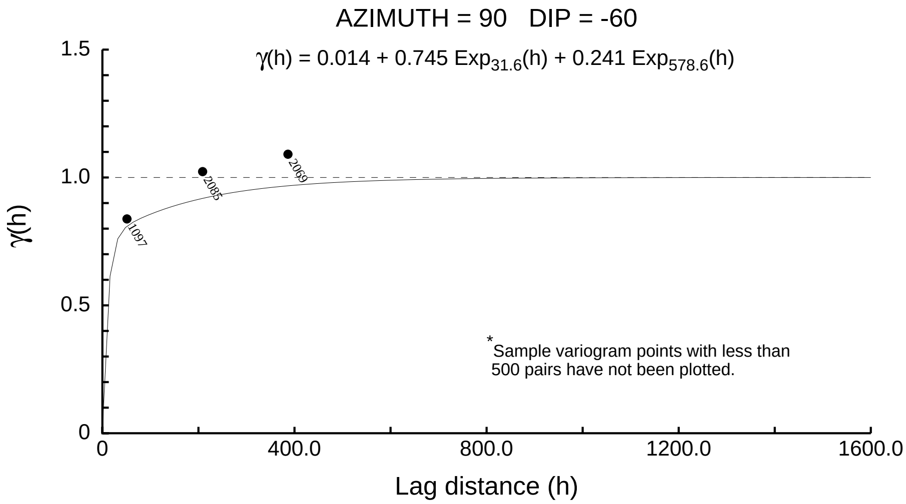

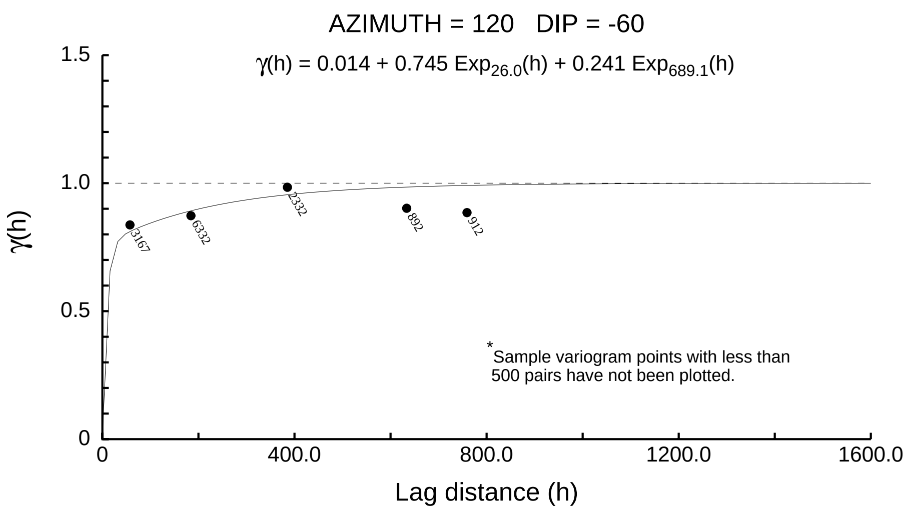

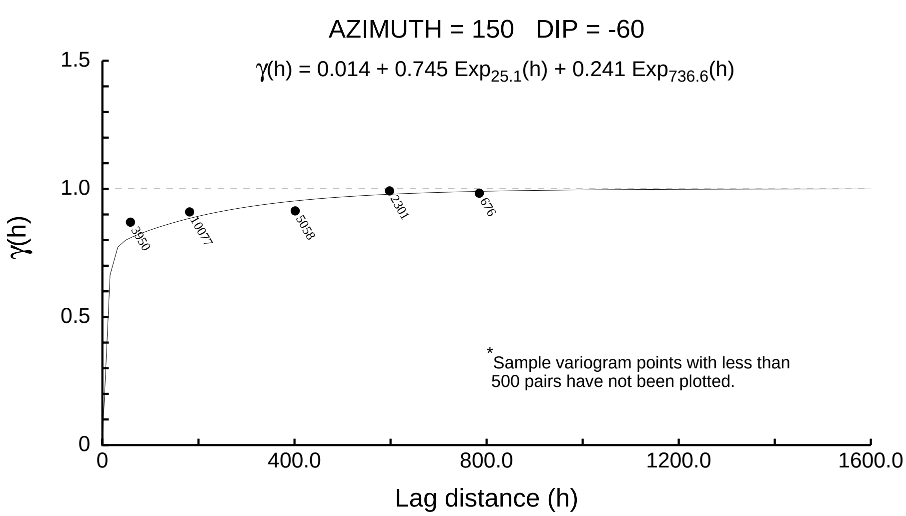

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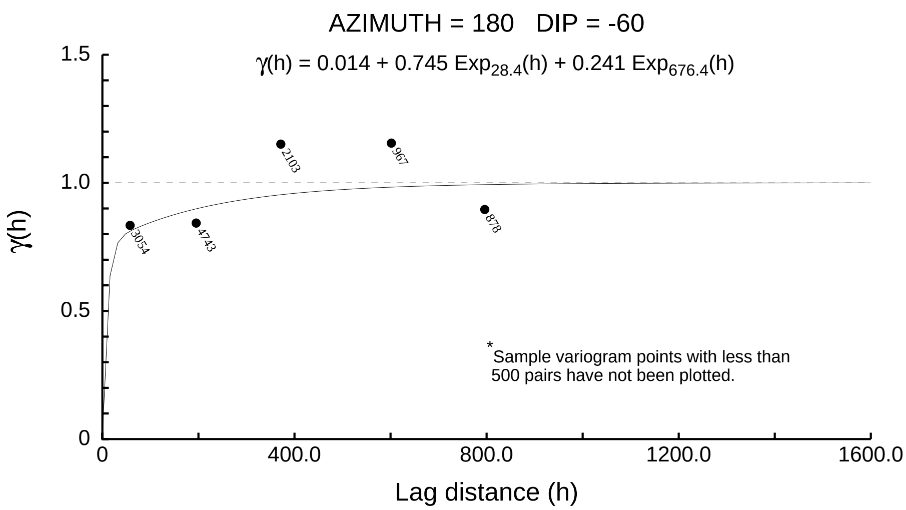
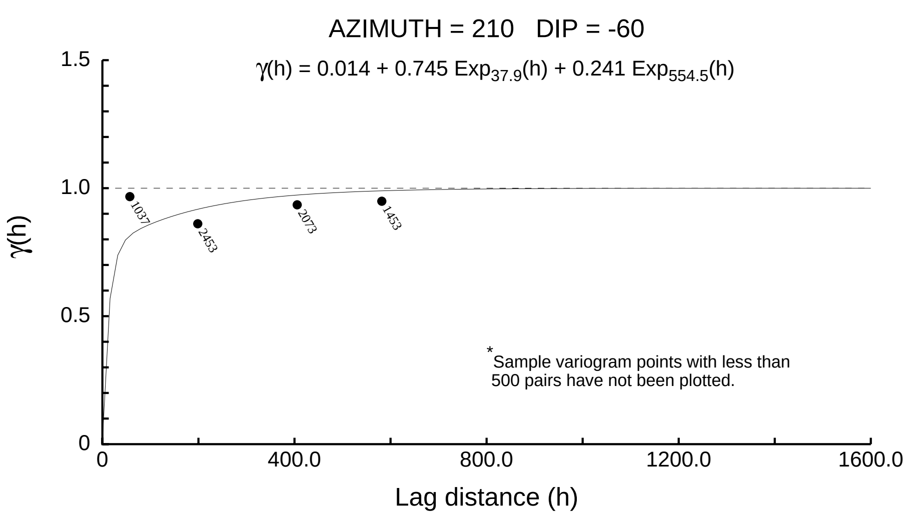
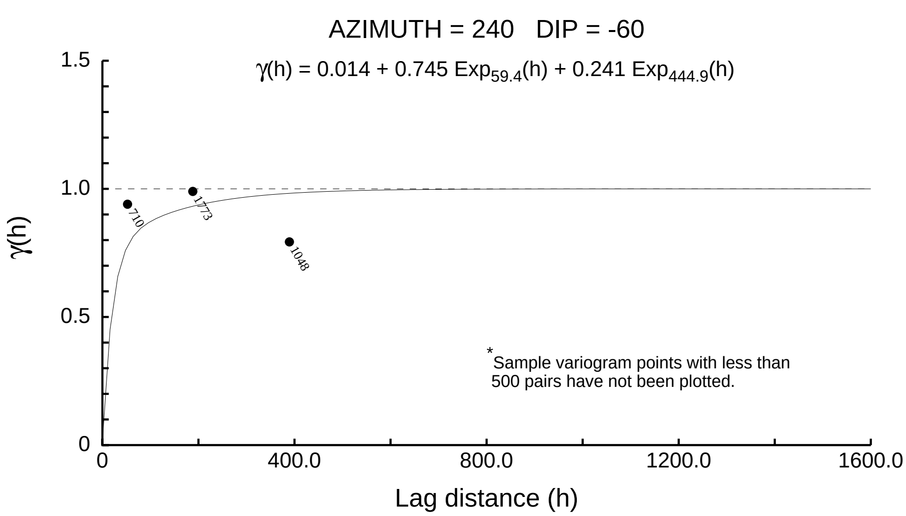
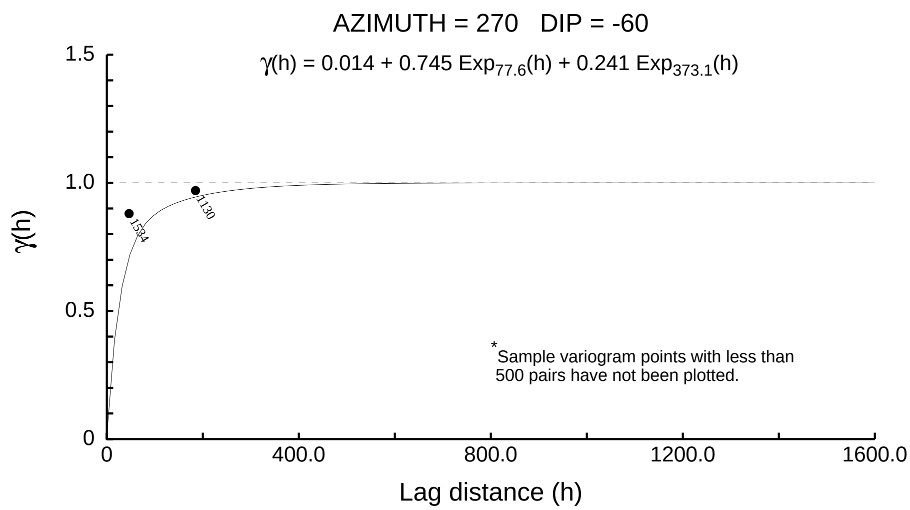


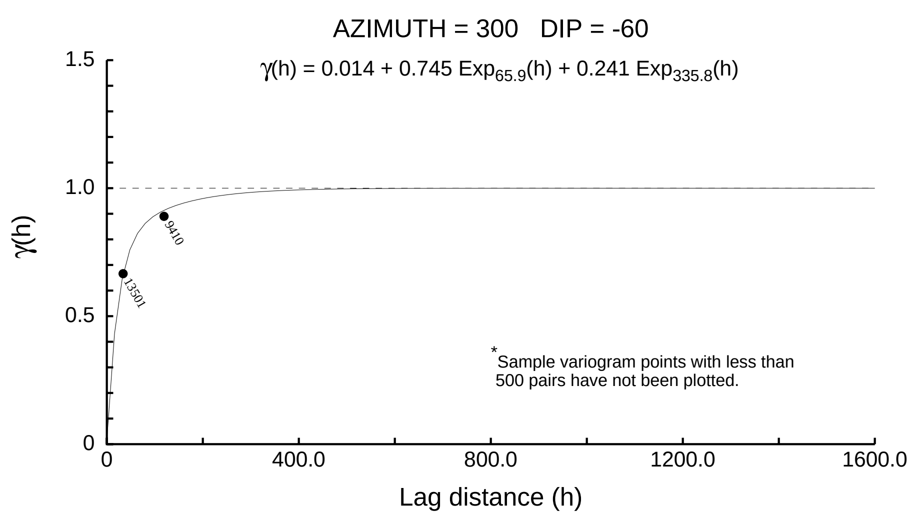


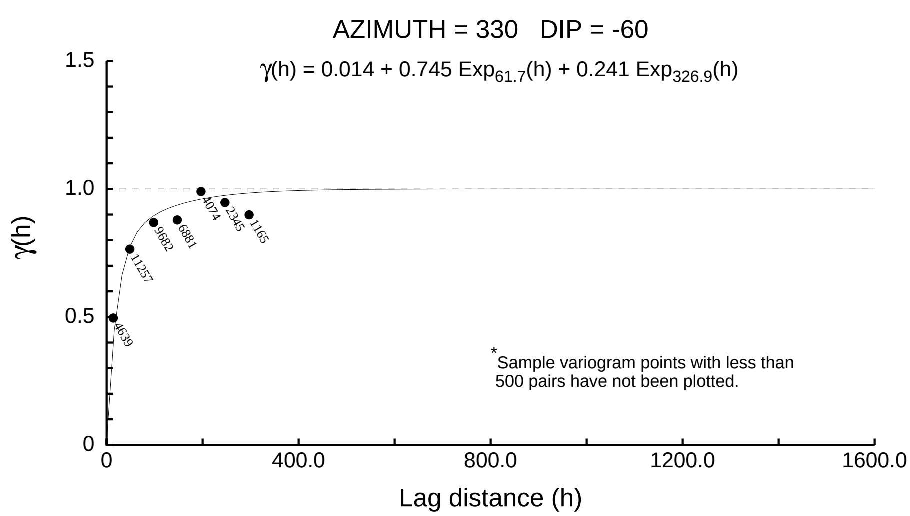


Isaaks & Co.
Consultants in Spatial Statistics

Downhole 1001 - Pt

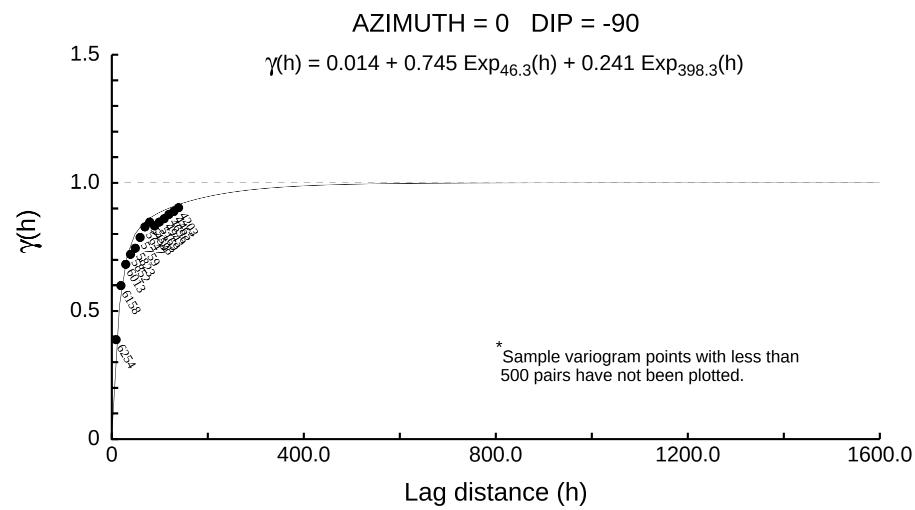






Isaaks & Co.
Consultants in Spatial Statistics

Downhole 1001 - Pt



Downhole 1001 - S

User Defined Rotation Conventions

Nugget ==> 0.015
C1 ==> 0.558
C2 ==> 0.427

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -59
RH Rotation about the Y’ axis ==> -56
RH Rotation about the Z’ axis ==> 9

Range along the Z’ axis	==> 26.4	Azimuth ==> 329	Dip ==> 34
Range along the Y’ axis	==> 471.4	Azimuth ==> 54	Dip ==> -7
Range along the X’ axis	==> 58.2	Azimuth ==> 134	Dip ==> 55

Second Structure -- Exponential with Practical Range

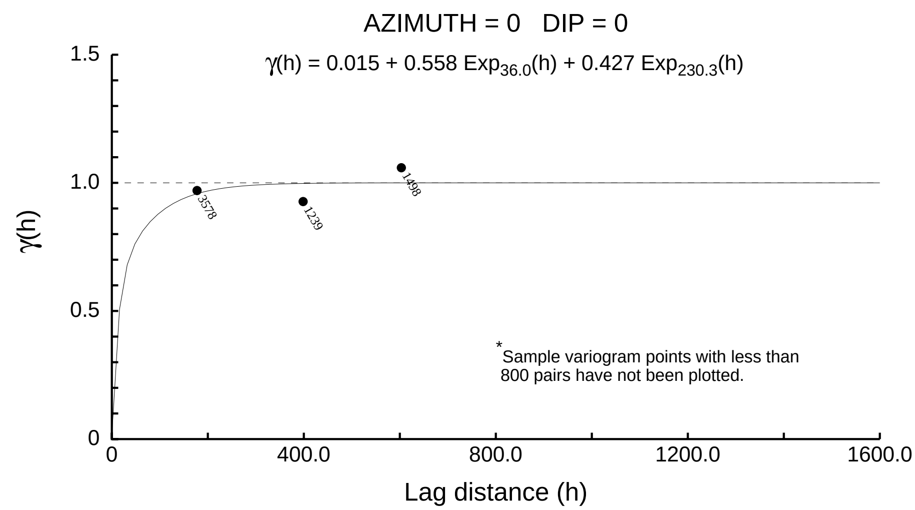
RH Rotation about the Z axis ==> -67
RH Rotation about the Y’ axis ==> 52
RH Rotation about the Z’ axis ==> 51

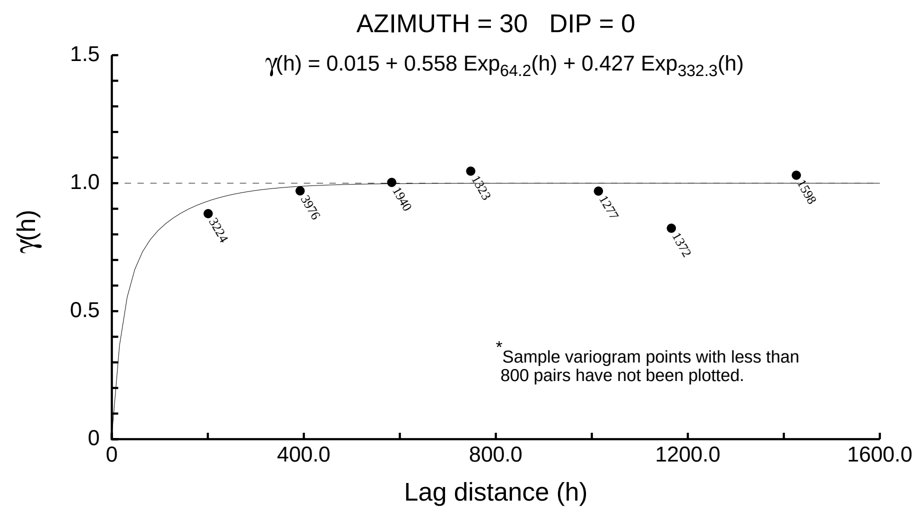
Range along the Z’ axis	==> 168.7	Azimuth ==> 157	Dip ==> 38
Range along the Y’ axis	==> 1071.9	Azimuth ==> 30	Dip ==> 38
Range along the X’ axis	==> 486.9	Azimuth ==> 94	Dip ==> -30

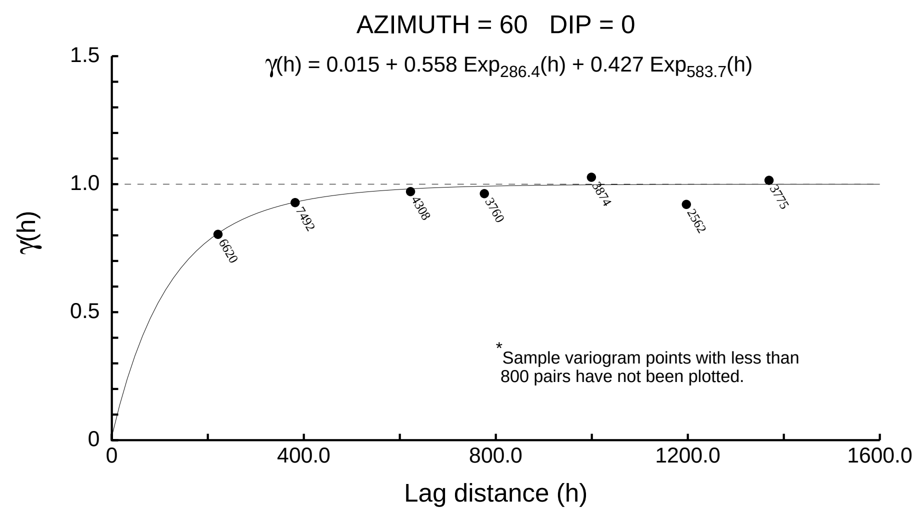
Modeling Criteria

Minimum number pairs req’d ==> 800
Sample variogram points weighted by # pairs

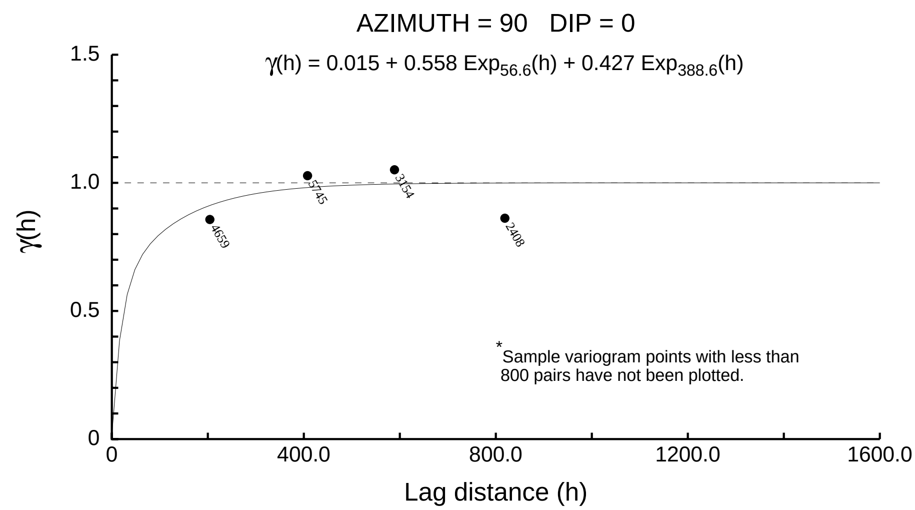
Downhole 1001 - S

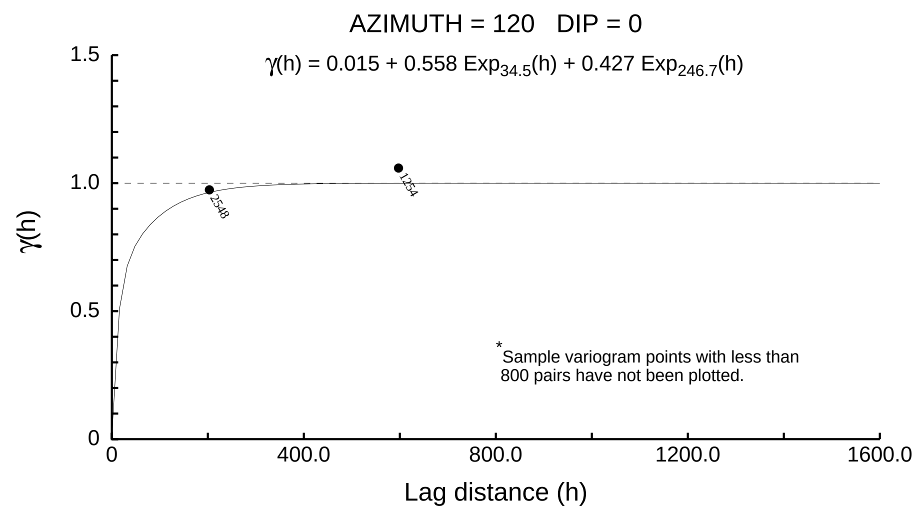


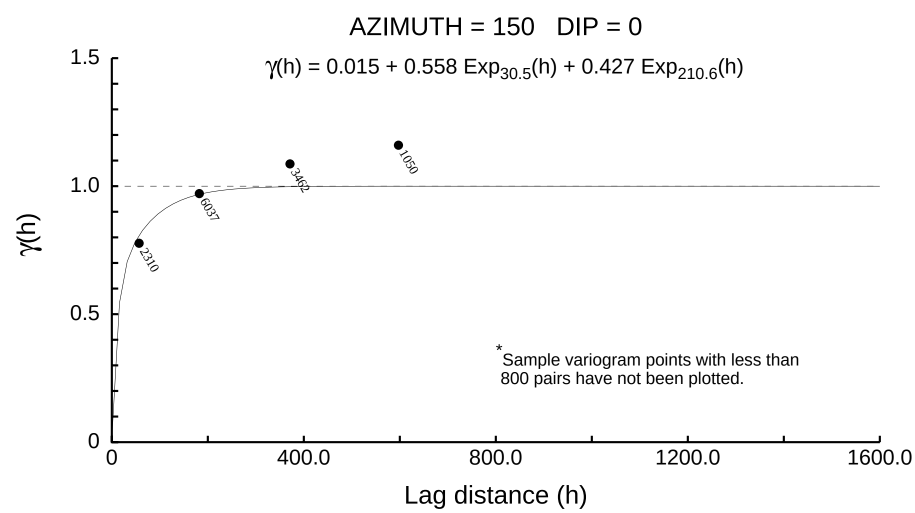




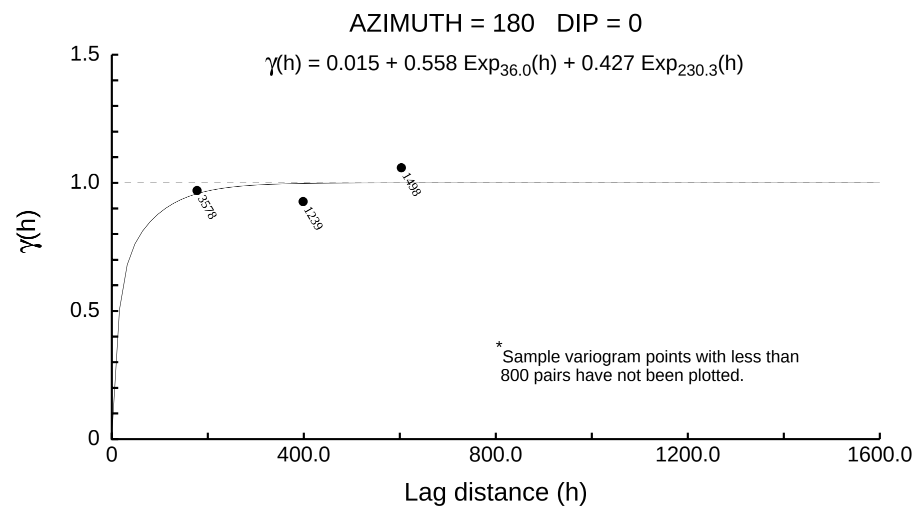
Downhole 1001 - S

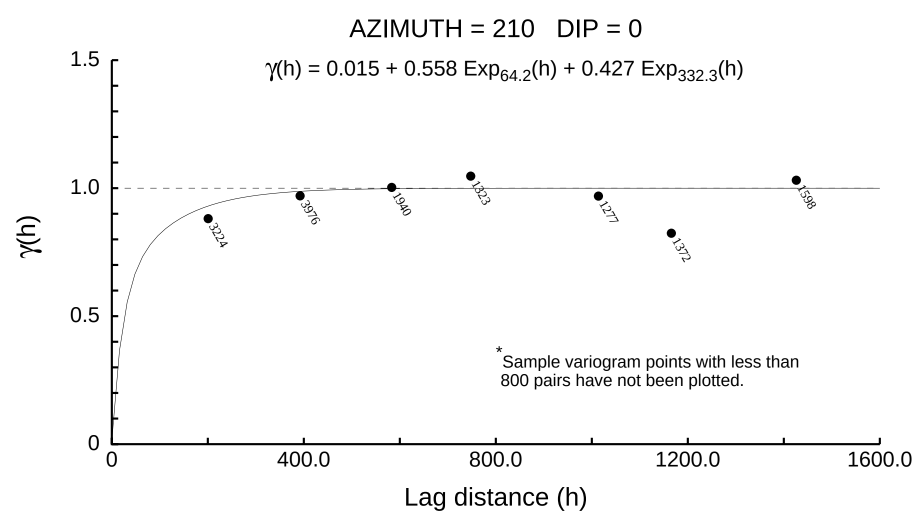


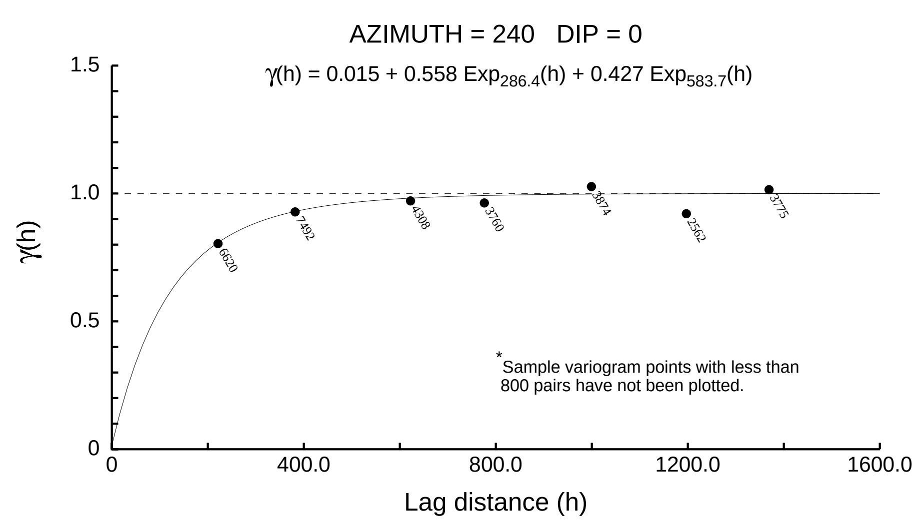




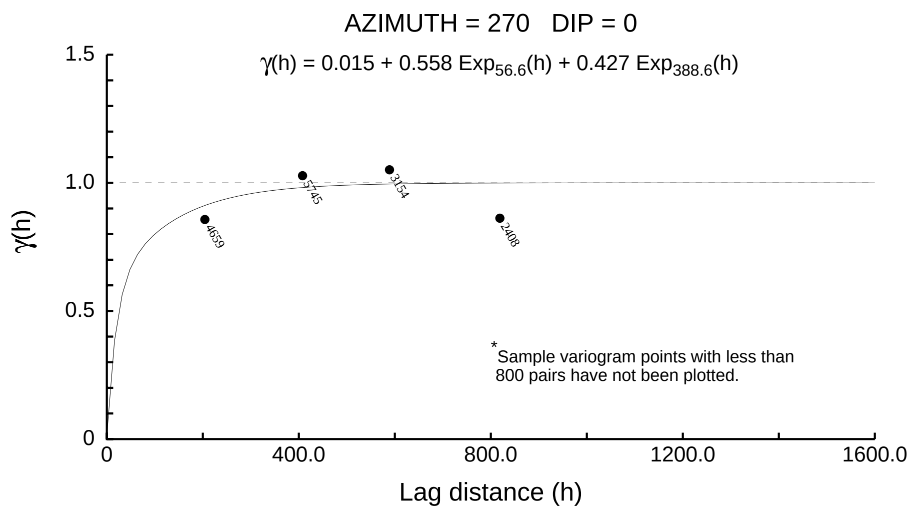
Downhole 1001 - S

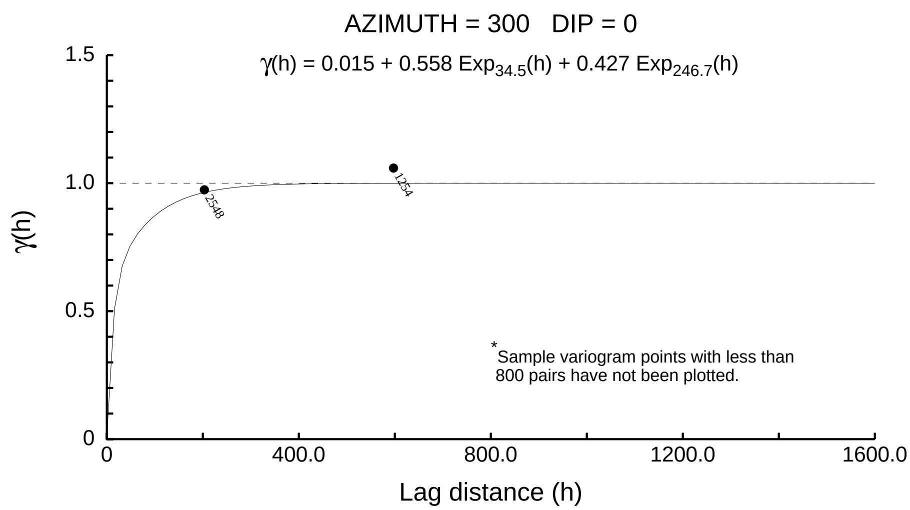


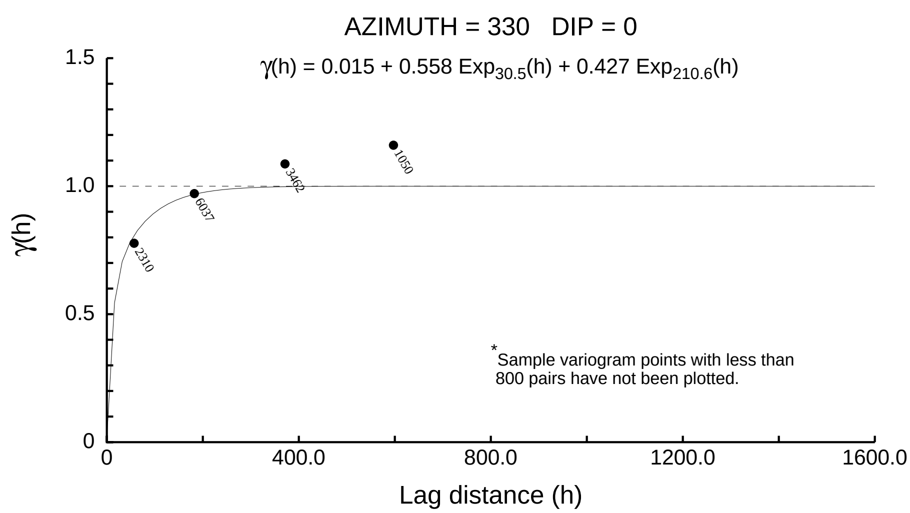




Downhole 1001 - S



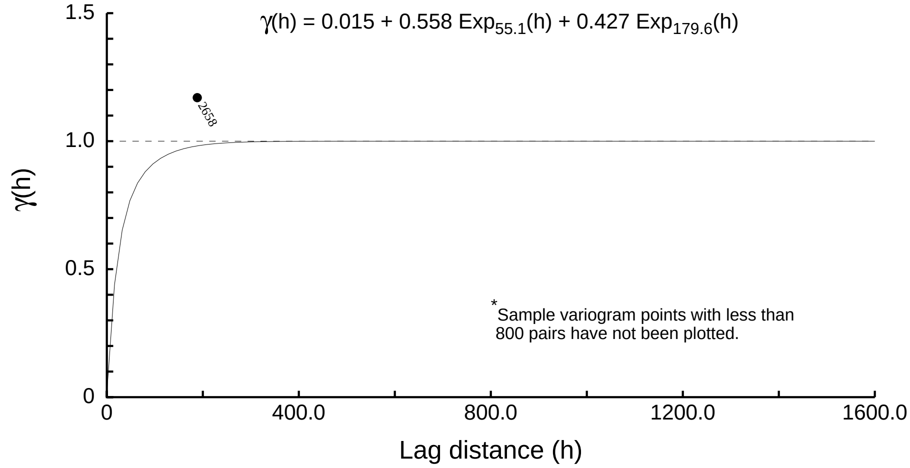




Downhole 1001 - S

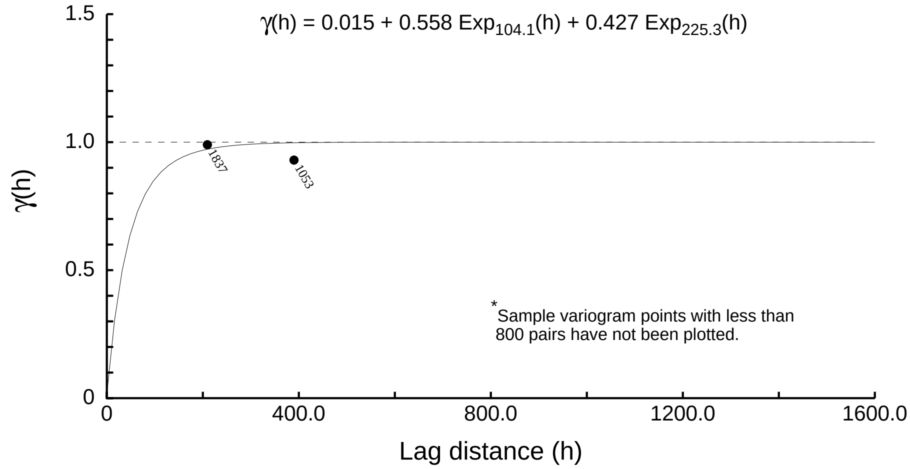
AZIMUTH = 0   DIP = -30

$\gamma(h) = 0.015 + 0.558\ Exp_{55.1}(h) + 0.427\ Exp_{179.6}(h)$



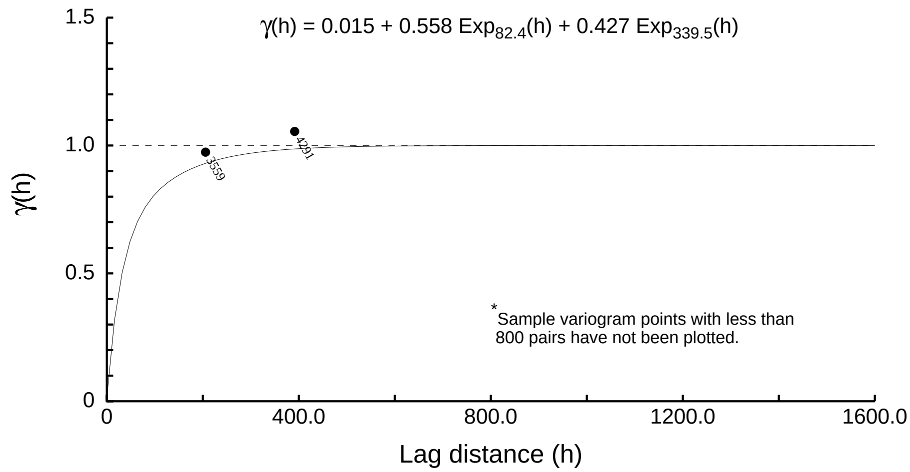
AZIMUTH = 30   DIP = -30

$\gamma(h) = 0.015 + 0.558\ Exp_{104.1}(h) + 0.427\ Exp_{225.3}(h)$



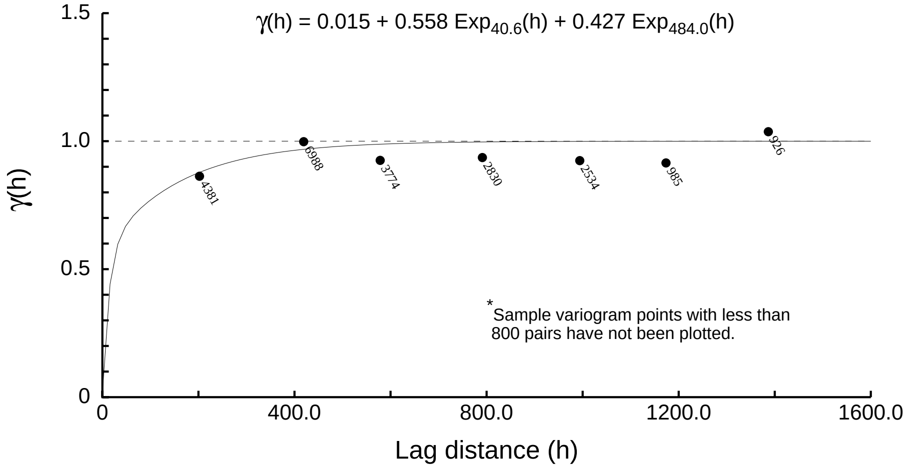
AZIMUTH = 60   DIP = -30

$\gamma(h) = 0.015 + 0.558\ Exp_{82.4}(h) + 0.427\ Exp_{339.5}(h)$

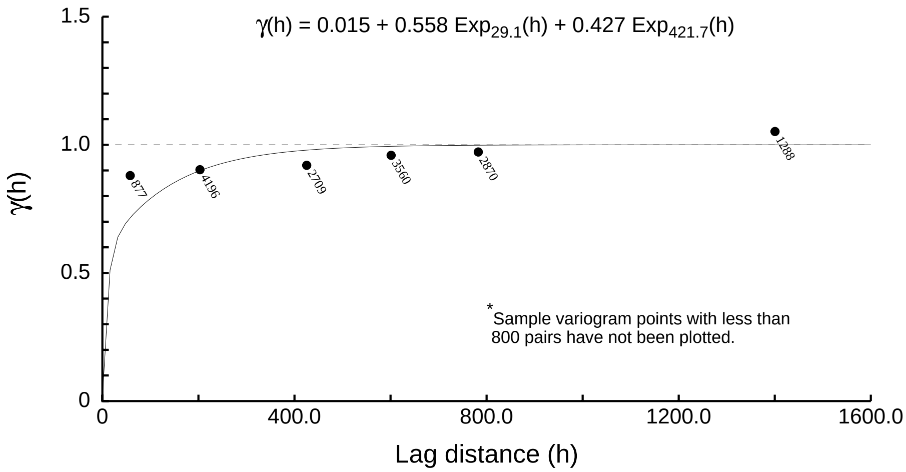


Downhole 1001 - S

AZIMUTH = 90   DIP = -30



AZIMUTH = 120   DIP = -30



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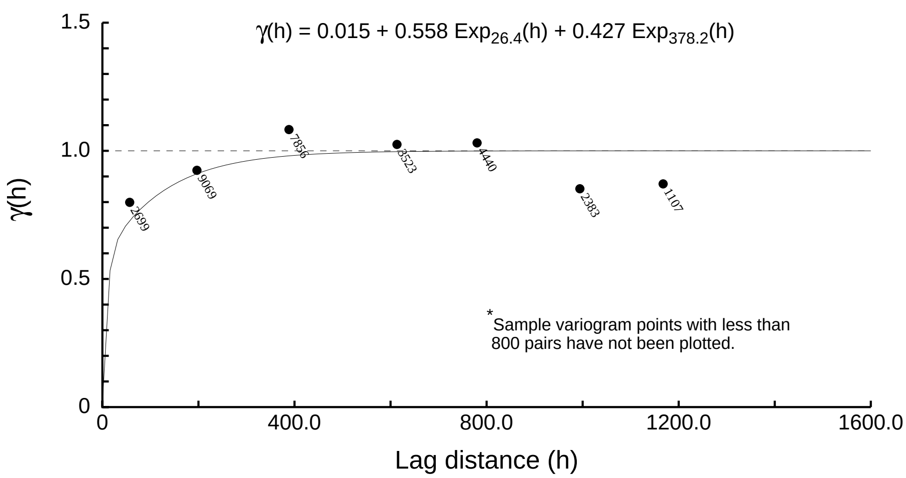
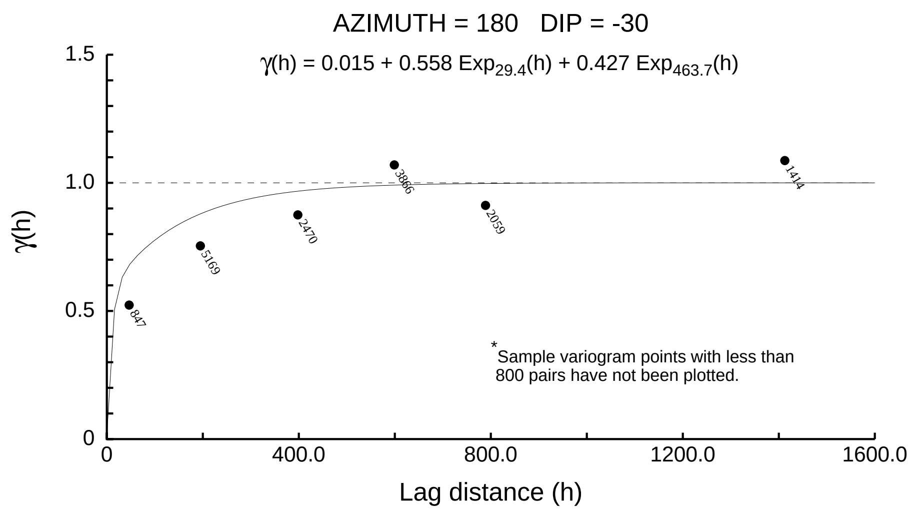
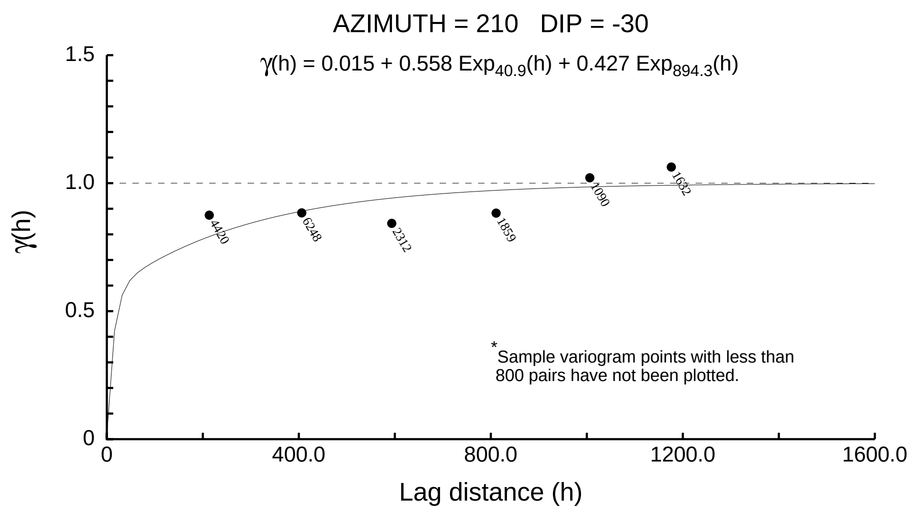
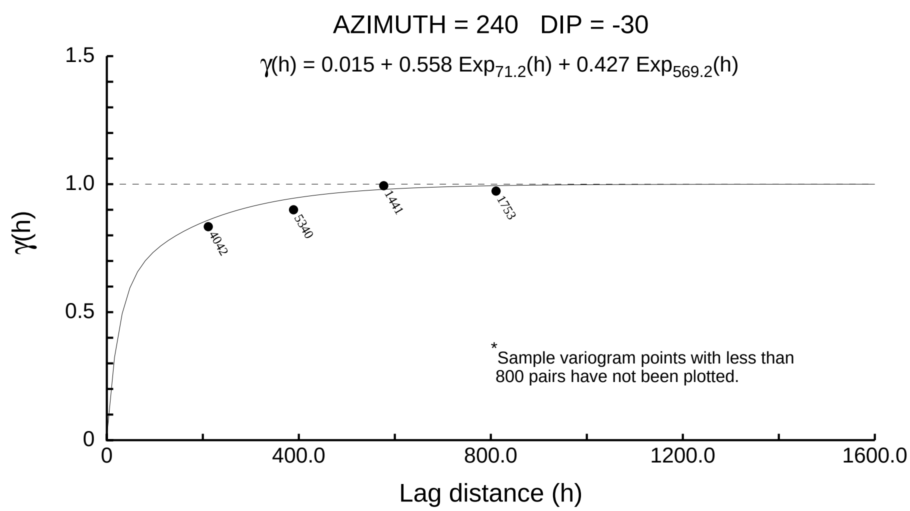


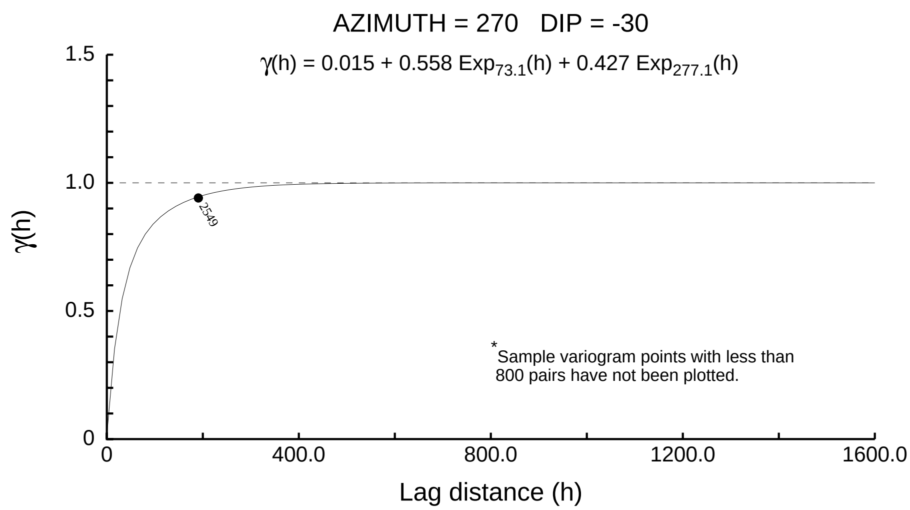
Downhole 1001 - S

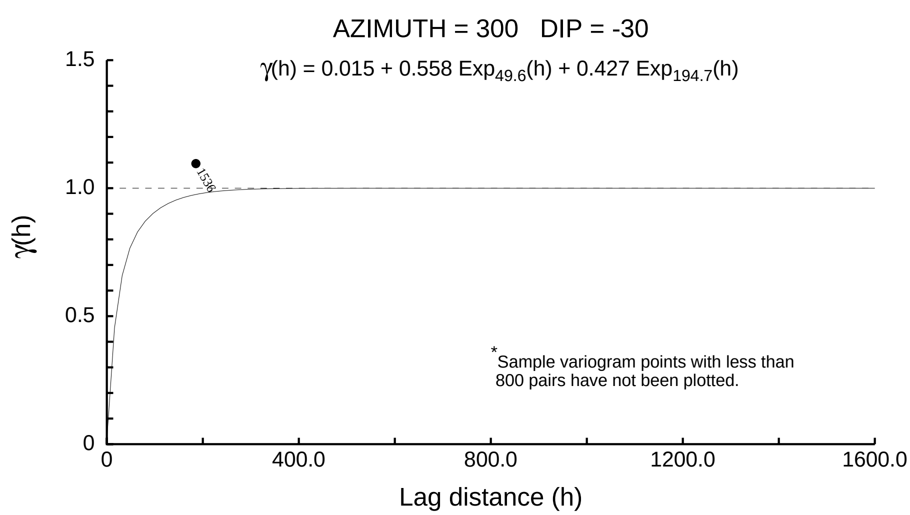


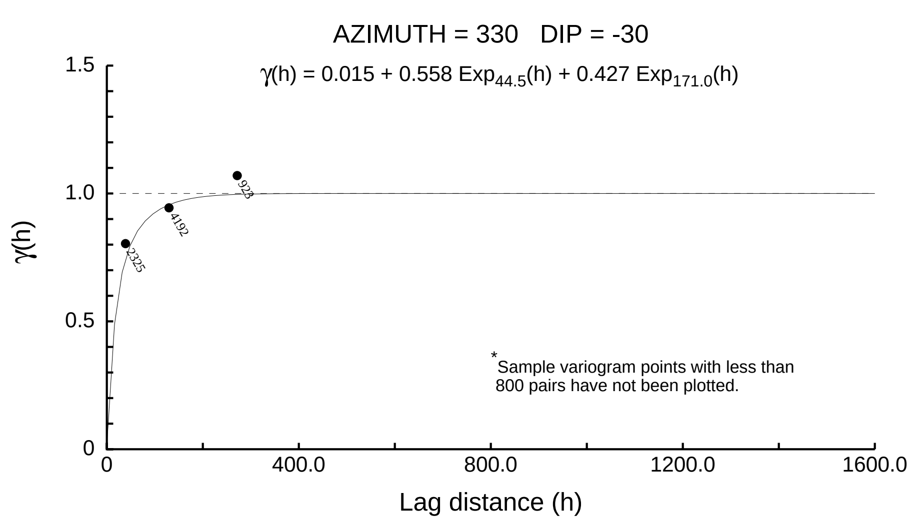




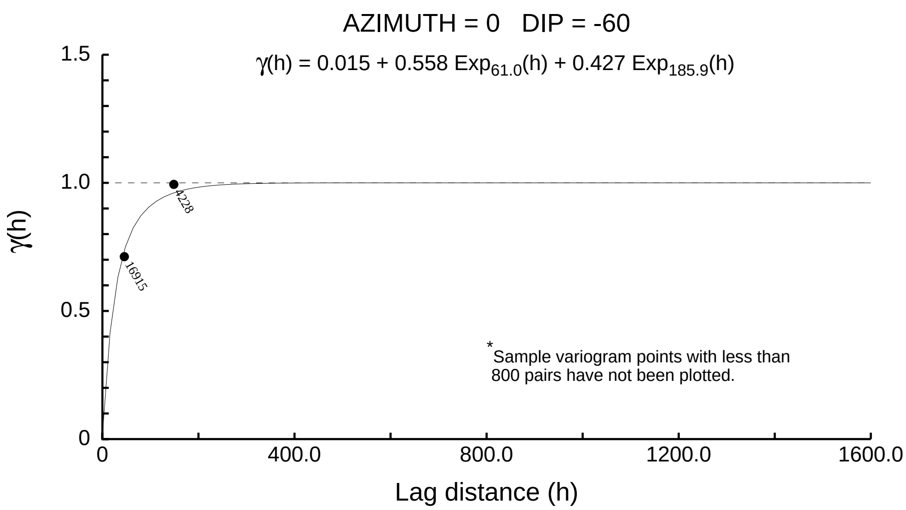
Downhole 1001 - S

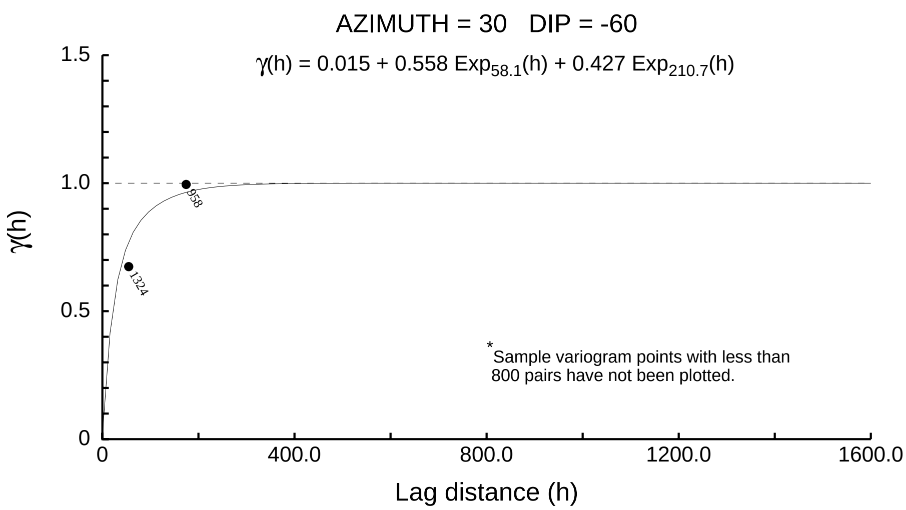


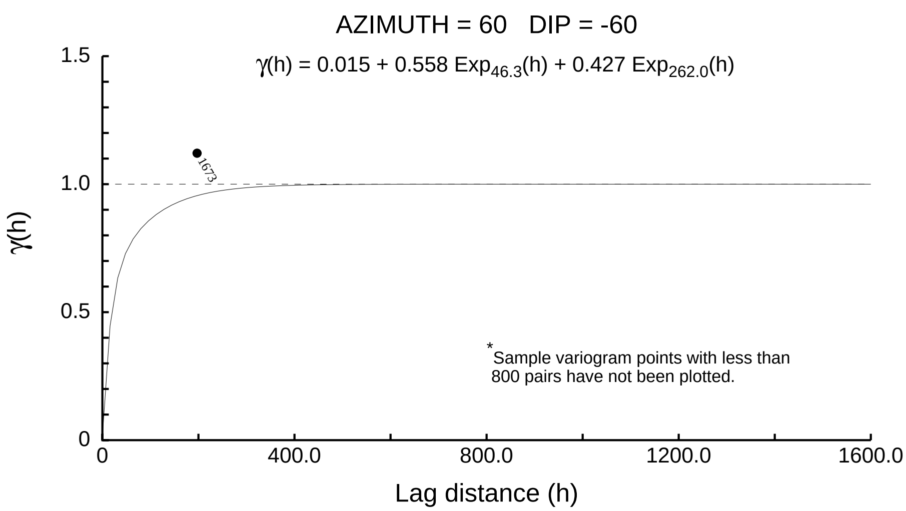




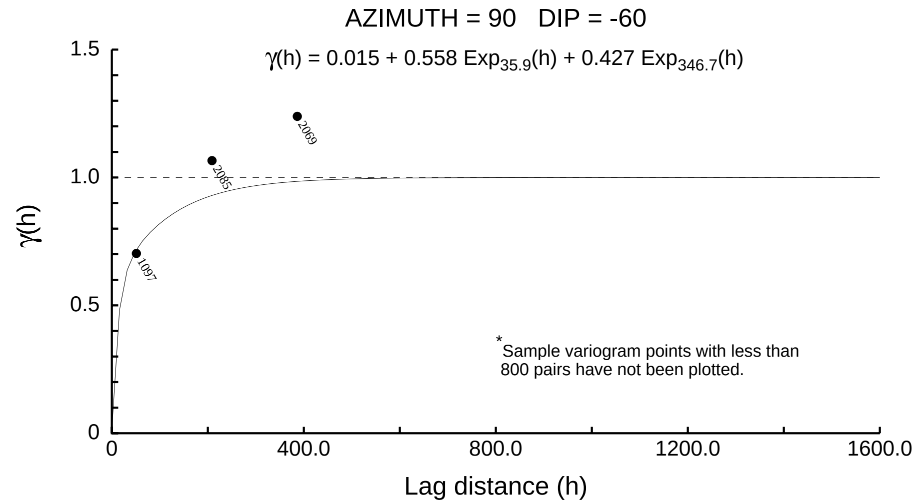
Downhole 1001 - S

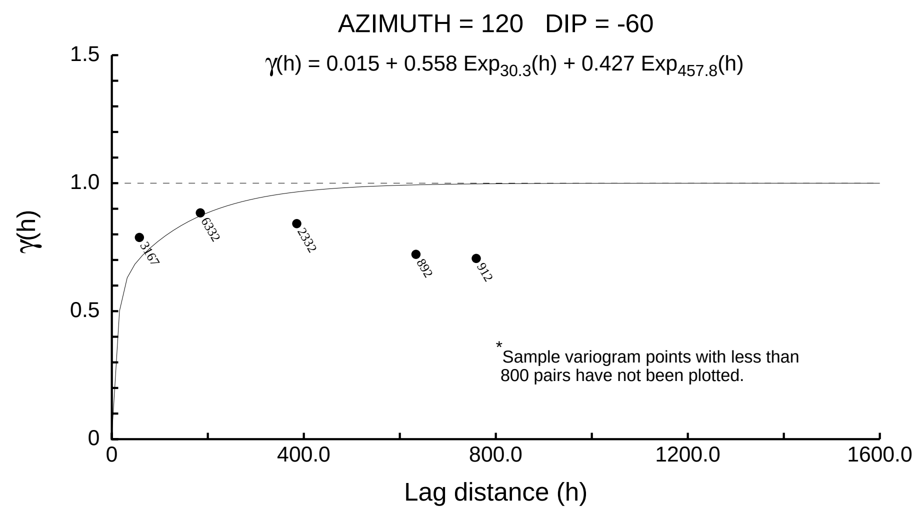


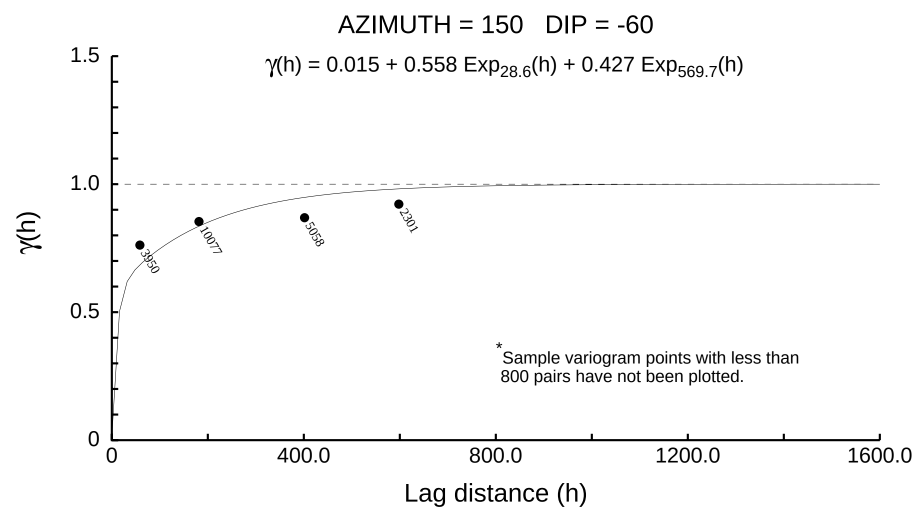




Downhole 1001 - S







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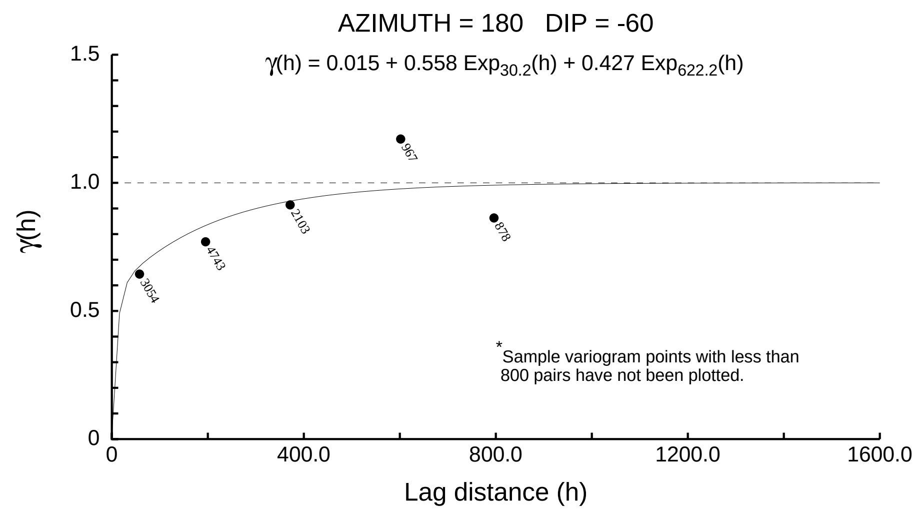
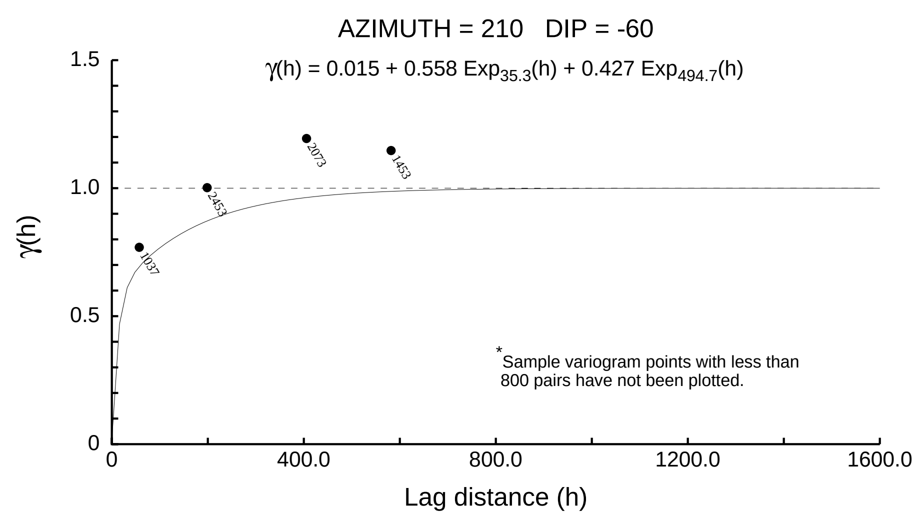
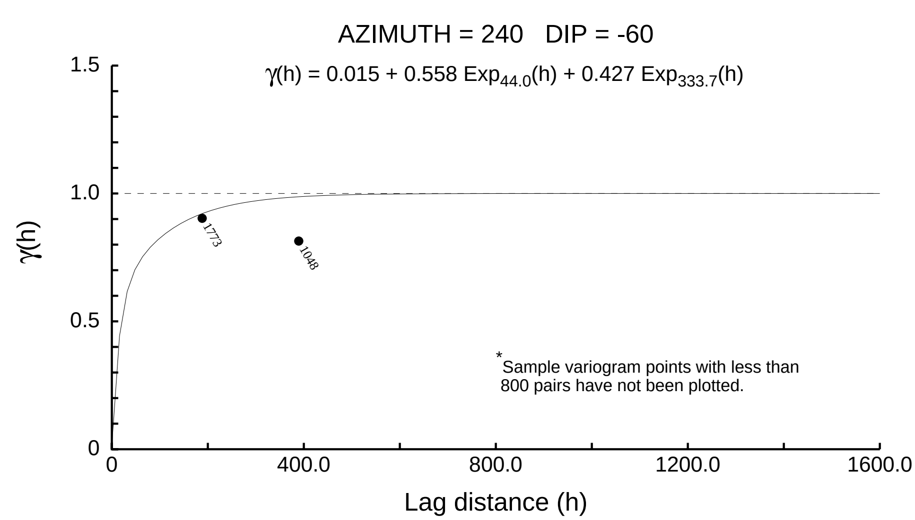
Downhole 1001 - S

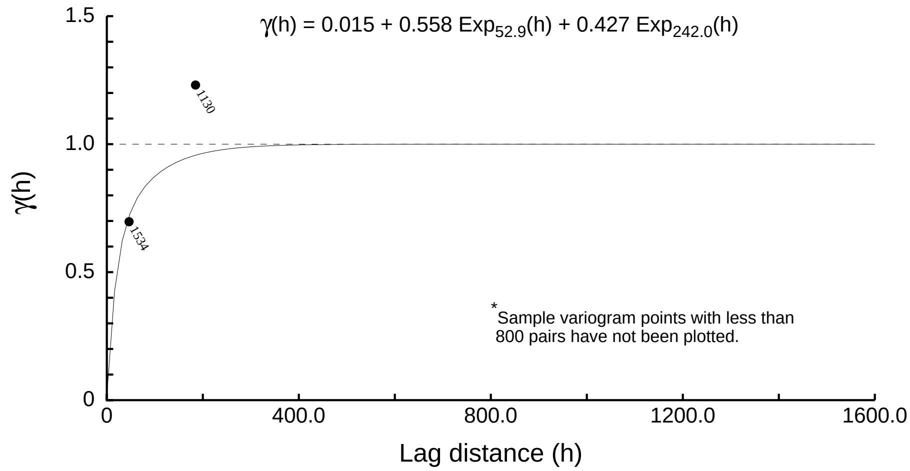




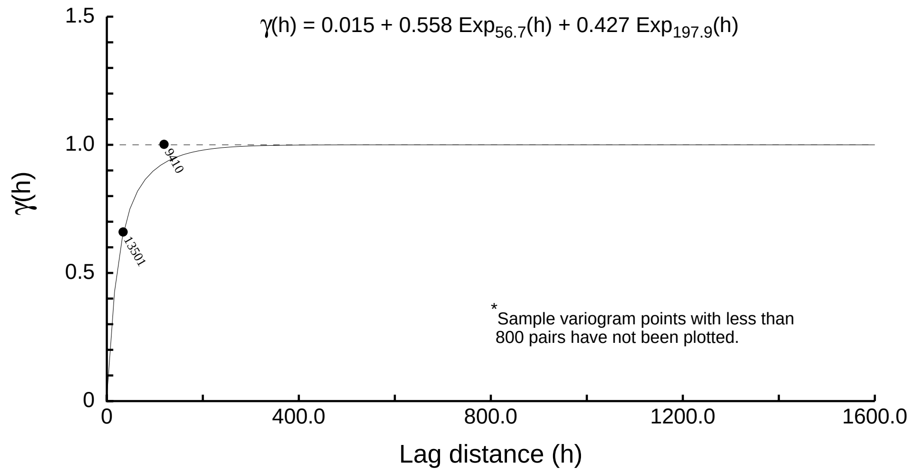


Downhole 1001 - S

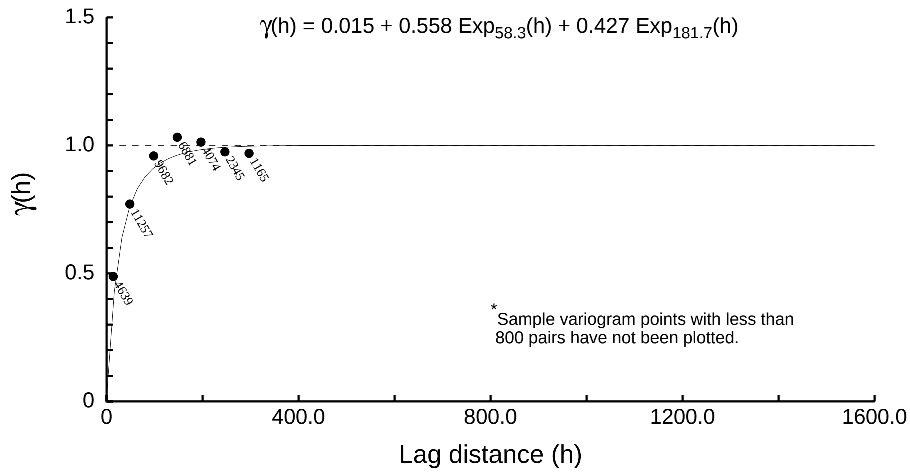
AZIMUTH = 270   DIP = -60



AZIMUTH = 300   DIP = -60



AZIMUTH = 330   DIP = -60



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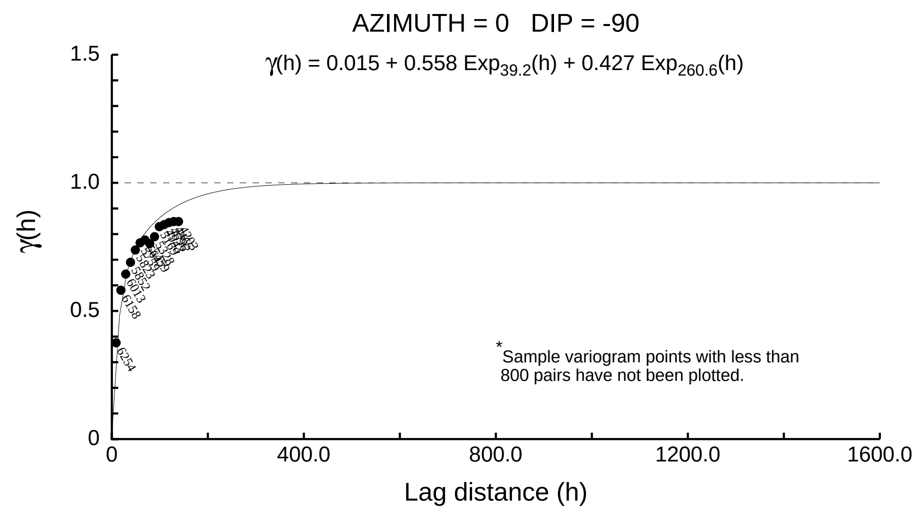
Downhole 1001 - S



Directional 1003 - Au

User Defined Rotation Conventions

Nugget ==> 0.013
C1 ==> 0.817
C2 ==> 0.170

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -114
RH Rotation about the Y’ axis ==> -33
RH Rotation about the Z’ axis ==> -39
Range along the Z’ axis ==> 28.5 Azimuth ==> 24 Dip ==> 57
Range along the Y’ axis ==> 60.9 Azimuth ==> 149 Dip ==> 21
Range along the X’ axis ==> 115.7 Azimuth ==> 249 Dip ==> 25

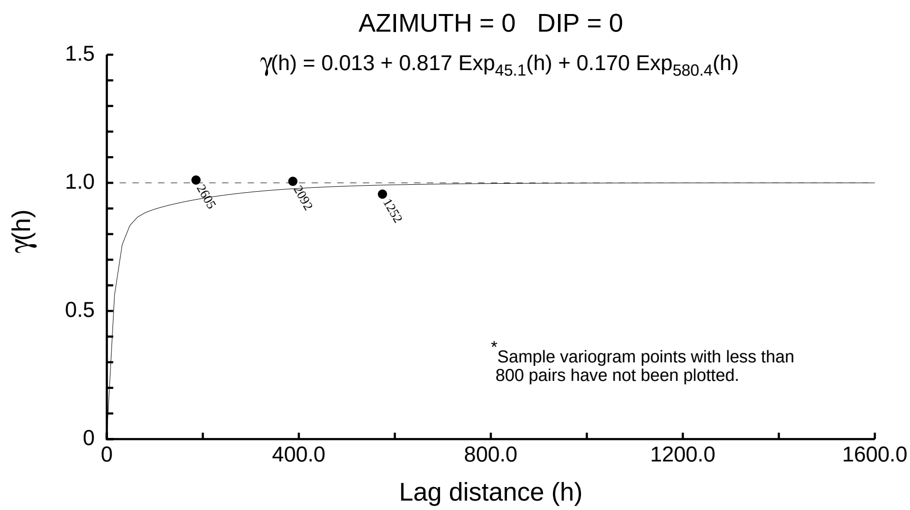
Second Structure -- Exponential with Practical Range

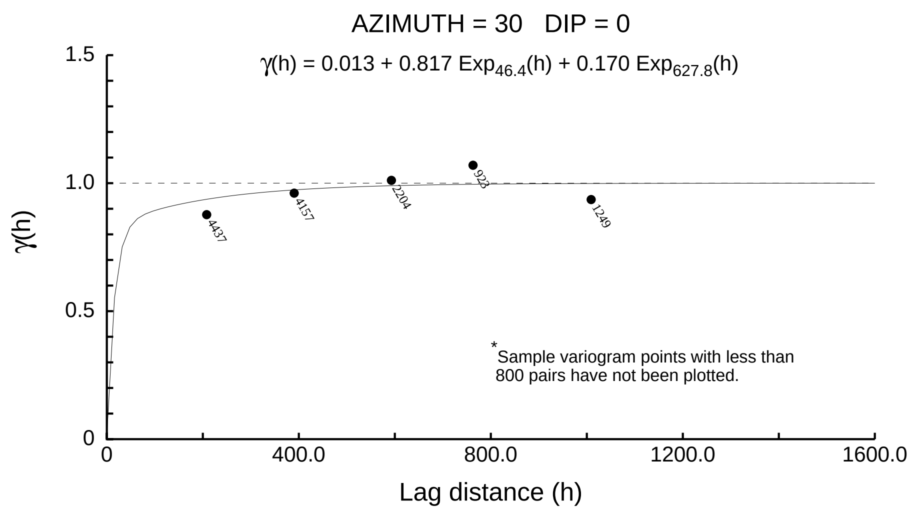
RH Rotation about the Z axis ==> -50
RH Rotation about the Y’ axis ==> -55
RH Rotation about the Z’ axis ==> 11
Range along the Z’ axis ==> 2619.4 Azimuth ==> 320 Dip ==> 35
Range along the Y’ axis ==> 604.1 Azimuth ==> 44 Dip ==> -9
Range along the X’ axis ==> 256.0 Azimuth ==> 122 Dip ==> 53

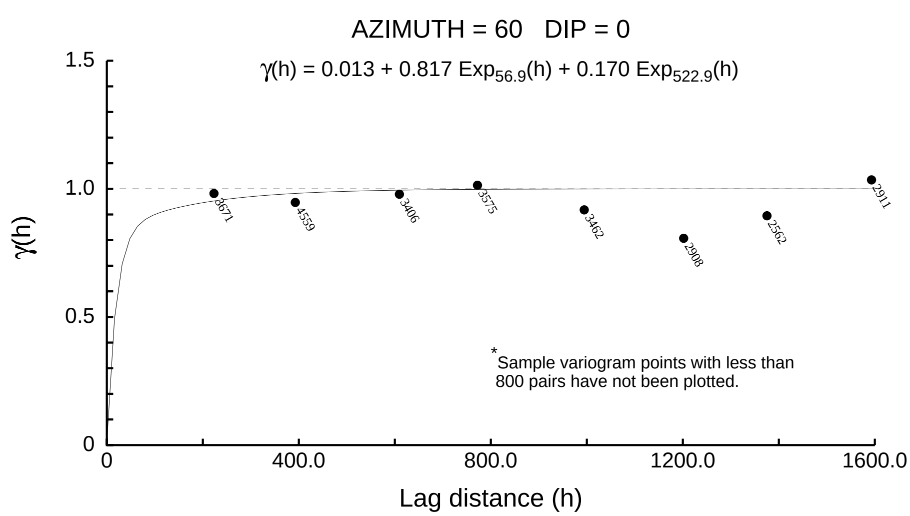
Modeling Criteria

Minimum number pairs req’d ==> 800
Sample variogram points weighted by # pairs

Directional 1003 - Au



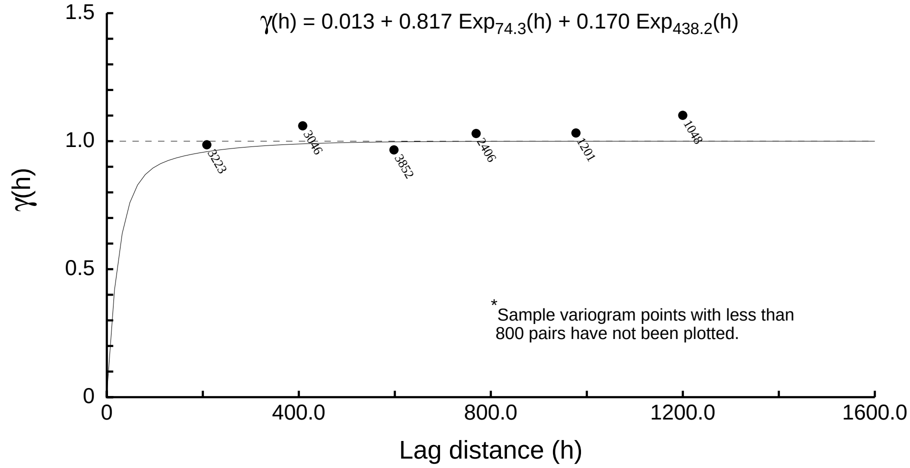




Directional 1003 - Au

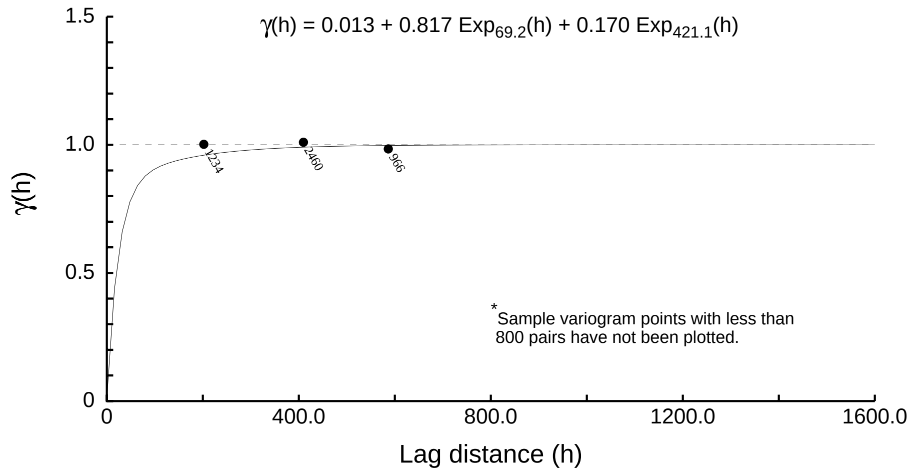
AZIMUTH = 90   DIP = 0

$\gamma(h) = 0.013 + 0.817\ Exp_{74.3}(h) + 0.170\ Exp_{438.2}(h)$



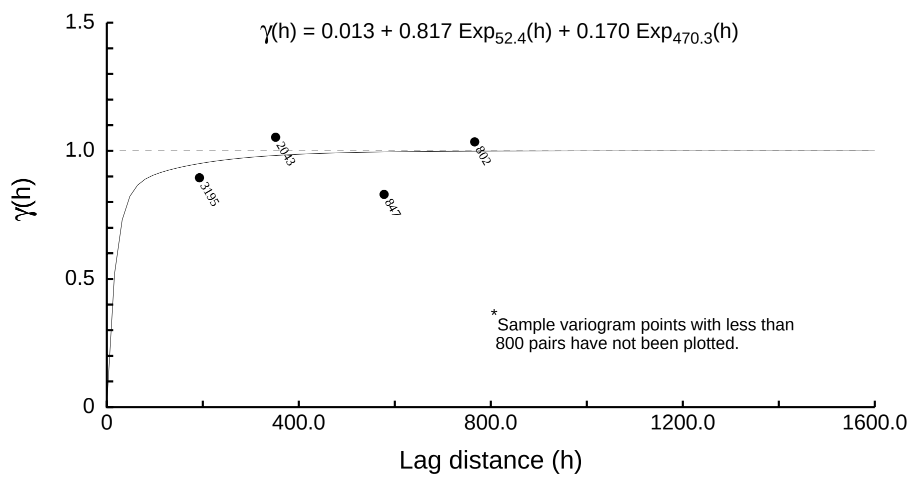
AZIMUTH = 120   DIP = 0

$\gamma(h) = 0.013 + 0.817\ Exp_{69.2}(h) + 0.170\ Exp_{421.1}(h)$



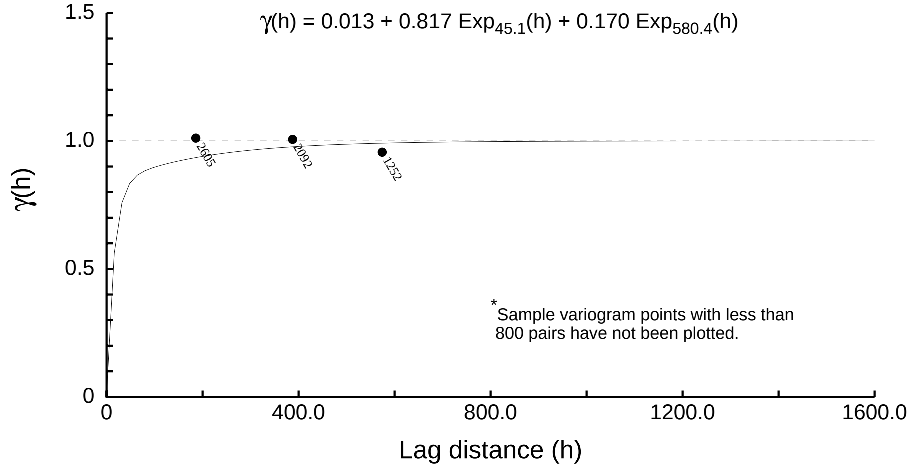
AZIMUTH = 150   DIP = 0

$\gamma(h) = 0.013 + 0.817\ Exp_{52.4}(h) + 0.170\ Exp_{470.3}(h)$

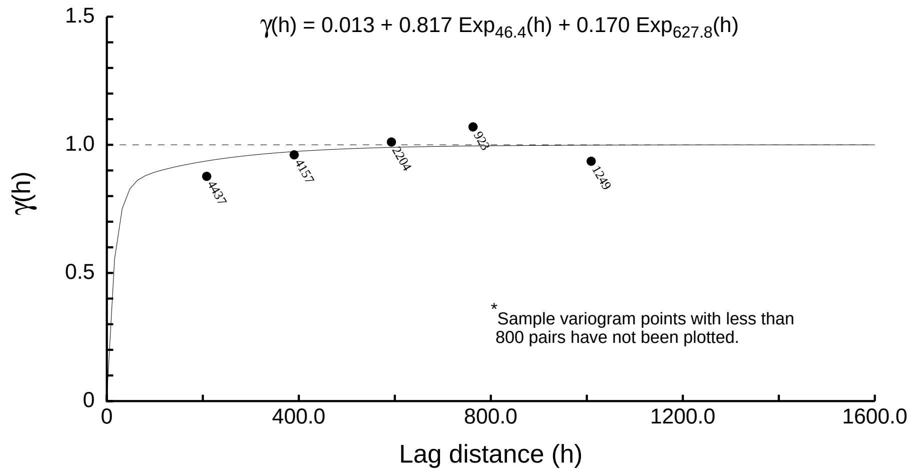


Directional 1003 - Au

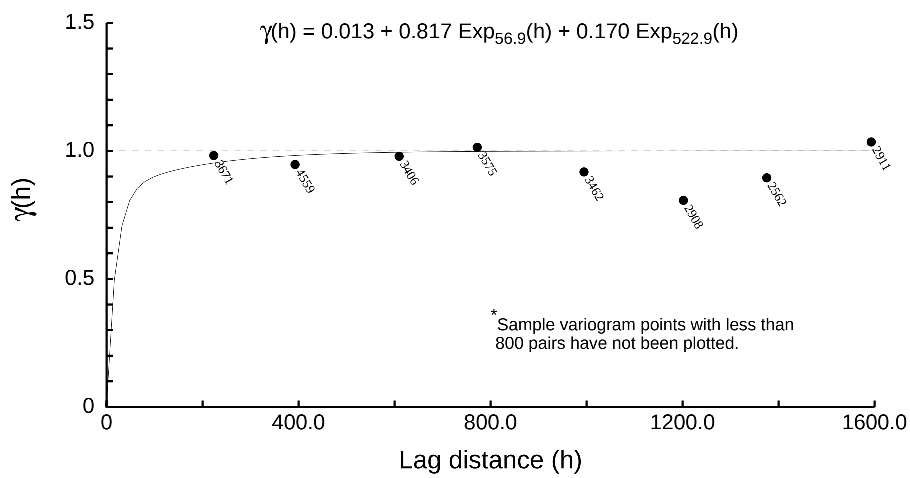
AZIMUTH = 180 DIP = 0



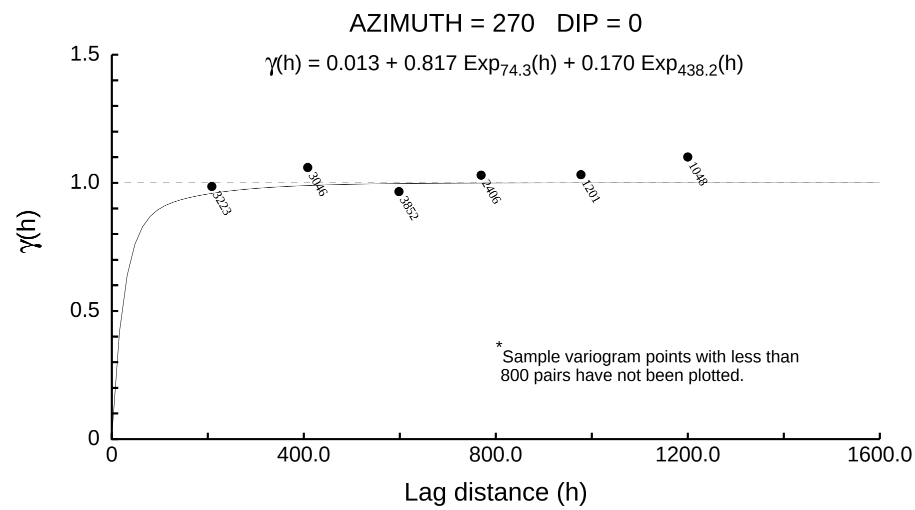
AZIMUTH = 210 DIP = 0

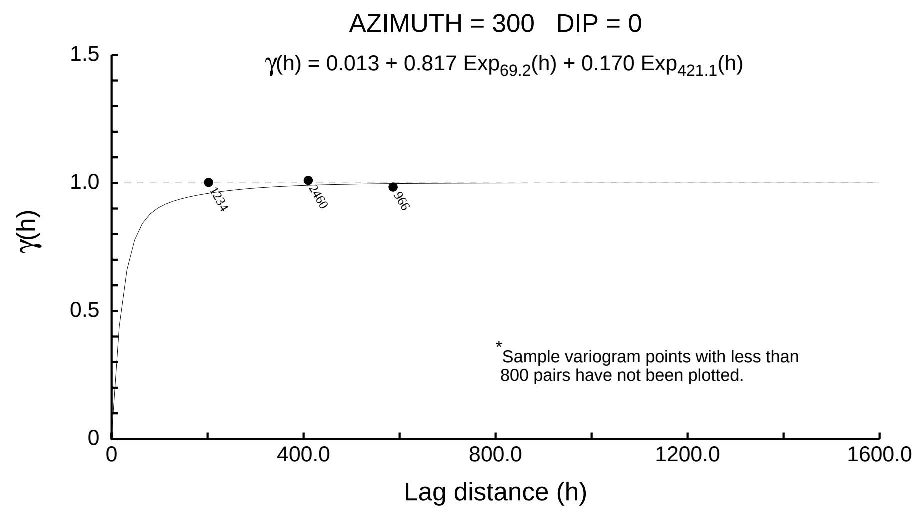


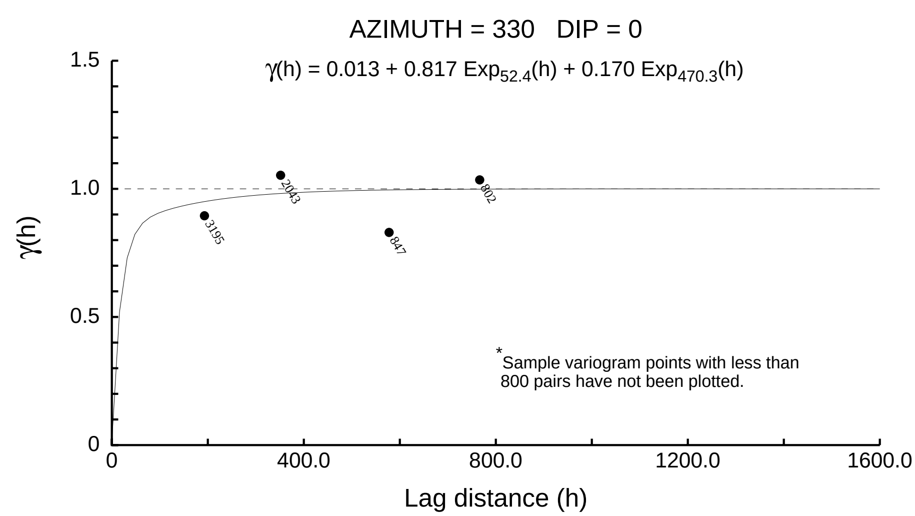
AZIMUTH = 240 DIP = 0



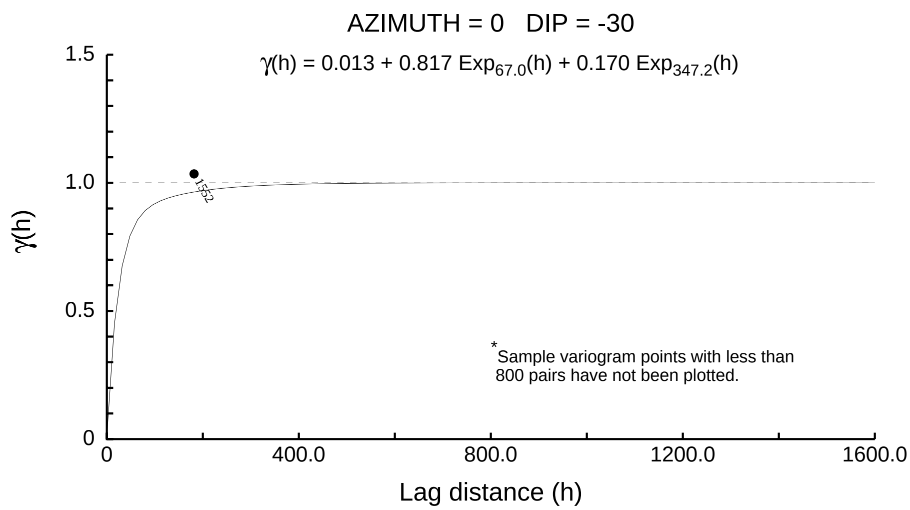
Directional 1003 - Au

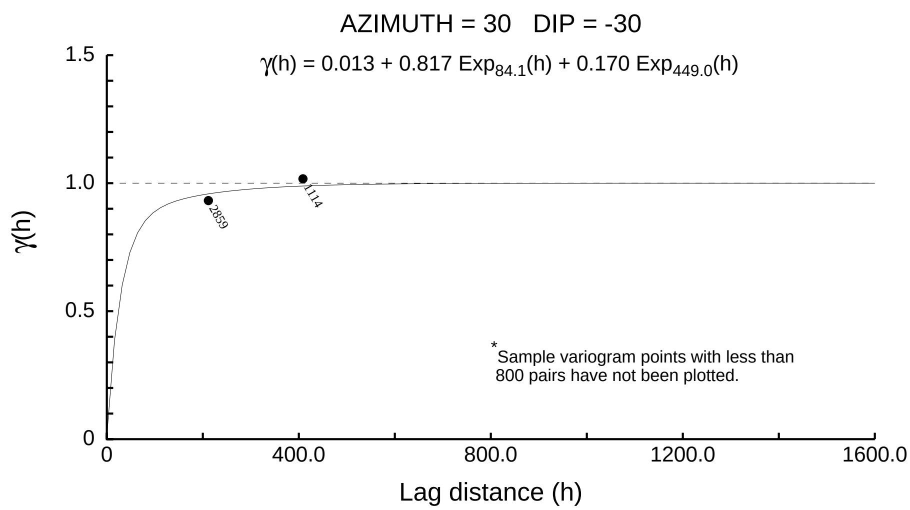


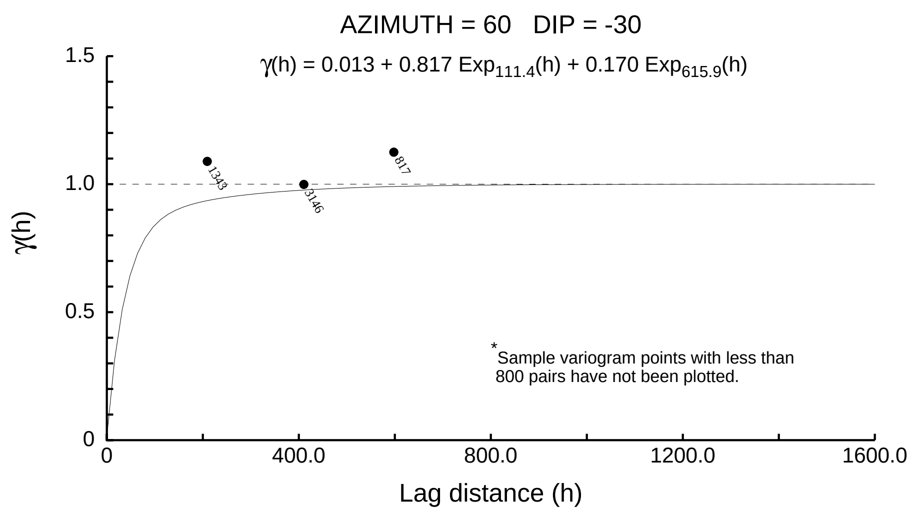




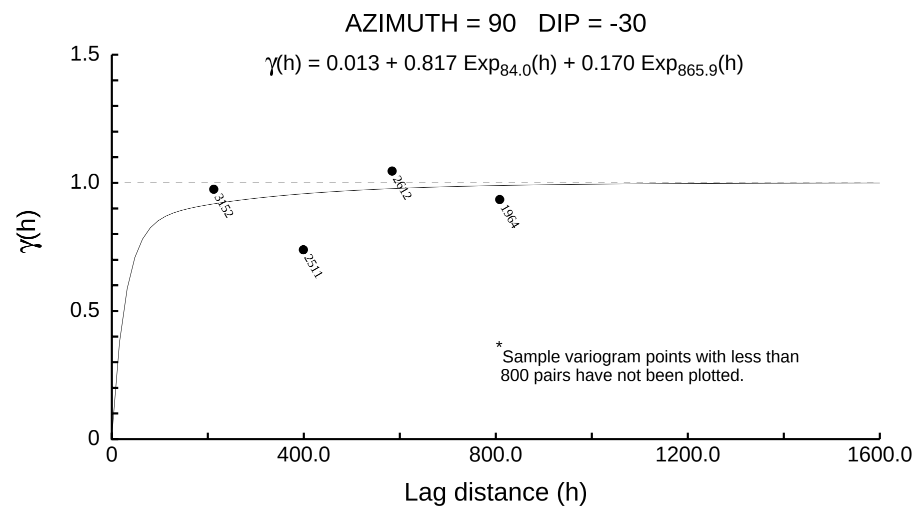
Directional 1003 - Au

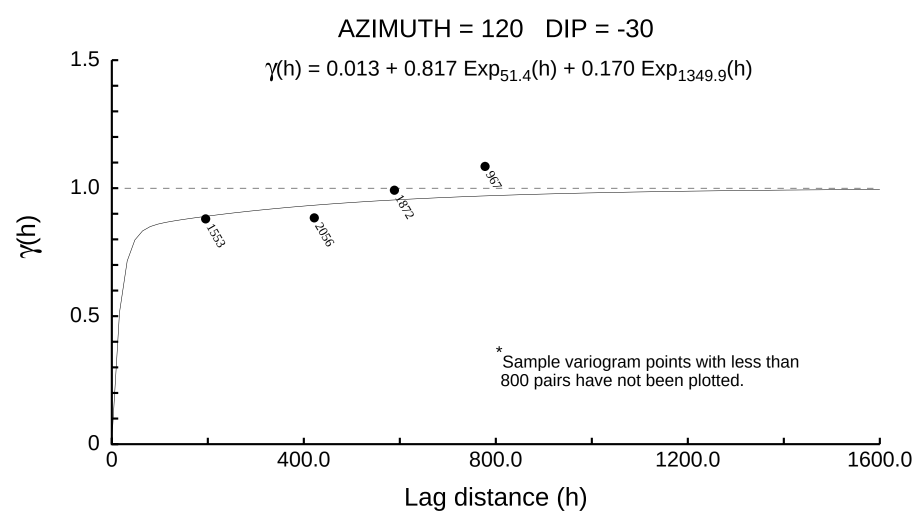


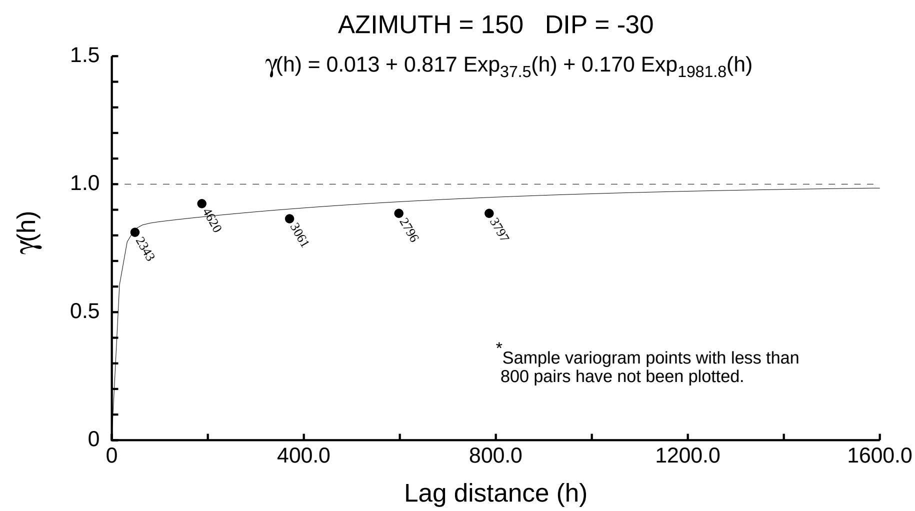




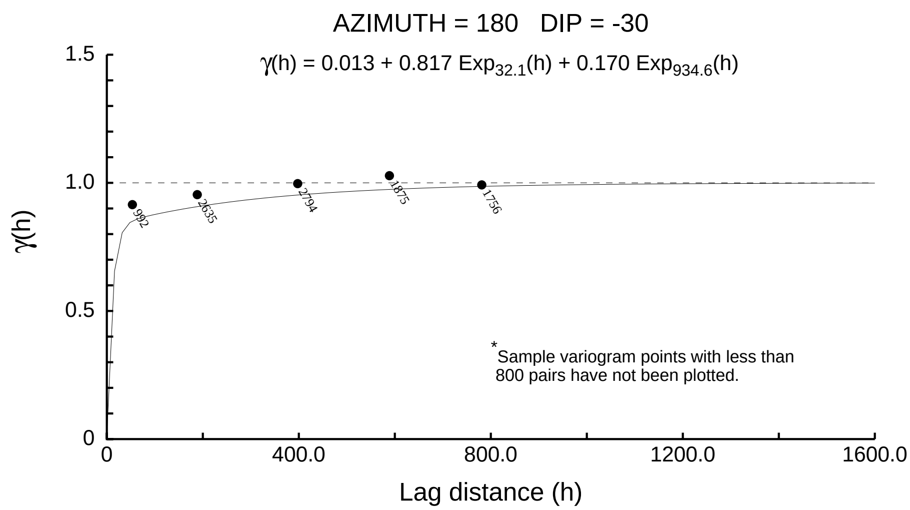
Directional 1003 - Au

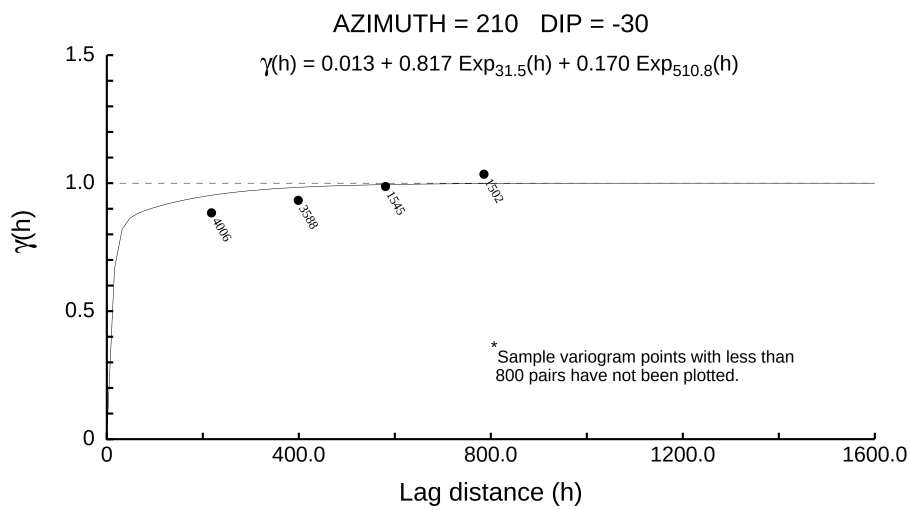


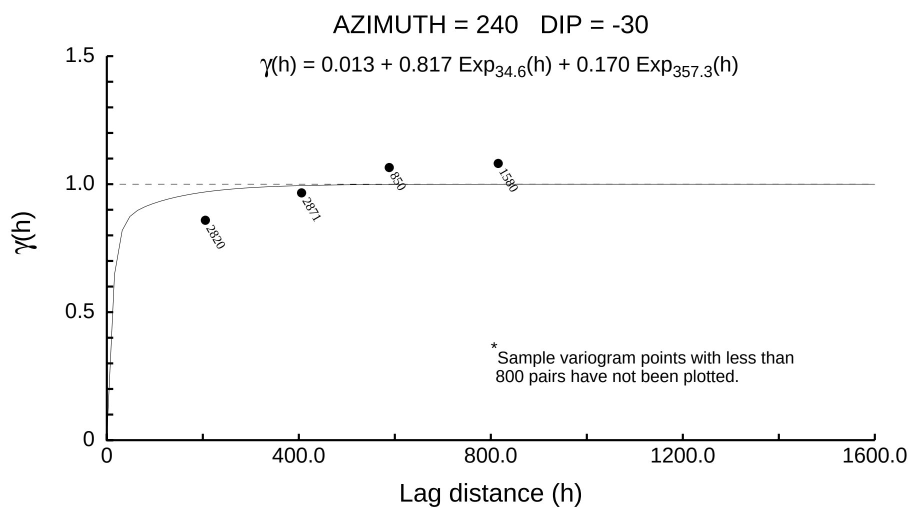




Directional 1003 - Au

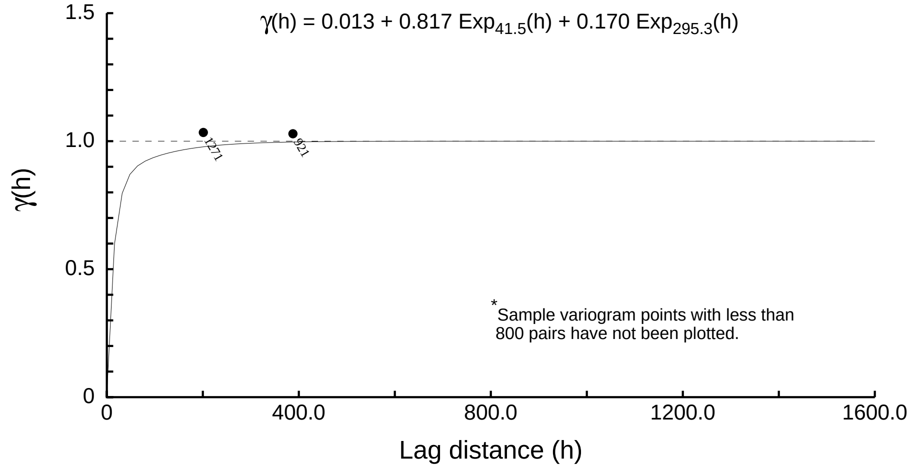




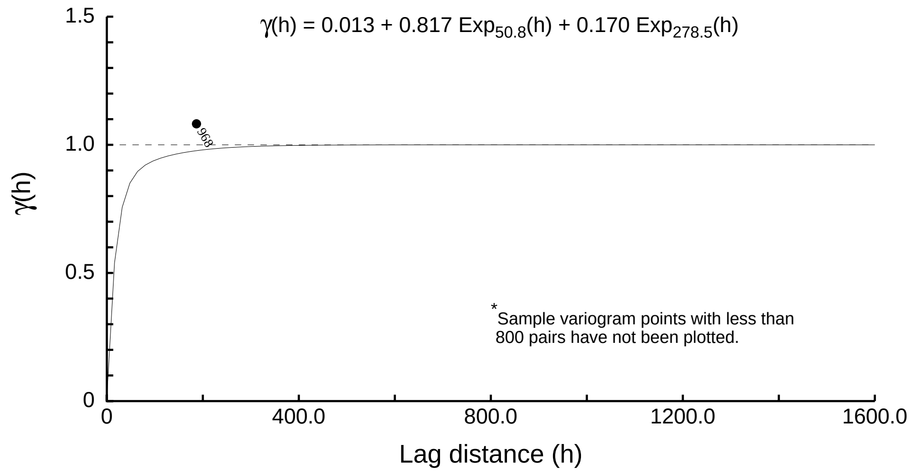


Directional 1003 - Au

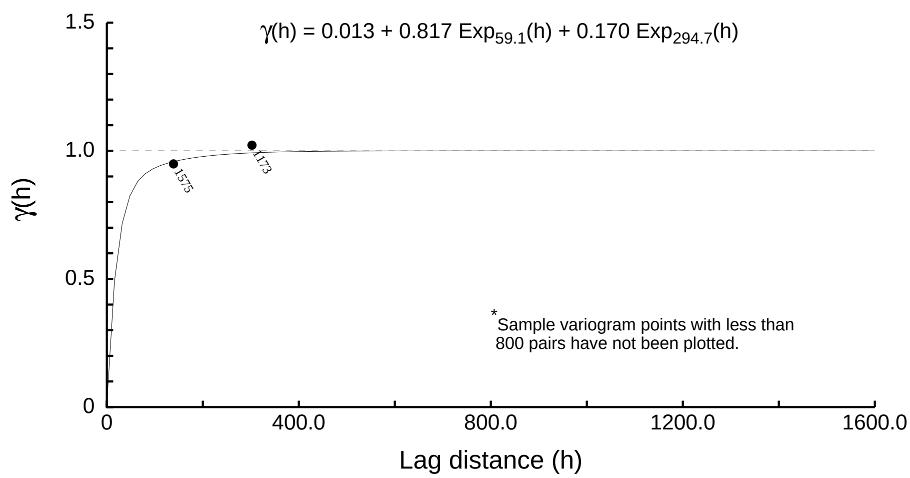
AZIMUTH = 270   DIP = -30



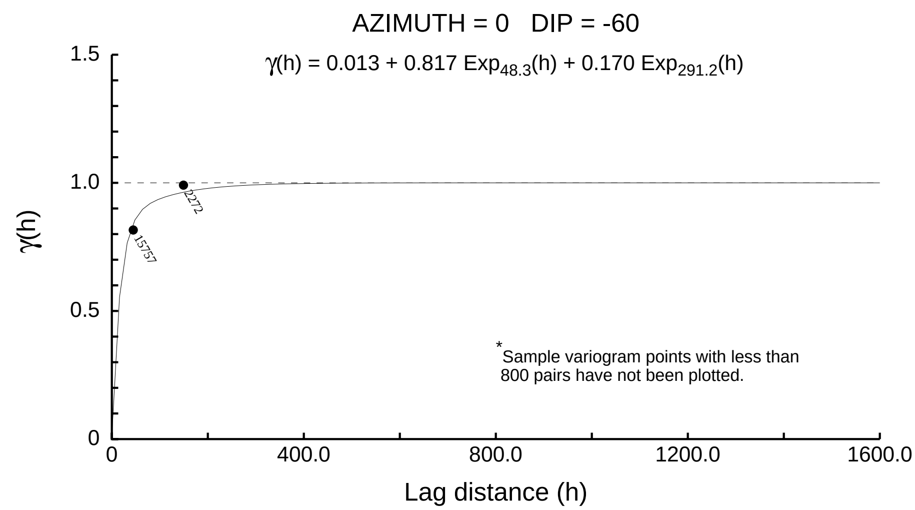
AZIMUTH = 300   DIP = -30

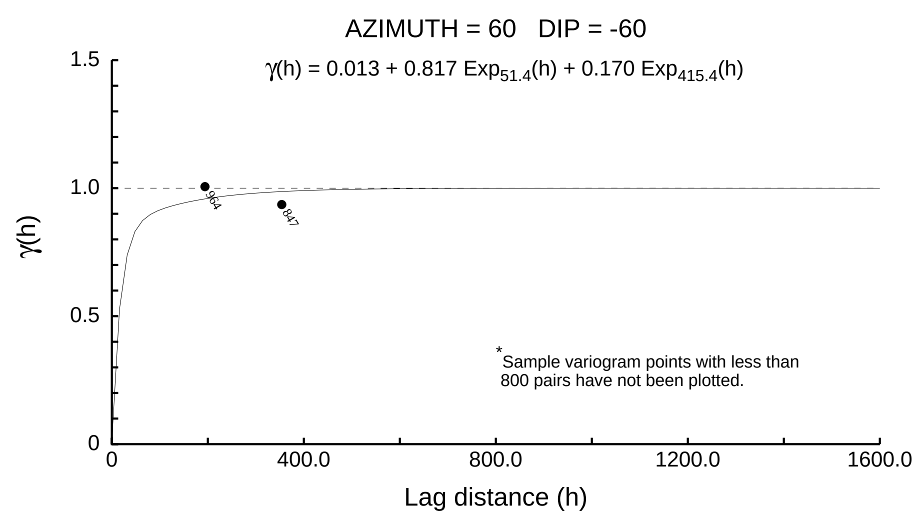


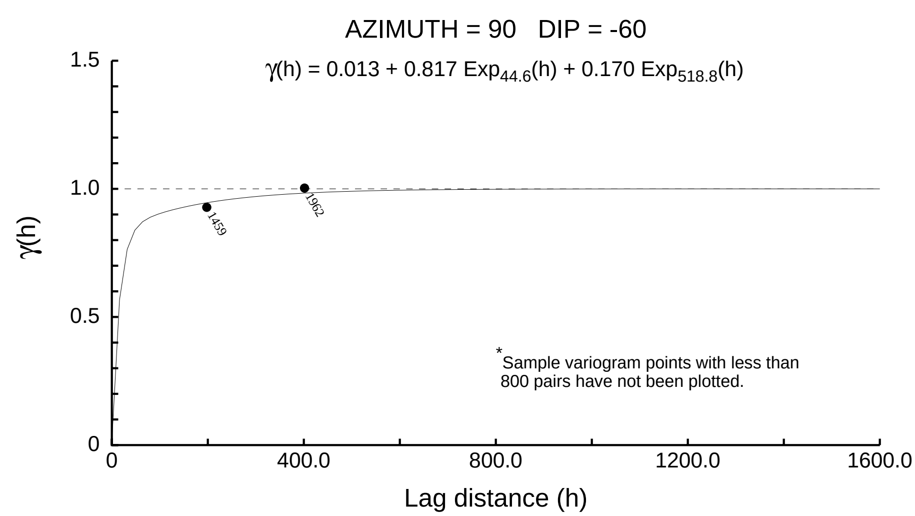
AZIMUTH = 330   DIP = -30



Directional 1003 - Au

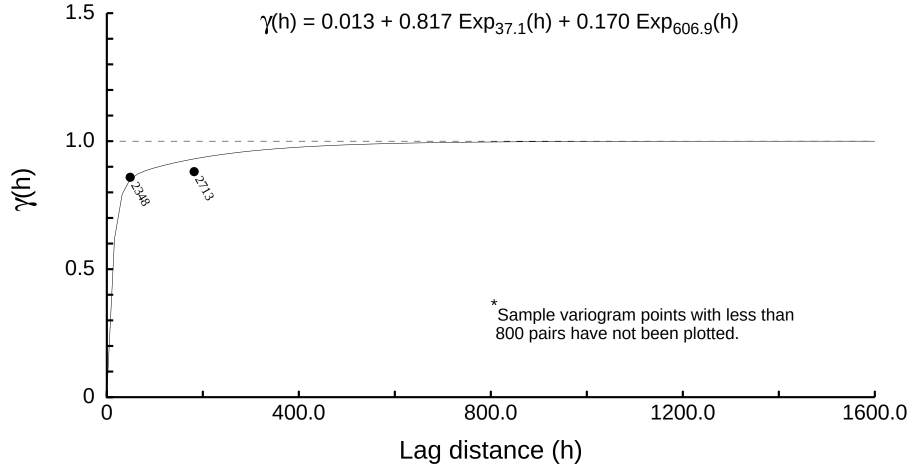




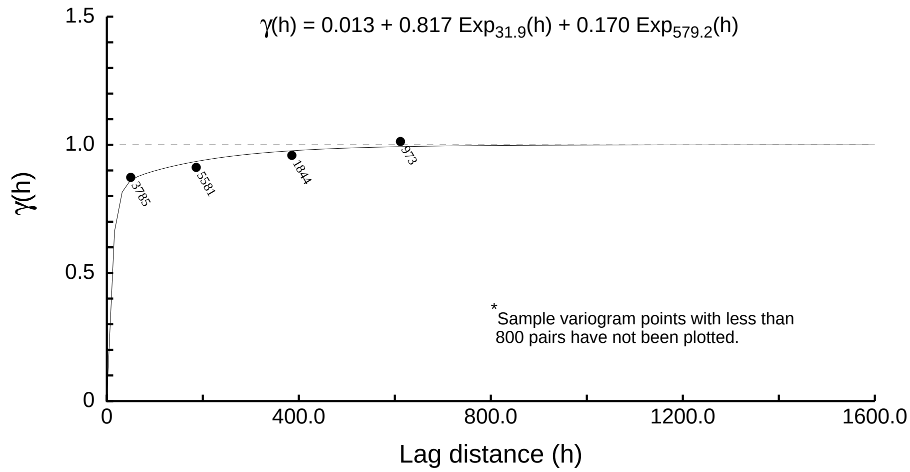


Directional 1003 - Au

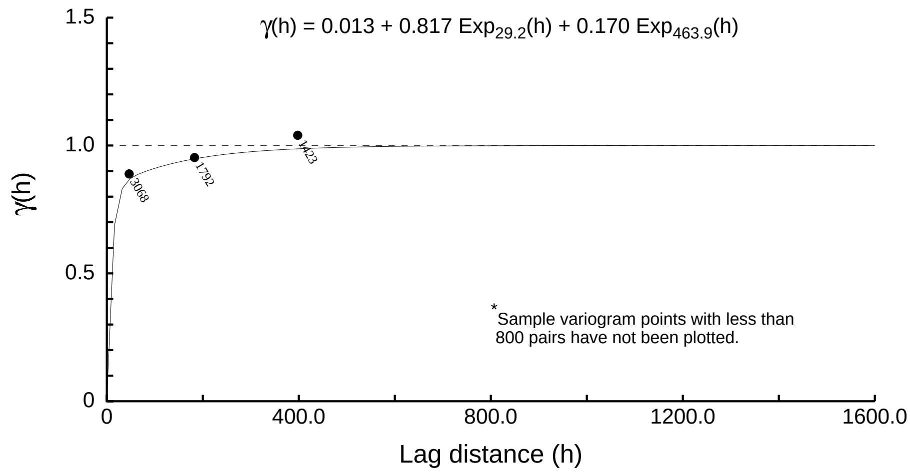
AZIMUTH = 120   DIP = -60



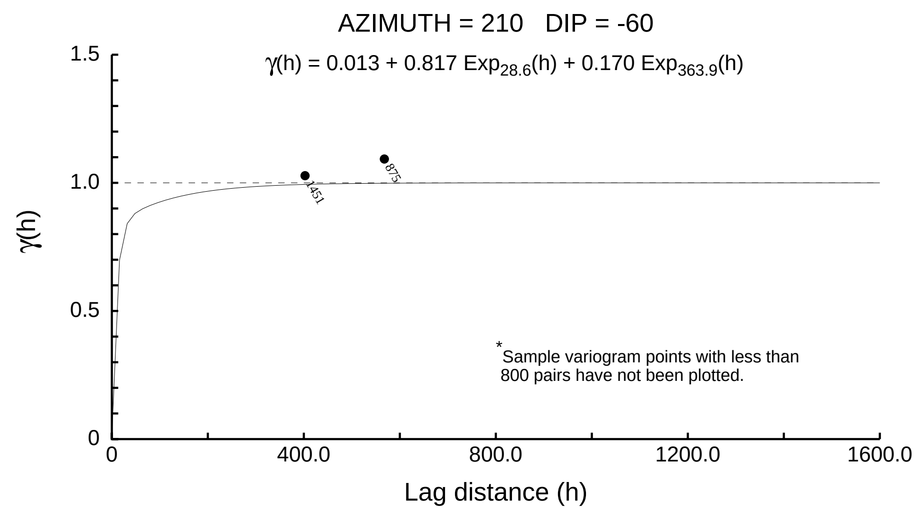
AZIMUTH = 150   DIP = -60

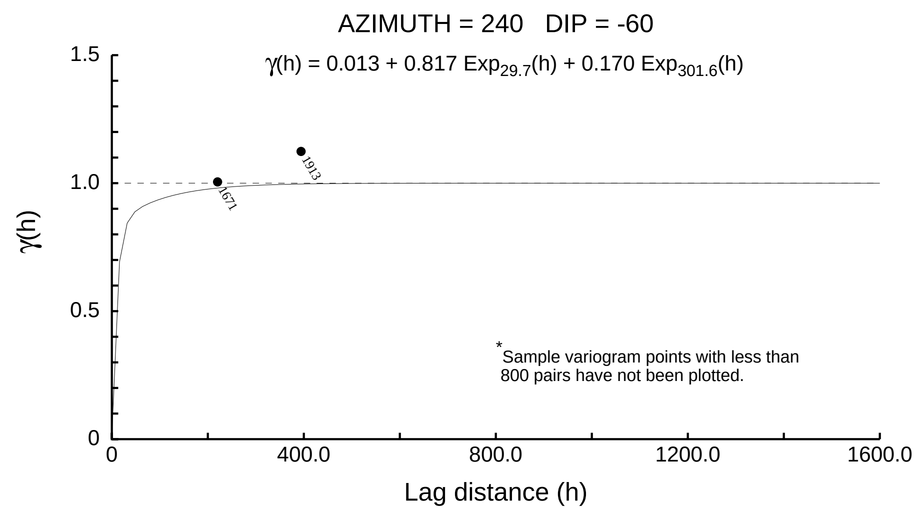


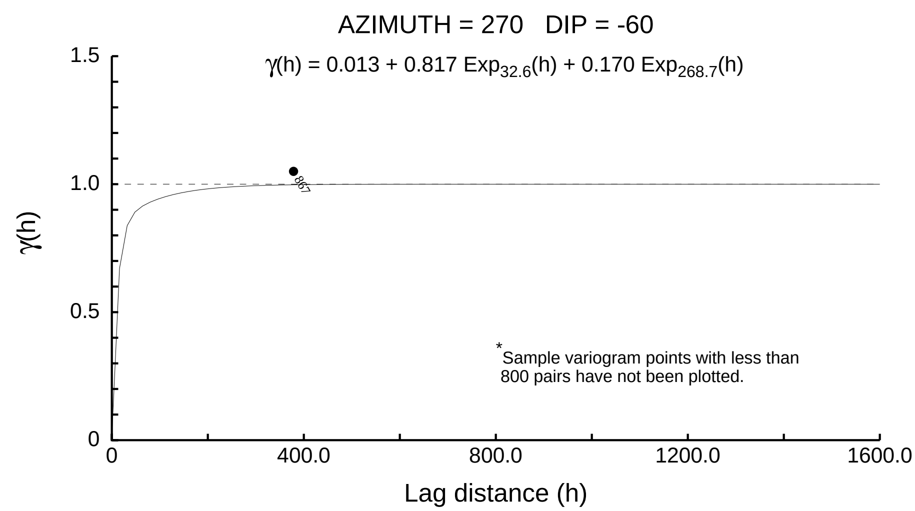
AZIMUTH = 180   DIP = -60



Directional 1003 - Au







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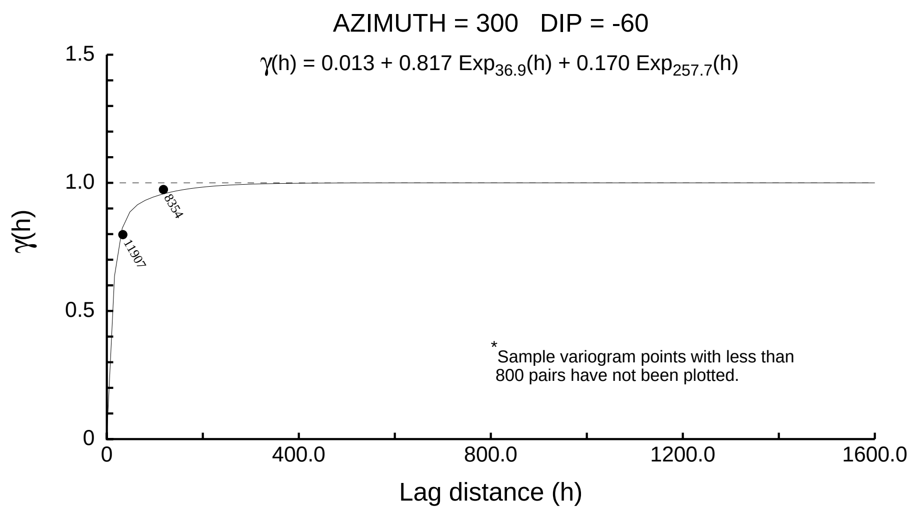
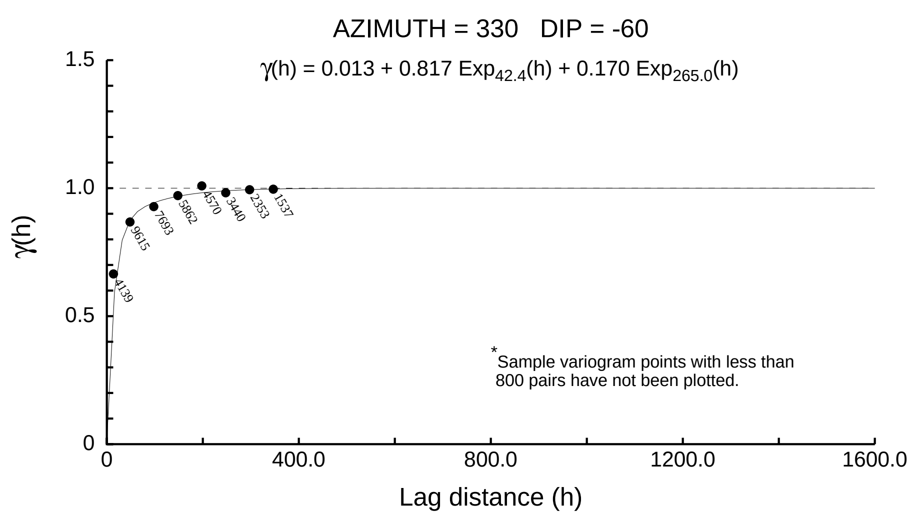
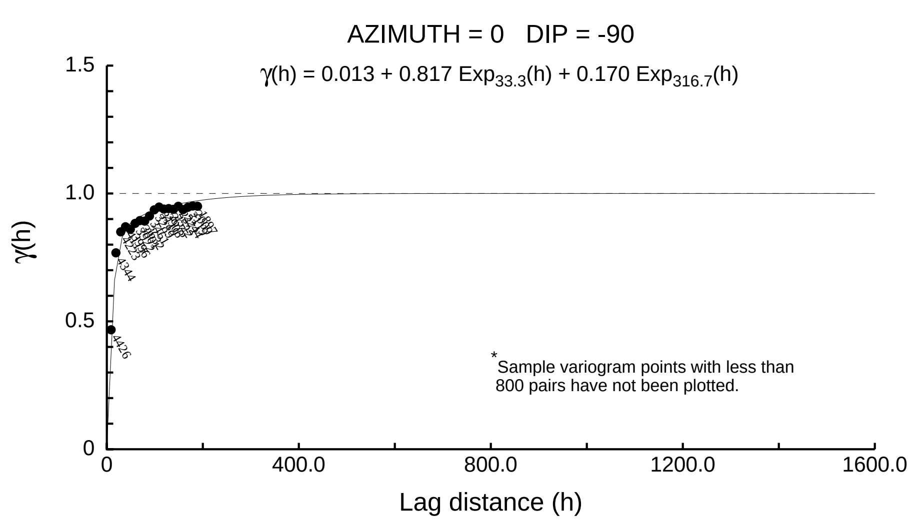
Directional 1003 - Au







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Directional 1003 - Co

User Defined Rotation Conventions

Nugget ==> 0.006
C1 ==> 0.626
C2 ==> 0.368

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> 29
RH Rotation about the Y' axis ==> 97
RH Rotation about the Z' axis ==> -95
Range along the Z' axis ==> 59.7 Azimuth ==> 61 Dip ==> -7
Range along the Y' axis ==> 496.6 Azimuth ==> 204 Dip ==> -82
Range along the X' axis ==> 32.1 Azimuth ==> 150 Dip ==> 5

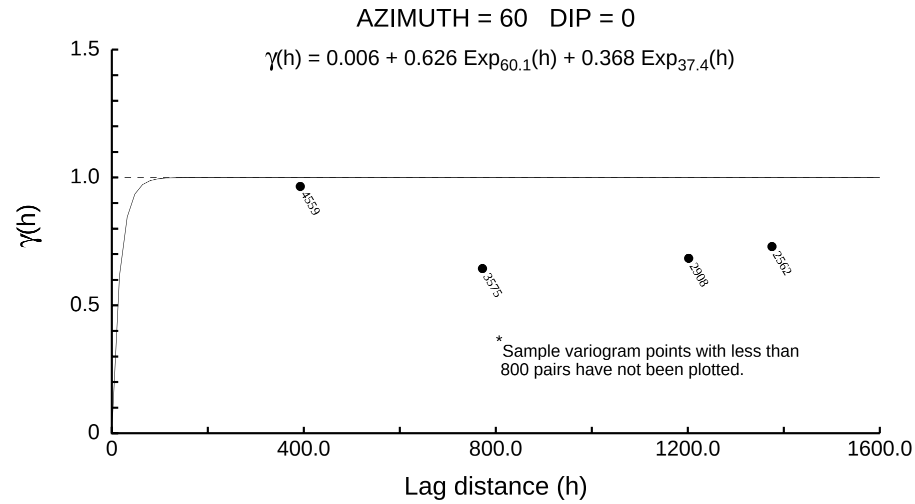
Second Structure -- Exponential with Practical Range

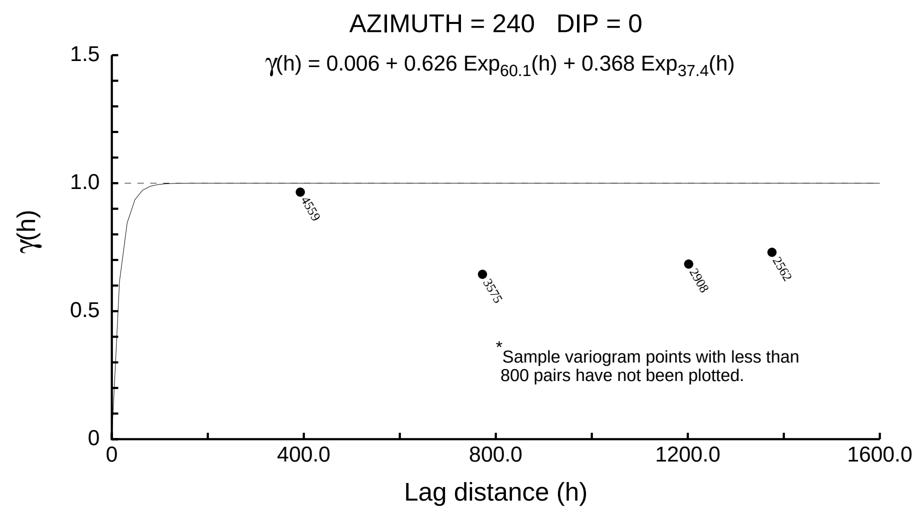
RH Rotation about the Z axis ==> -33
RH Rotation about the Y' axis ==> 31
RH Rotation about the Z' axis ==> 67
Range along the Z' axis ==> 1475.8 Azimuth ==> 123 Dip ==> 59
Range along the Y' axis ==> 8895.7 Azimuth ==> 330 Dip ==> 29
Range along the X' axis ==> 36.3 Azimuth ==> 53 Dip ==> -12

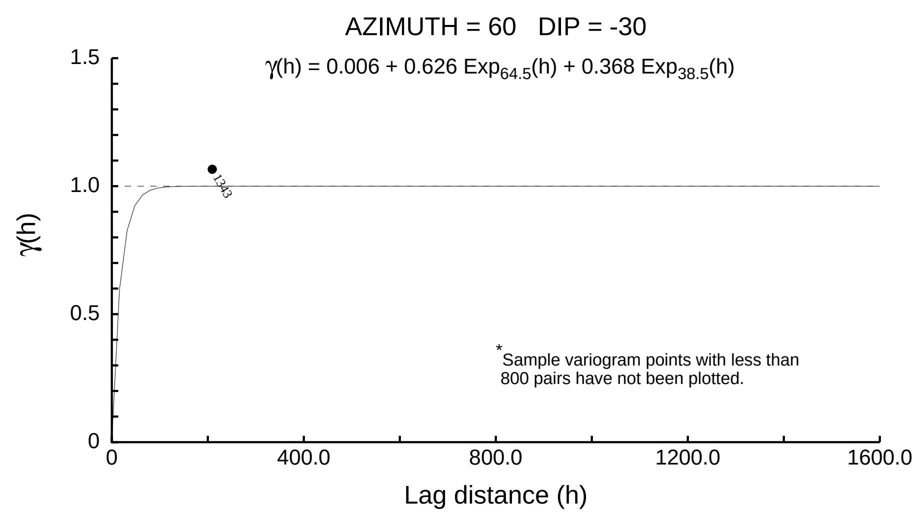
Modeling Criteria

Minimum number pairs req'd ==> 800
Sample variogram points weighted by # pairs
Max allowable drift on head and tail means ==> 1.5

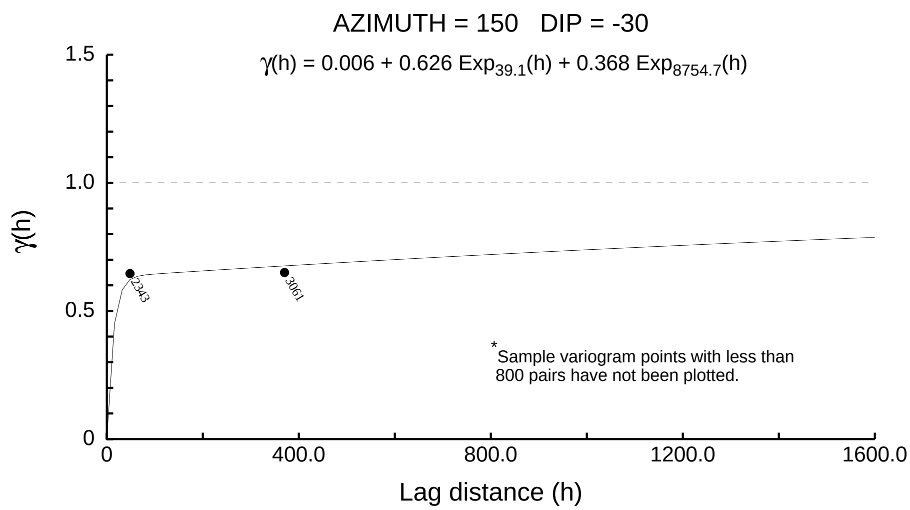
Directional 1003 - Co

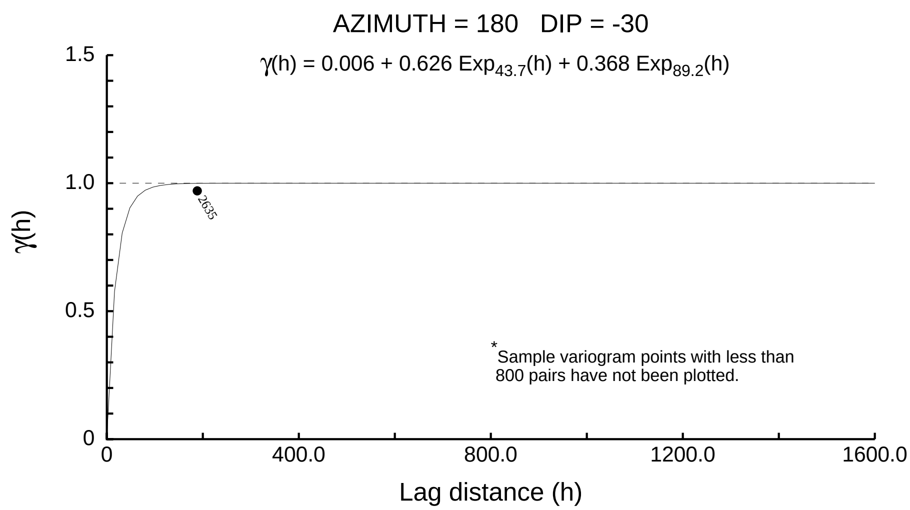


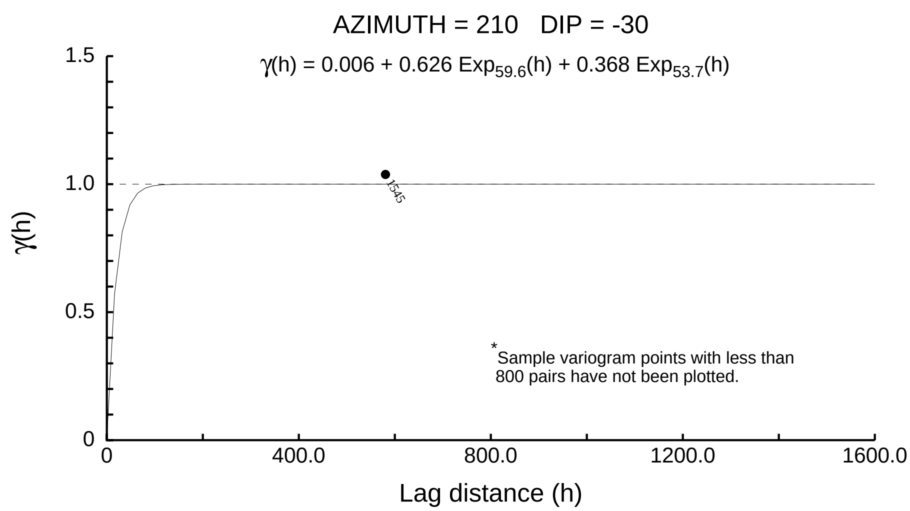




Directional 1003 - Co



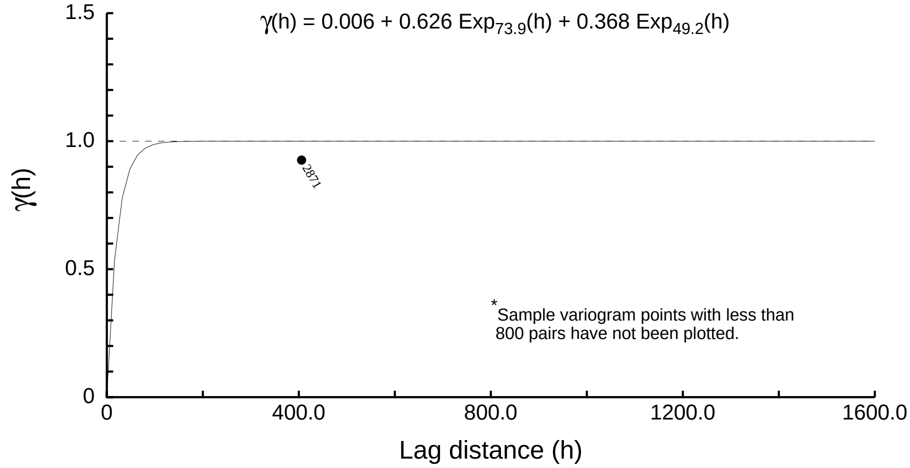




Directional 1003 - Co

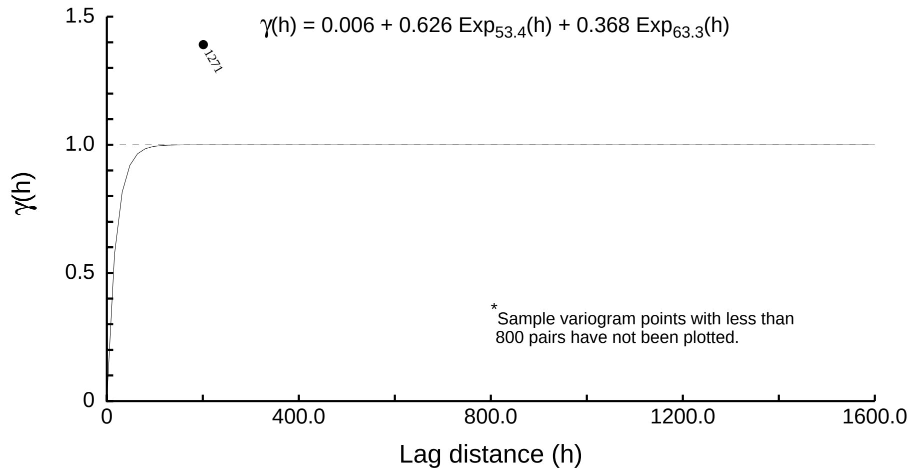
AZIMUTH = 240 DIP = -30

$\gamma(h) = 0.006 + 0.626\ Exp_{73.9}(h) + 0.368\ Exp_{49.2}(h)$



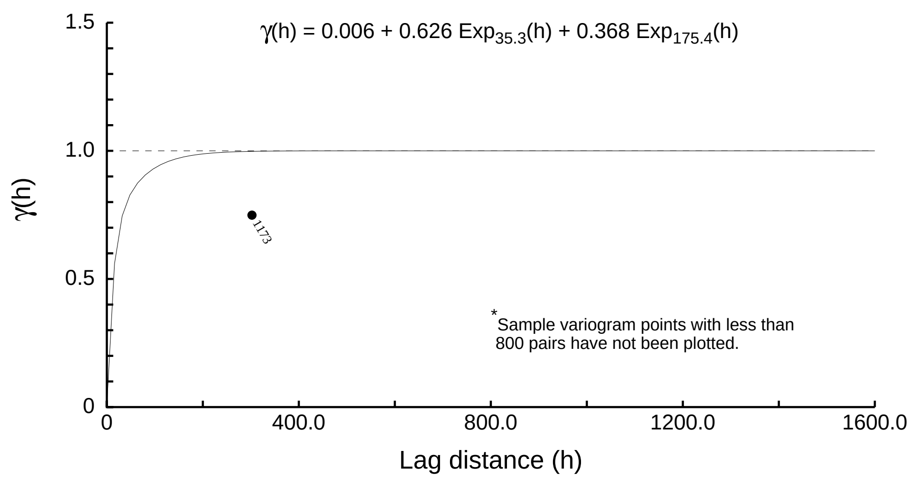
AZIMUTH = 270 DIP = -30

$\gamma(h) = 0.006 + 0.626\ Exp_{53.4}(h) + 0.368\ Exp_{63.3}(h)$

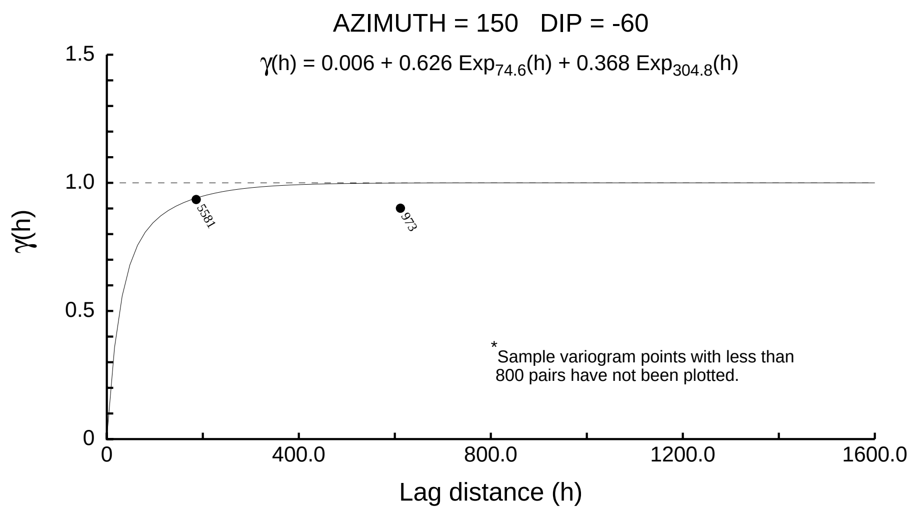


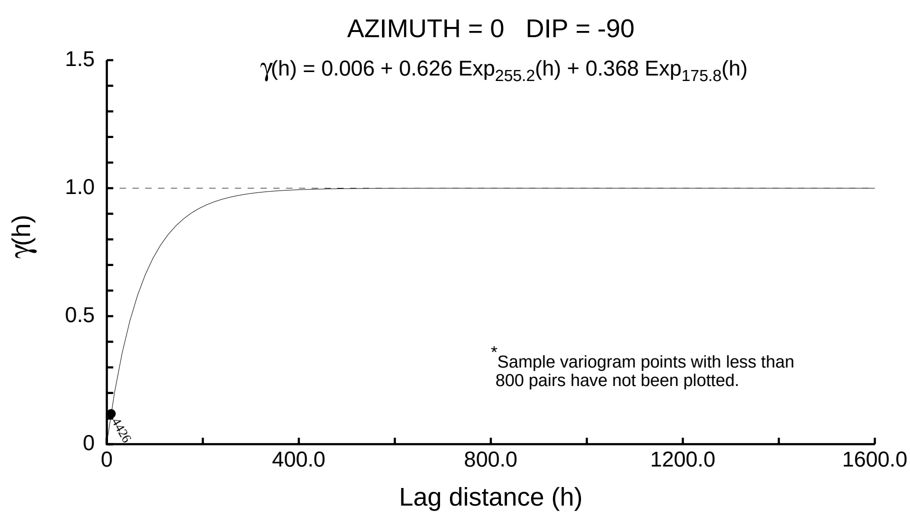
AZIMUTH = 330 DIP = -30

$\gamma(h) = 0.006 + 0.626\ Exp_{35.3}(h) + 0.368\ Exp_{175.4}(h)$



Directional 1003 - Co





Directional 1003 - Cu

User Defined Rotation Conventions

Nugget ==> 0.028
C1 ==> 0.833
C2 ==> 0.139

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -57
RH Rotation about the Y' axis ==> -79
RH Rotation about the Z' axis ==> 61
Range along the Z' axis ==> 17.3 Azimuth ==> 327 Dip ==> 11
Range along the Y' axis ==> 254.0 Azimuth ==> 37 Dip ==> -59
Range along the X' axis ==> 53.6 Azimuth ==> 63 Dip ==> 29

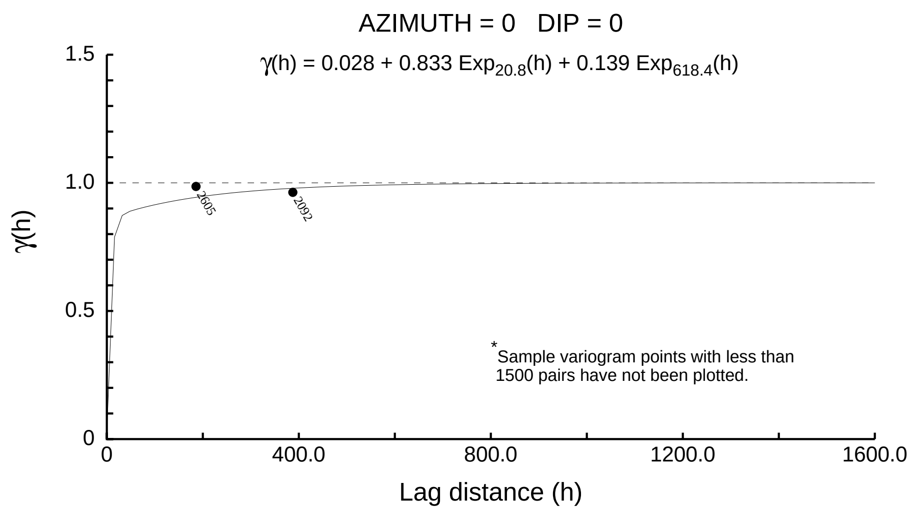
Second Structure -- Exponential with Practical Range

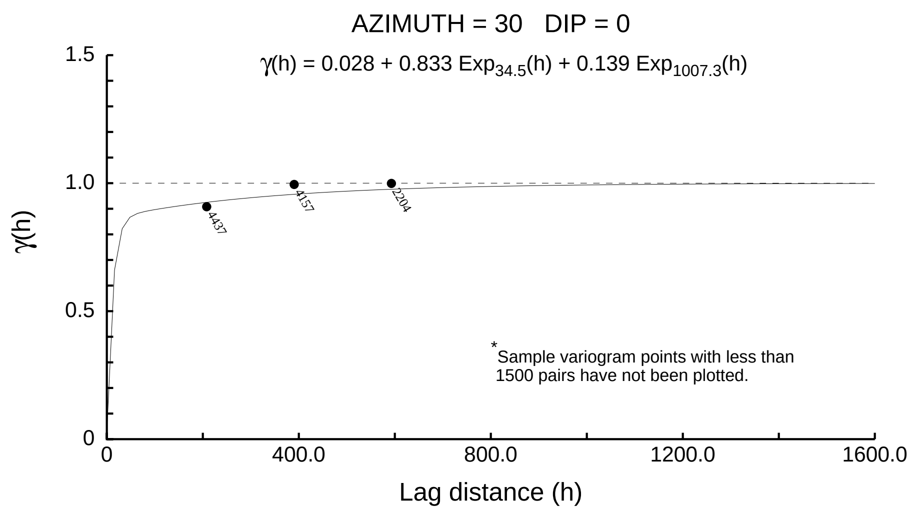
RH Rotation about the Z axis ==> -25
RH Rotation about the Y' axis ==> -37
RH Rotation about the Z' axis ==> -31
Range along the Z' axis ==> 1945.7 Azimuth ==> 295 Dip ==> 53
Range along the Y' axis ==> 3752.6 Azimuth ==> 51 Dip ==> 18
Range along the X' axis ==> 470.5 Azimuth ==> 152 Dip ==> 31

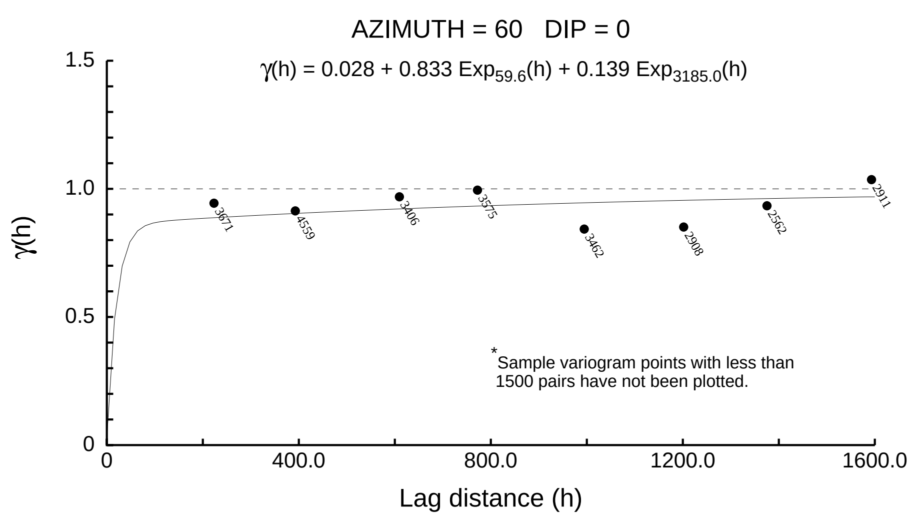
Modeling Criteria

Minimum number pairs req'd ==> 1500
Sample variogram points weighted by # pairs

Directional 1003 - Cu

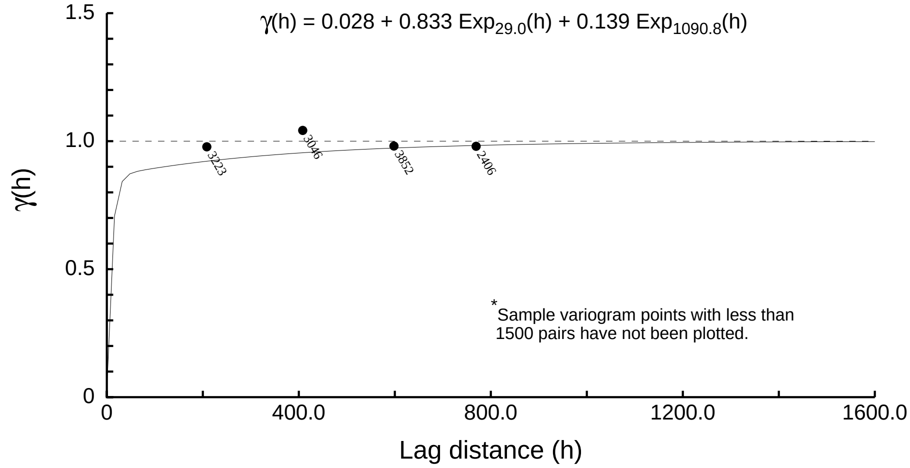




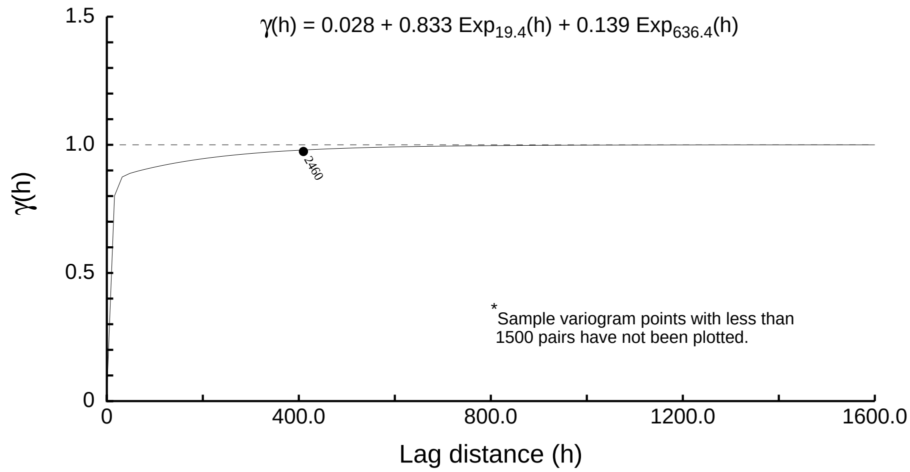


Directional 1003 - Cu

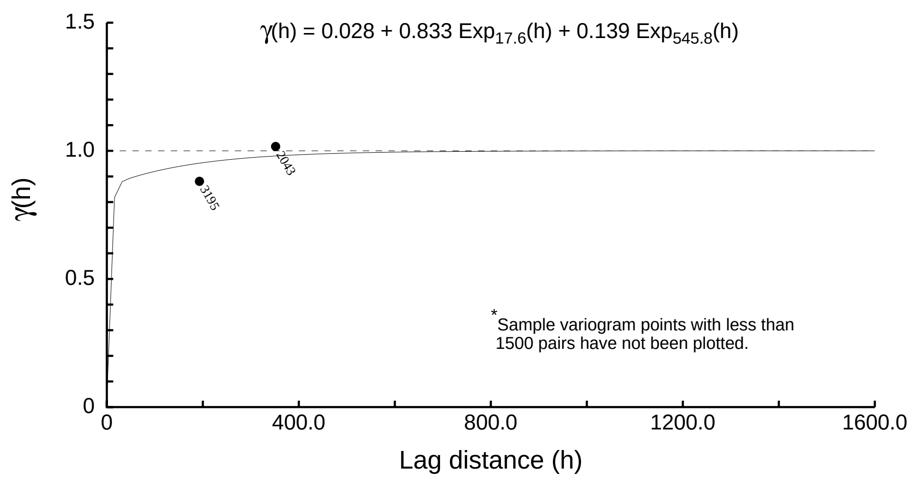
AZIMUTH = 90   DIP = 0



AZIMUTH = 120   DIP = 0



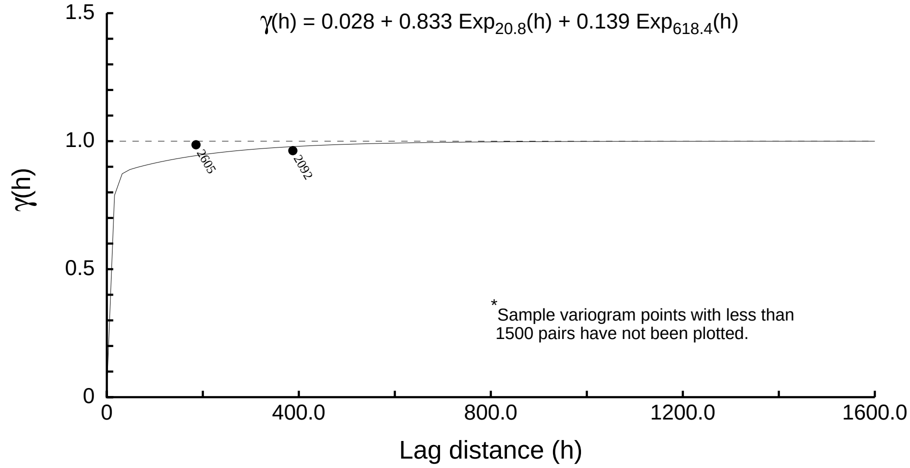
AZIMUTH = 150   DIP = 0



Directional 1003 - Cu

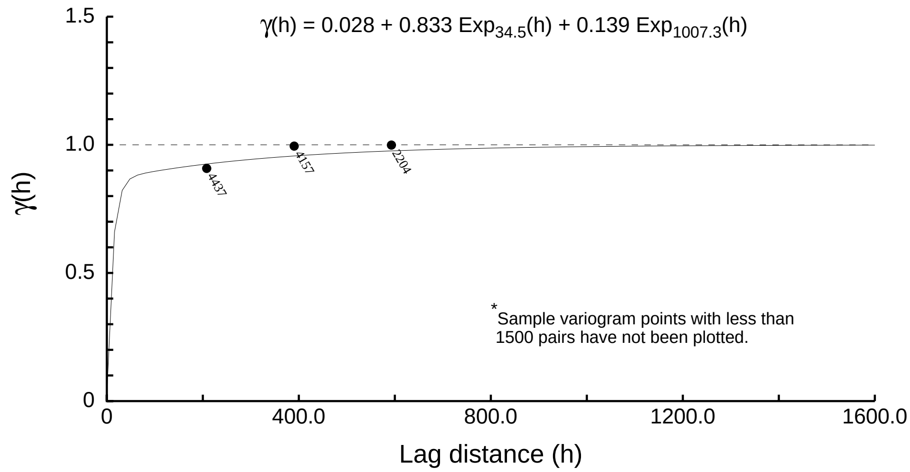
AZIMUTH = 180 DIP = 0

$\gamma(h) = 0.028 + 0.833\ Exp_{20.8}(h) + 0.139\ Exp_{618.4}(h)$



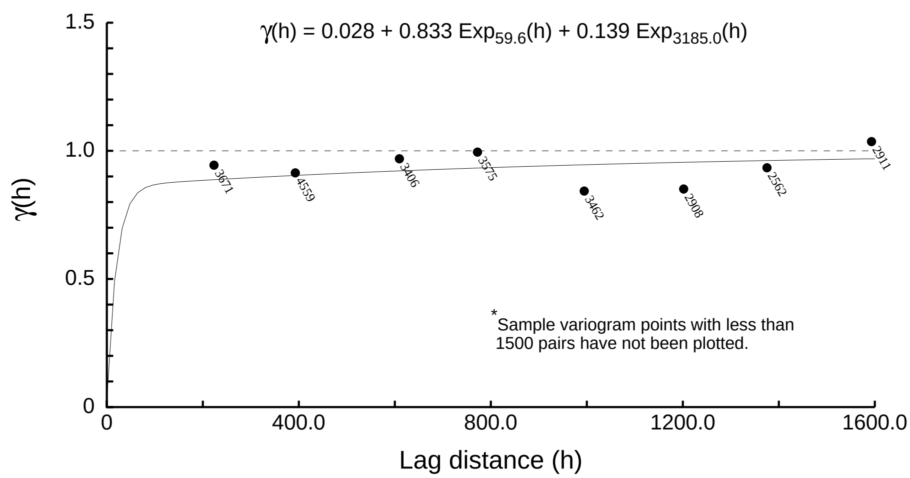
AZIMUTH = 210 DIP = 0

$\gamma(h) = 0.028 + 0.833\ Exp_{34.5}(h) + 0.139\ Exp_{1007.3}(h)$

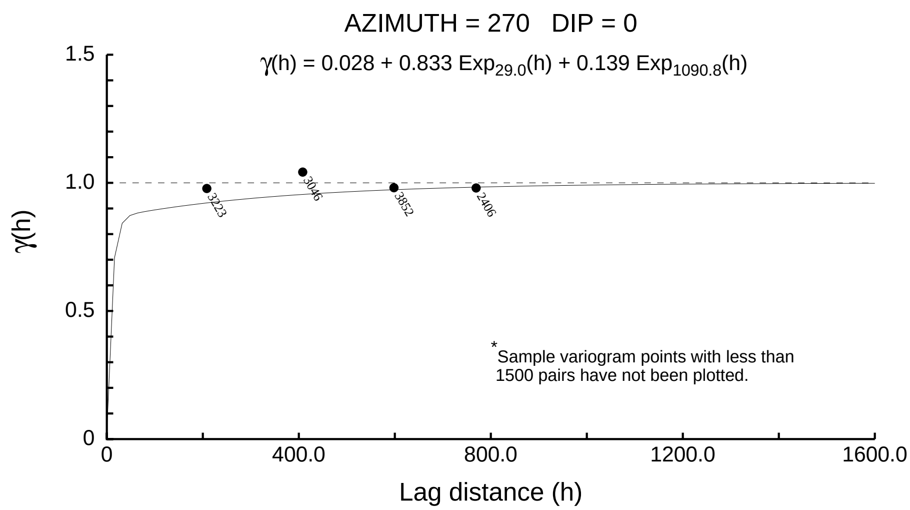


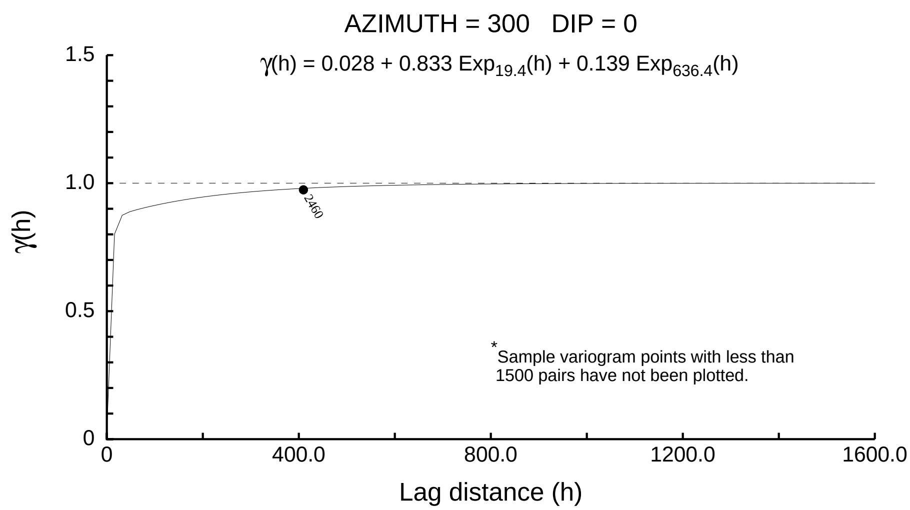
AZIMUTH = 240 DIP = 0

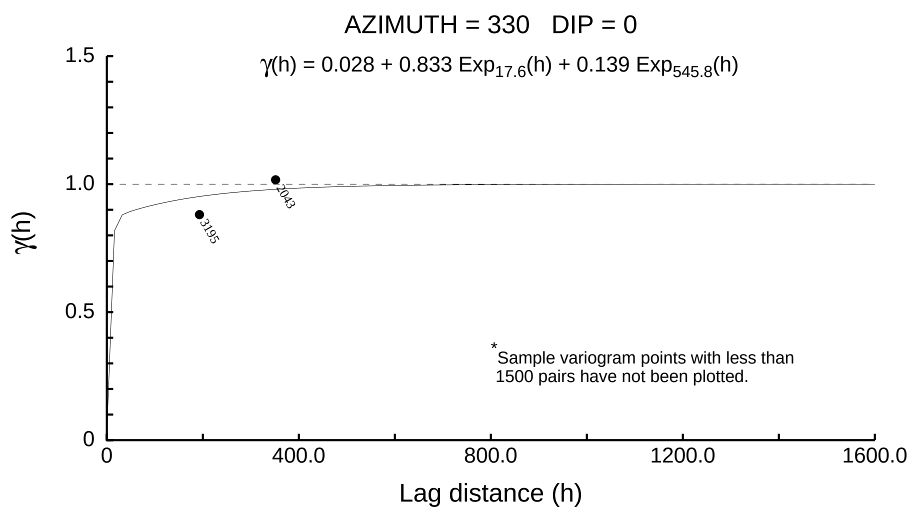
$\gamma(h) = 0.028 + 0.833\ Exp_{59.6}(h) + 0.139\ Exp_{3185.0}(h)$



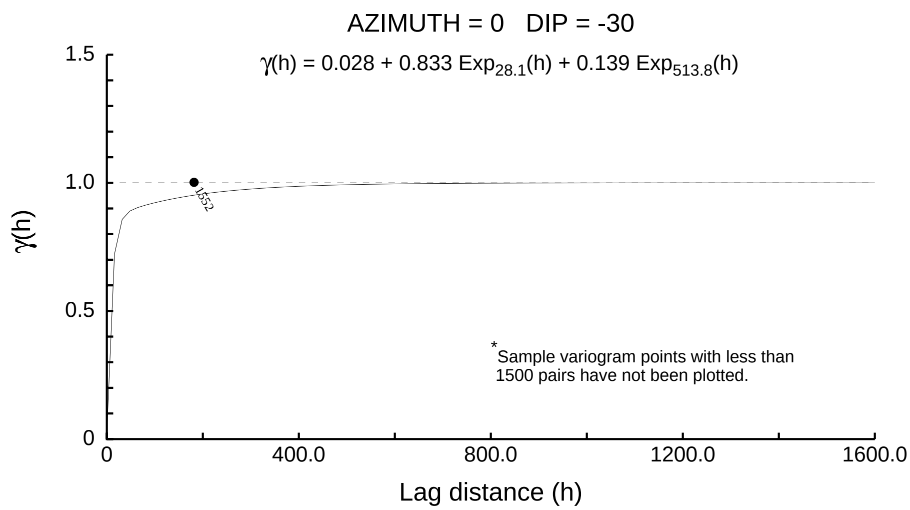
Directional 1003 - Cu

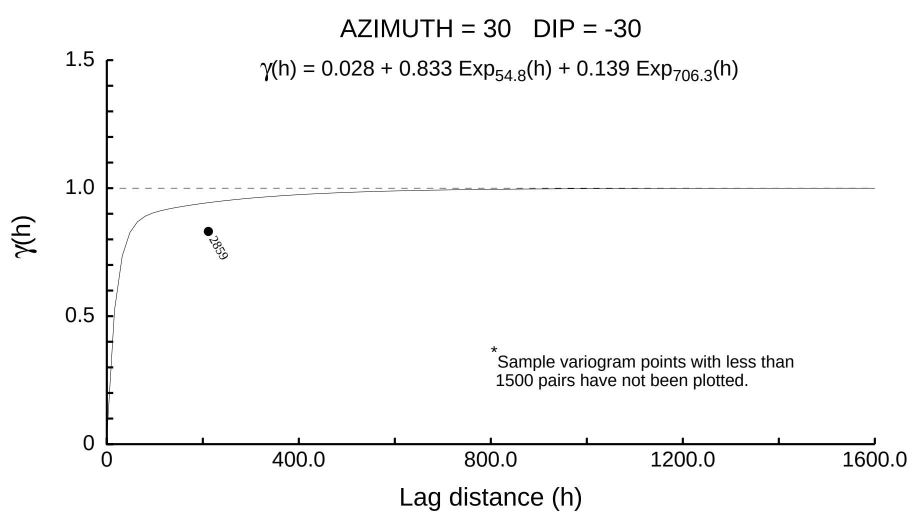


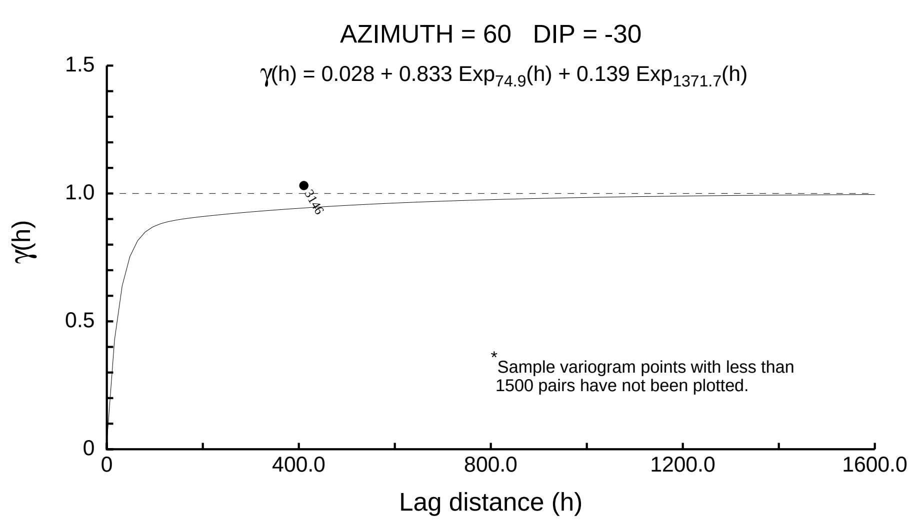




Directional 1003 - Cu



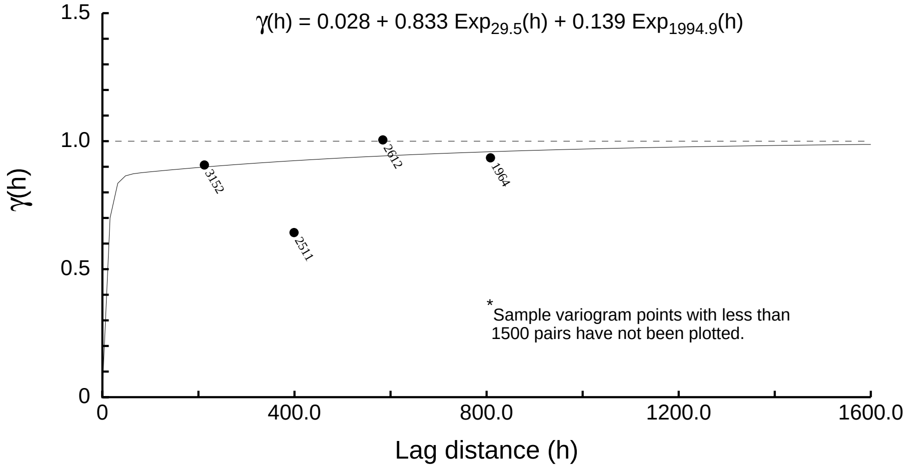




Directional 1003 - Cu

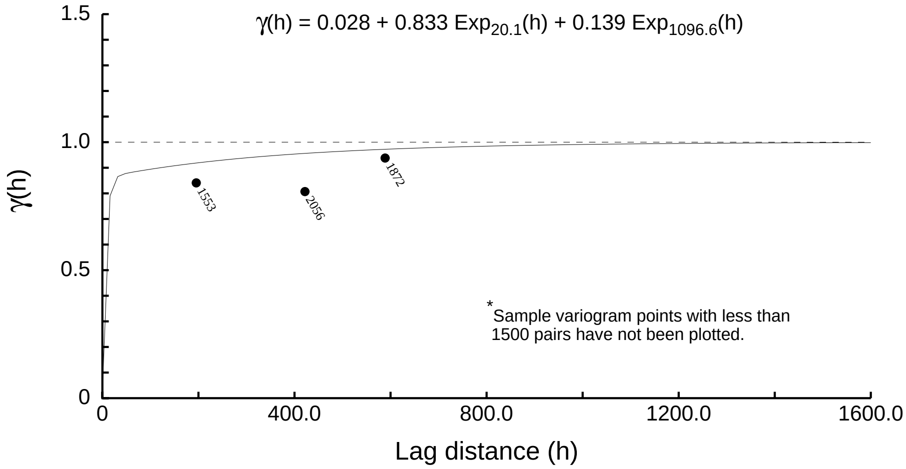
AZIMUTH = 90   DIP = -30

$\gamma(h) = 0.028 + 0.833\ Exp_{29.5}(h) + 0.139\ Exp_{1994.9}(h)$



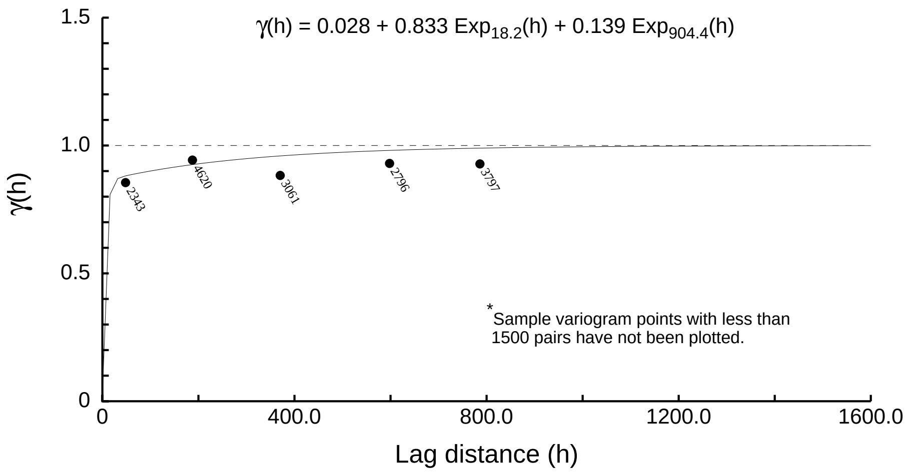
AZIMUTH = 120   DIP = -30

$\gamma(h) = 0.028 + 0.833\ Exp_{20.1}(h) + 0.139\ Exp_{1096.6}(h)$

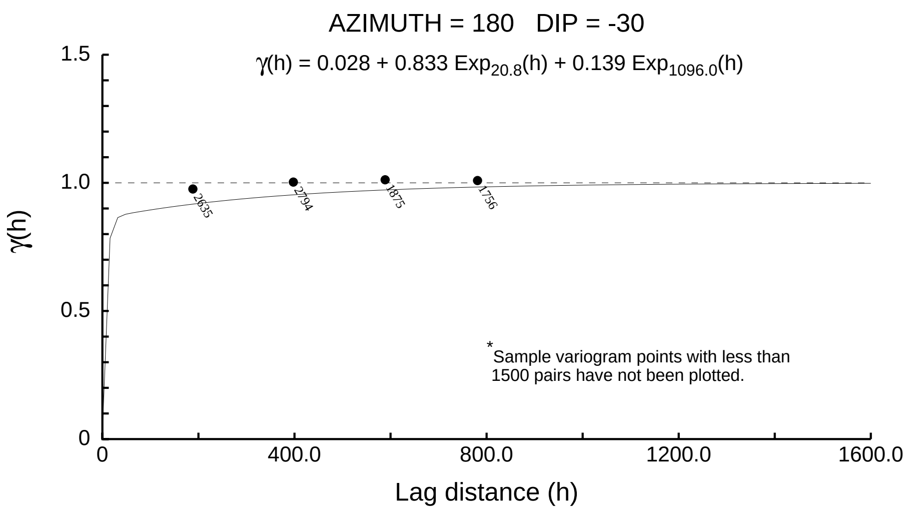


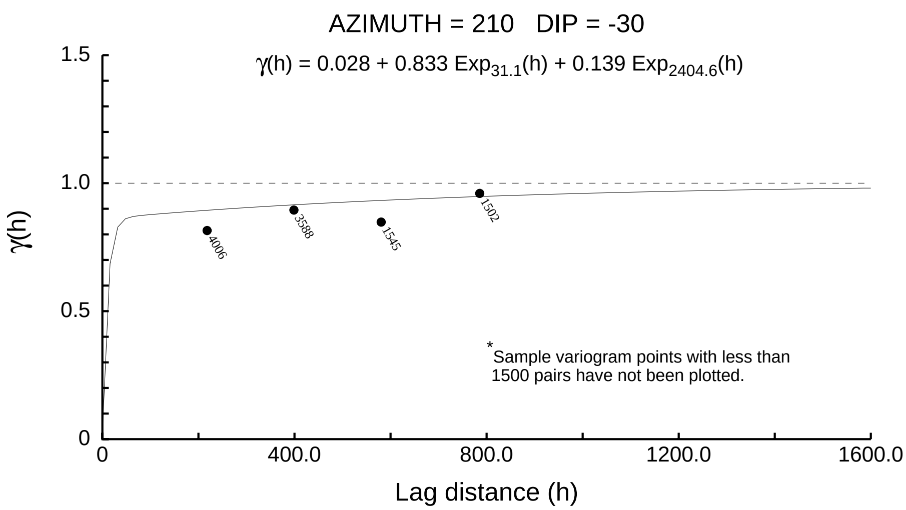
AZIMUTH = 150   DIP = -30

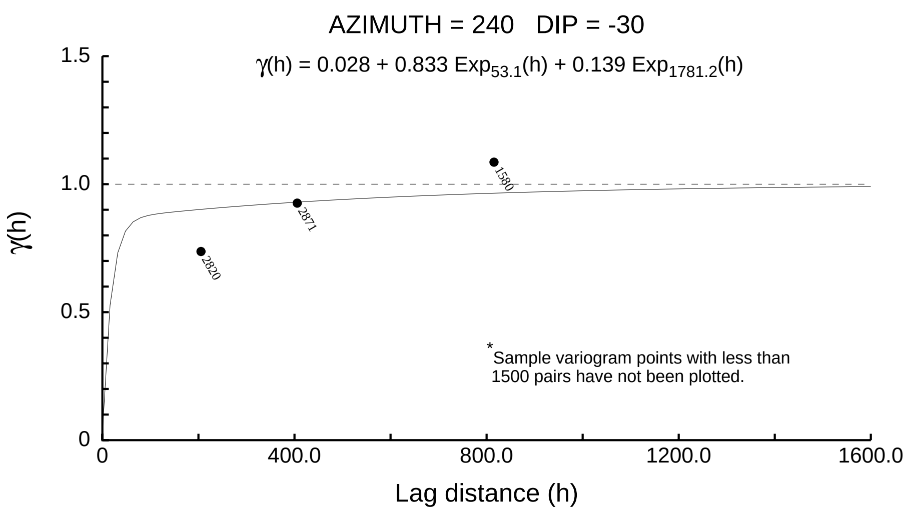
$\gamma(h) = 0.028 + 0.833\ Exp_{18.2}(h) + 0.139\ Exp_{904.4}(h)$



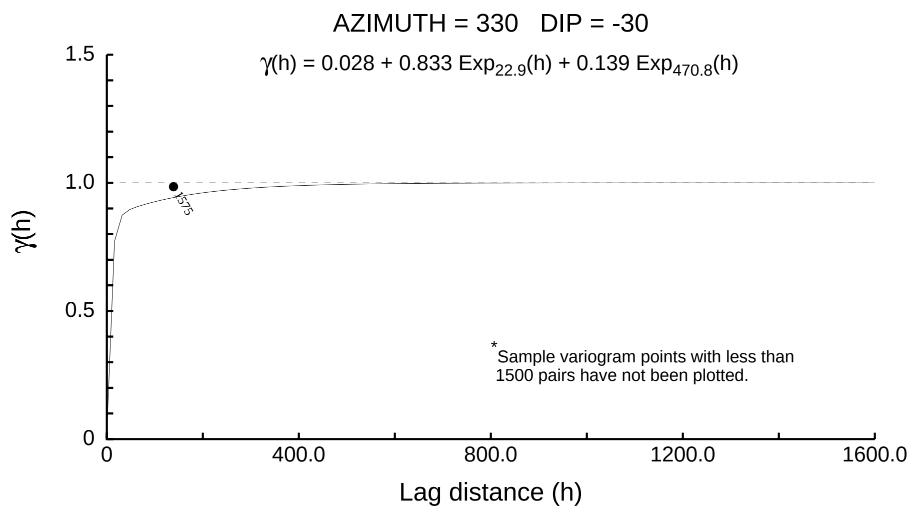
Directional 1003 - Cu

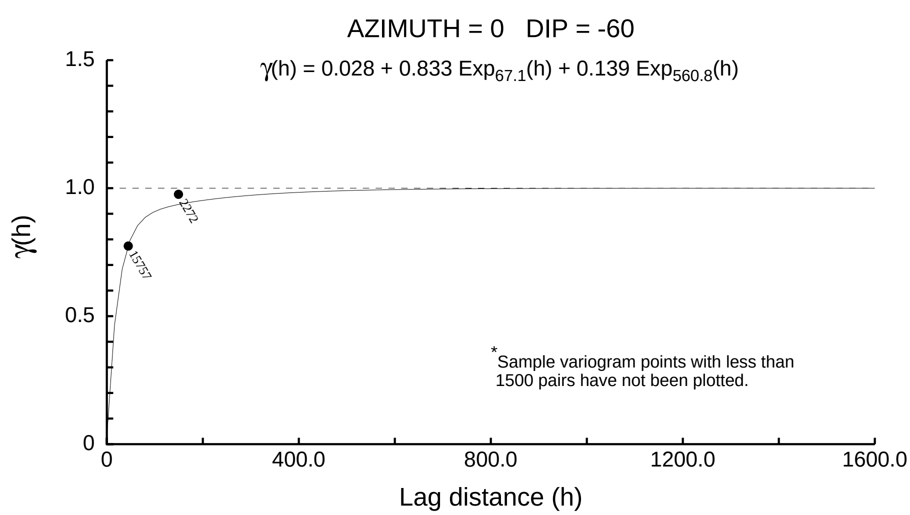


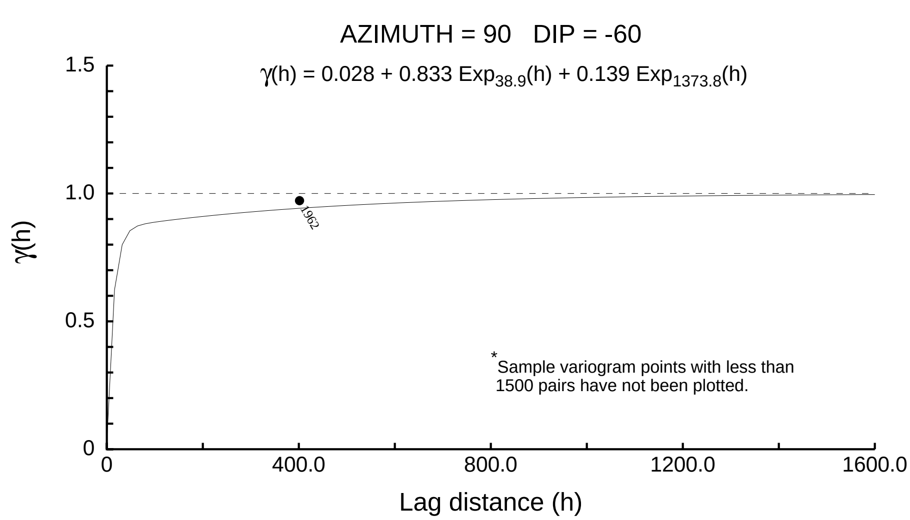




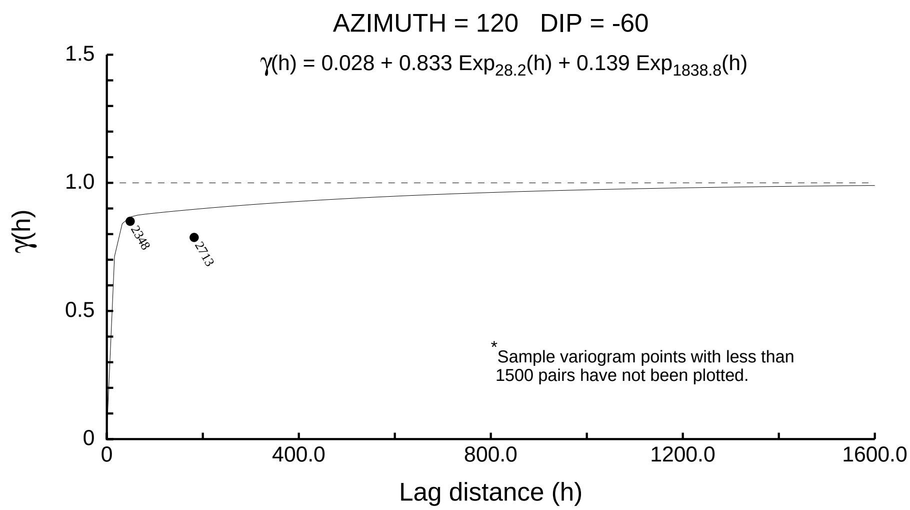
Directional 1003 - Cu

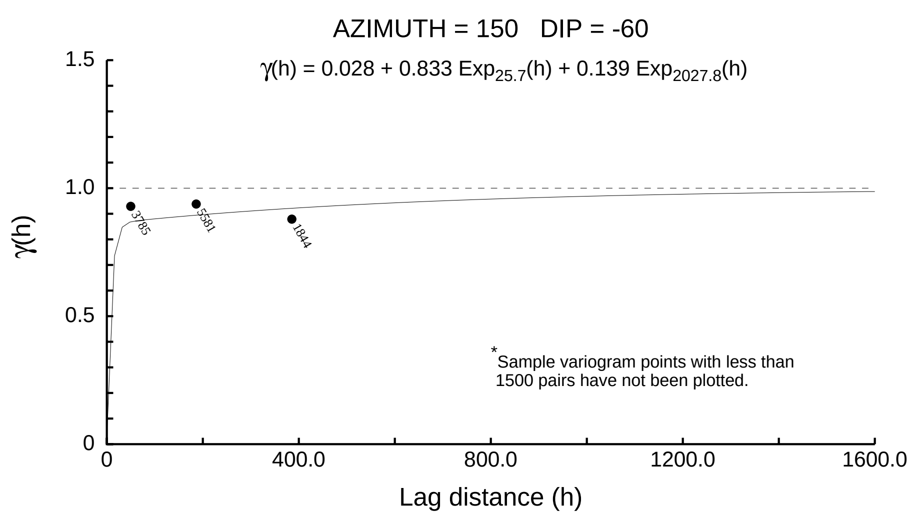


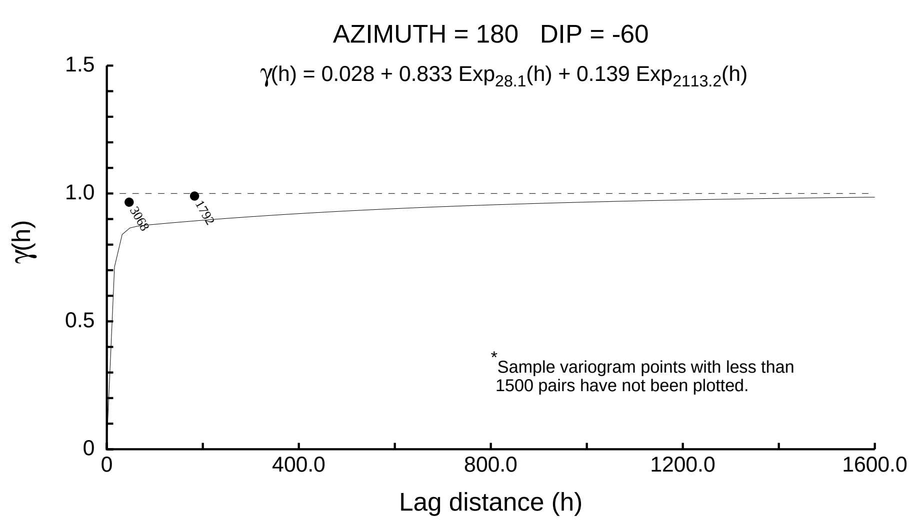




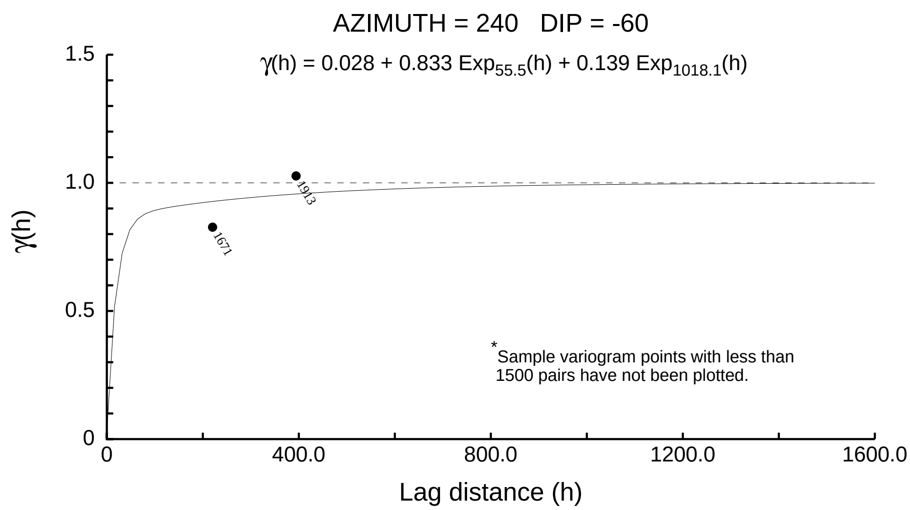
Directional 1003 - Cu

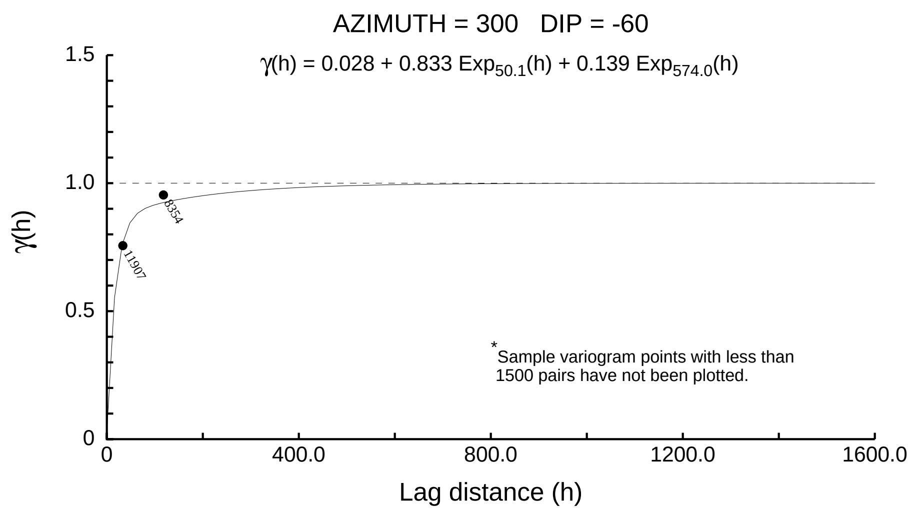


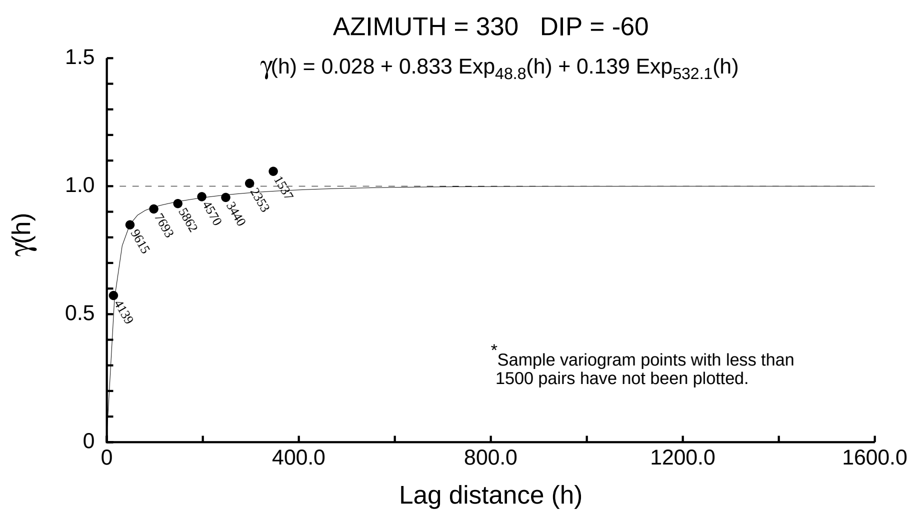




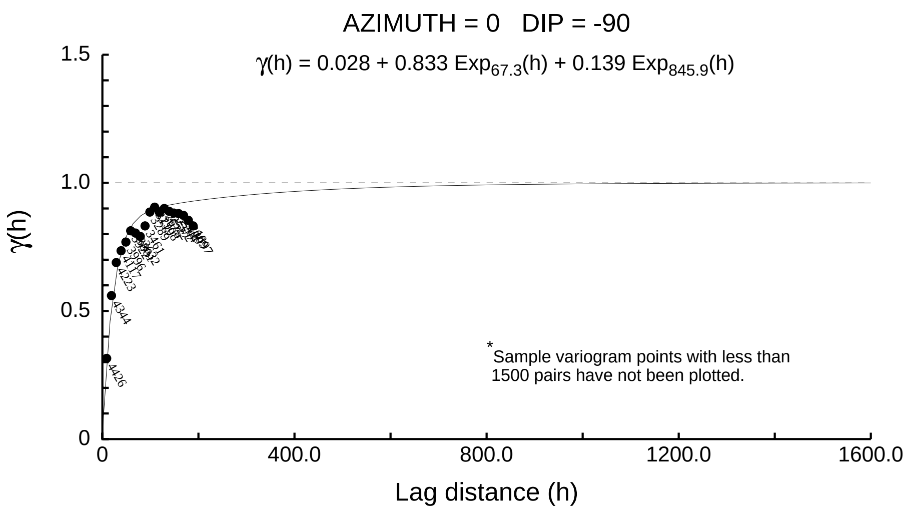
Directional 1003 - Cu







Directional 1003 - Cu



Directional 1003 - Ni

User Defined Rotation Conventions

Nugget ==> 0.016
C1 ==> 0.559
C2 ==> 0.425

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -69
RH Rotation about the Y' axis ==> -9
RH Rotation about the Z' axis ==> -4
Range along the Z' axis ==> 42.5 Azimuth ==> 339 Dip ==> 81
Range along the Y' axis ==> 313.7 Azimuth ==> 73 Dip ==> 1
Range along the X' axis ==> 239.3 Azimuth ==> 163 Dip ==> 9

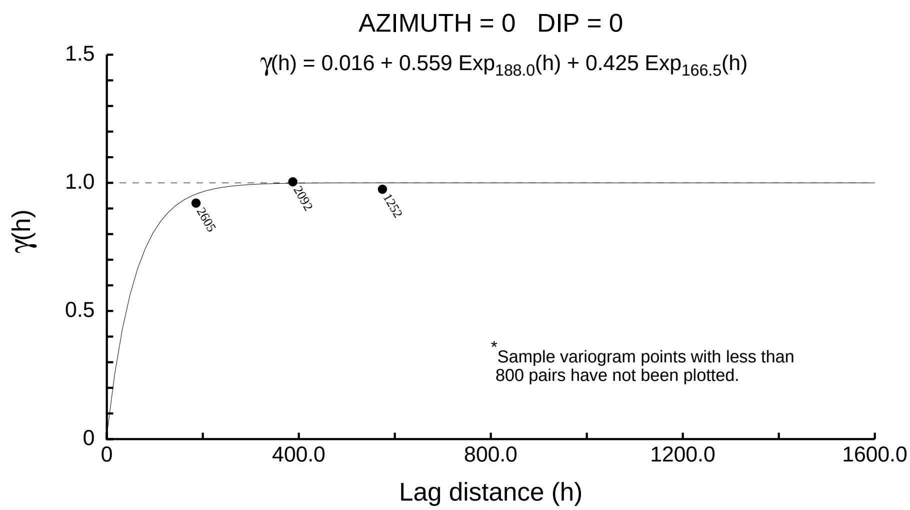
Second Structure -- Exponential with Practical Range

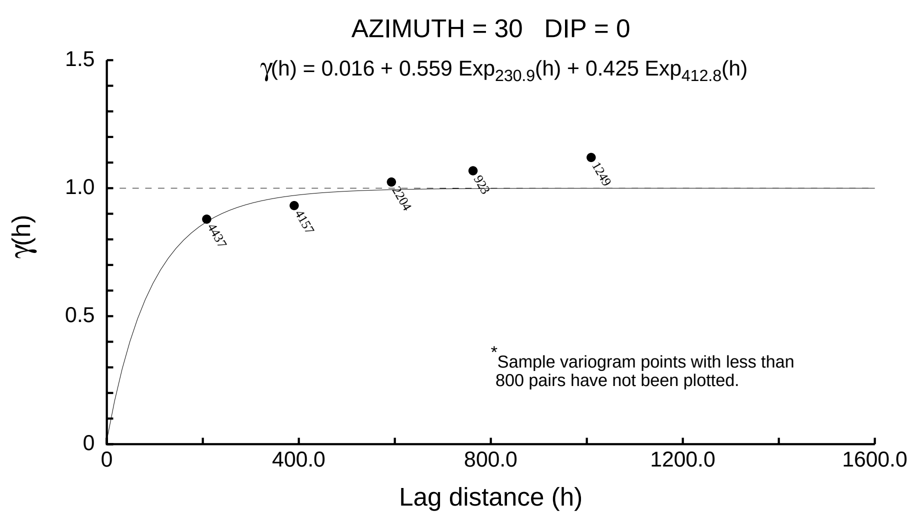
RH Rotation about the Z axis ==> -14
RH Rotation about the Y' axis ==> -1
RH Rotation about the Z' axis ==> -32
Range along the Z' axis ==> 761.3 Azimuth ==> 284 Dip ==> 89
Range along the Y' axis ==> 1431.6 Azimuth ==> 46 Dip ==> 1
Range along the X' axis ==> 120.9 Azimuth ==> 136 Dip ==> 1

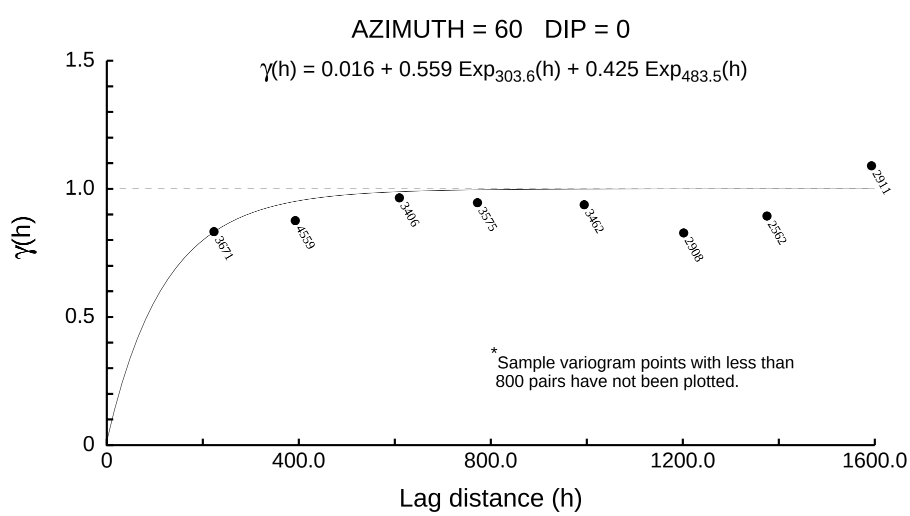
Modeling Criteria

Minimum number pairs req'd ==> 800
Sample variogram points weighted by # pairs

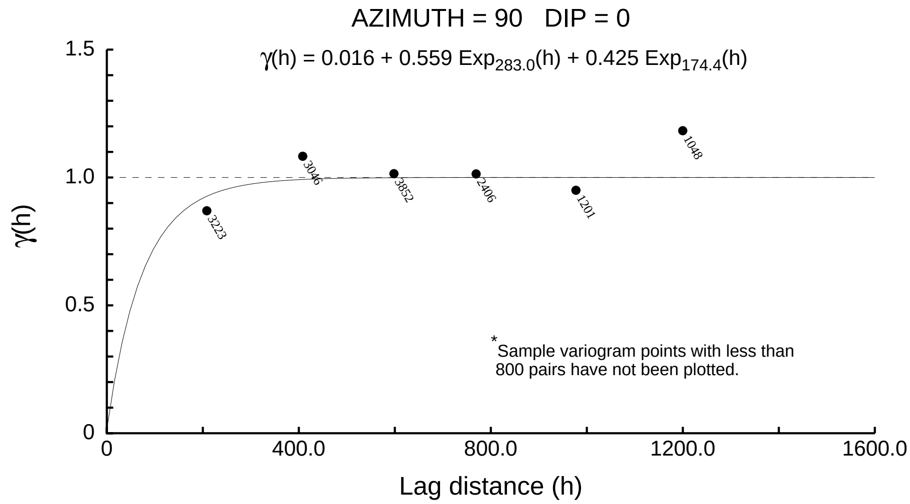
Directional 1003 - Ni

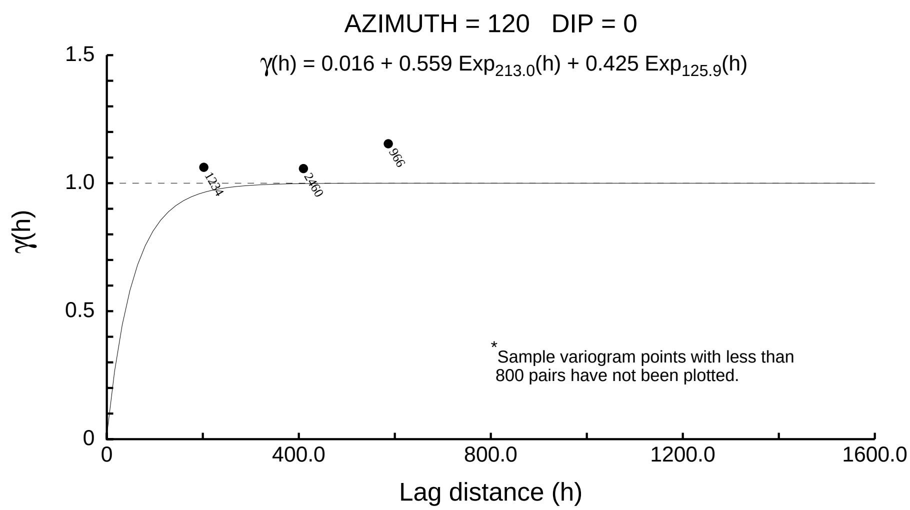


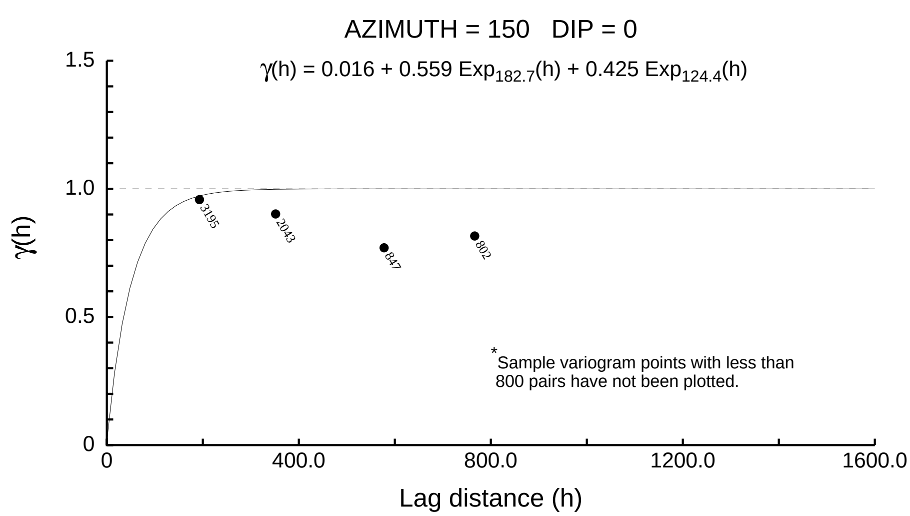




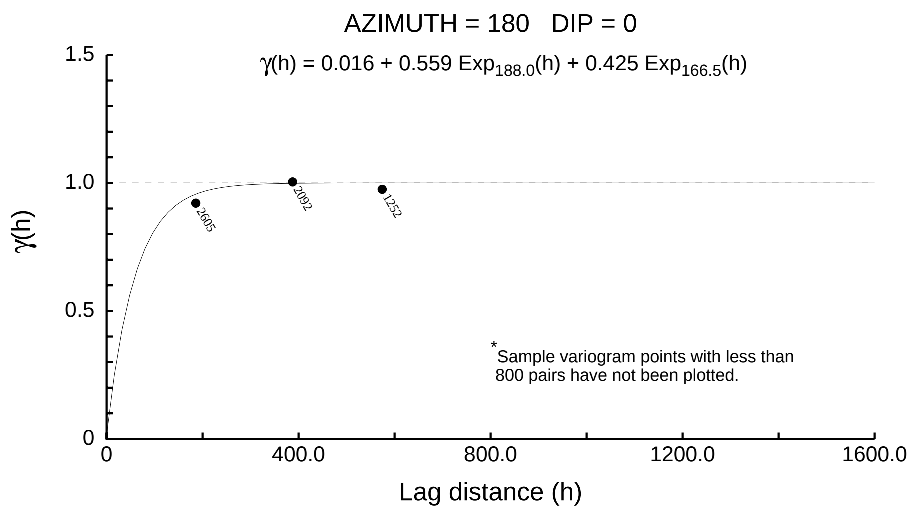
Directional 1003 - Ni

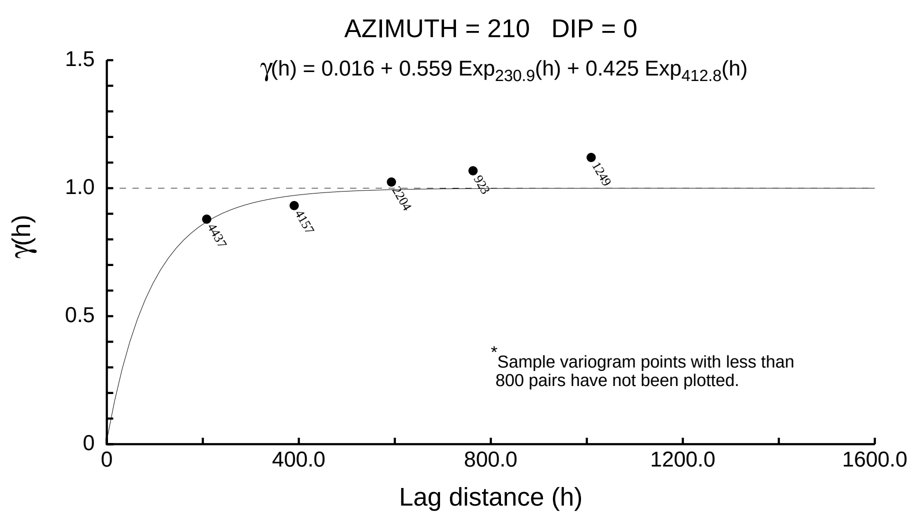


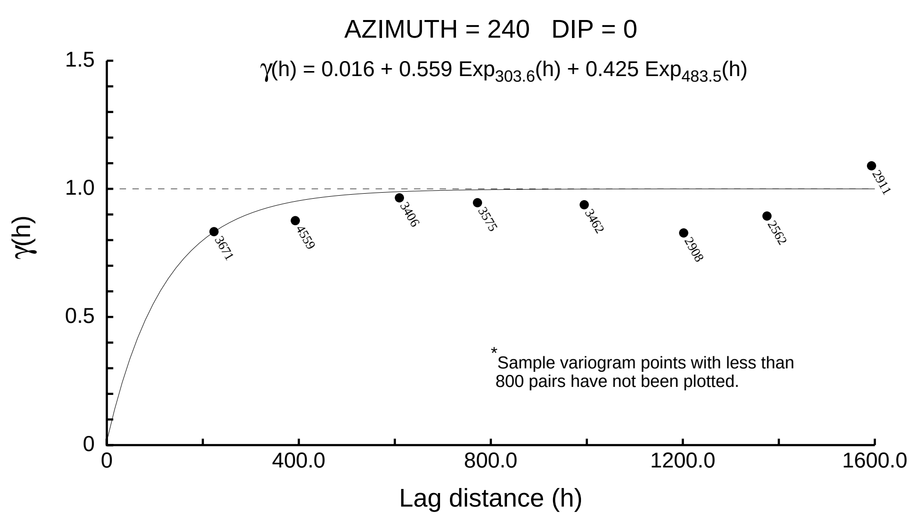




Directional 1003 - Ni

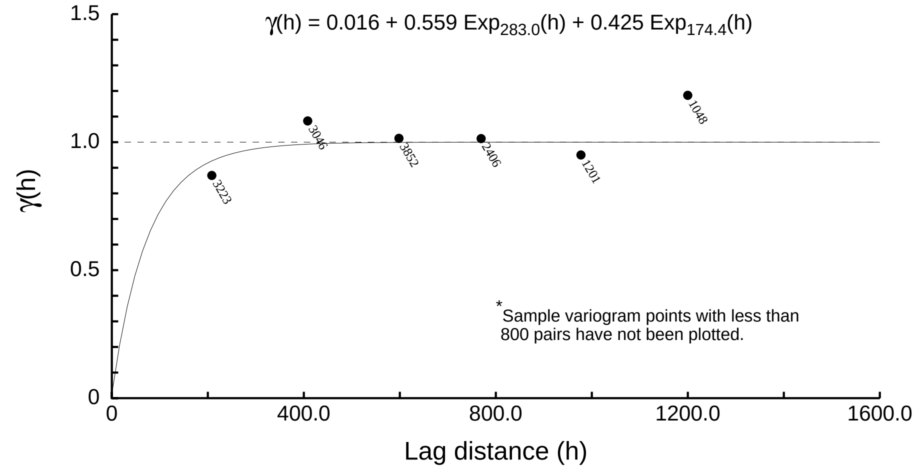




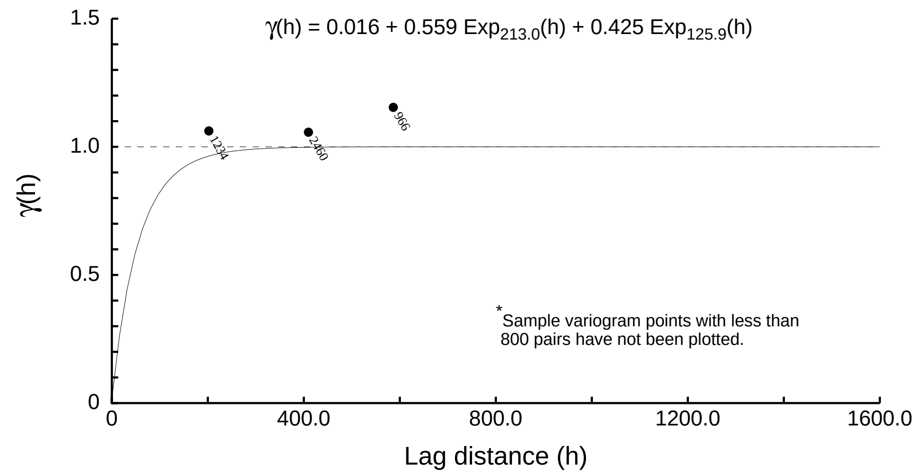


Directional 1003 - Ni

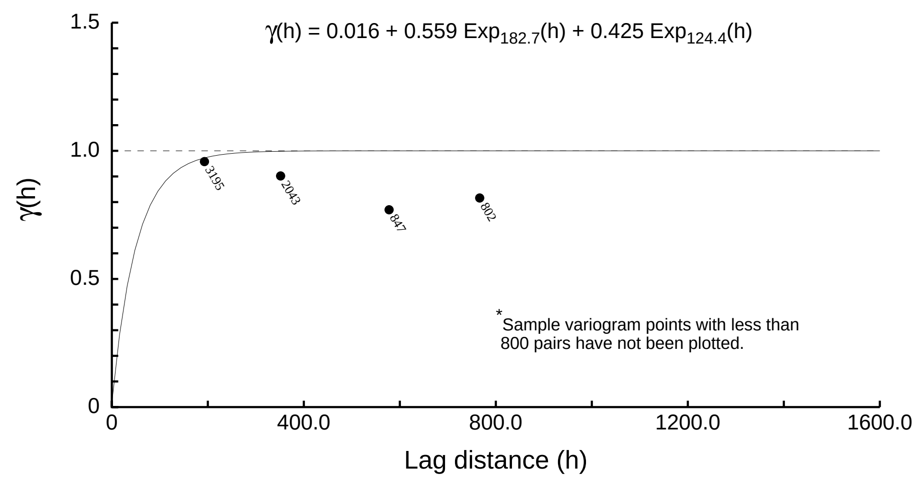
AZIMUTH = 270   DIP = 0



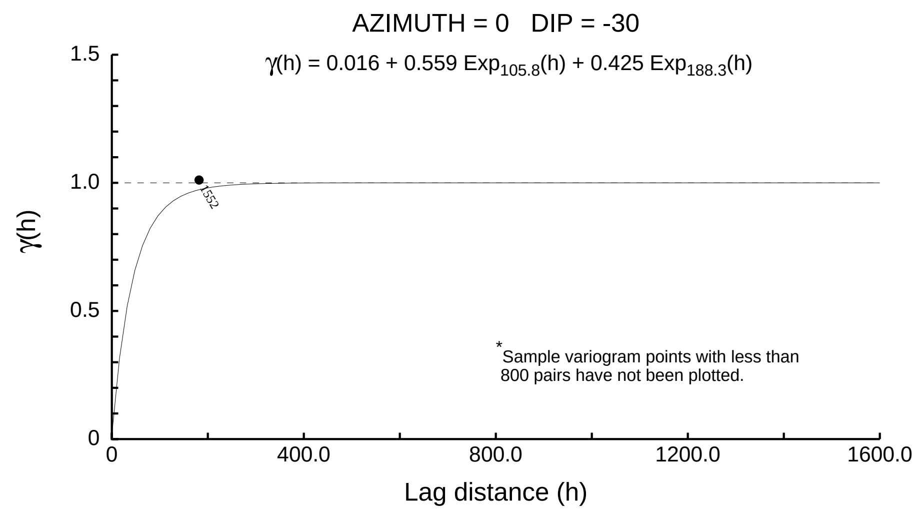
AZIMUTH = 300   DIP = 0

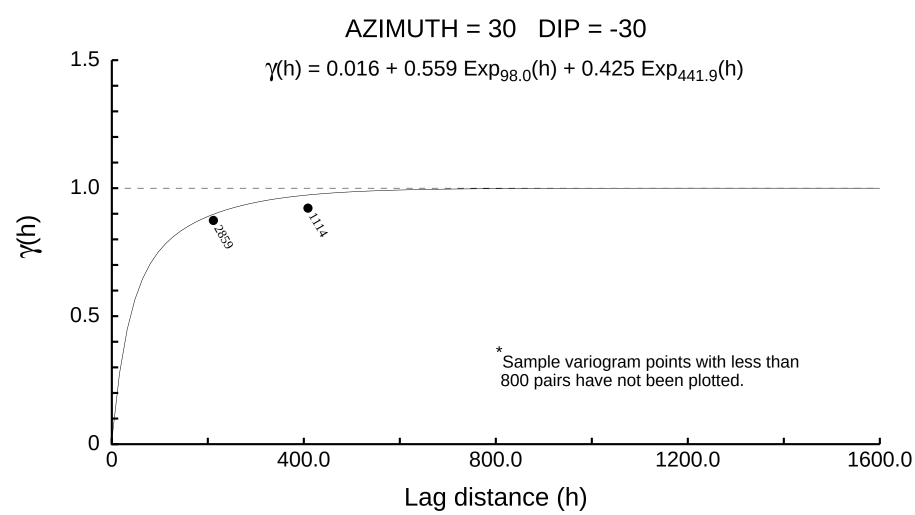


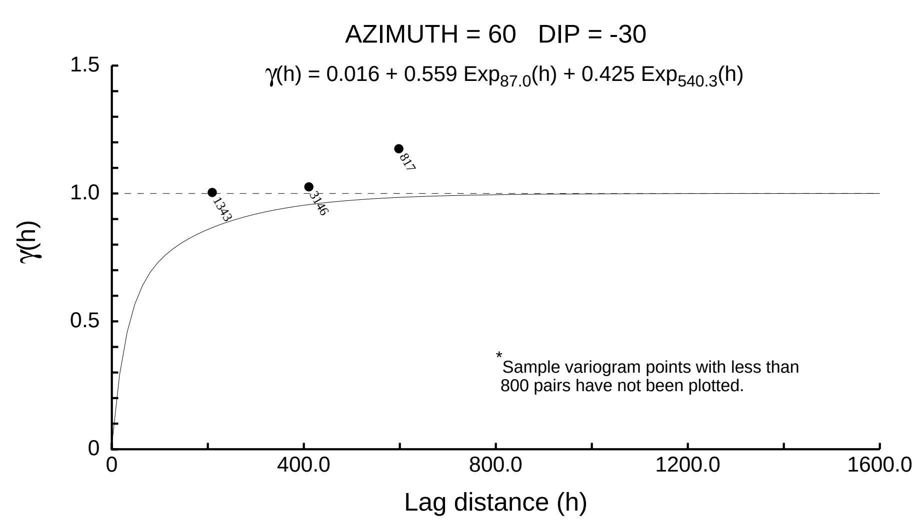
AZIMUTH = 330   DIP = 0



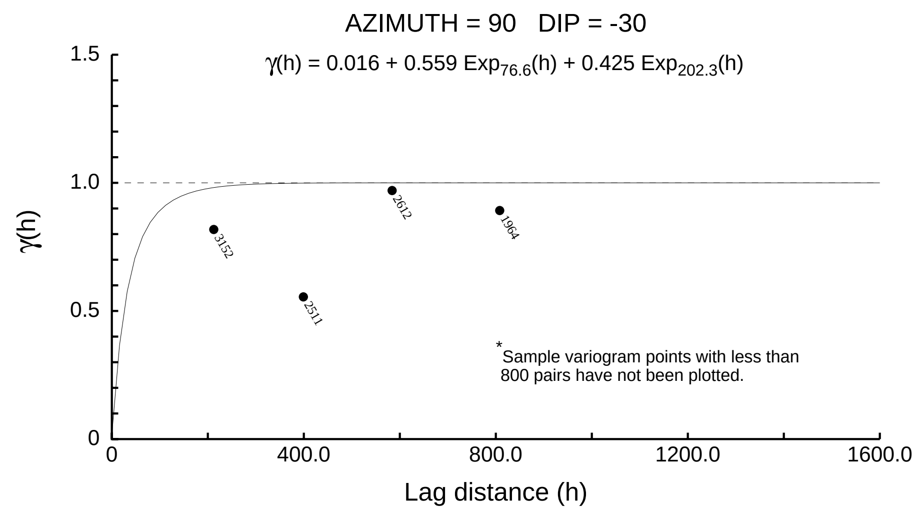
Directional 1003 - Ni

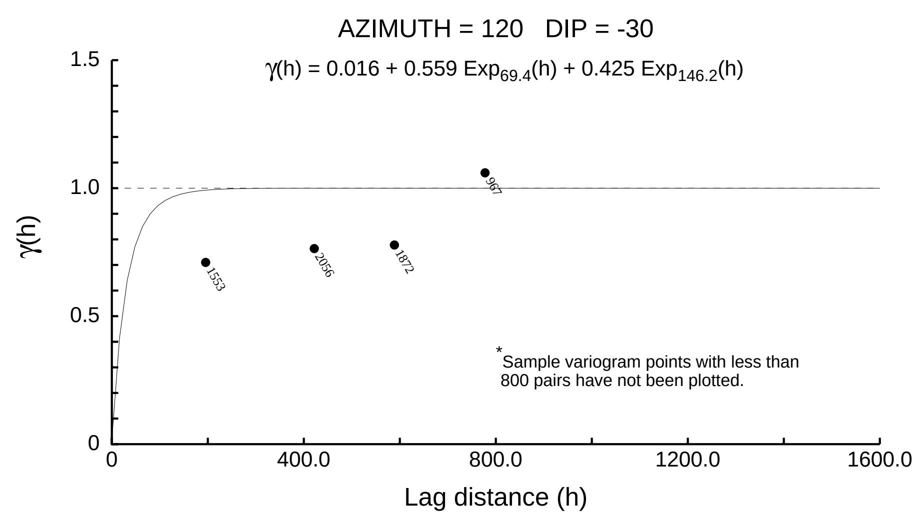


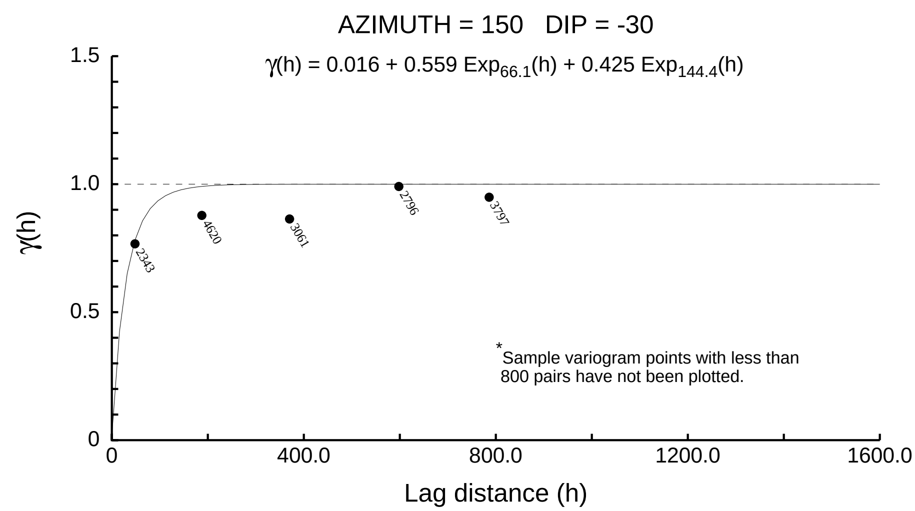




Directional 1003 - Ni







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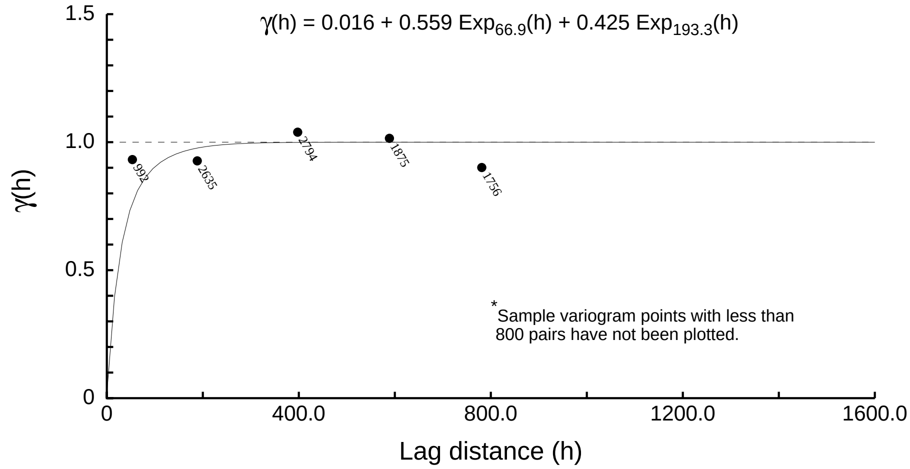
Directional 1003 - Ni

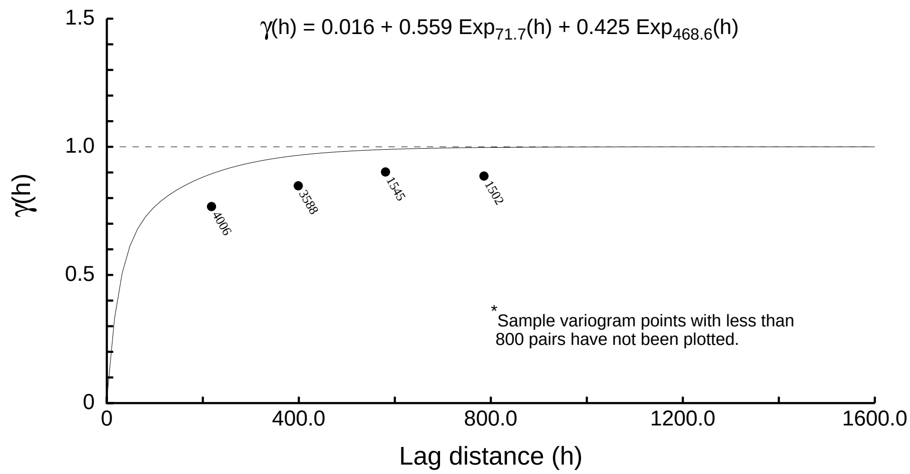
AZIMUTH = 180 DIP = -30

$\gamma(h) = 0.016 + 0.559\ Exp_{66.9}(h) + 0.425\ Exp_{193.3}(h)$



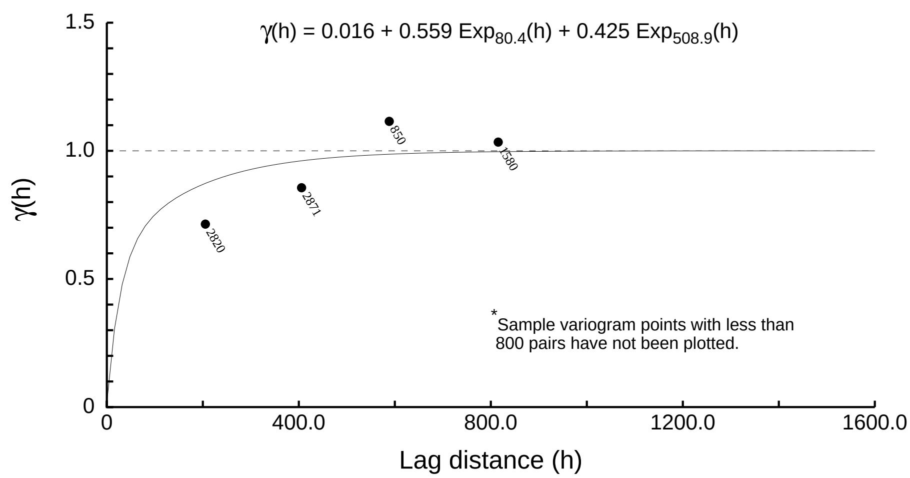
AZIMUTH = 210 DIP = -30

$\gamma(h) = 0.016 + 0.559\ Exp_{71.7}(h) + 0.425\ Exp_{468.6}(h)$

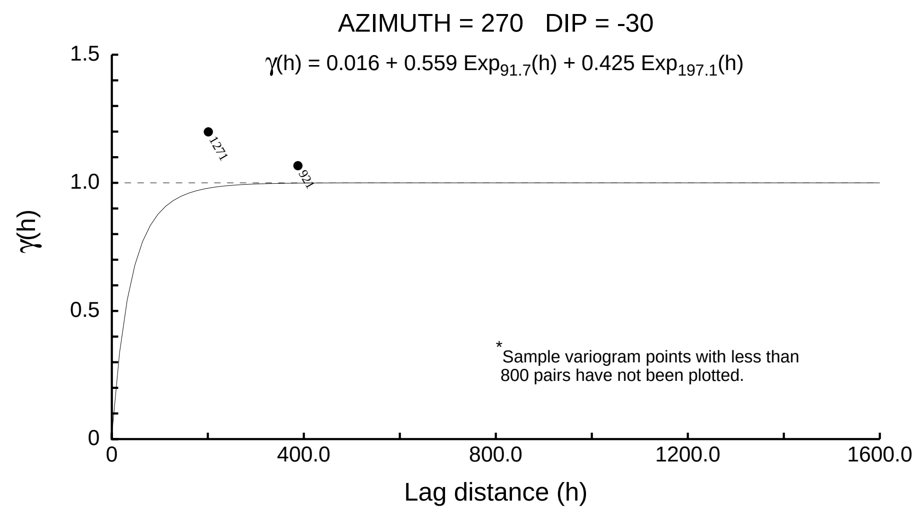


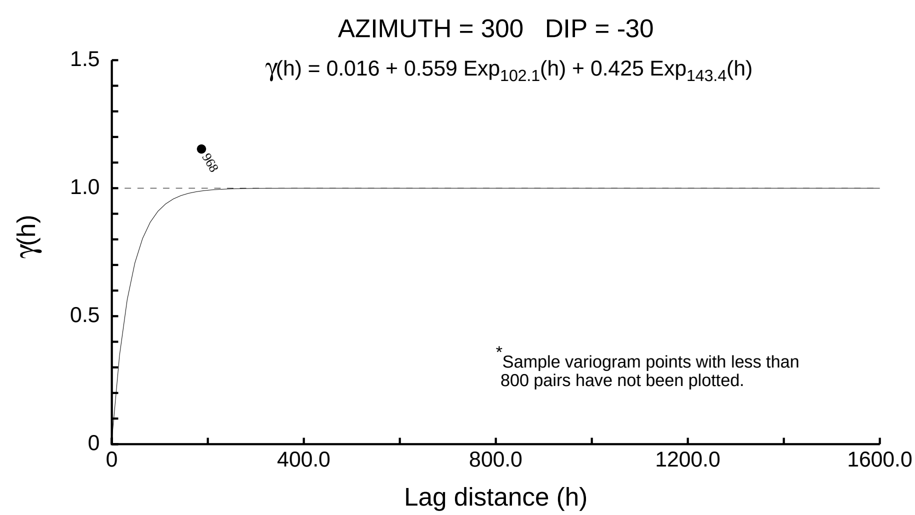
AZIMUTH = 240 DIP = -30

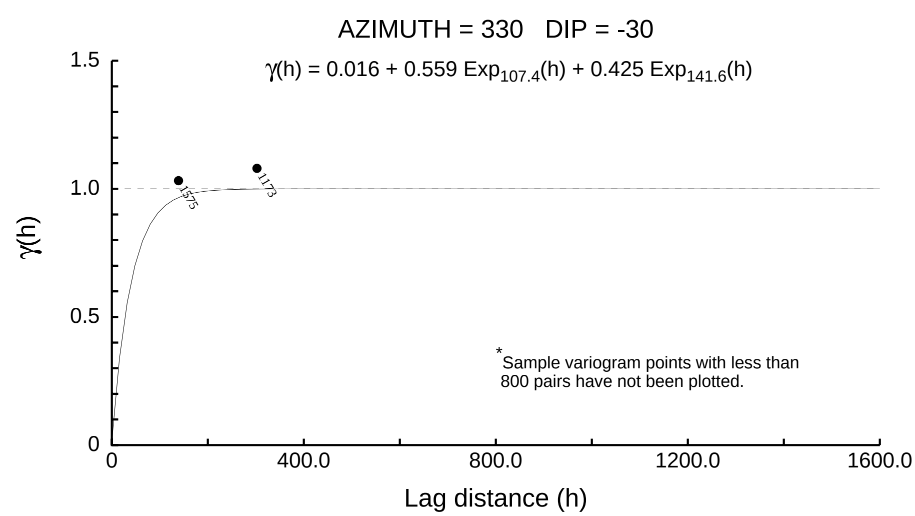
$\gamma(h) = 0.016 + 0.559\ Exp_{80.4}(h) + 0.425\ Exp_{508.9}(h)$



Directional 1003 - Ni

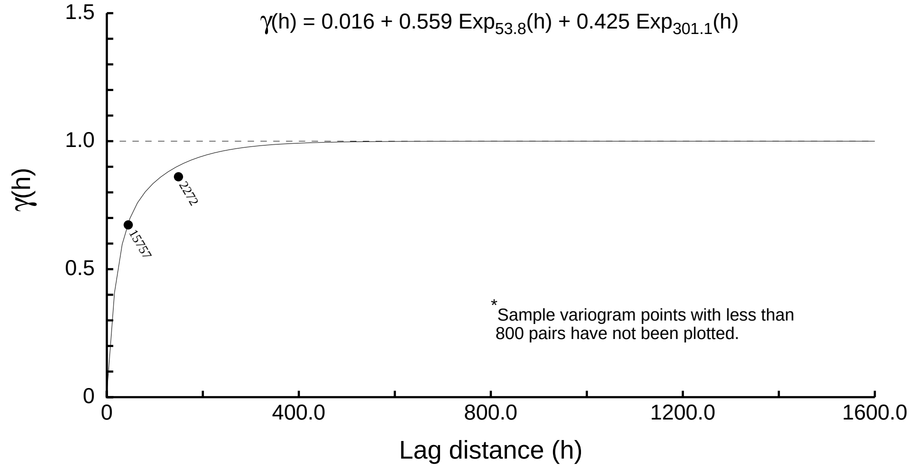




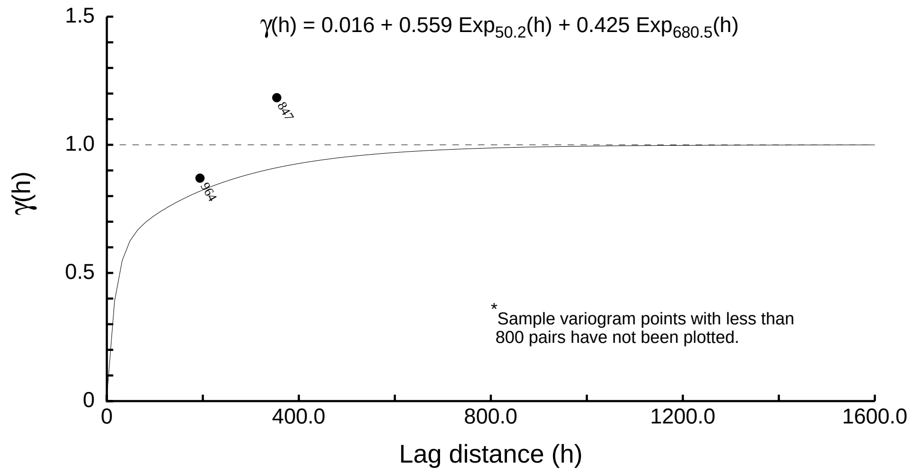


Directional 1003 - Ni

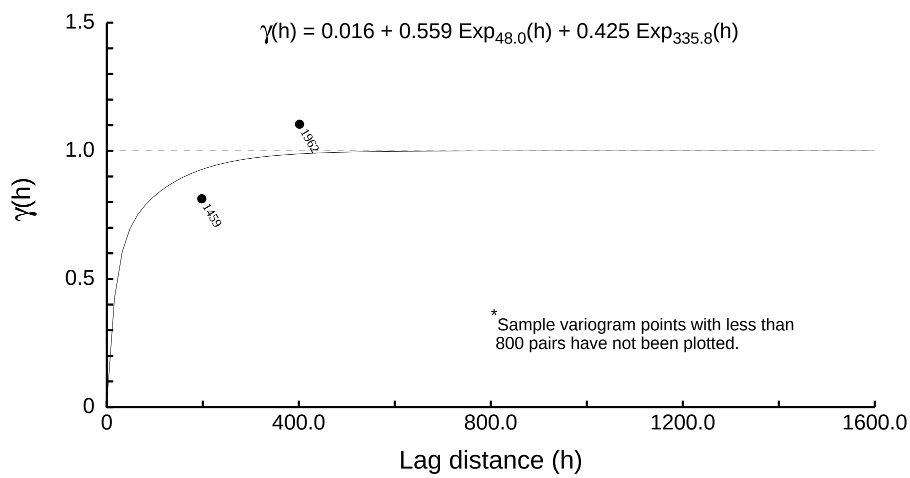
AZIMUTH = 0   DIP = -60



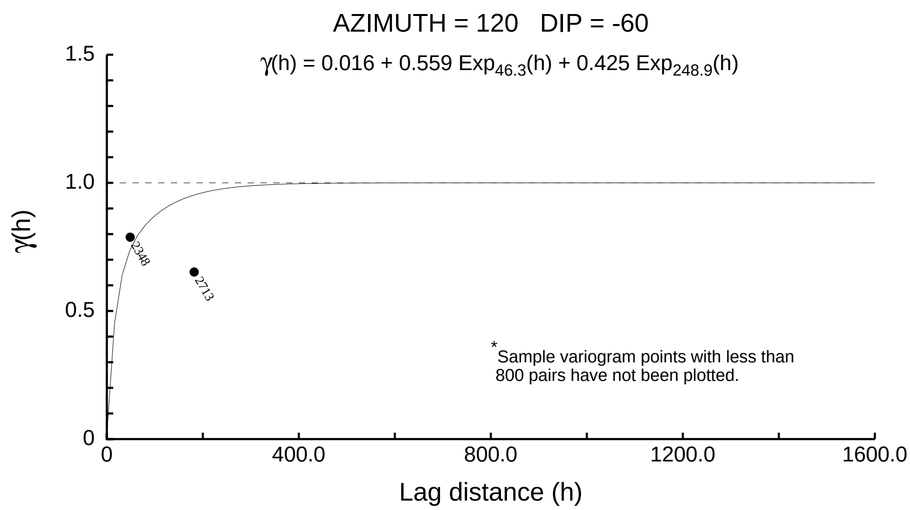
AZIMUTH = 60   DIP = -60

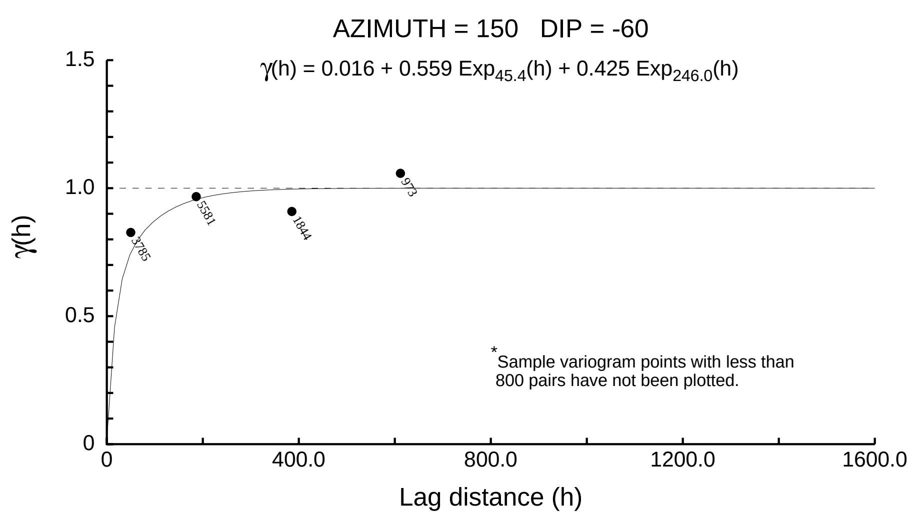


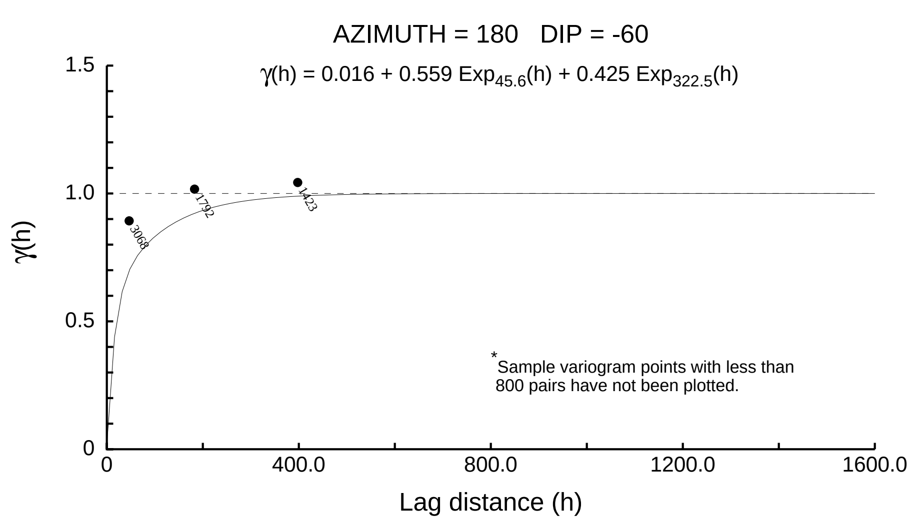
AZIMUTH = 90   DIP = -60



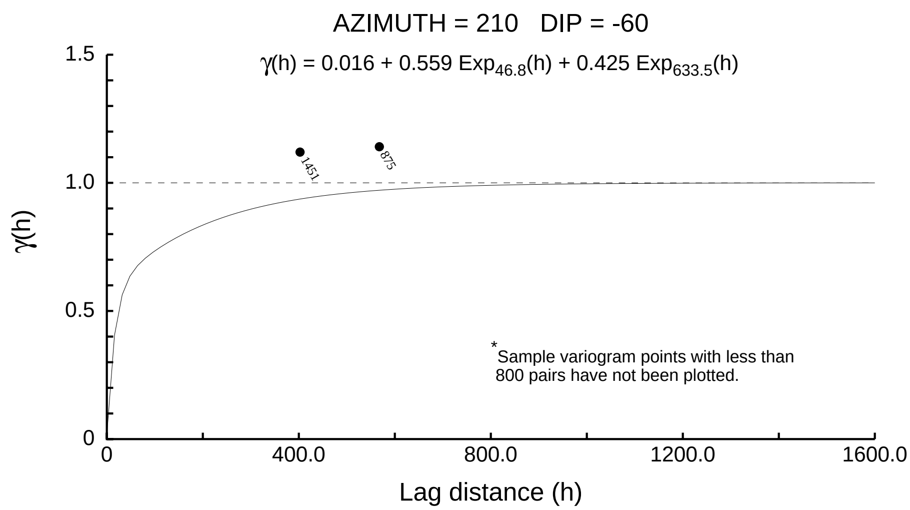
Directional 1003 - Ni

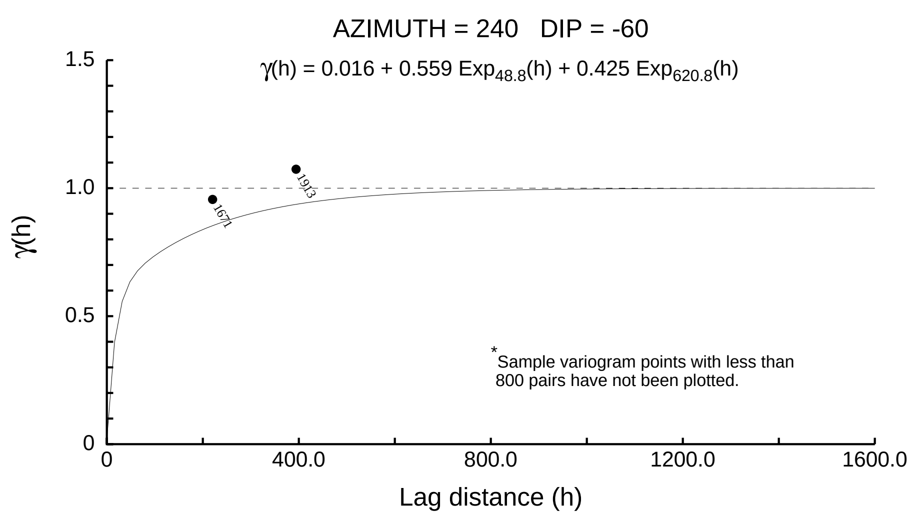


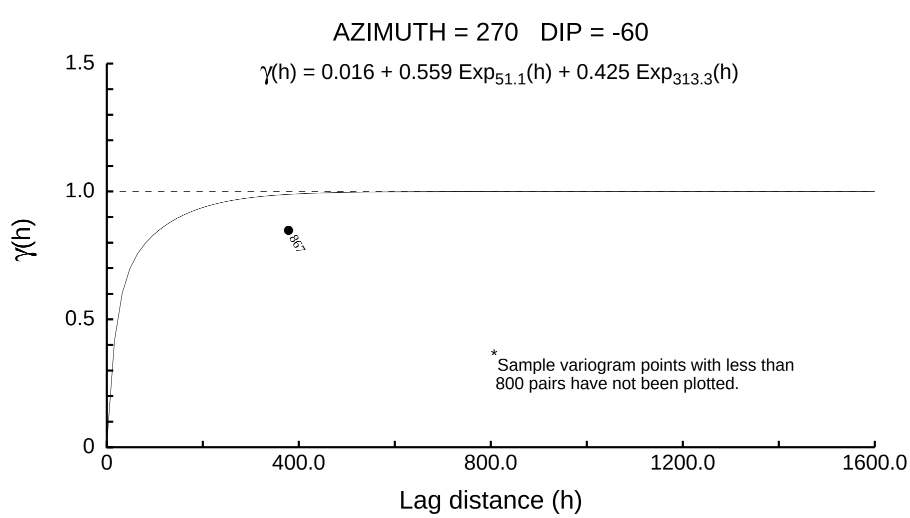




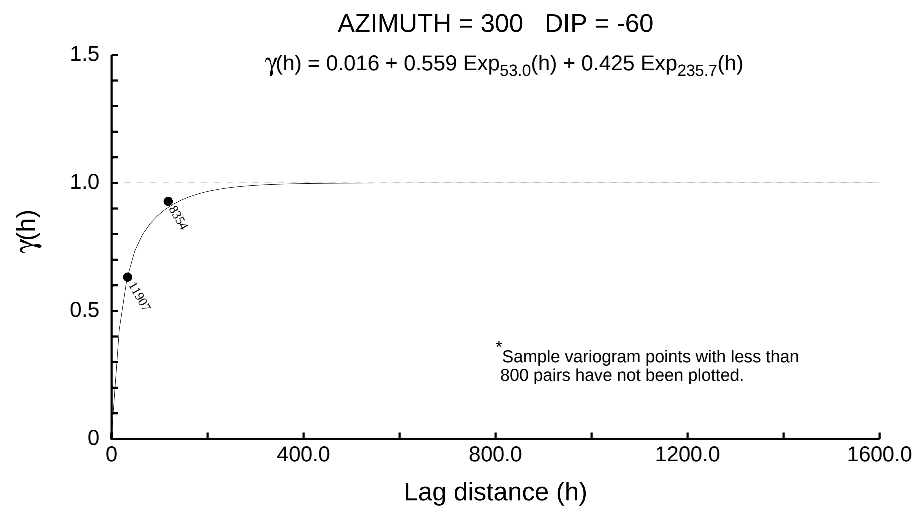
Directional 1003 - Ni

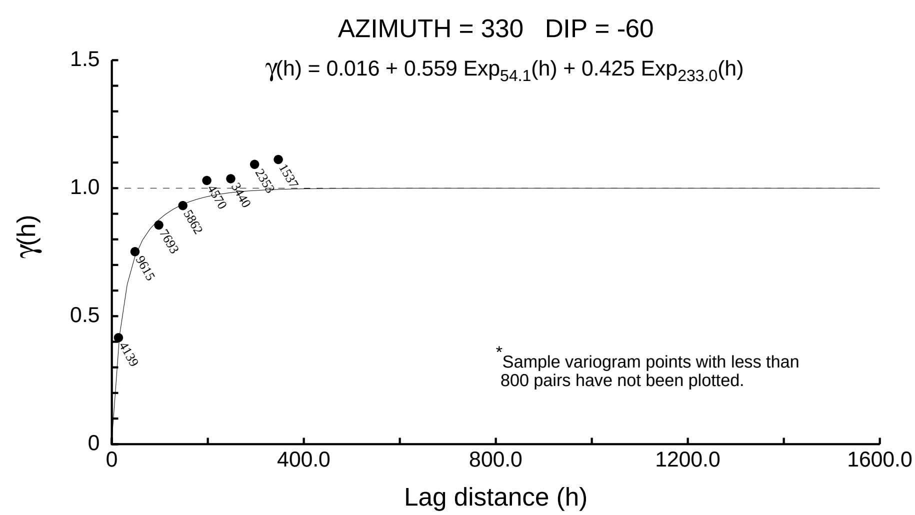


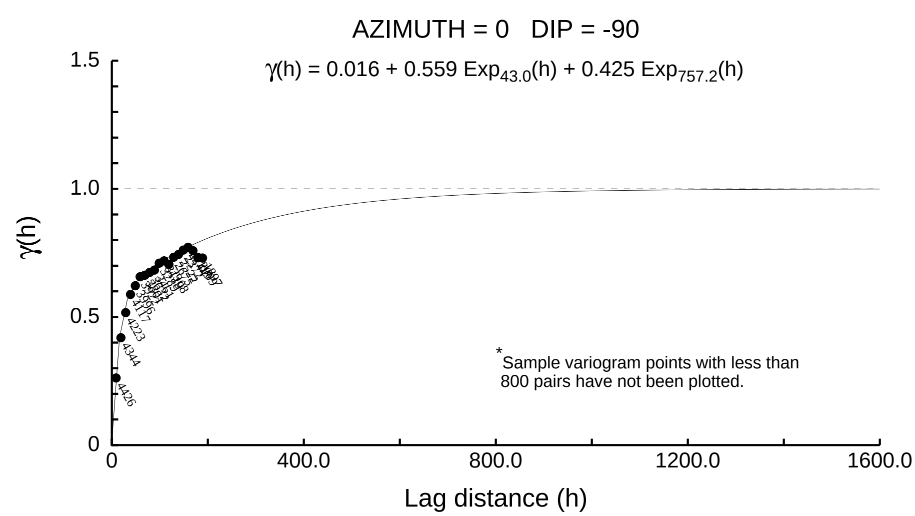




Directional 1003 - Ni







Directional 1003 - Pd

User Defined Rotation Conventions

Nugget ==> 0.004
C1 ==> 0.790
C2 ==> 0.206

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -35
RH Rotation about the Y' axis ==> -32
RH Rotation about the Z' axis ==> 6
Range along the Z' axis ==> 29.1 Azimuth ==> 305 Dip ==> 58
Range along the Y' axis ==> 268.8 Azimuth ==> 30 Dip ==> -3
Range along the X' axis ==> 69.5 Azimuth ==> 117 Dip ==> 31

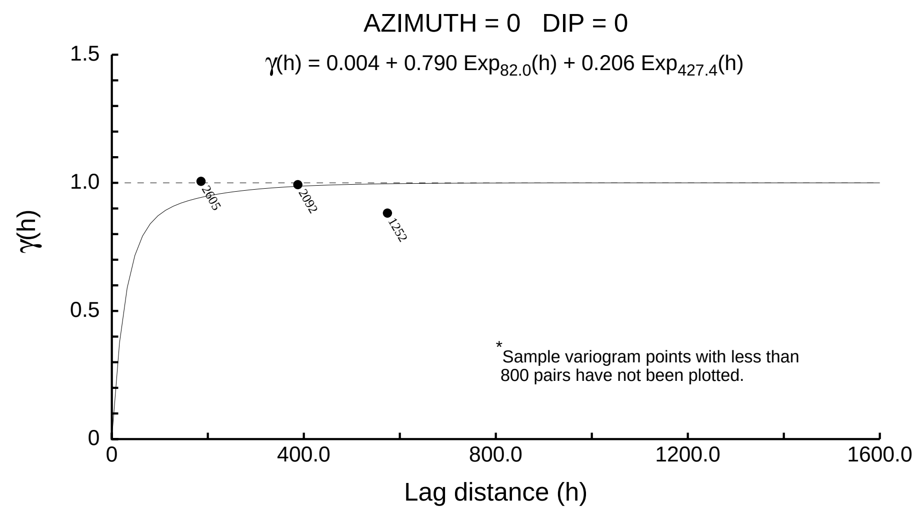
Second Structure -- Exponential with Practical Range

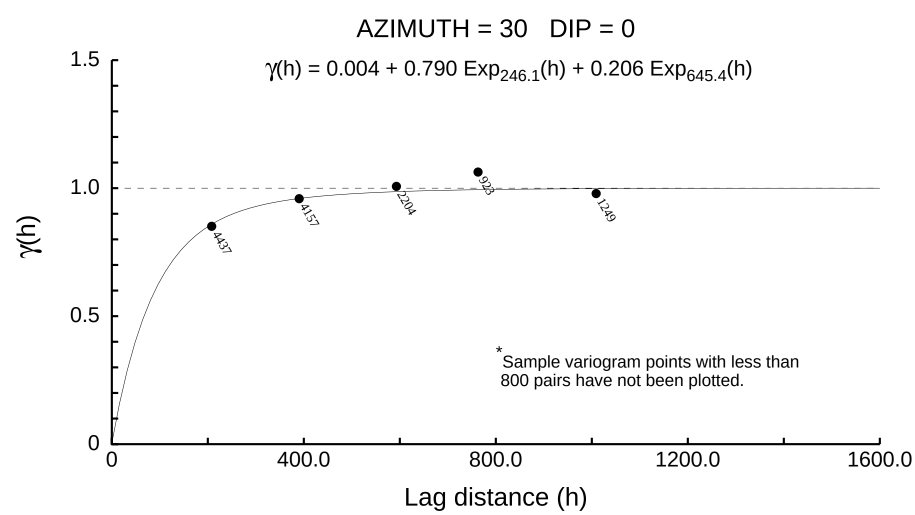
RH Rotation about the Z axis ==> -20
RH Rotation about the Y' axis ==> -54
RH Rotation about the Z' axis ==> -21
Range along the Z' axis ==> 3123.2 Azimuth ==> 290 Dip ==> 36
Range along the Y' axis ==> 831.6 Azimuth ==> 32 Dip ==> 17
Range along the X' axis ==> 244.9 Azimuth ==> 143 Dip ==> 49

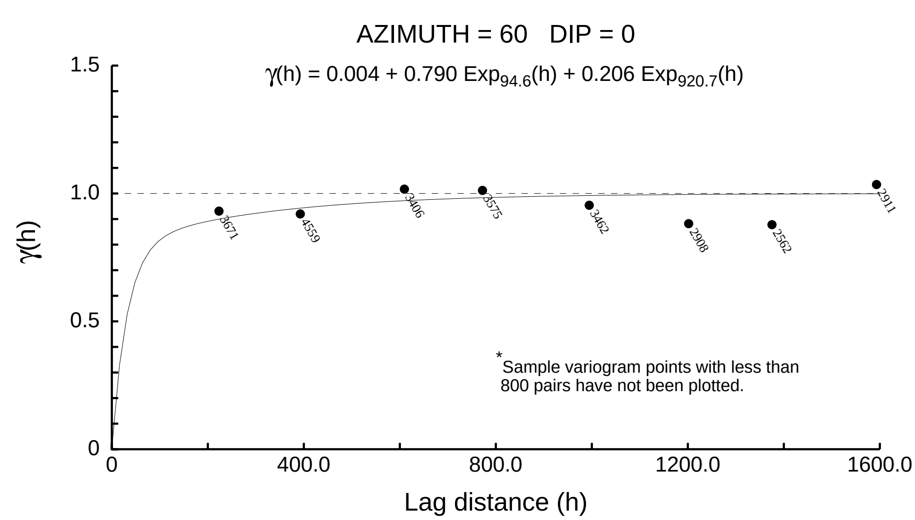
Modeling Criteria

Minimum number pairs req'd ==> 800
Sample variogram points weighted by # pairs

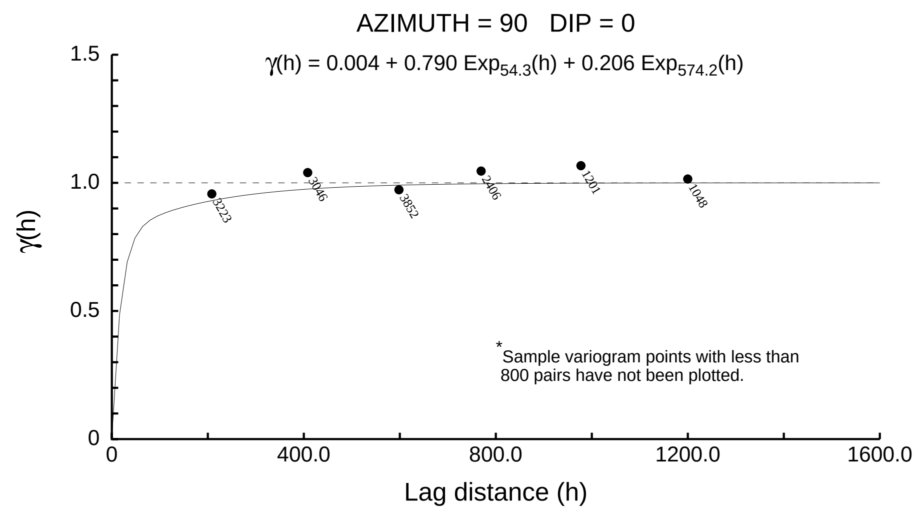
Directional 1003 - Pd

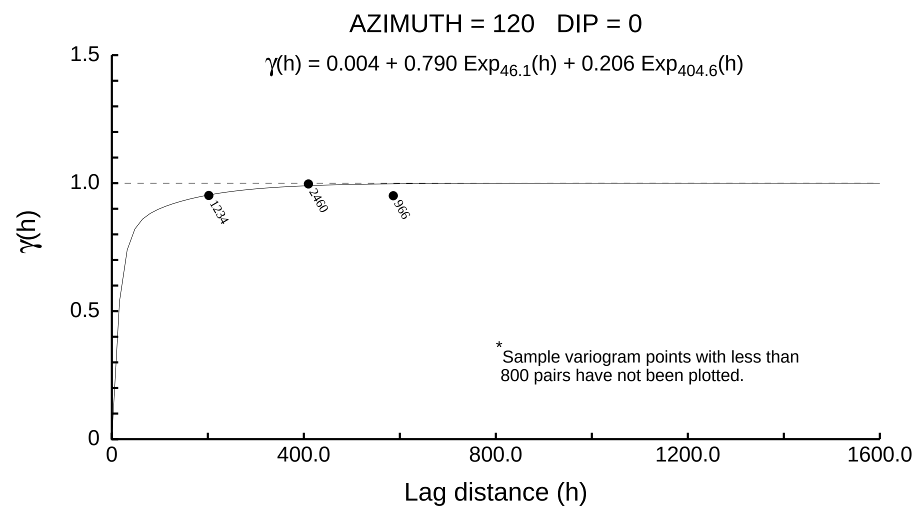


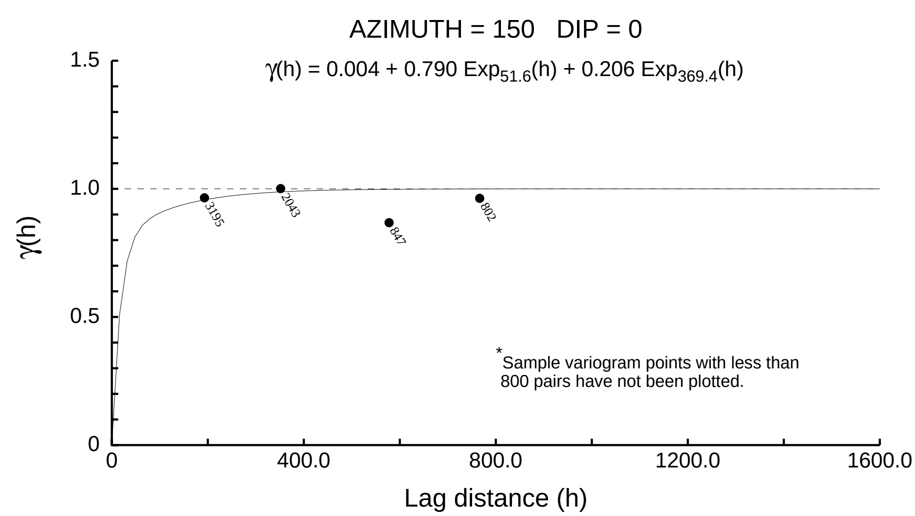




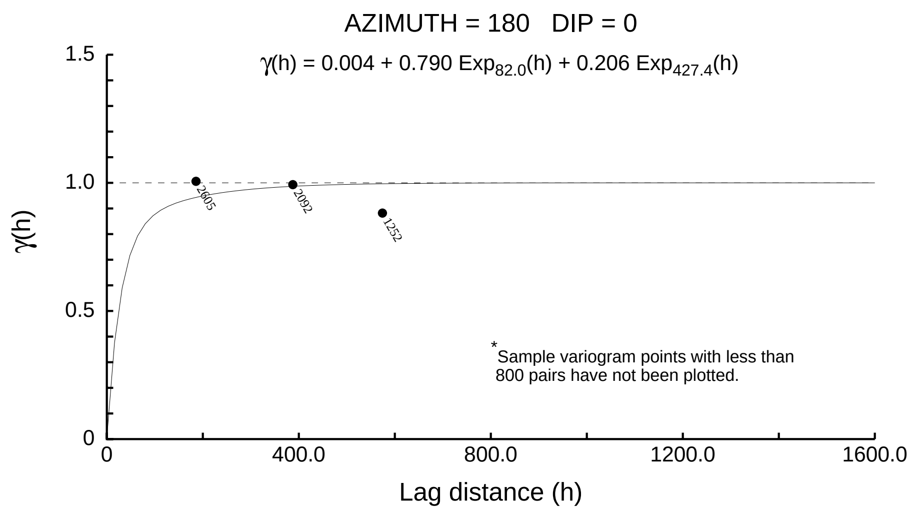
Directional 1003 - Pd

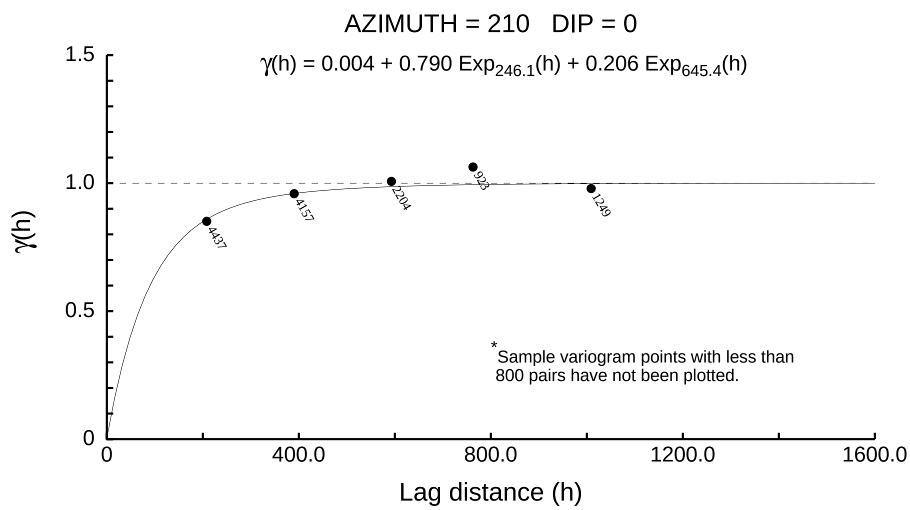


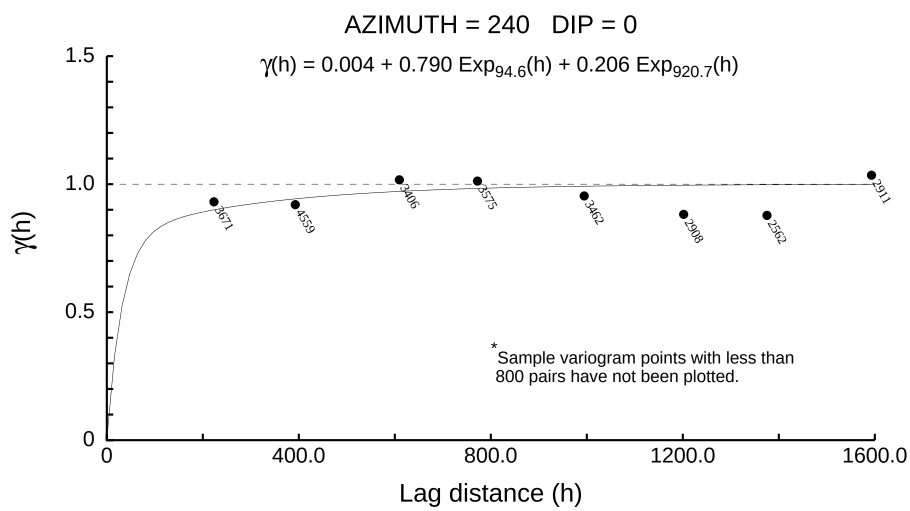




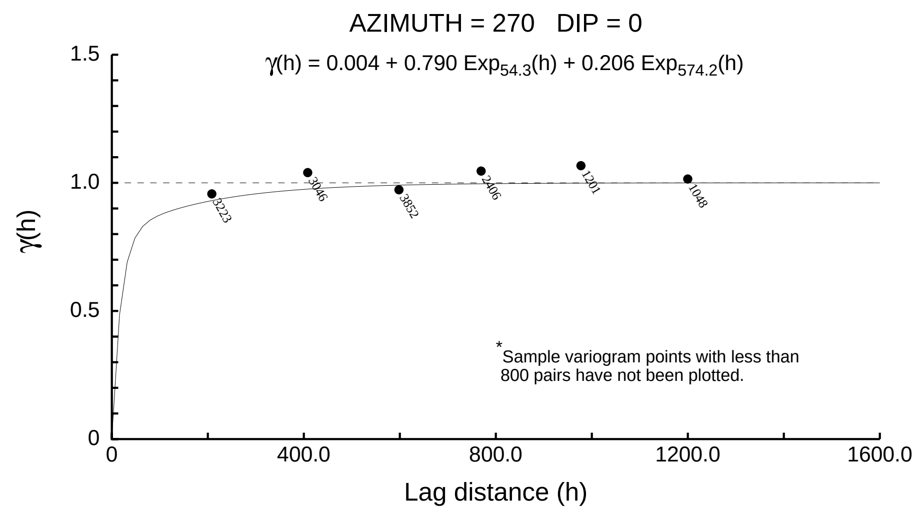
Directional 1003 - Pd

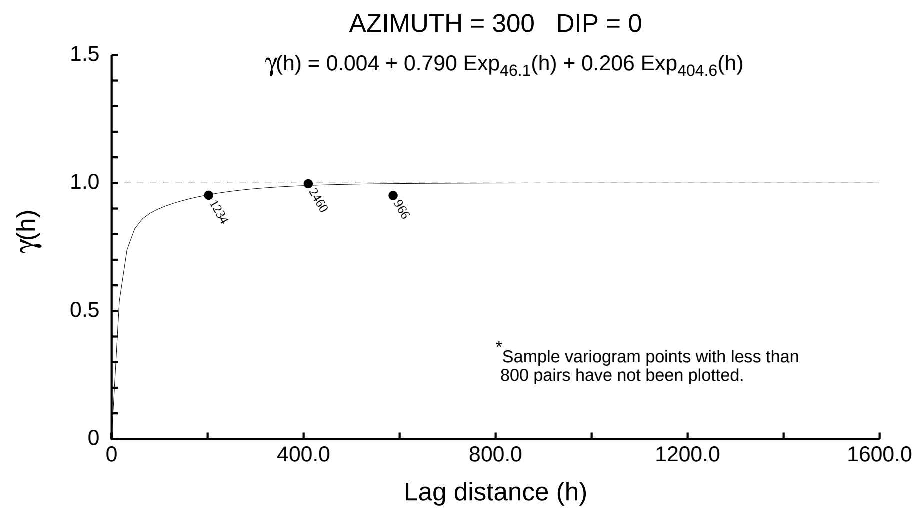


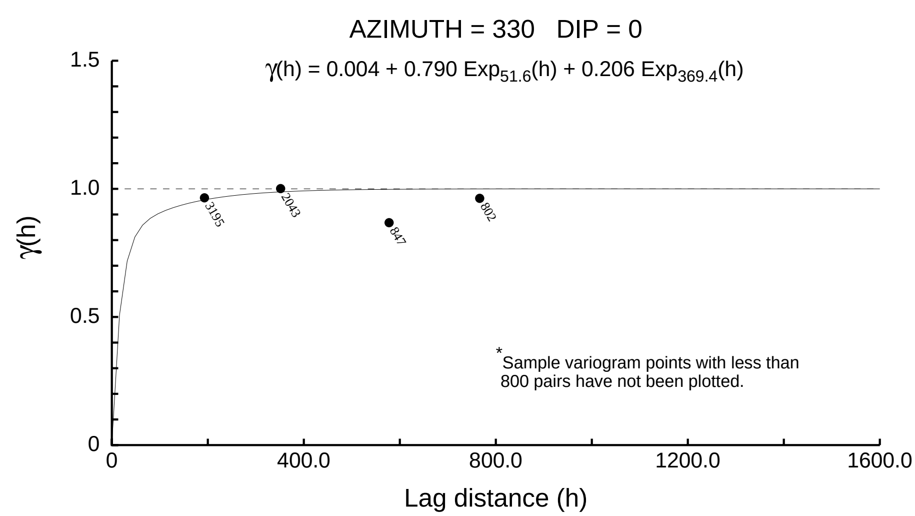




Directional 1003 - Pd

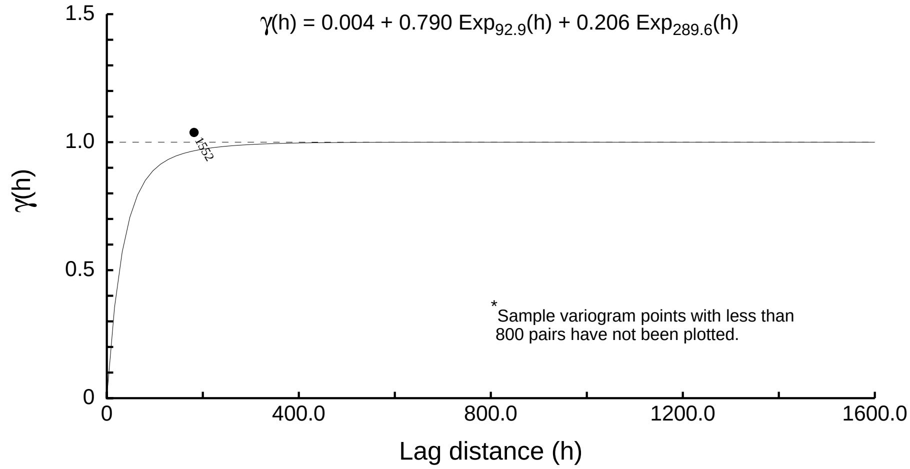




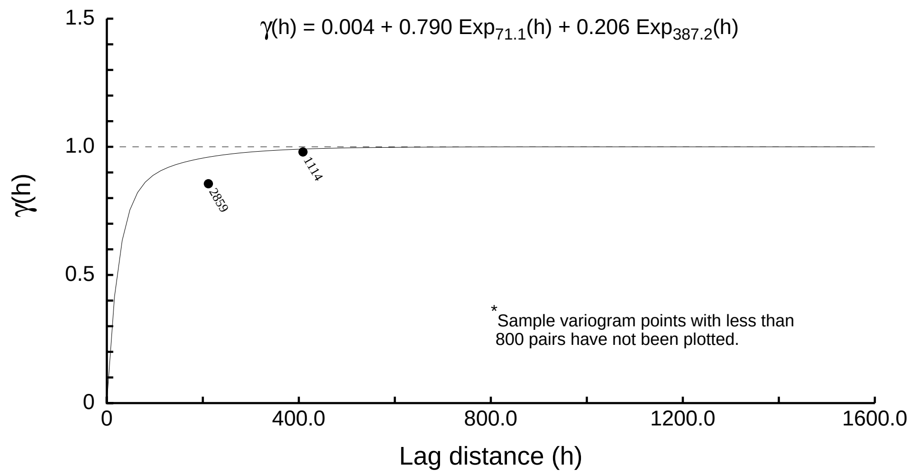


Directional 1003 - Pd

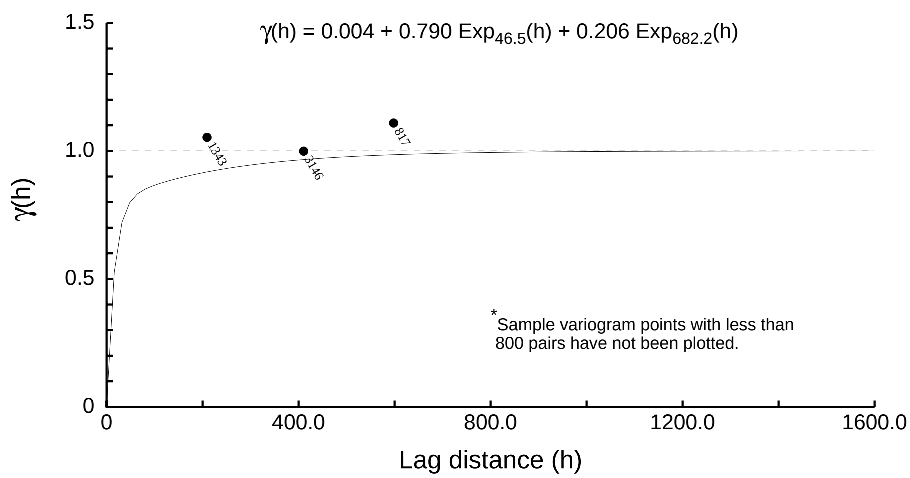
AZIMUTH = 0   DIP = -30



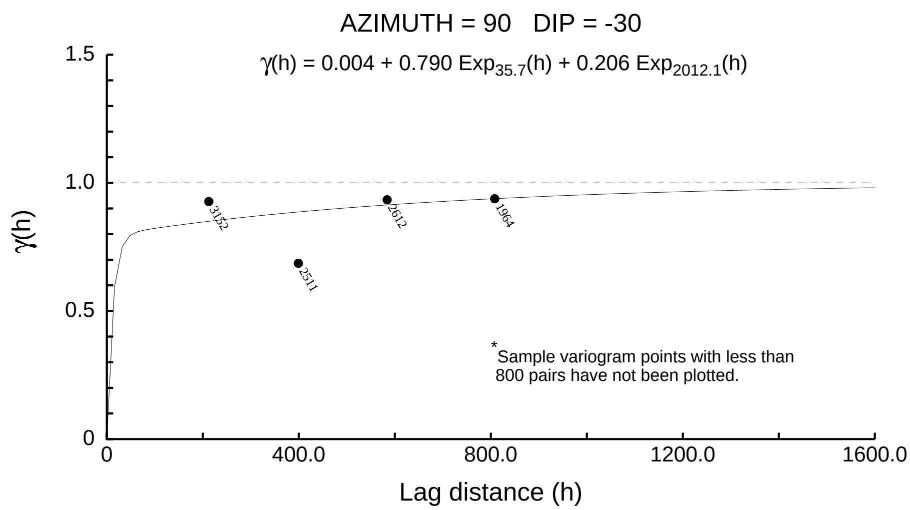
AZIMUTH = 30   DIP = -30

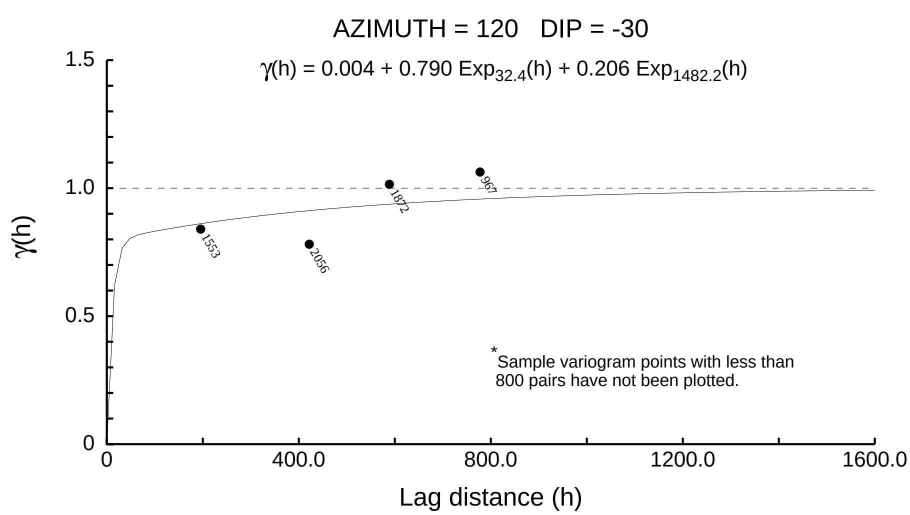


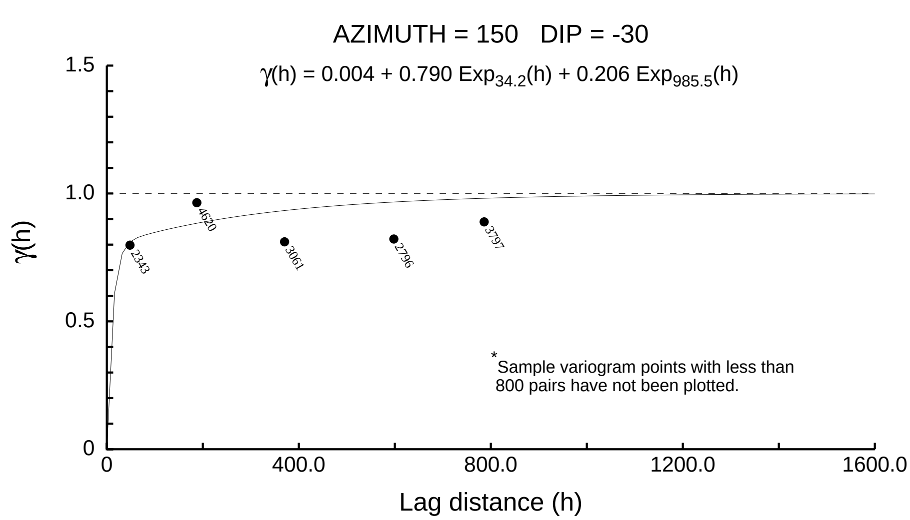
AZIMUTH = 60   DIP = -30



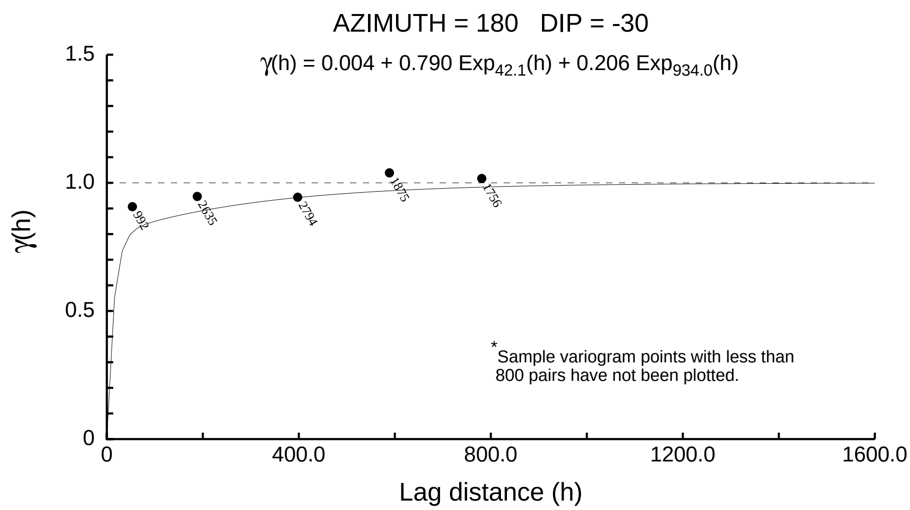
Directional 1003 - Pd

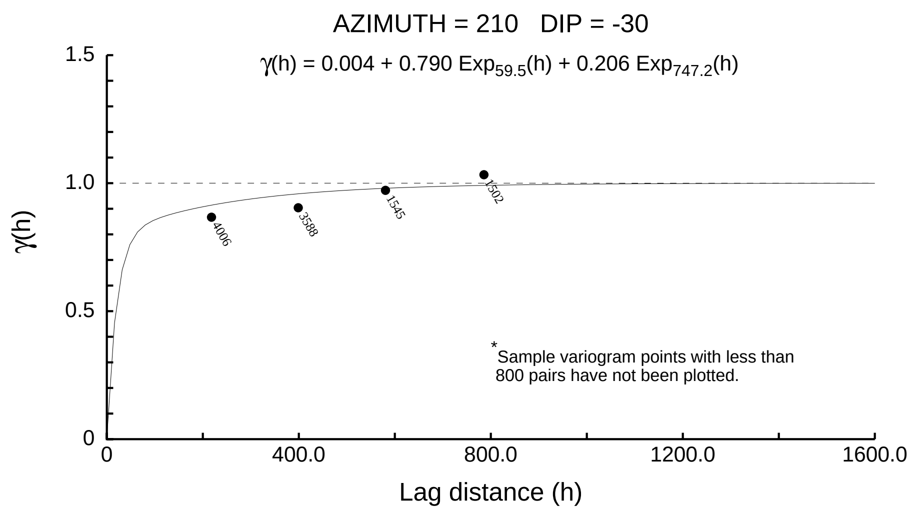


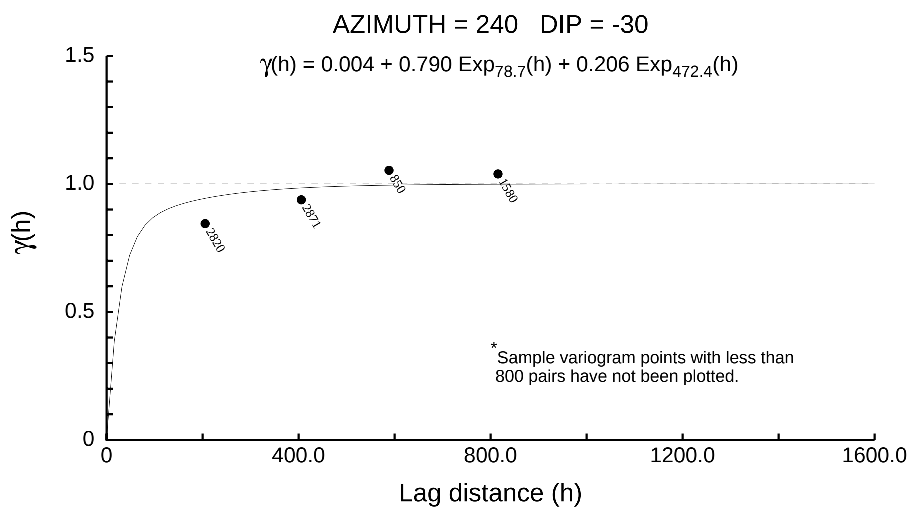




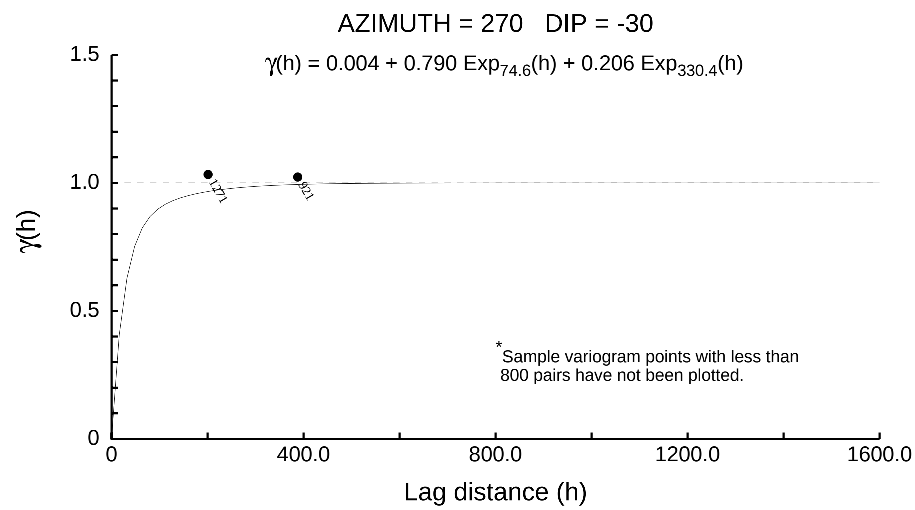
Directional 1003 - Pd

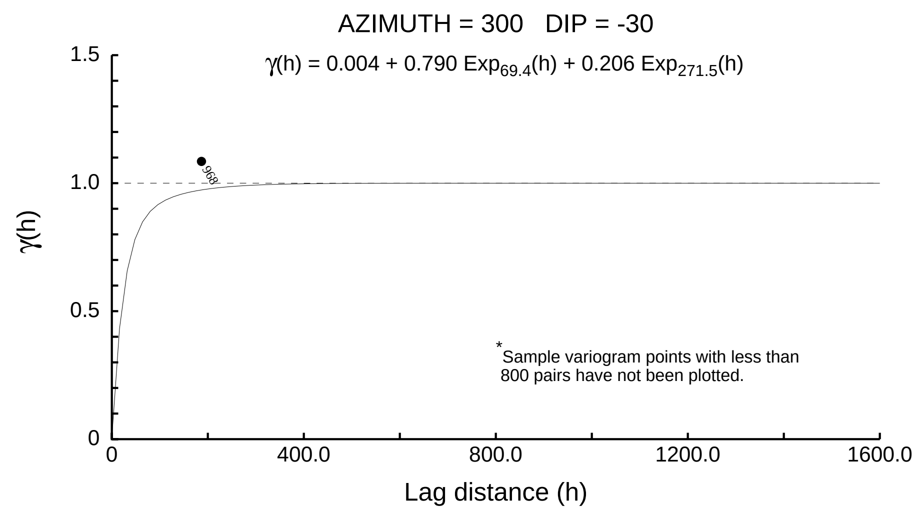


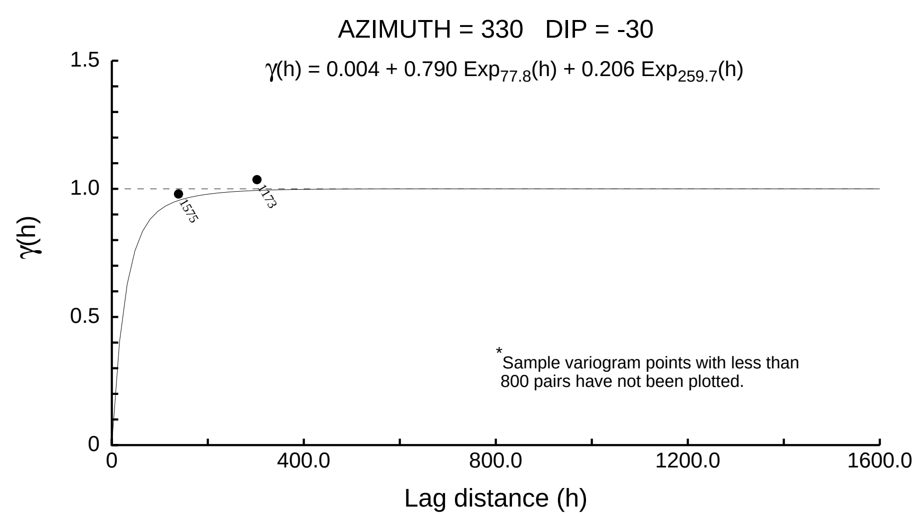




Directional 1003 - Pd

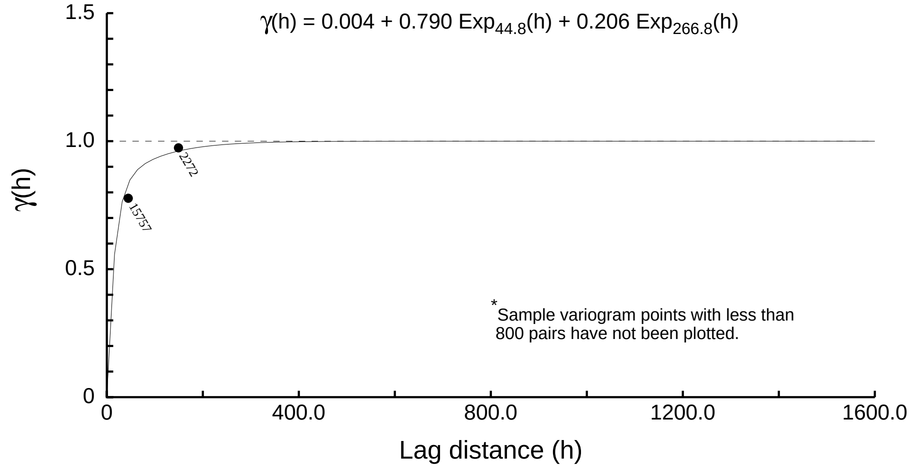




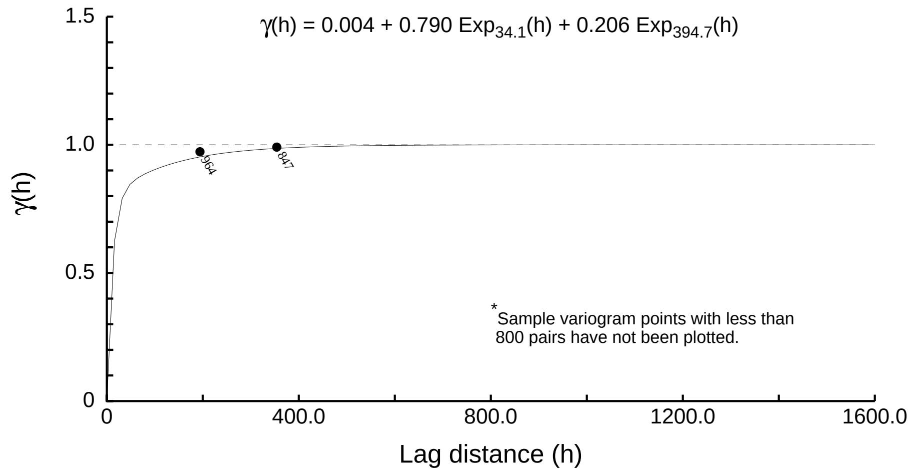


Directional 1003 - Pd

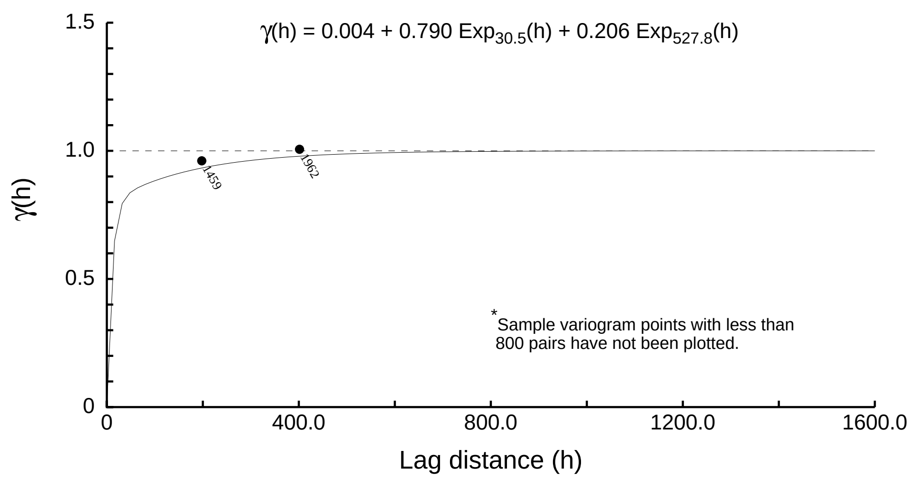
AZIMUTH = 0   DIP = -60



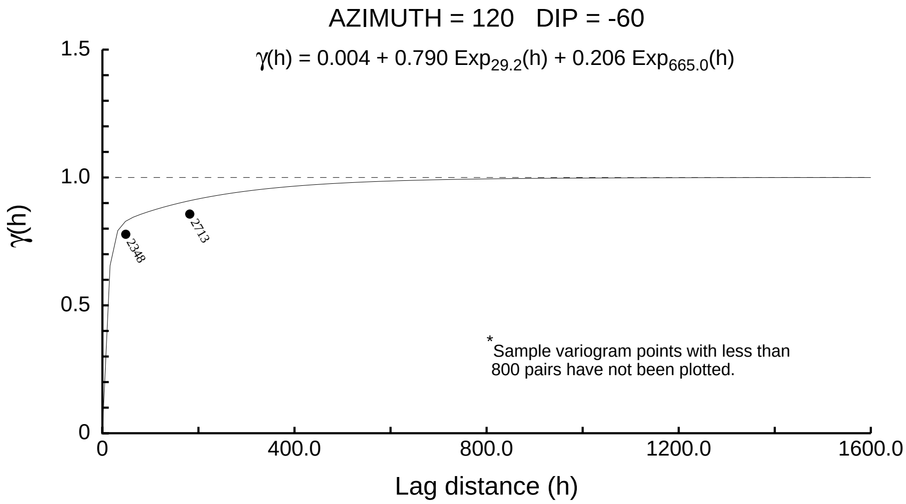
AZIMUTH = 60   DIP = -60

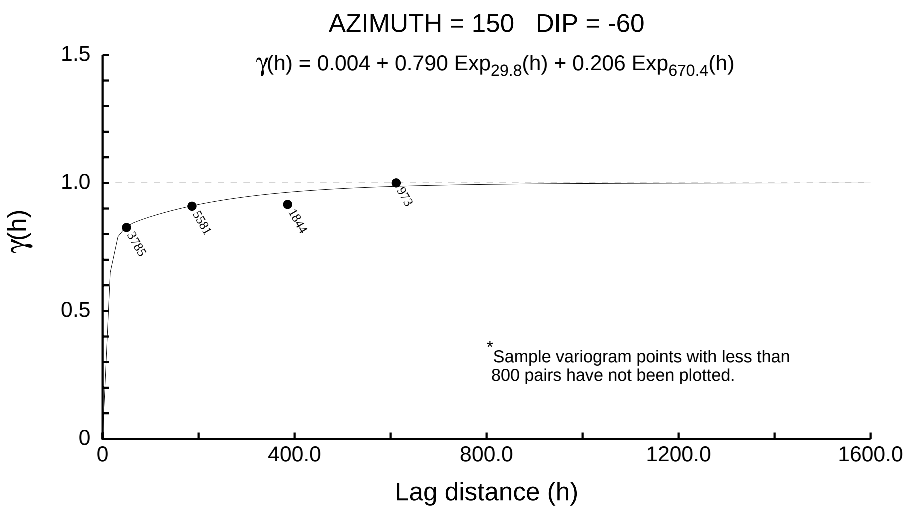


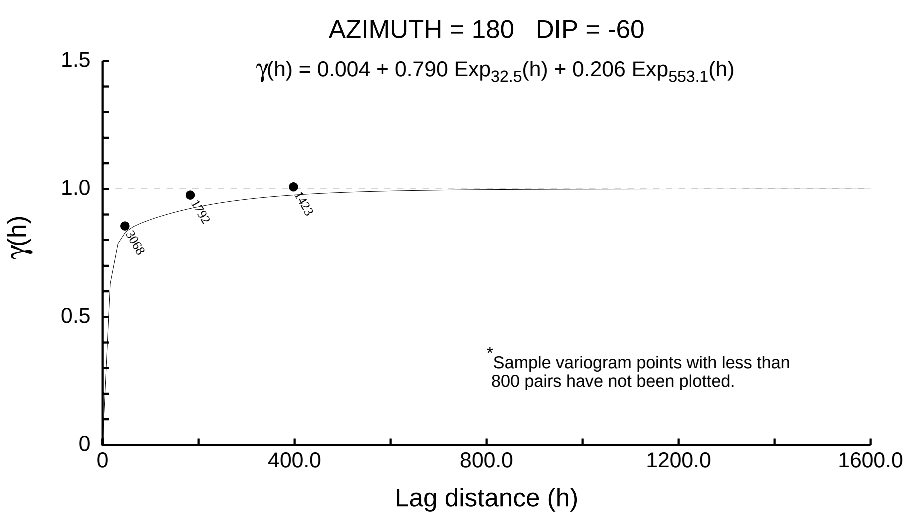
AZIMUTH = 90   DIP = -60



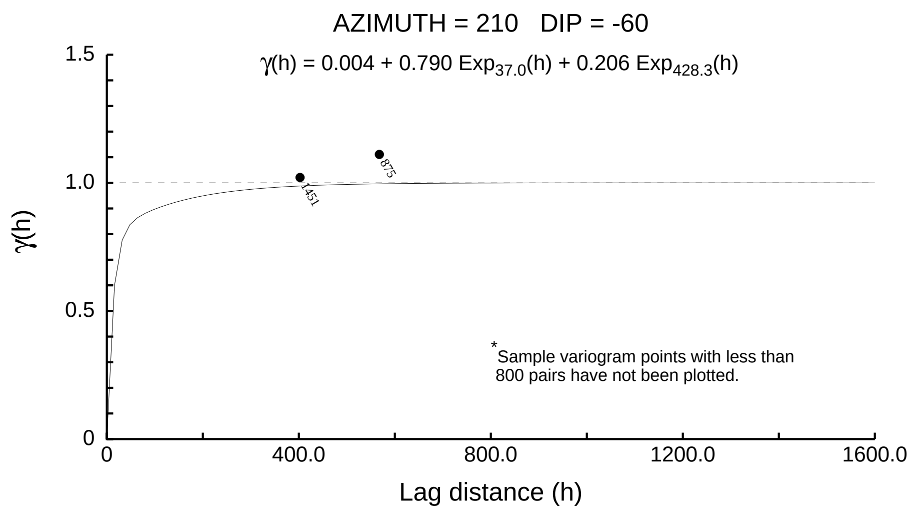
Directional 1003 - Pd

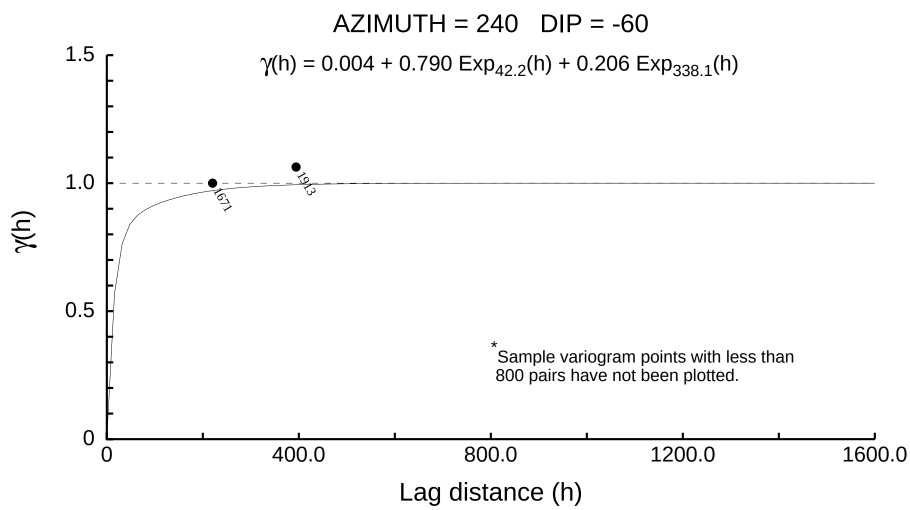


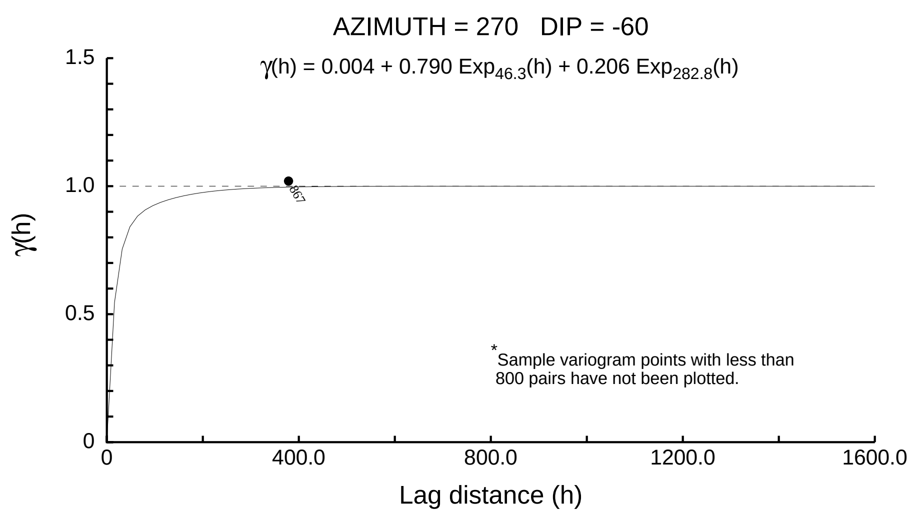




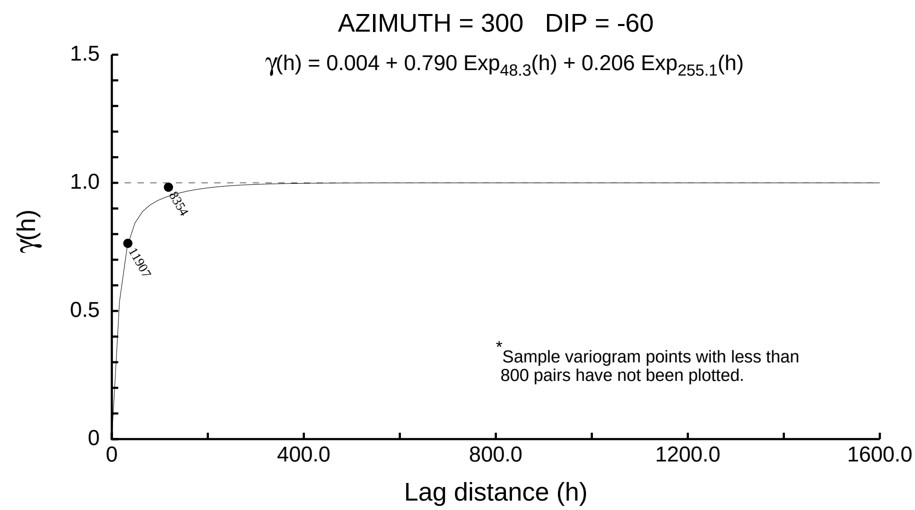
Directional 1003 - Pd

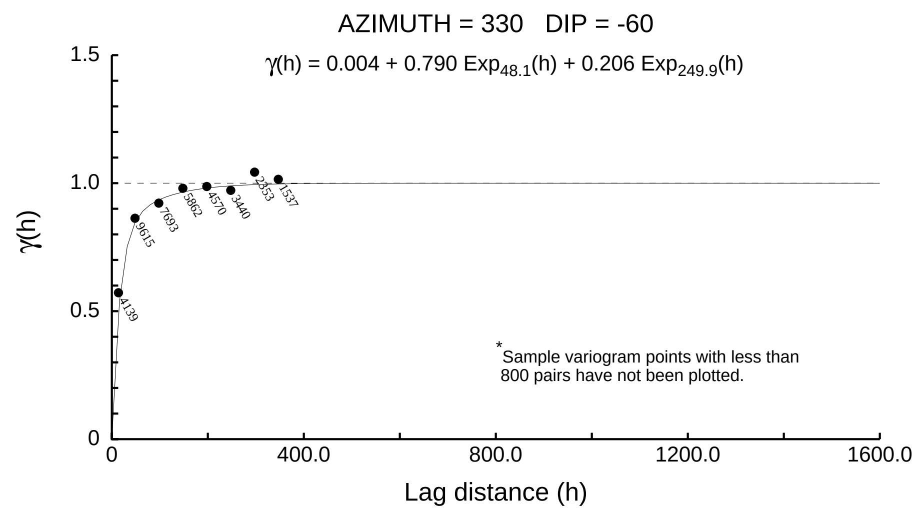


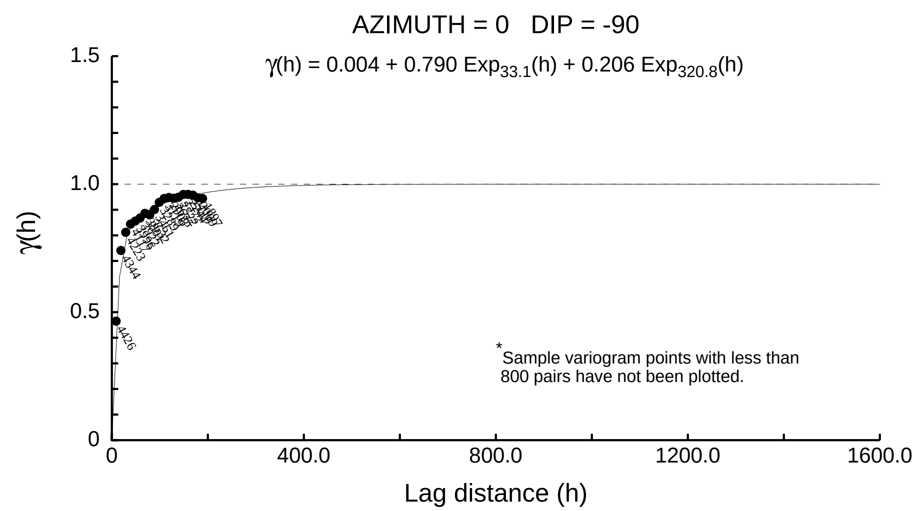




Directional 1003 - Pd







Directional 1003 - Pt

User Defined Rotation Conventions

Nugget ==> 0.416
C1 ==> 0.391
C2 ==> 0.193

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -55
RH Rotation about the Y’ axis ==> -55
RH Rotation about the Z’ axis ==> 14
Range along the Z’ axis ==> 11.2 Azimuth ==> 325 Dip ==> 35
Range along the Y’ axis ==> 623.4 Azimuth ==> 47 Dip ==> -11
Range along the X’ axis ==> 149.6 Azimuth ==> 122 Dip ==> 53

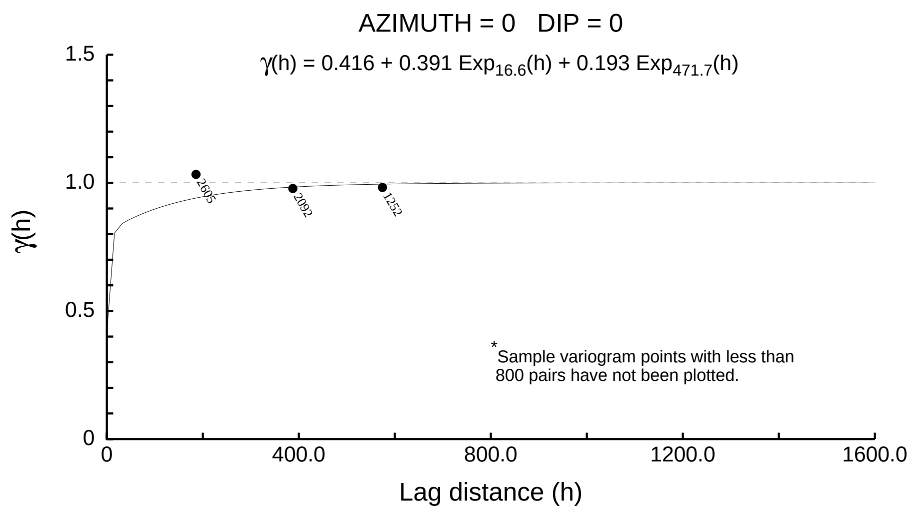
Second Structure -- Exponential with Practical Range

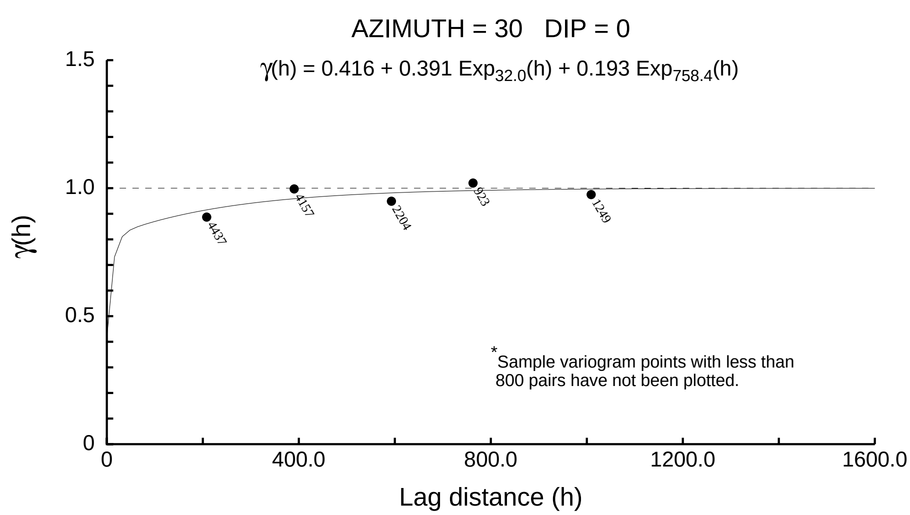
RH Rotation about the Z axis ==> -40
RH Rotation about the Y’ axis ==> -46
RH Rotation about the Z’ axis ==> -12
Range along the Z’ axis ==> 1920.4 Azimuth ==> 310 Dip ==> 44
Range along the Y’ axis ==> 1340.1 Azimuth ==> 49 Dip ==> 9
Range along the X’ axis ==> 294.3 Azimuth ==> 147 Dip ==> 44

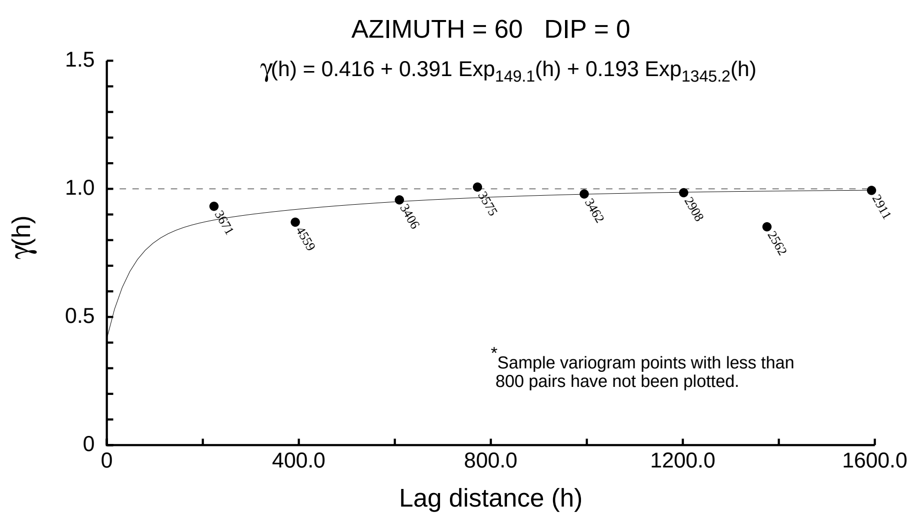
Modeling Criteria

Minimum number pairs req’d ==> 800
Sample variogram points weighted by # pairs

Directional 1003 - Pt







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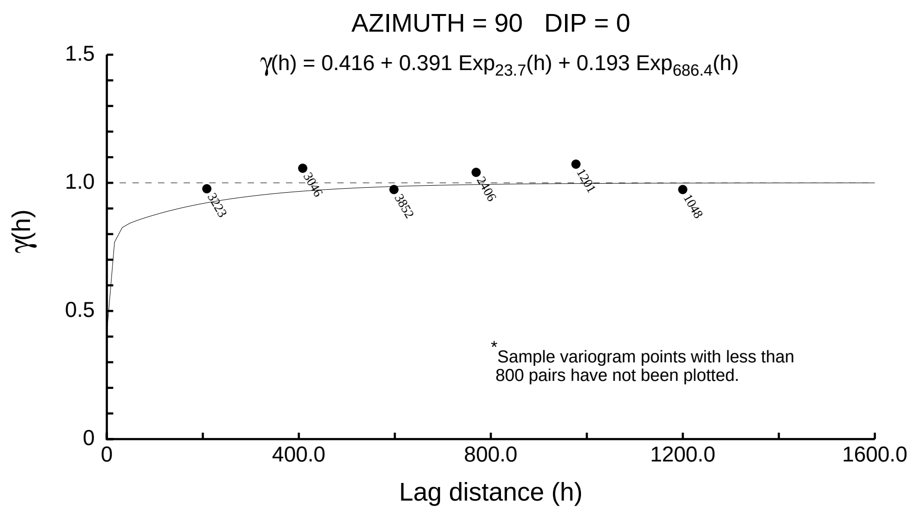
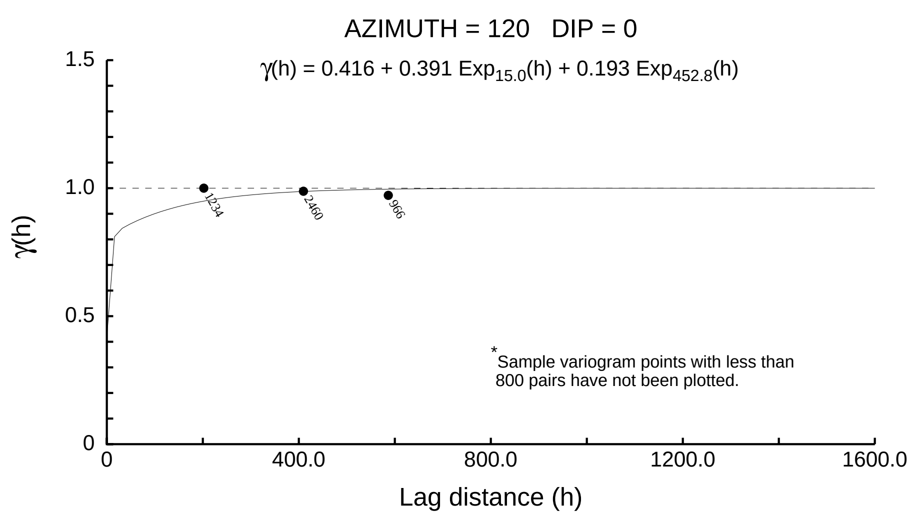
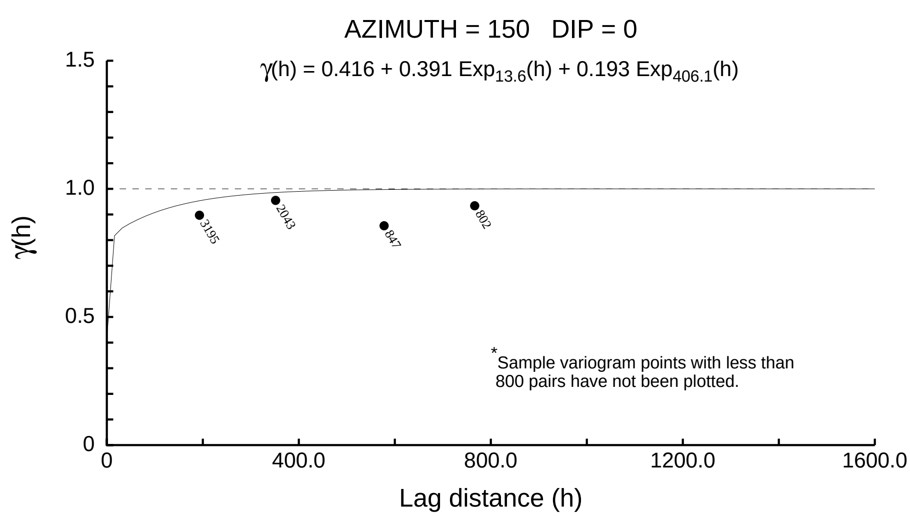
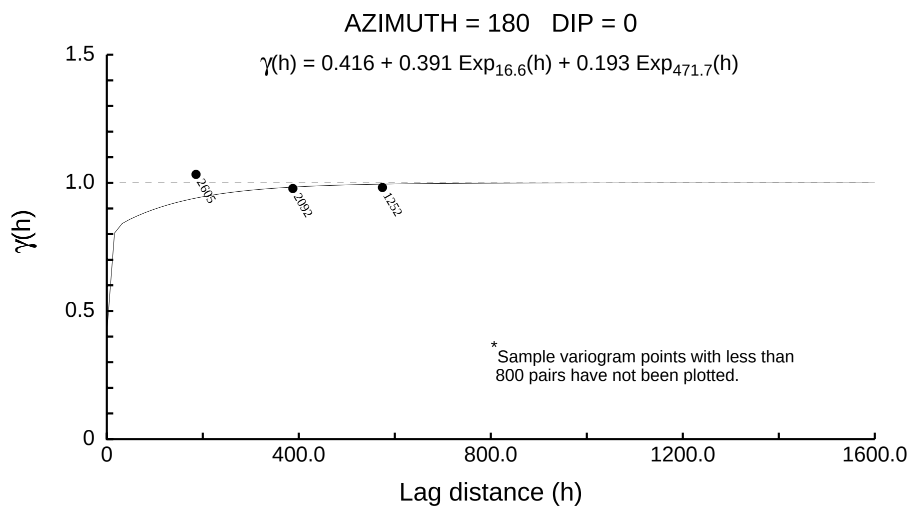
Directional 1003 - Pt

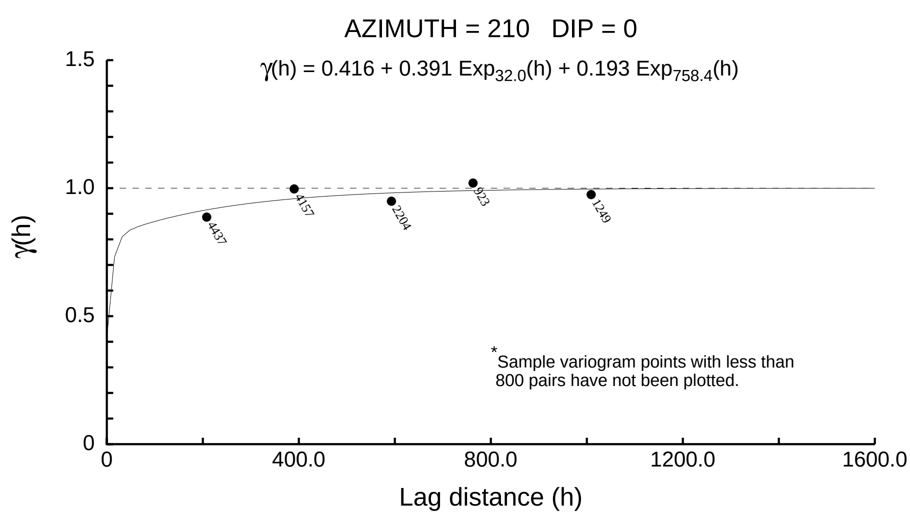


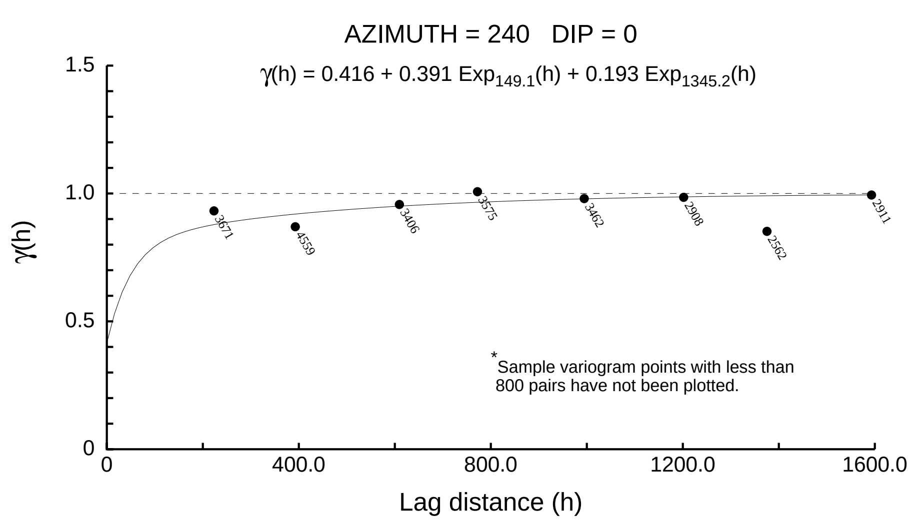




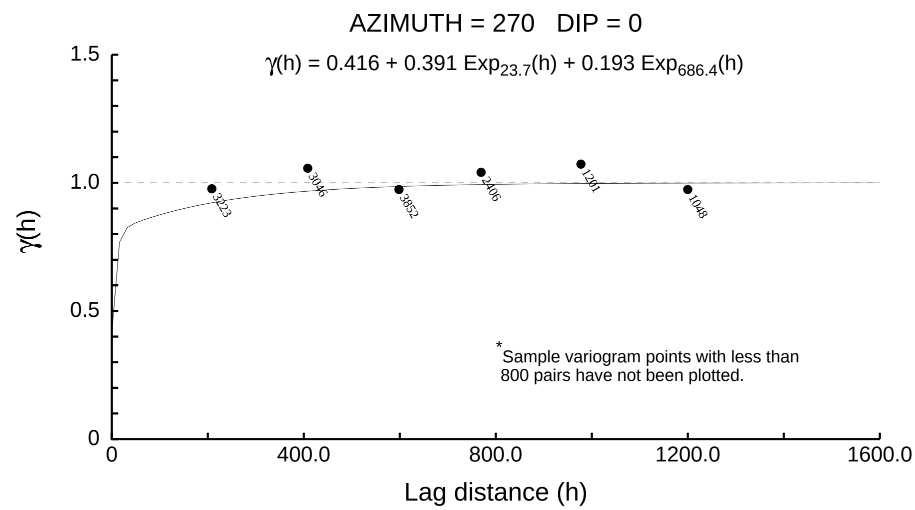
Directional 1003 - Pt

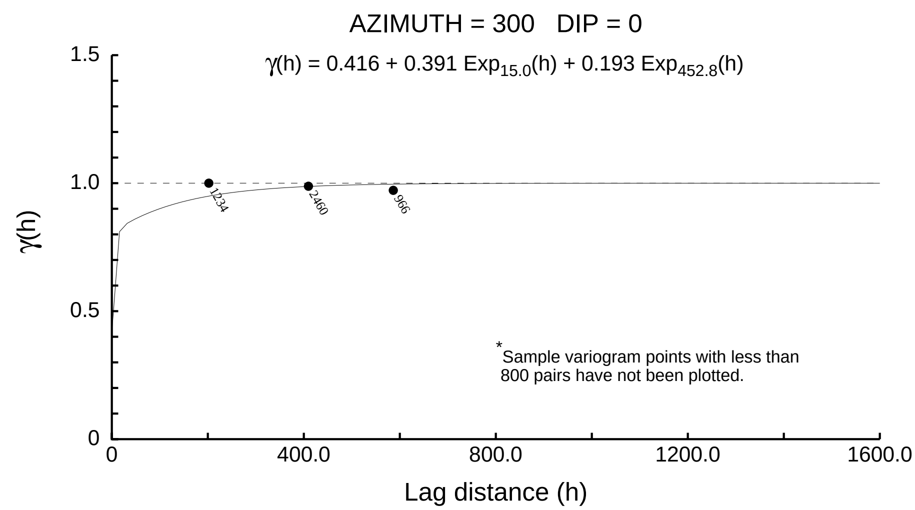


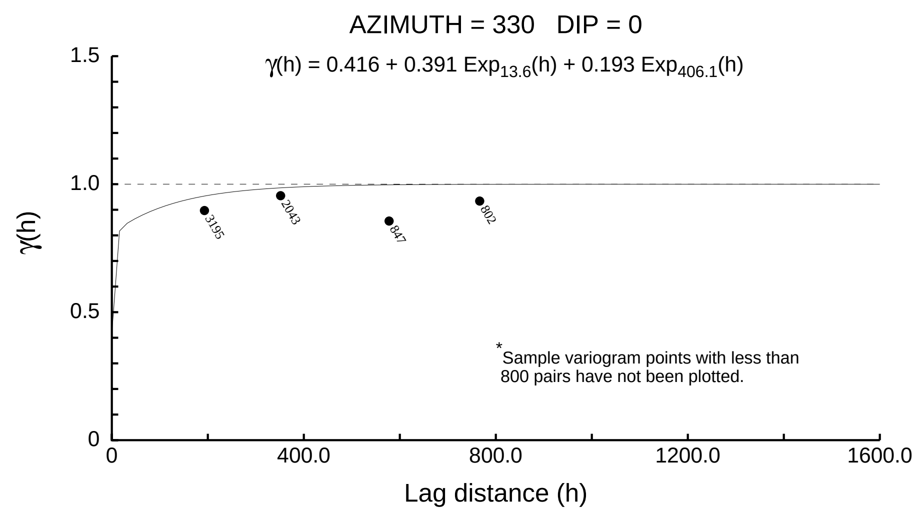




Directional 1003 - Pt



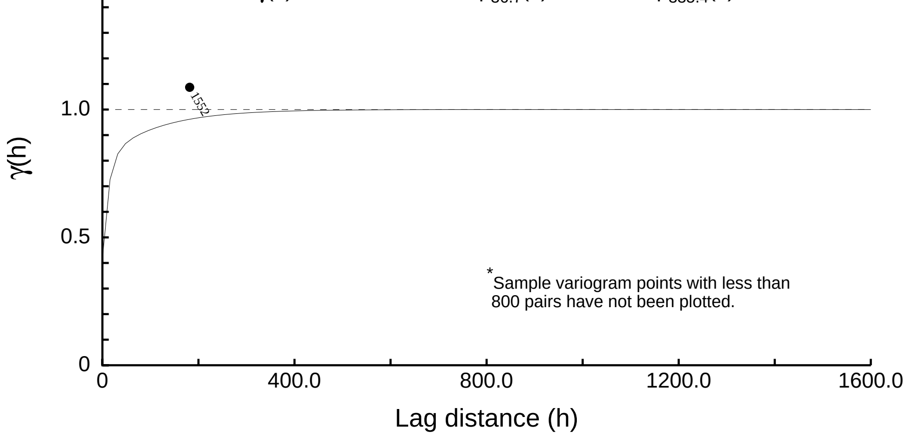




Directional 1003 - Pt

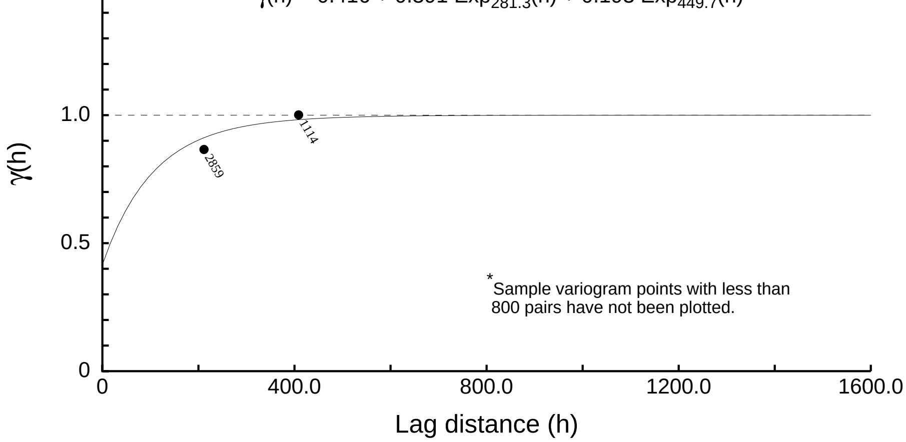
AZIMUTH = 0   DIP = -30

$\gamma(h) = 0.416 + 0.391\ Exp_{36.7}(h) + 0.193\ Exp_{335.4}(h)$



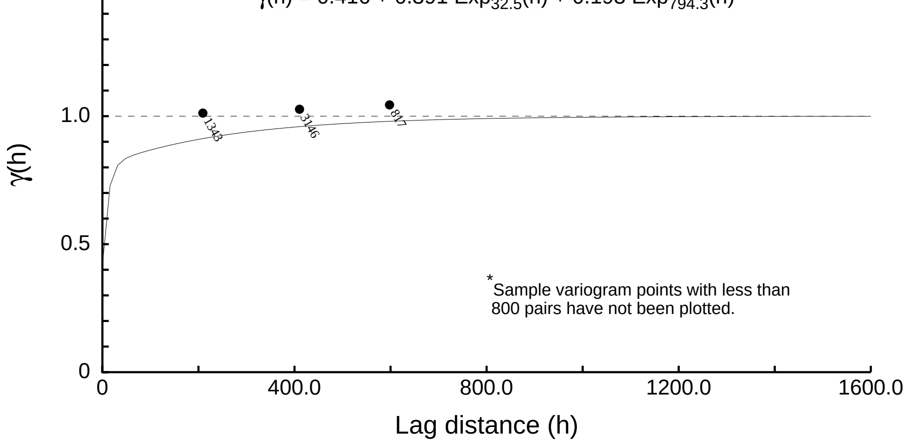
AZIMUTH = 30   DIP = -30

$\gamma(h) = 0.416 + 0.391\ Exp_{281.3}(h) + 0.193\ Exp_{449.7}(h)$



AZIMUTH = 60   DIP = -30

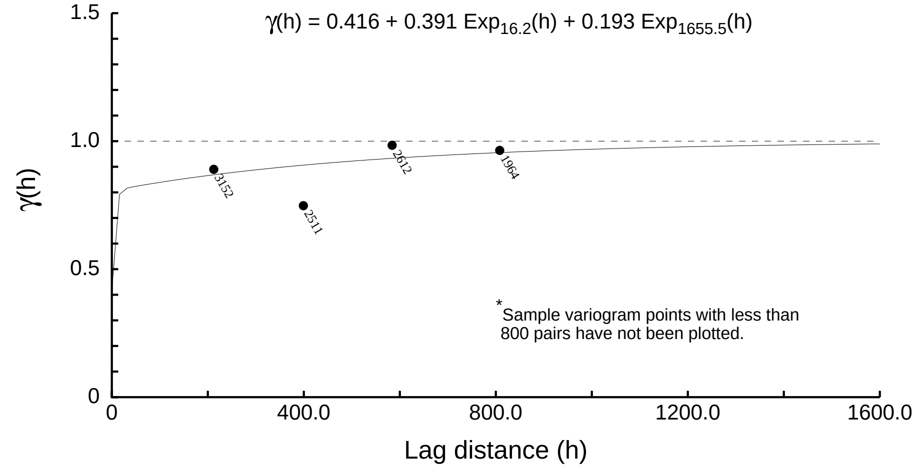
$\gamma(h) = 0.416 + 0.391\ Exp_{32.5}(h) + 0.193\ Exp_{794.3}(h)$



Directional 1003 - Pt

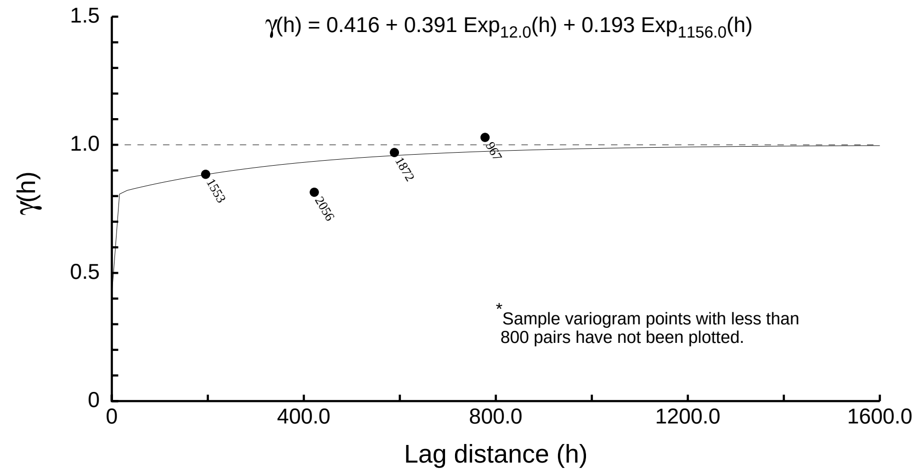
AZIMUTH = 90   DIP = -30

$\gamma(h) = 0.416 + 0.391\ Exp_{16.2}(h) + 0.193\ Exp_{1655.5}(h)$



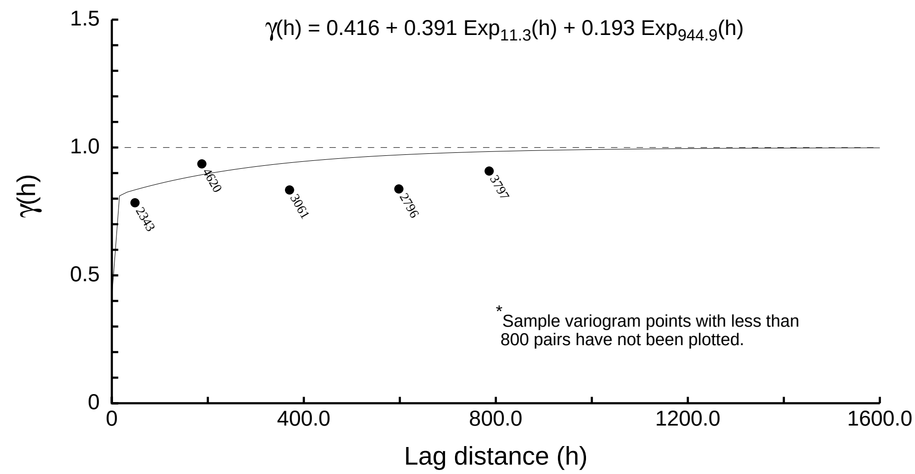
AZIMUTH = 120   DIP = -30

$\gamma(h) = 0.416 + 0.391\ Exp_{12.0}(h) + 0.193\ Exp_{1156.0}(h)$

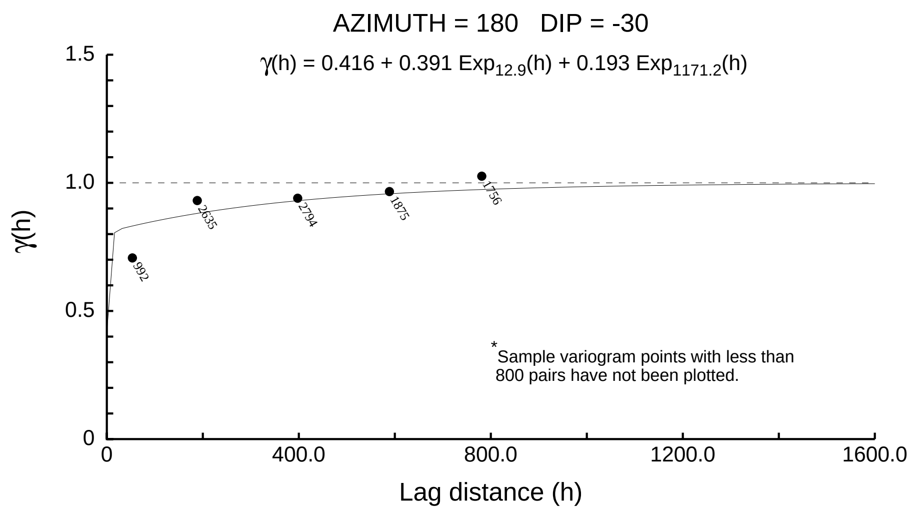


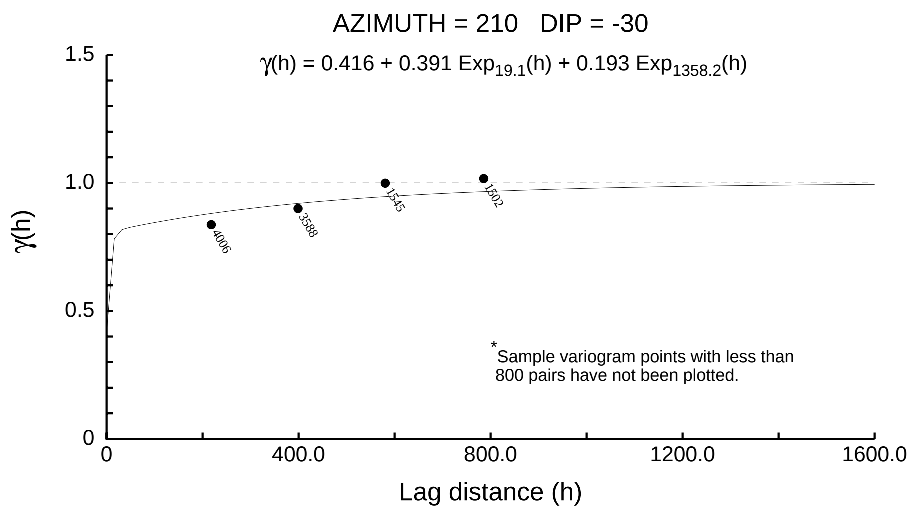
AZIMUTH = 150   DIP = -30

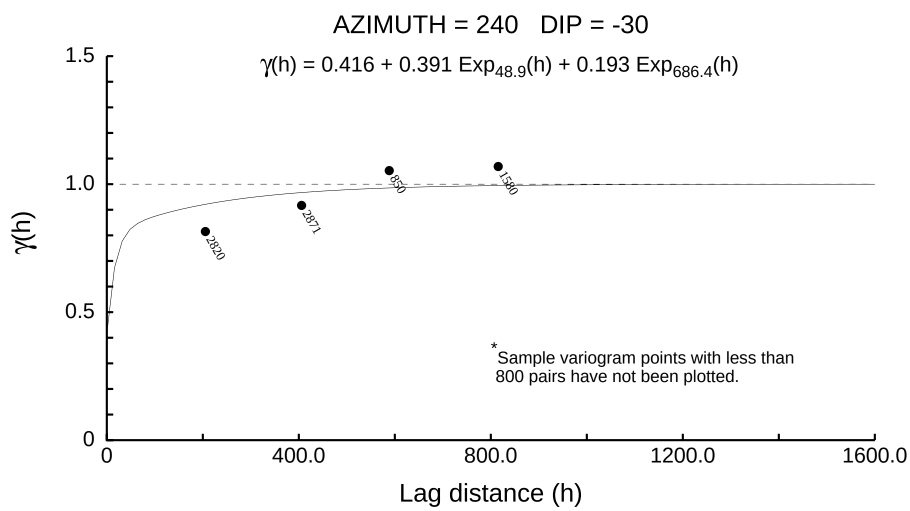
$\gamma(h) = 0.416 + 0.391\ Exp_{11.3}(h) + 0.193\ Exp_{944.9}(h)$



Directional 1003 - Pt



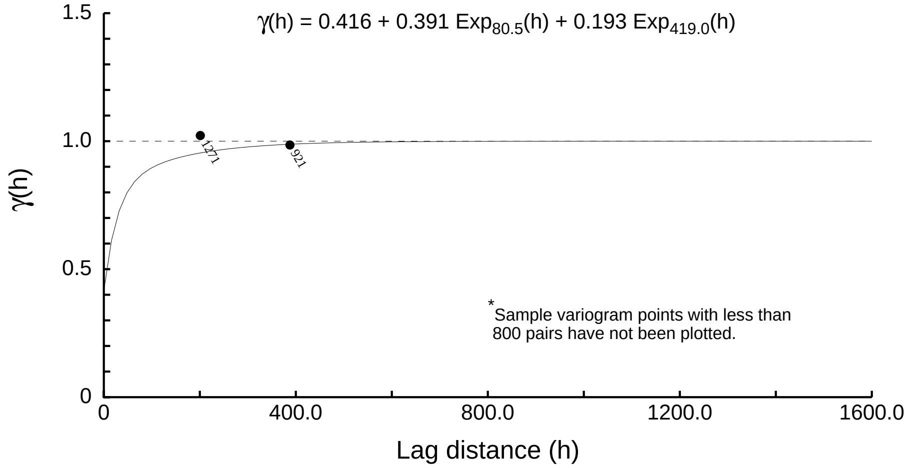




Directional 1003 - Pt

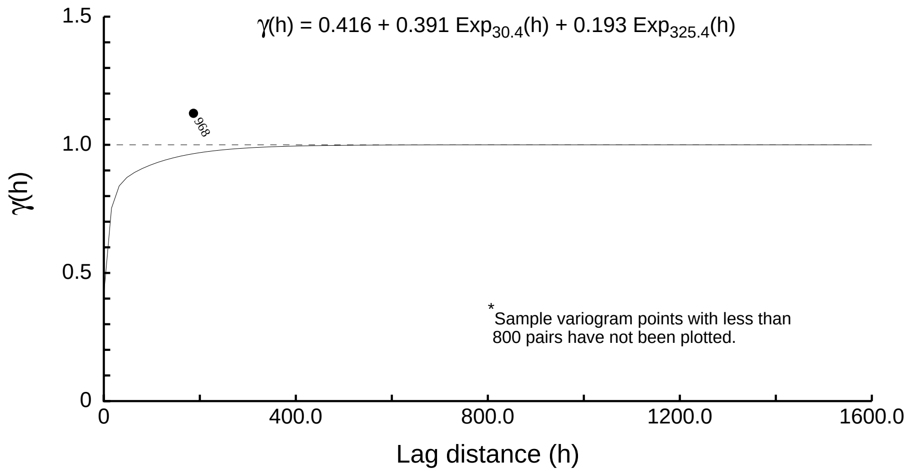
AZIMUTH = 270   DIP = -30

$\gamma(h) = 0.416 + 0.391\ \text{Exp}_{80.5}(h) + 0.193\ \text{Exp}_{419.0}(h)$



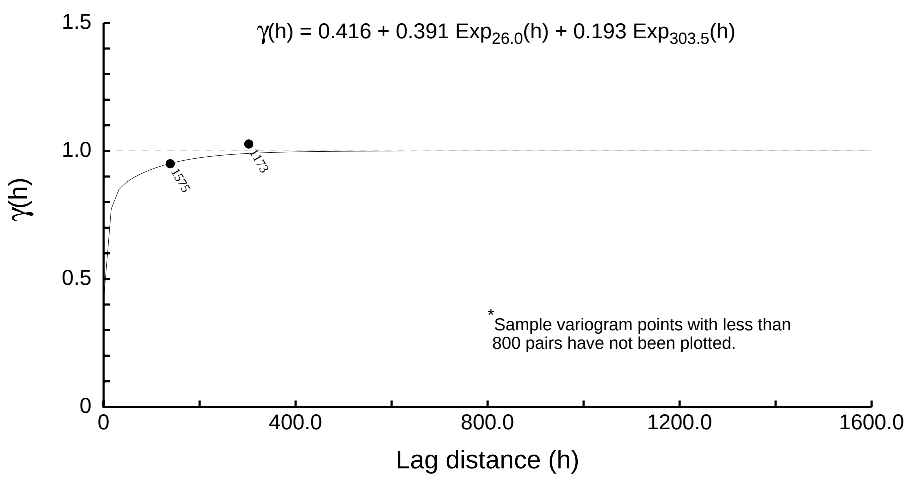
AZIMUTH = 300   DIP = -30

$\gamma(h) = 0.416 + 0.391\ \text{Exp}_{30.4}(h) + 0.193\ \text{Exp}_{325.4}(h)$

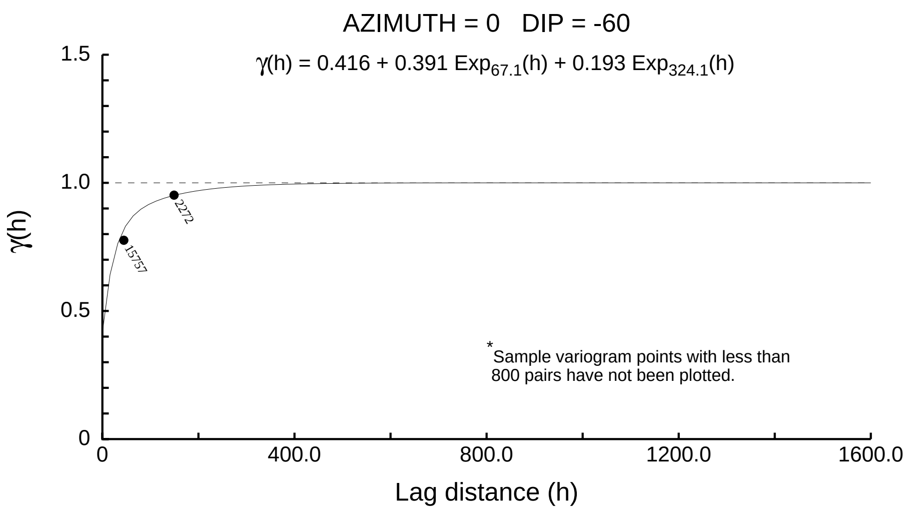


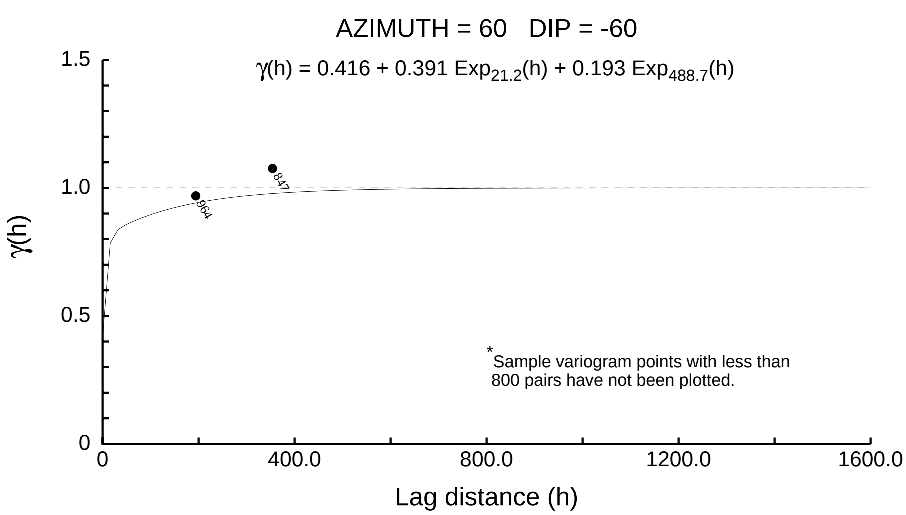
AZIMUTH = 330   DIP = -30

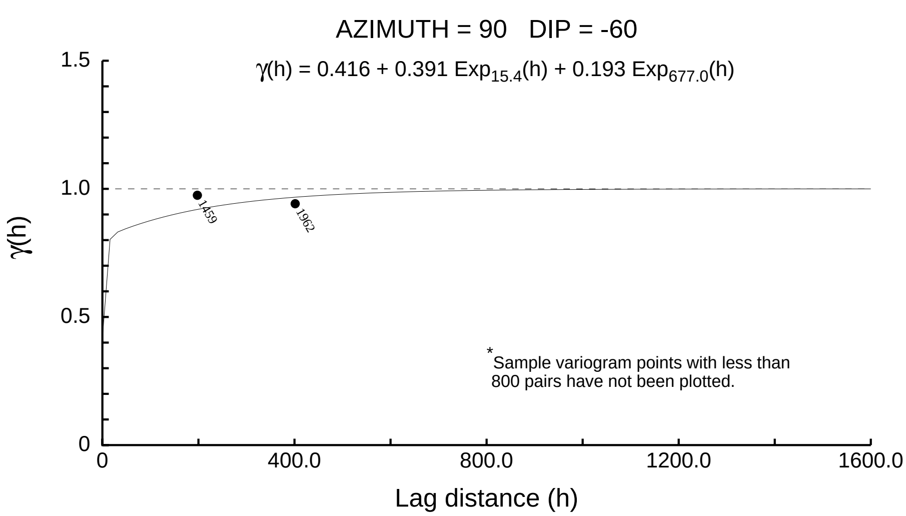
$\gamma(h) = 0.416 + 0.391\ \text{Exp}_{26.0}(h) + 0.193\ \text{Exp}_{303.5}(h)$



Directional 1003 - Pt



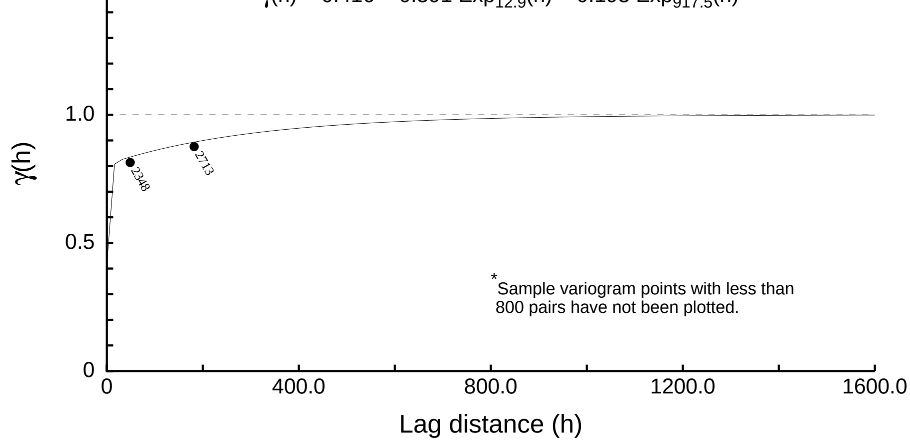




Directional 1003 - Pt

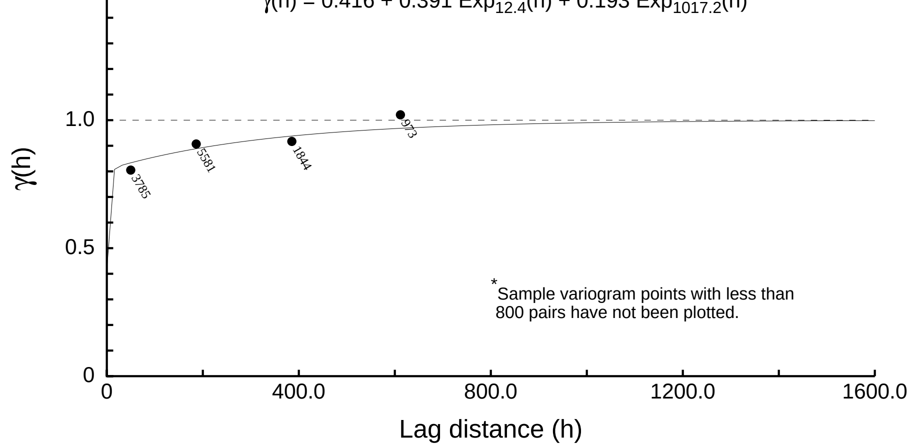
AZIMUTH = 120   DIP = -60

$\gamma(h) = 0.416 + 0.391\ \mathrm{Exp}_{12.9}(h) + 0.193\ \mathrm{Exp}_{917.5}(h)$



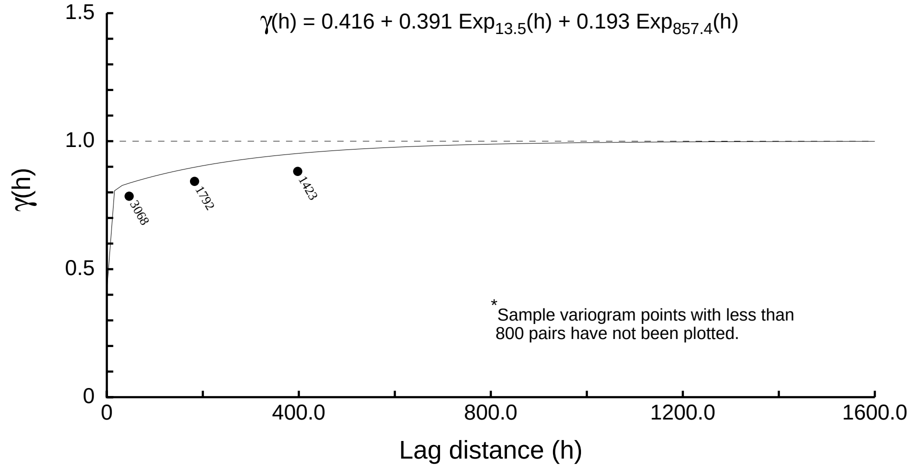
AZIMUTH = 150   DIP = -60

$\gamma(h) = 0.416 + 0.391\ \mathrm{Exp}_{12.4}(h) + 0.193\ \mathrm{Exp}_{1017.2}(h)$

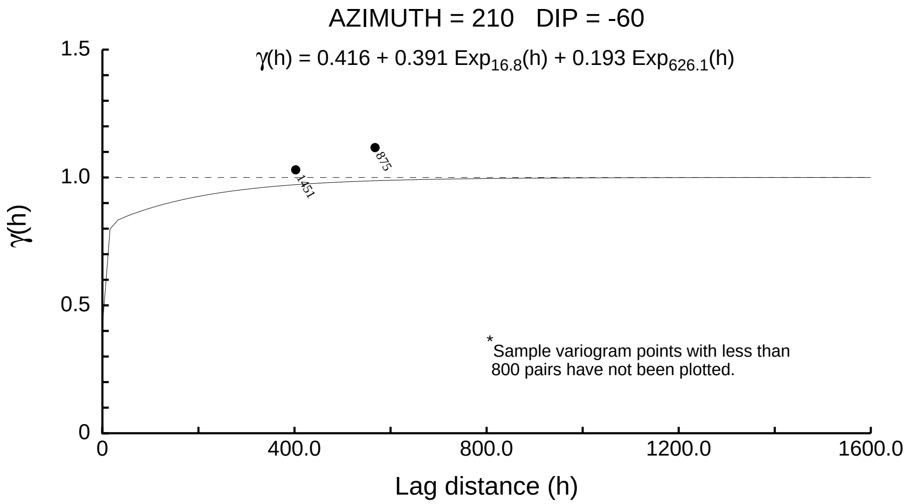


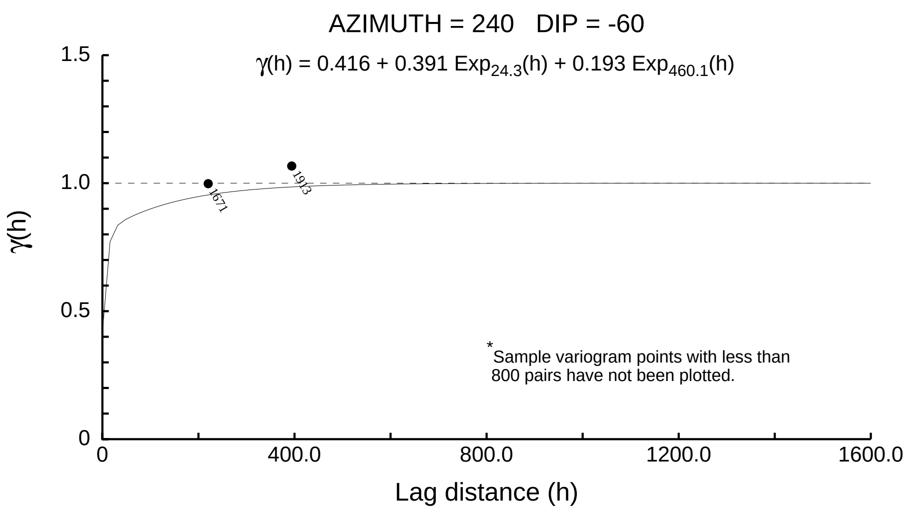
AZIMUTH = 180   DIP = -60

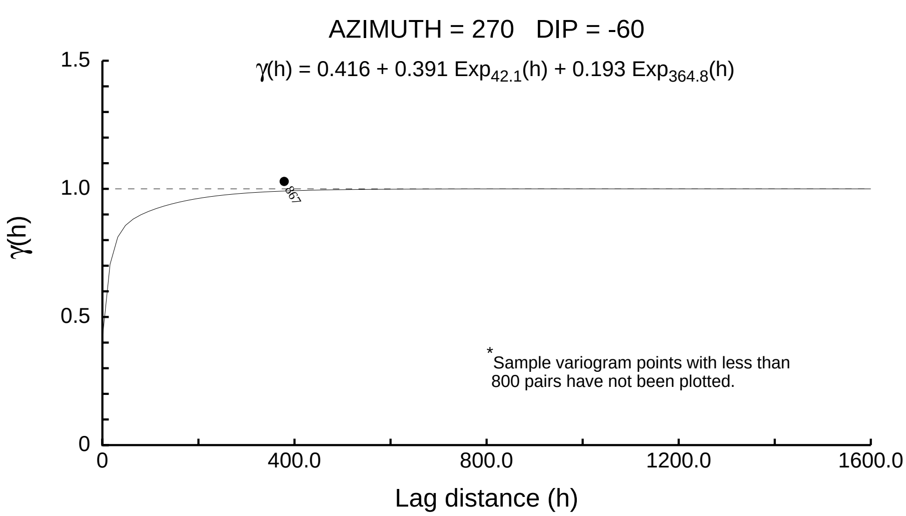
$\gamma(h) = 0.416 + 0.391\ \mathrm{Exp}_{13.5}(h) + 0.193\ \mathrm{Exp}_{857.4}(h)$



Directional 1003 - Pt



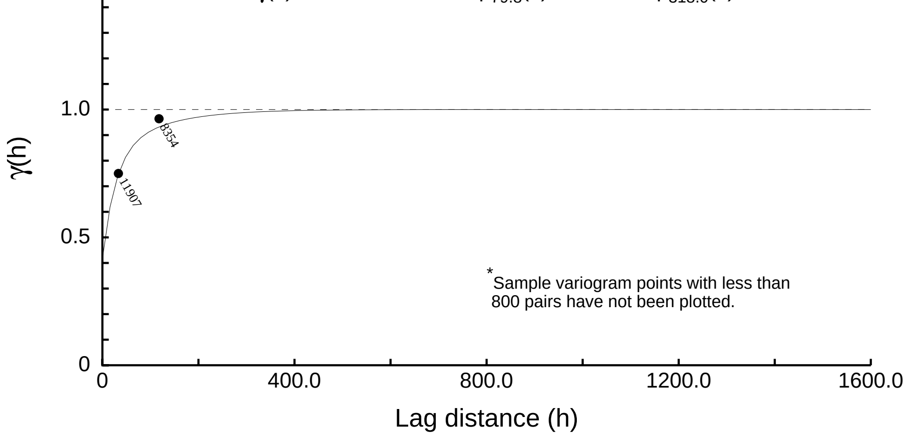




Directional 1003 - Pt

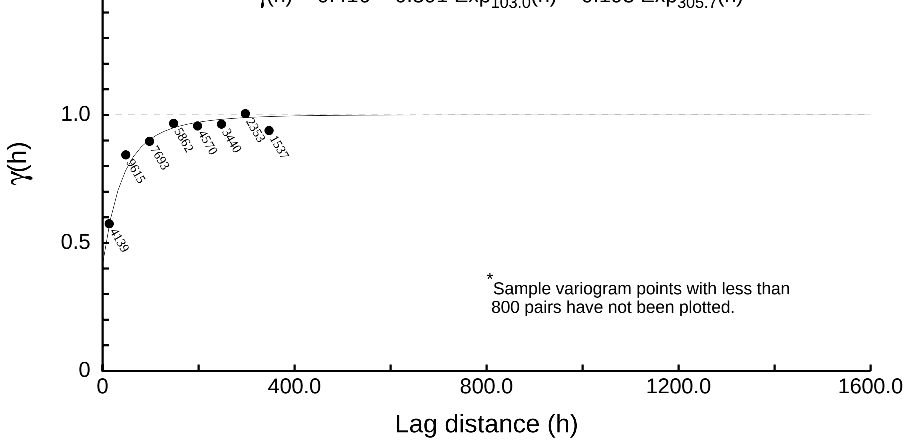
AZIMUTH = 300   DIP = -60

$\gamma(h) = 0.416 + 0.391\ Exp_{79.8}(h) + 0.193\ Exp_{318.0}(h)$



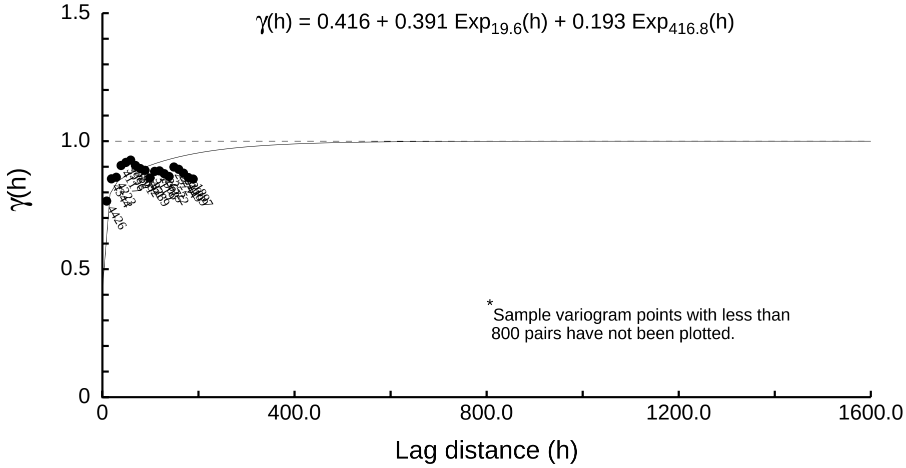
AZIMUTH = 330   DIP = -60

$\gamma(h) = 0.416 + 0.391\ Exp_{103.0}(h) + 0.193\ Exp_{305.7}(h)$



AZIMUTH = 0   DIP = -90

$\gamma(h) = 0.416 + 0.391\ Exp_{19.6}(h) + 0.193\ Exp_{416.8}(h)$



Directional 1003 - S

User Defined Rotation Conventions

Nugget ==> 0.061
C1 ==> 0.819
C2 ==> 0.120

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -32
RH Rotation about the Y' axis ==> -69
RH Rotation about the Z' axis ==> -0

Range along the Z' axis ==> 28.2	Azimuth ==> 302	Dip ==> 21
Range along the Y' axis ==> 301.5	Azimuth ==> 32	Dip ==> 0
Range along the X' axis ==> 112.0	Azimuth ==> 123	Dip ==> 69

Second Structure -- Exponential with Practical Range

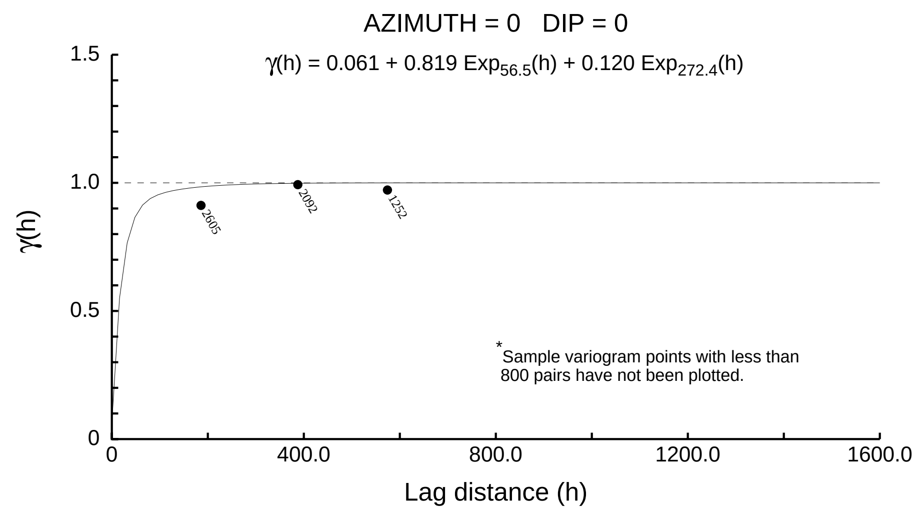
RH Rotation about the Z axis ==> -48
RH Rotation about the Y' axis ==> -9
RH Rotation about the Z' axis ==> -11

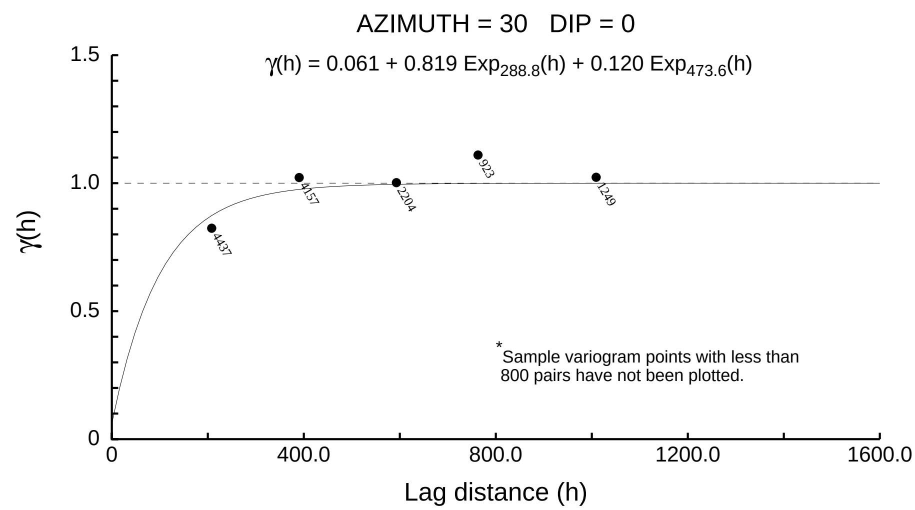
Range along the Z' axis ==> 1057.5	Azimuth ==> 318	Dip ==> 81
Range along the Y' axis ==> 4705.2	Azimuth ==> 59	Dip ==> 2
Range along the X' axis ==> 232.6	Azimuth ==> 150	Dip ==> 9

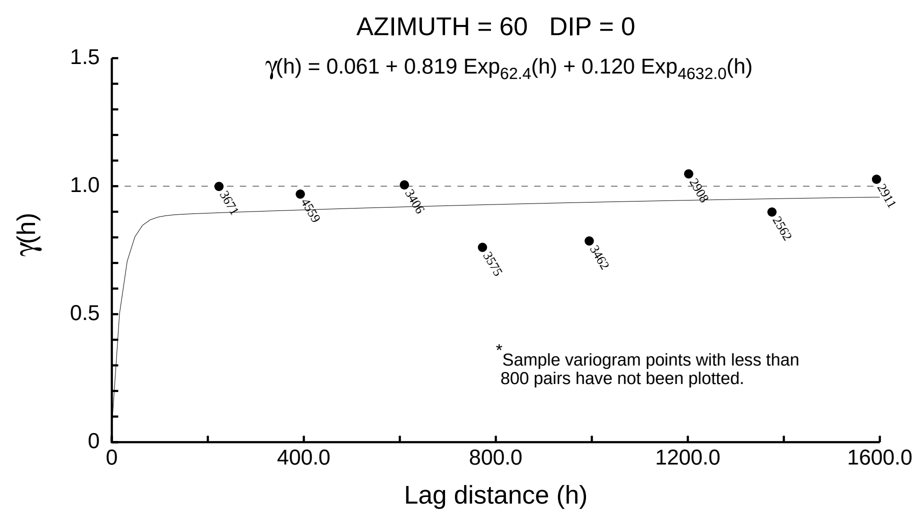
Modeling Criteria

Minimum number pairs req'd ==> 800
Sample variogram points weighted by # pairs

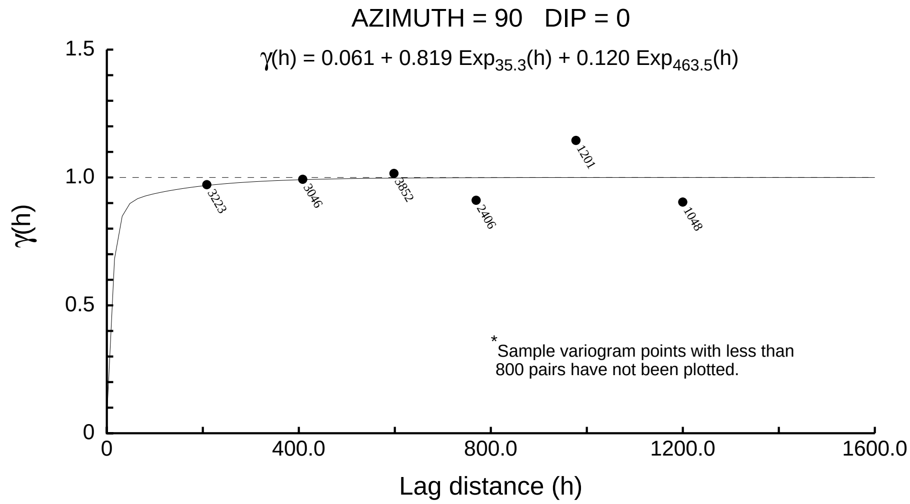
Directional 1003 - S

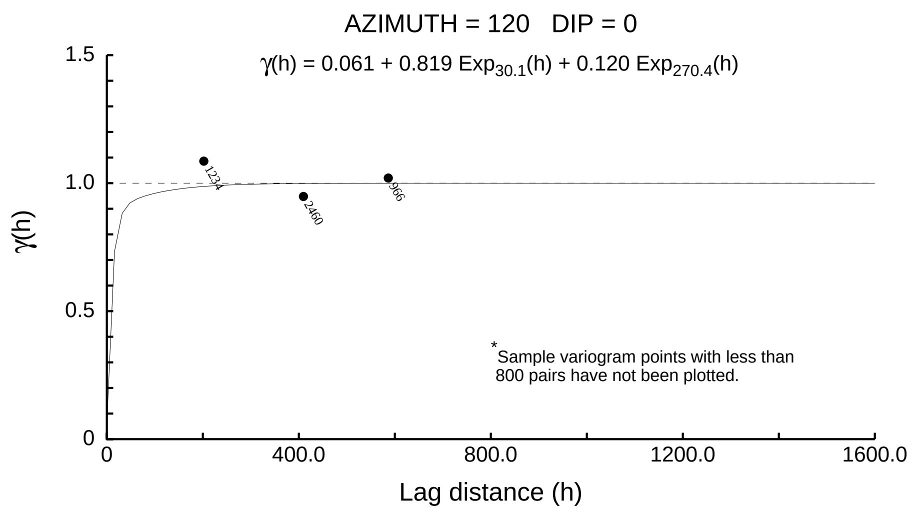


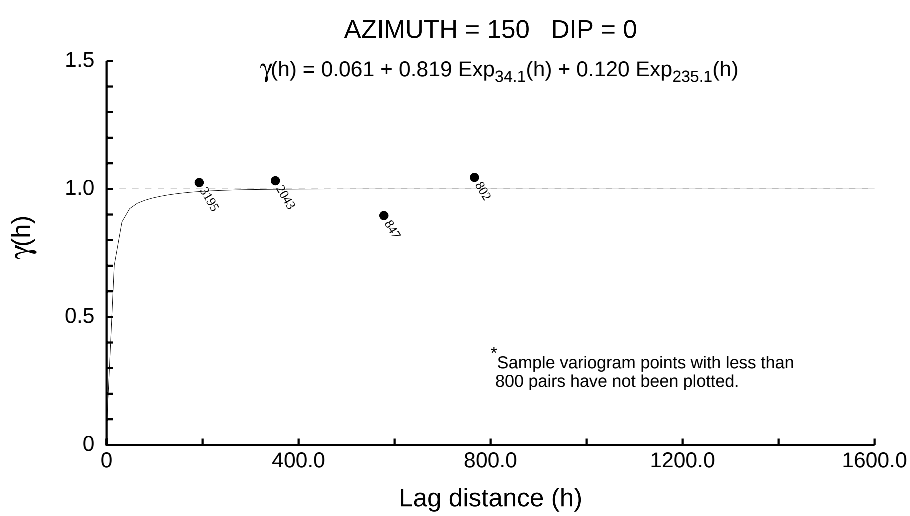




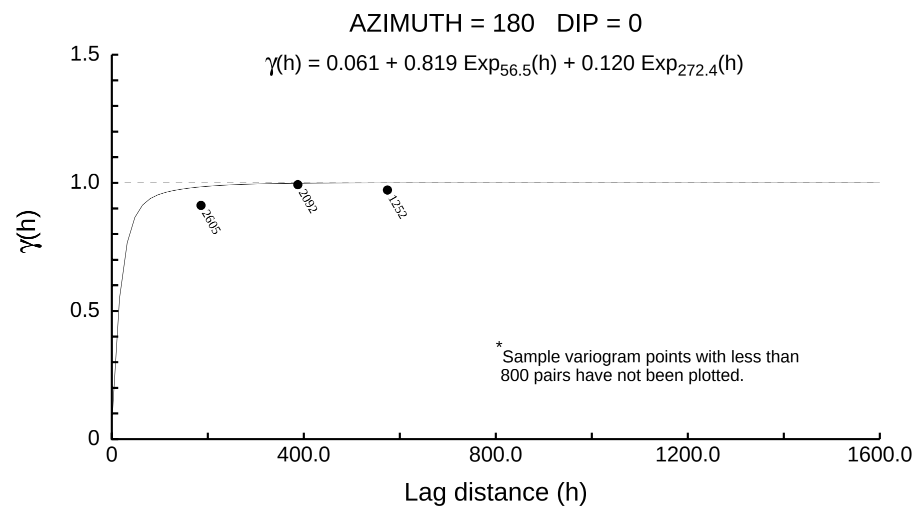
Directional 1003 - S

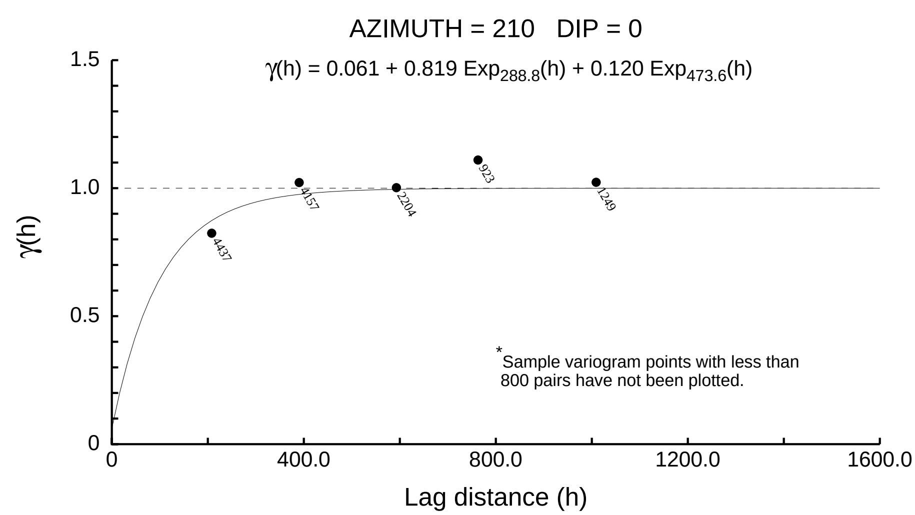


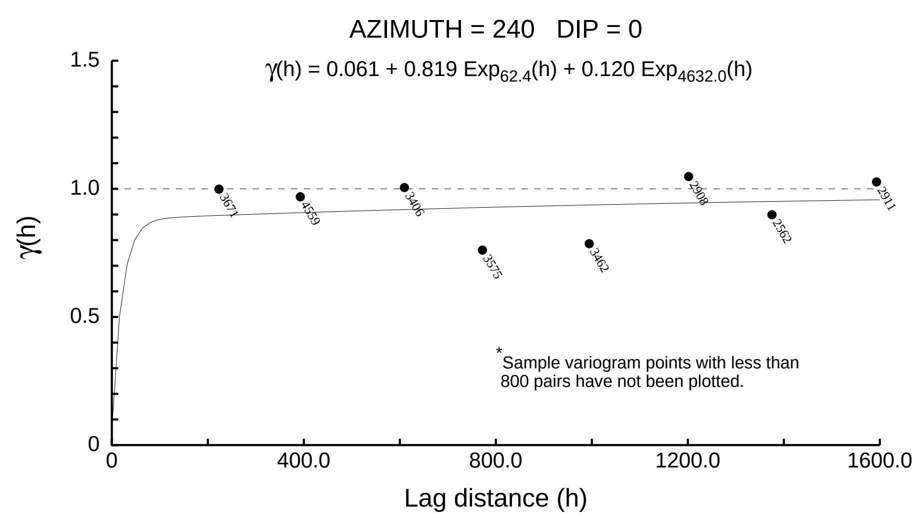




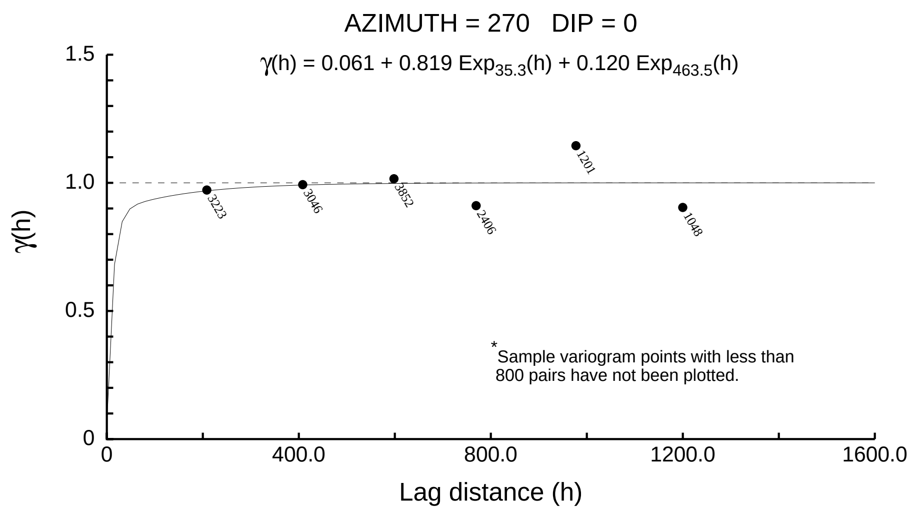
Directional 1003 - S

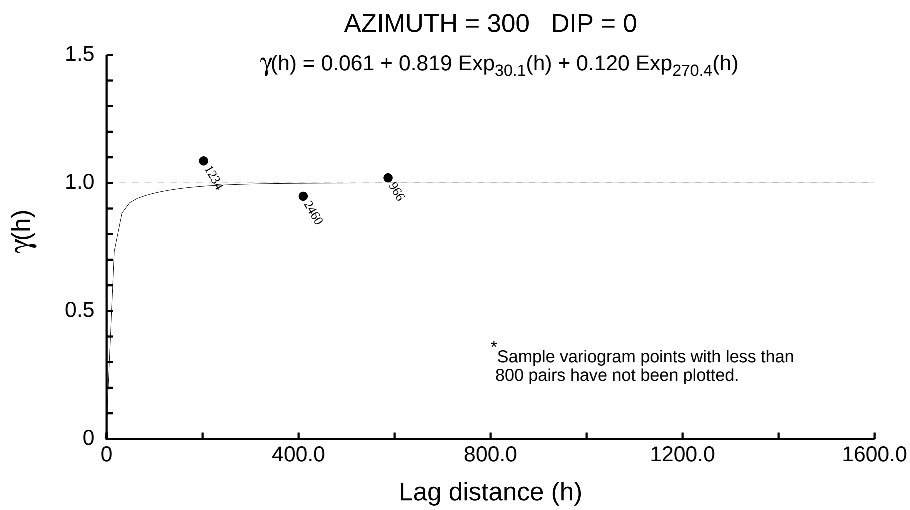


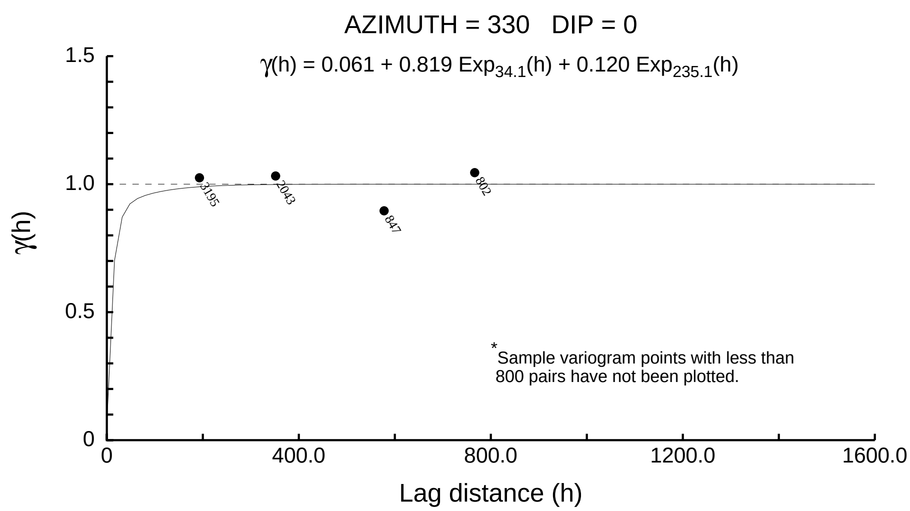




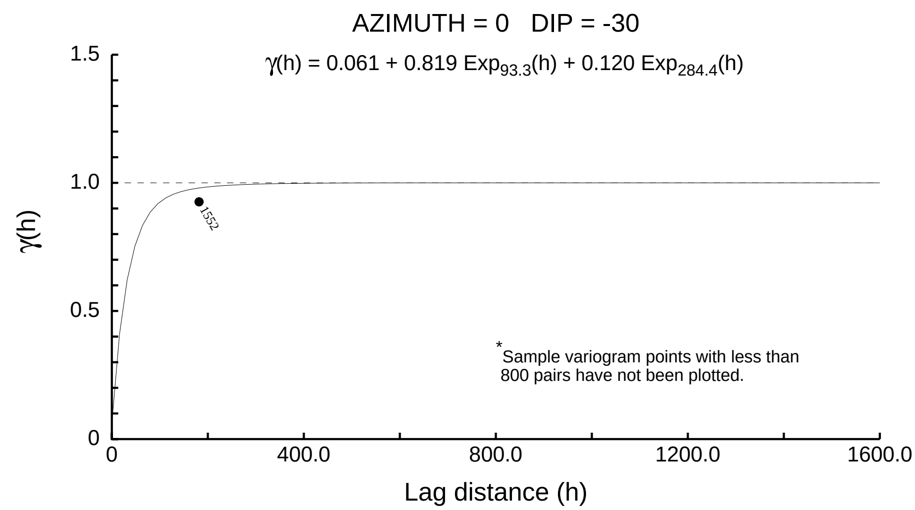
Directional 1003 - S

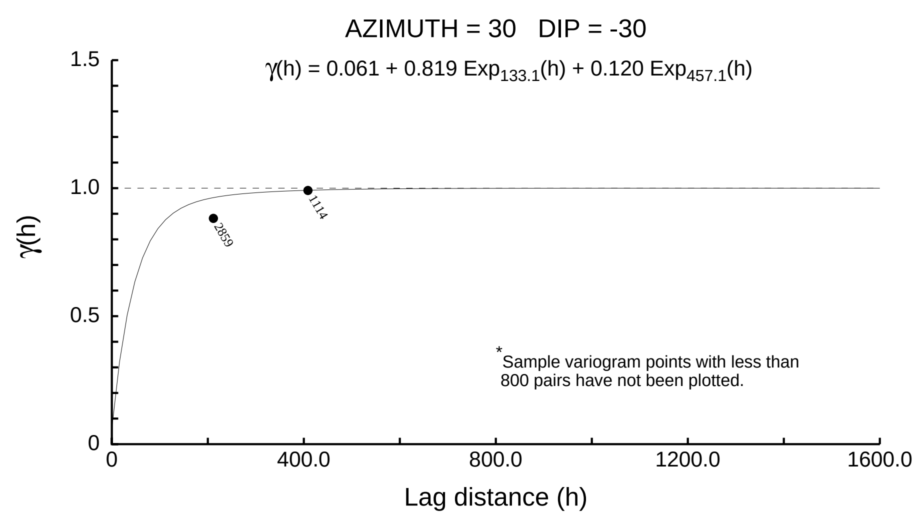


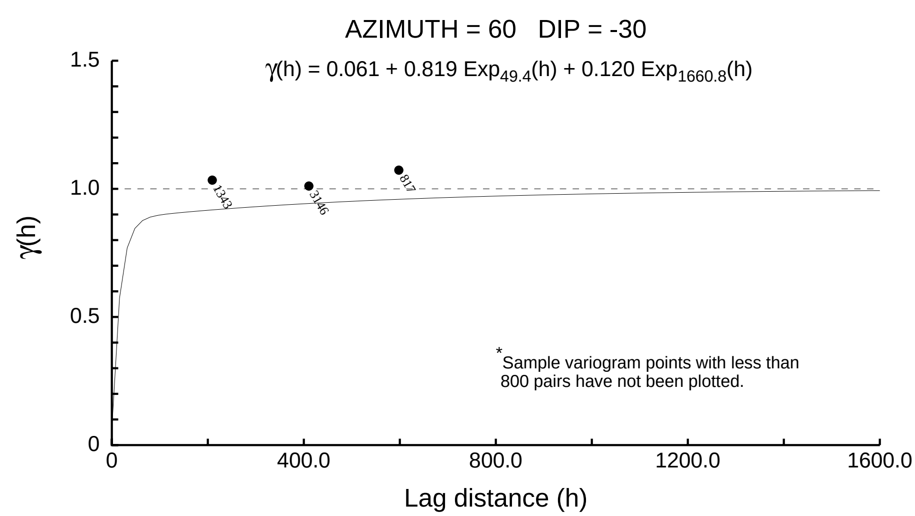




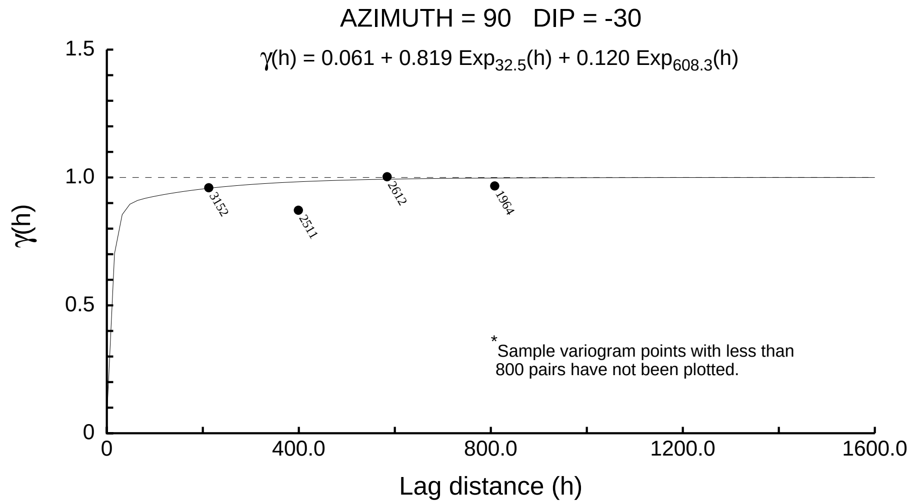
Directional 1003 - S

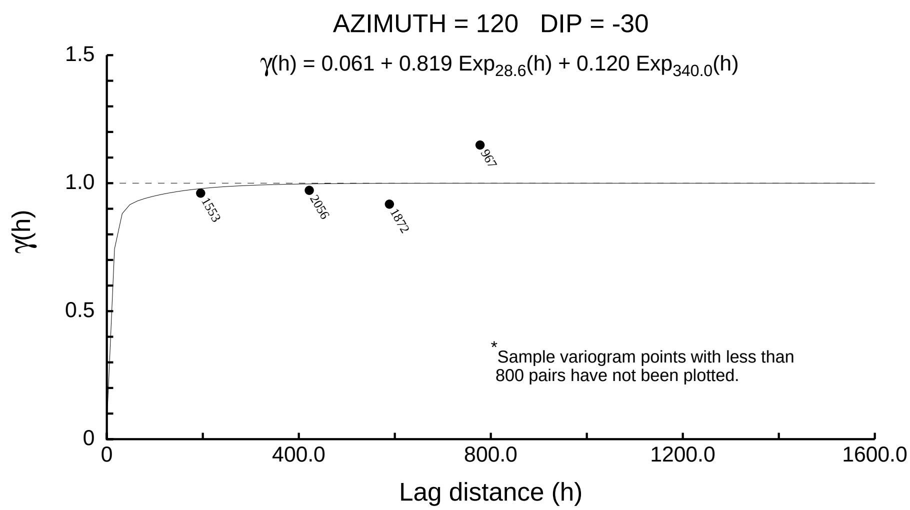


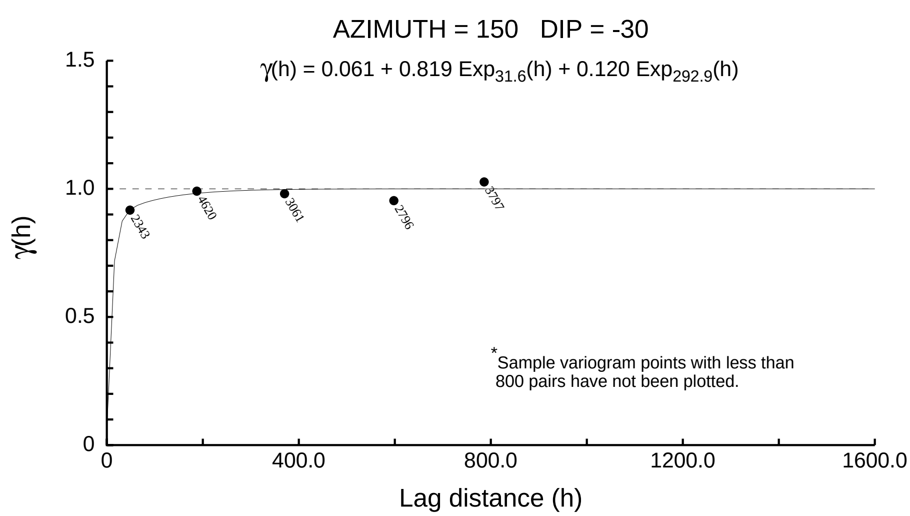




Directional 1003 - S

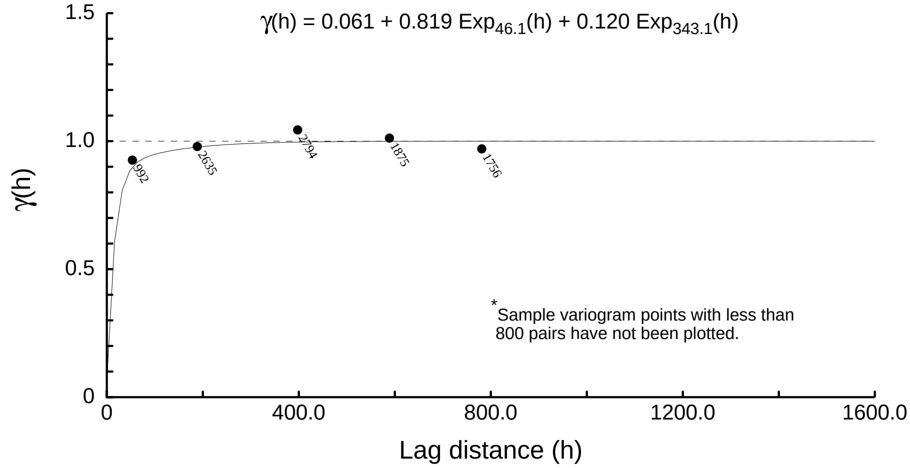




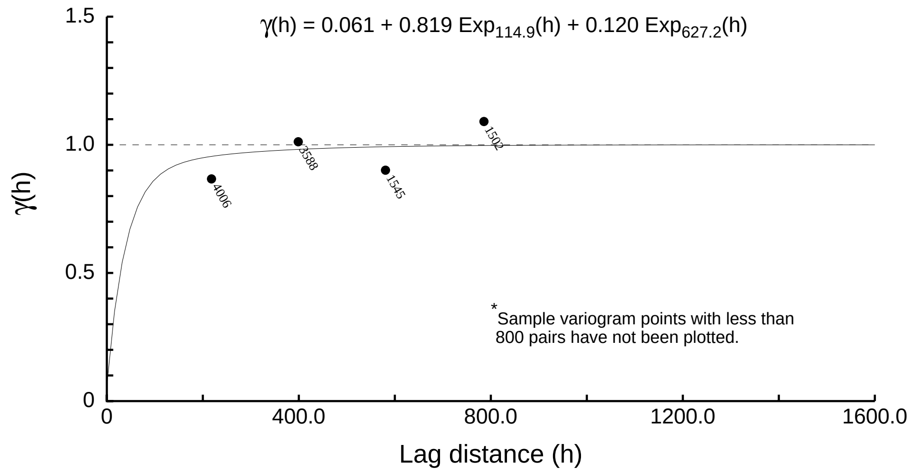


Directional 1003 - S

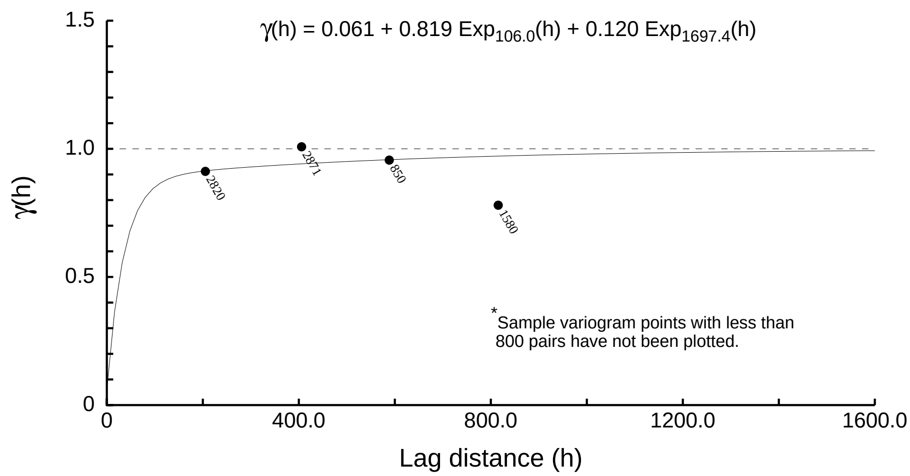
AZIMUTH = 180   DIP = -30



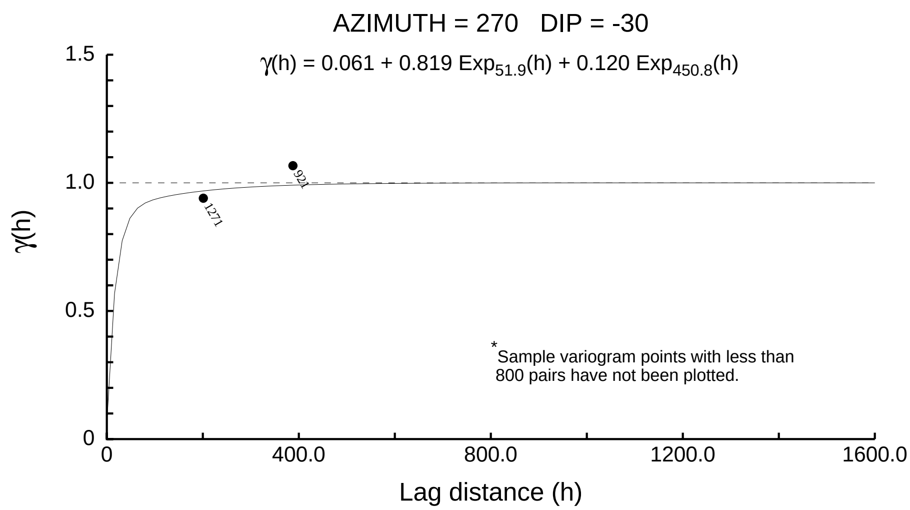
AZIMUTH = 210   DIP = -30

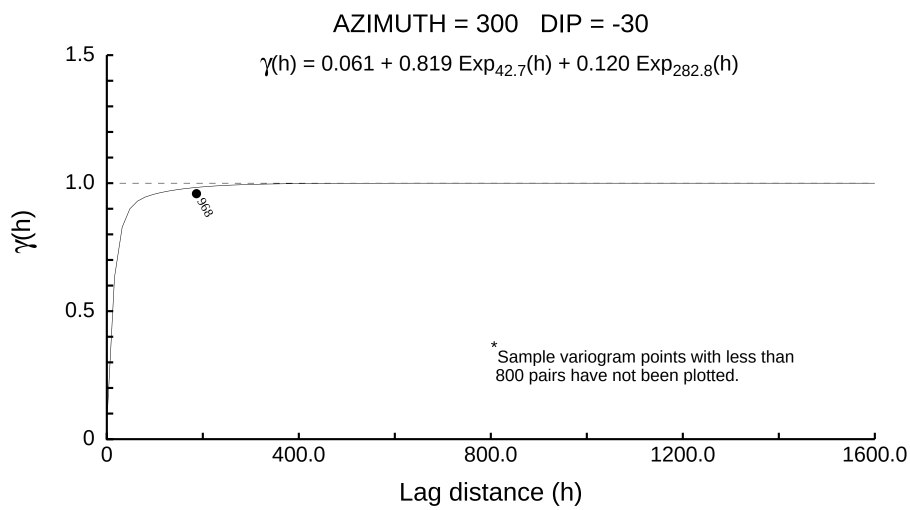


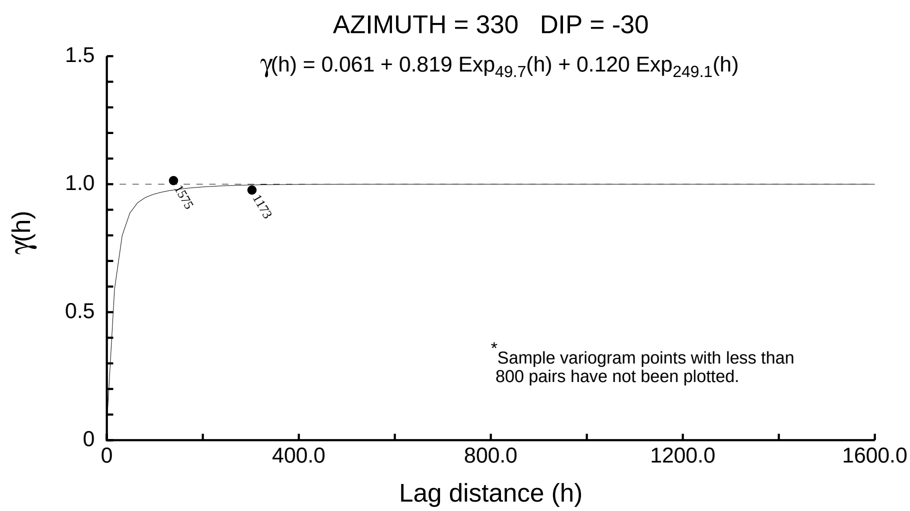
AZIMUTH = 240   DIP = -30



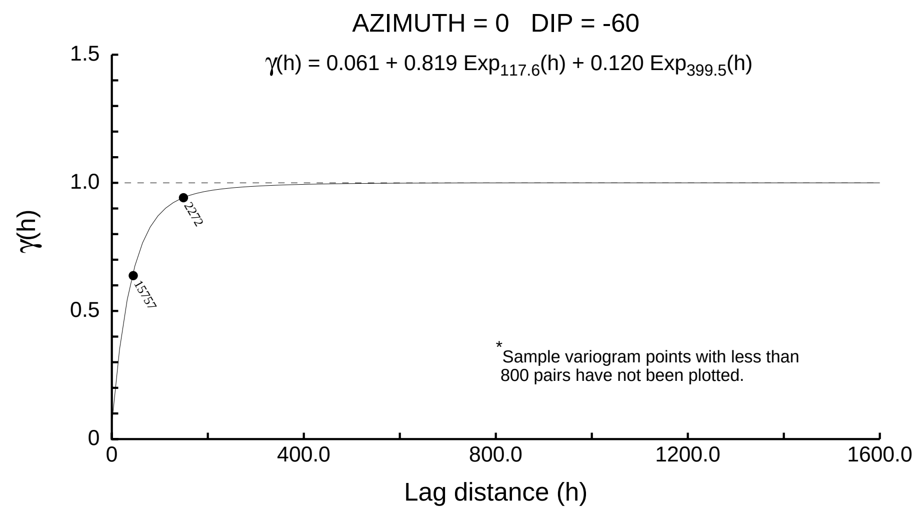
Directional 1003 - S

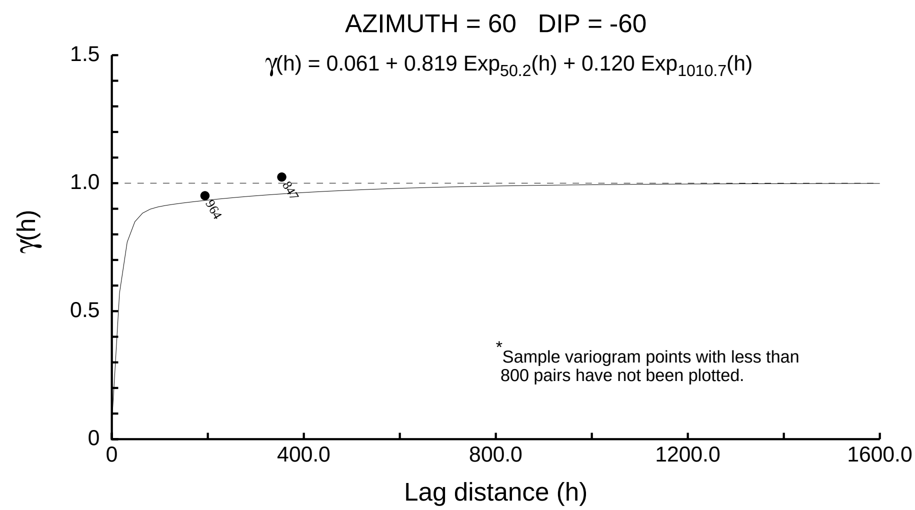


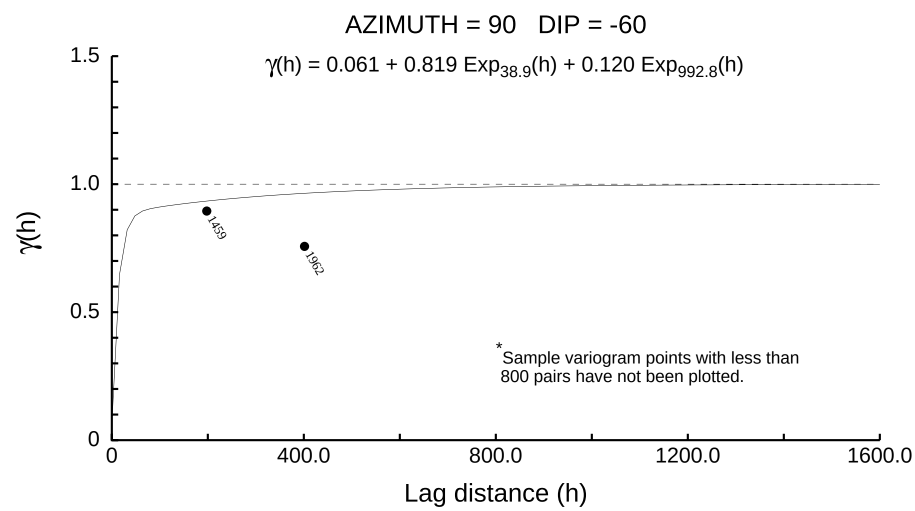




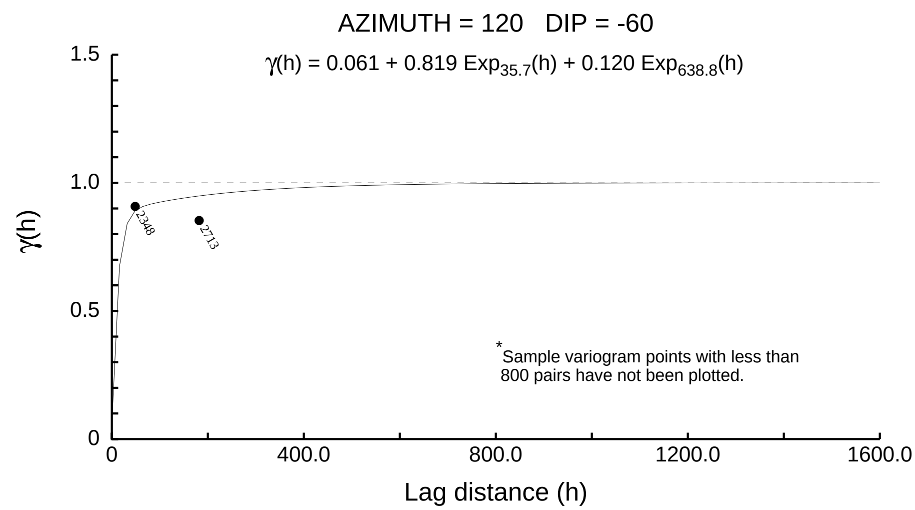
Directional 1003 - S

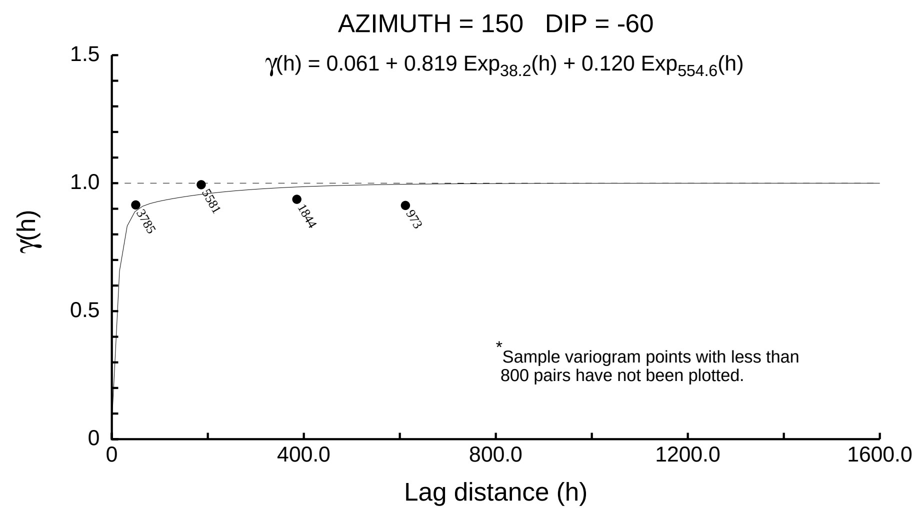


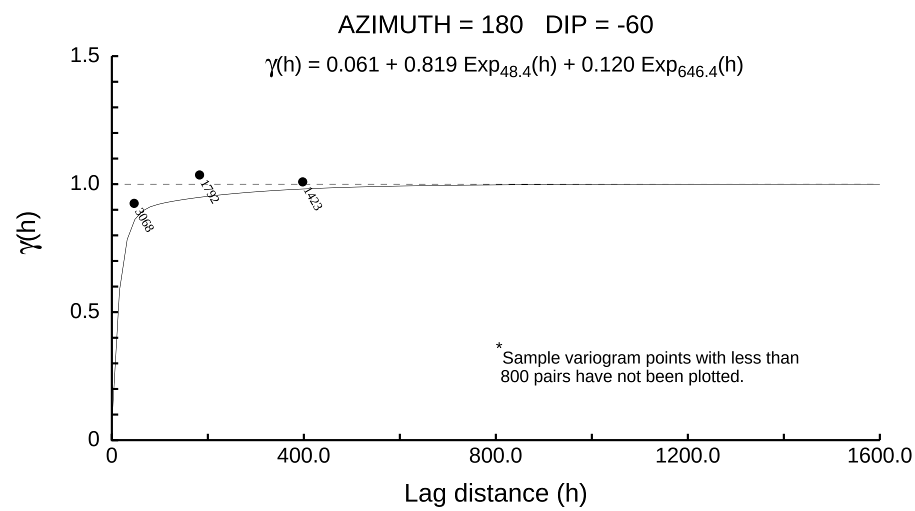




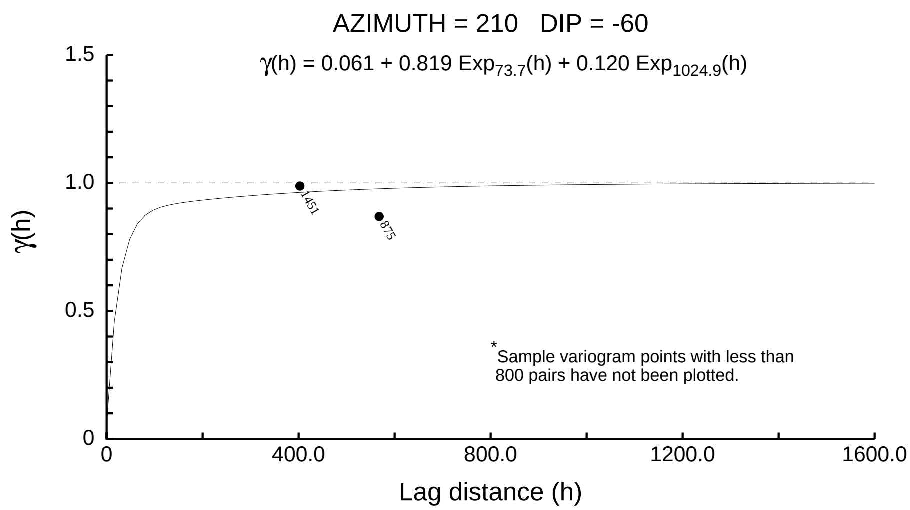
Directional 1003 - S

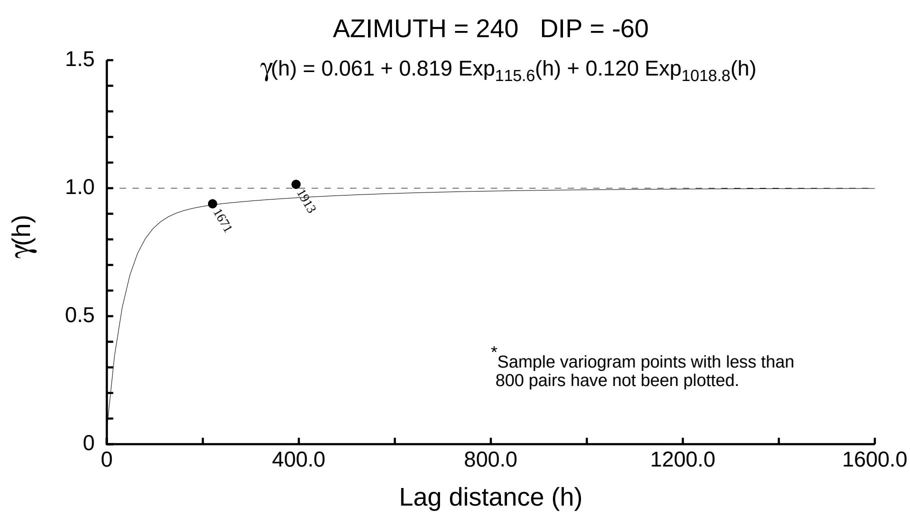


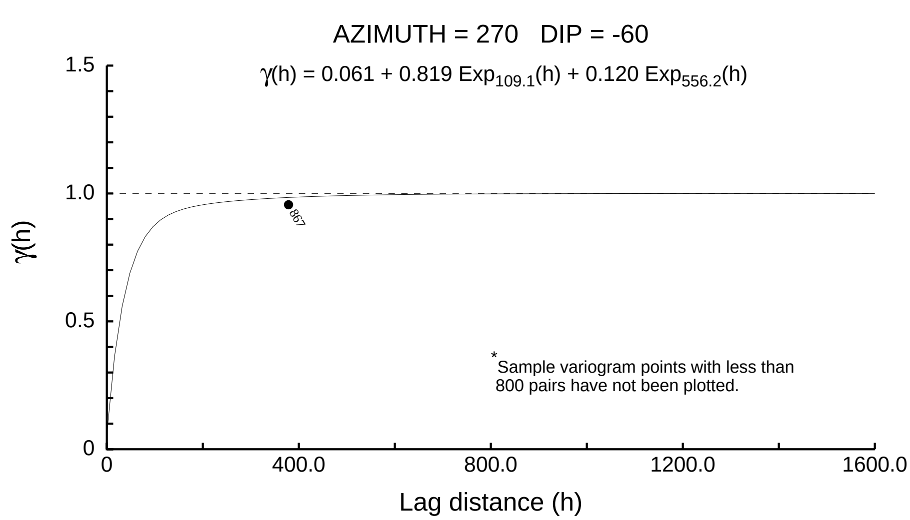




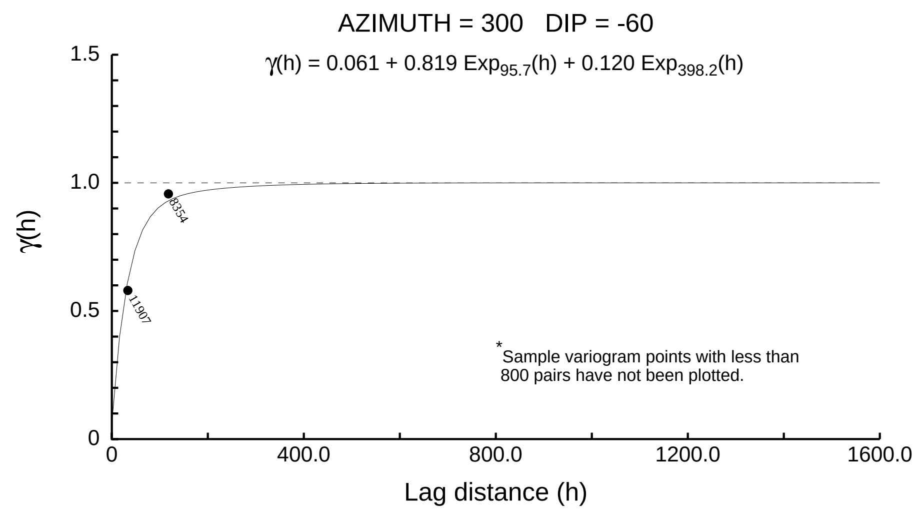
Directional 1003 - S

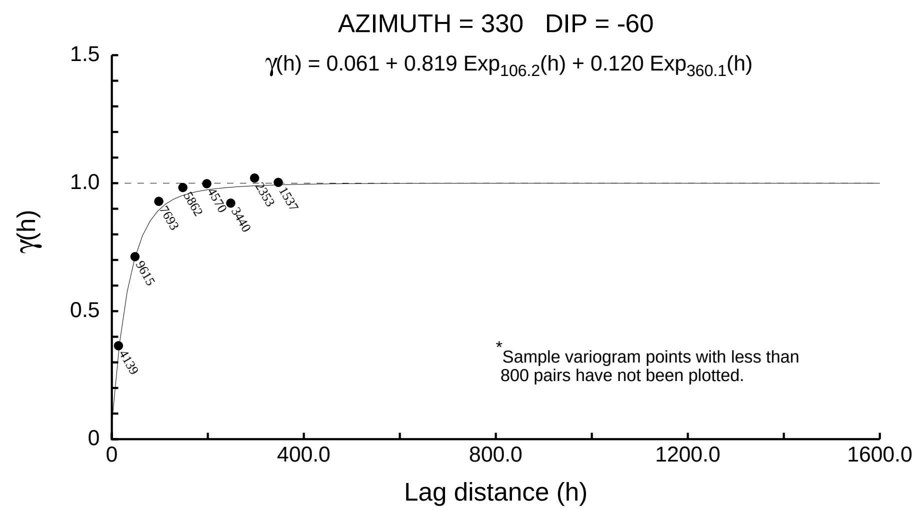


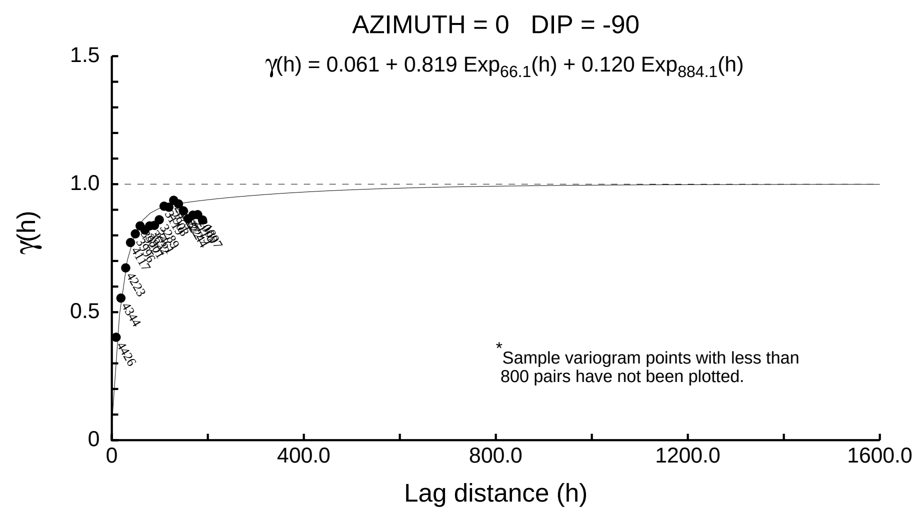




Directional 1003 - S







Downhole 2000 - Au

User Defined Rotation Conventions

Nugget ==> 0.004
C1 ==> 0.796
C2 ==> 0.200

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -14
RH Rotation about the Y’ axis ==> 41
RH Rotation about the Z’ axis ==> -57

Range along the Z’ axis	==> 39.3	Azimuth ==> 104	Dip ==> 49
Range along the Y’ axis	==> 231.5	Azimuth ==> 64	Dip ==> -33
Range along the X’ axis	==> 104.1	Azimuth ==> 168	Dip ==> -21

Second Structure -- Exponential with Practical Range

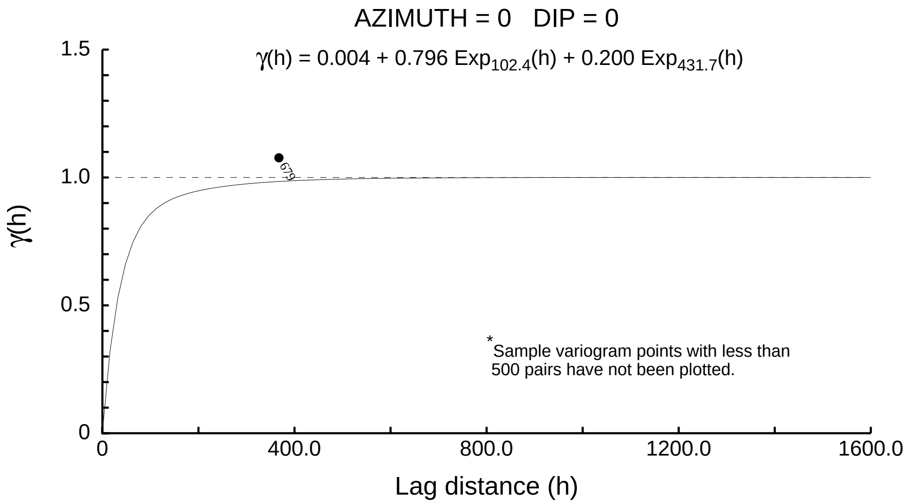
RH Rotation about the Z axis ==> -69
RH Rotation about the Y’ axis ==> -69
RH Rotation about the Z’ axis ==> 3

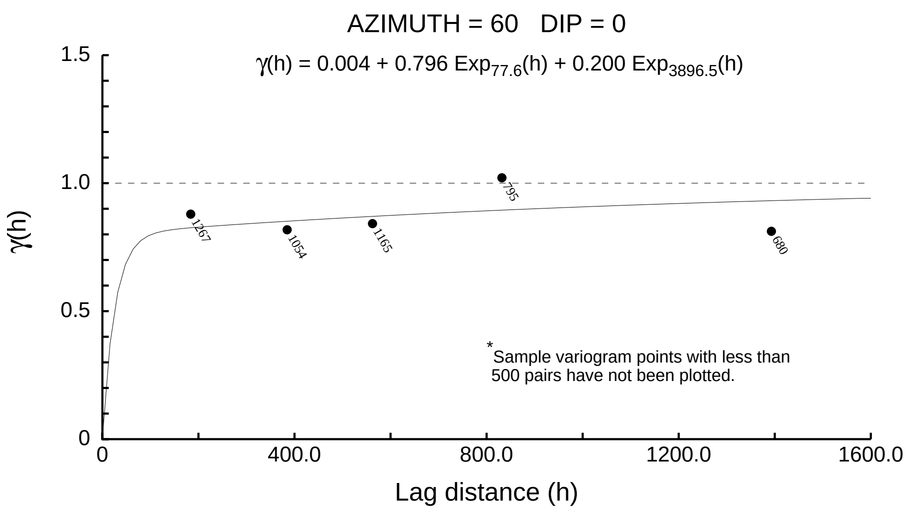
Range along the Z’ axis	==> 1409.9	Azimuth ==> 339	Dip ==> 21
Range along the Y’ axis	==> 4827.4	Azimuth ==> 68	Dip ==> -2
Range along the X’ axis	==> 145.6	Azimuth ==> 153	Dip ==> 69

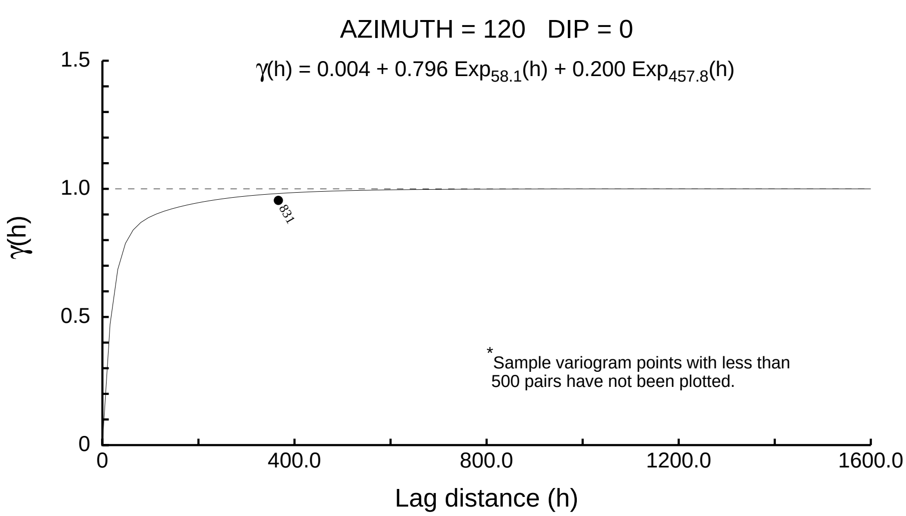
Modeling Criteria

Minimum number pairs req’d ==> 500
Sample variogram points weighted by # pairs

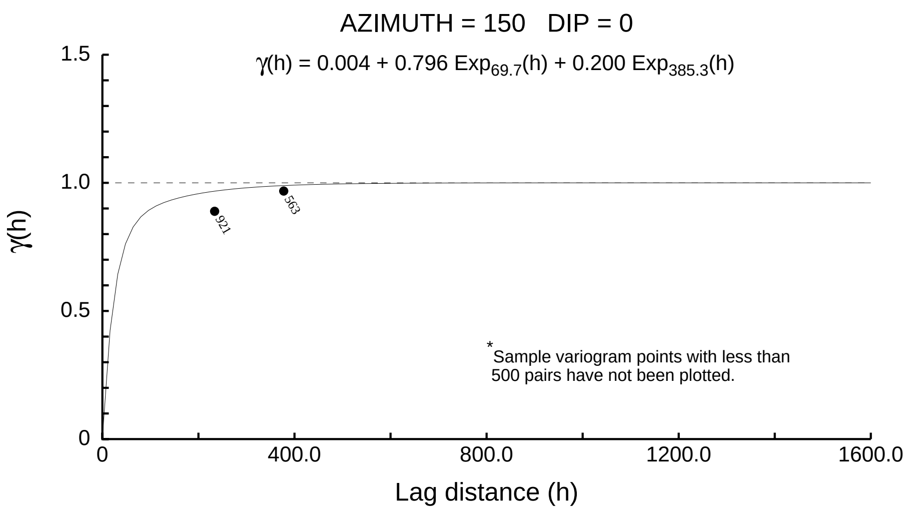
Downhole 2000 - Au

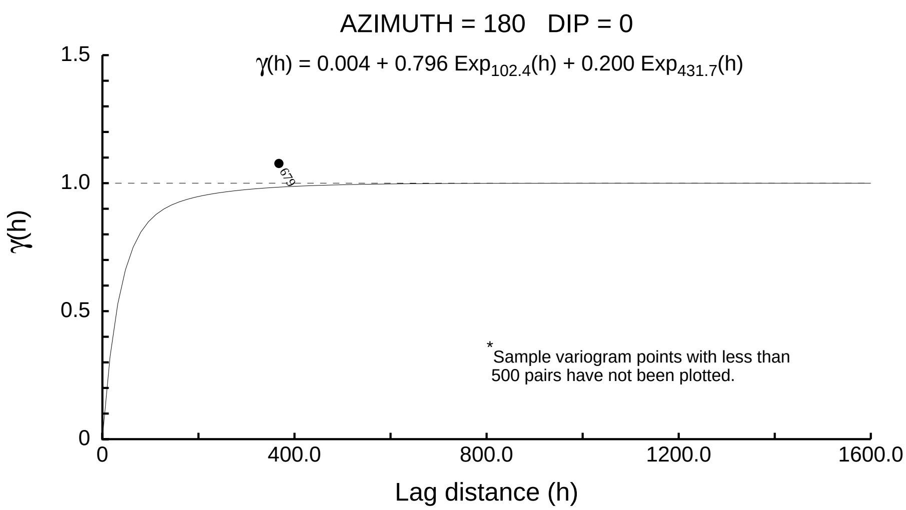


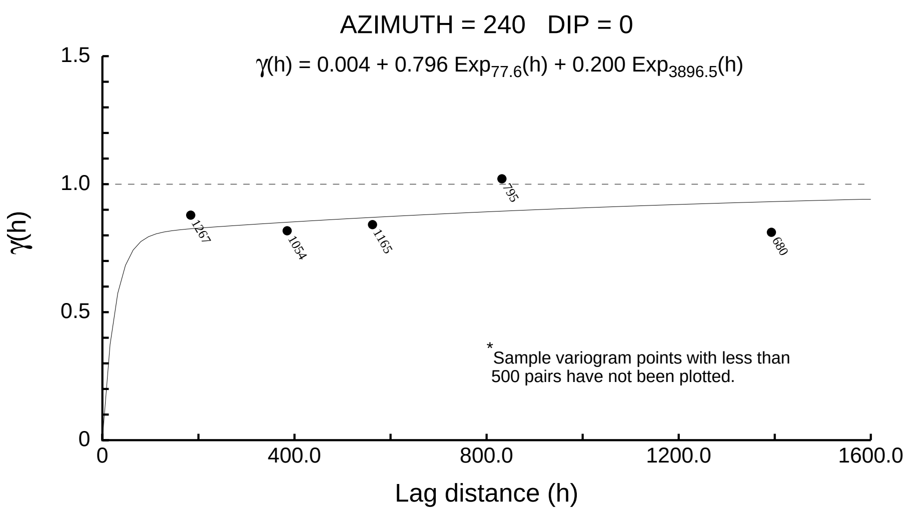




Downhole 2000 - Au

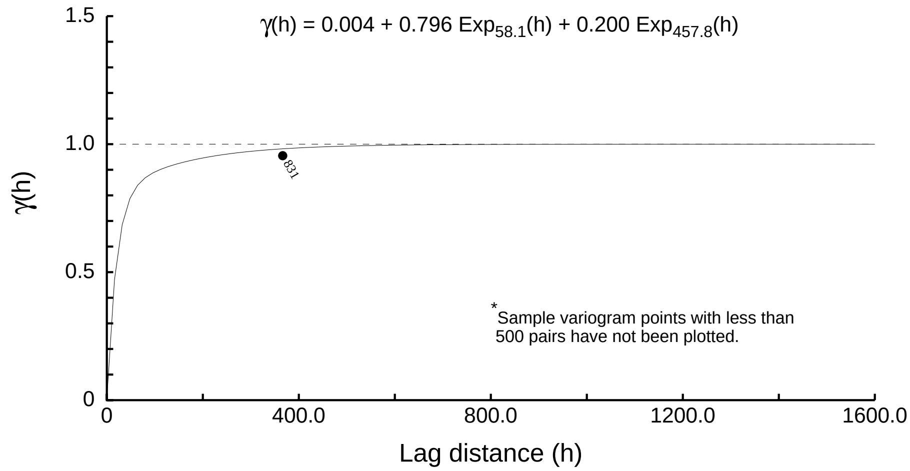




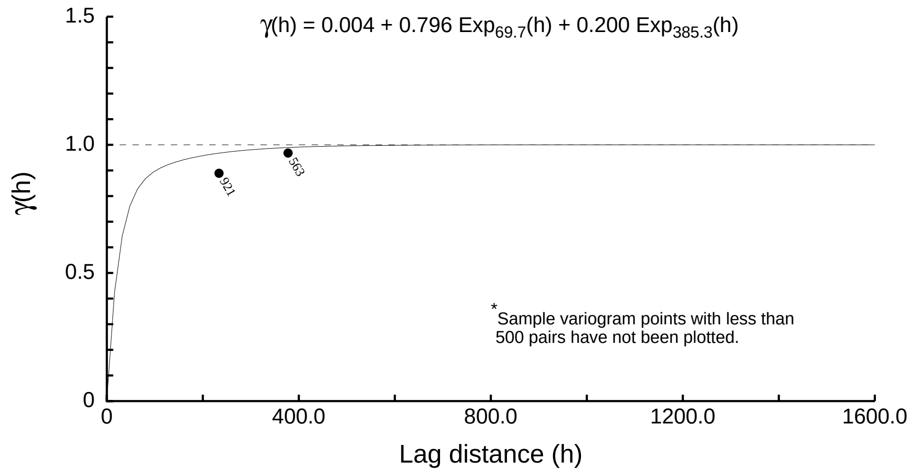


Downhole 2000 - Au

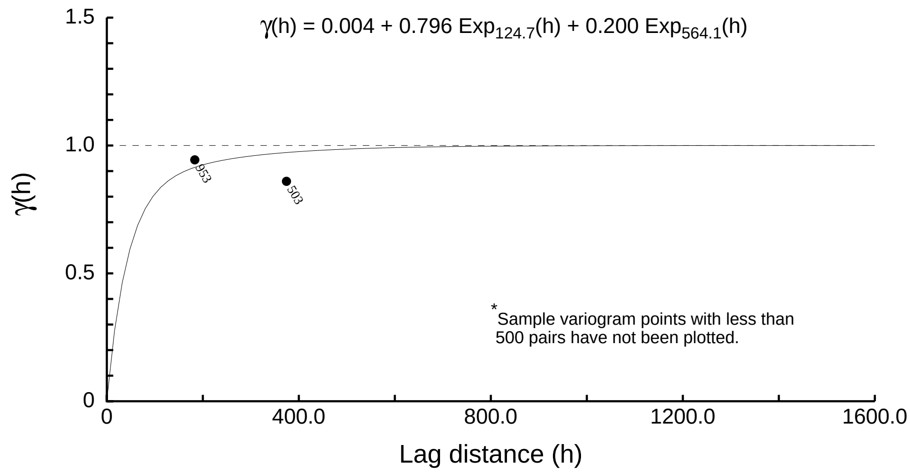
AZIMUTH = 300   DIP = 0



AZIMUTH = 330   DIP = 0

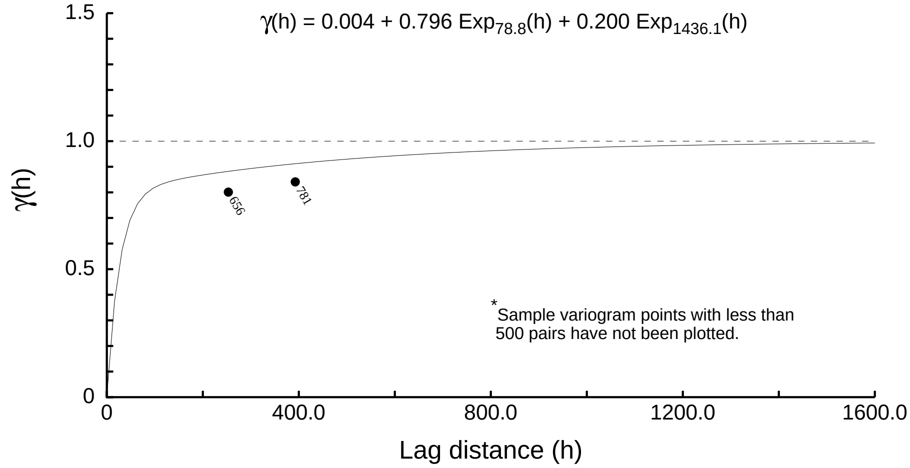


AZIMUTH = 60   DIP = -15

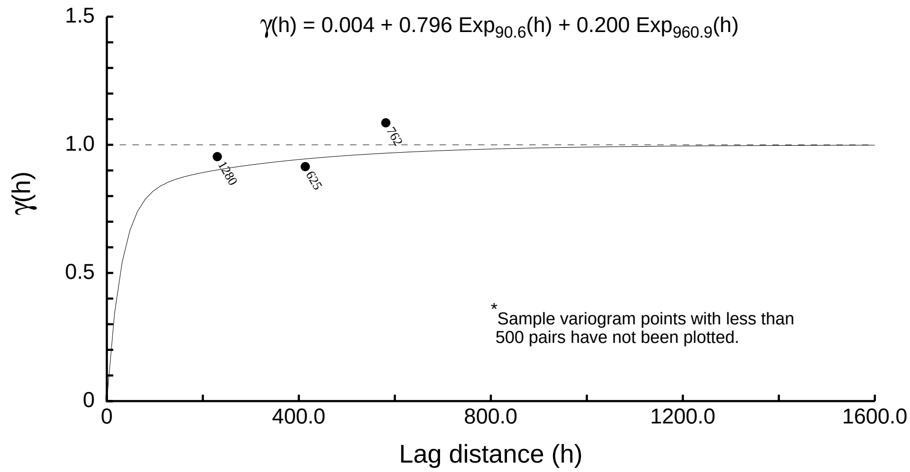


Downhole 2000 - Au

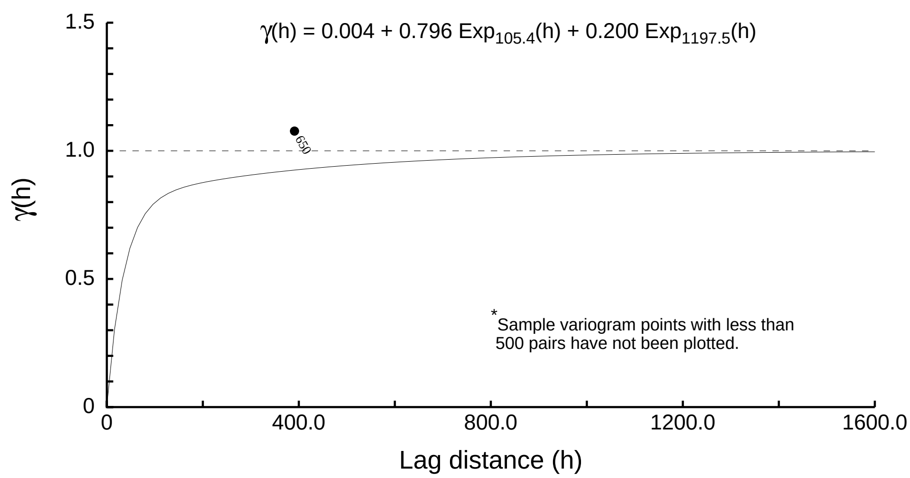
AZIMUTH = 120   DIP = -15



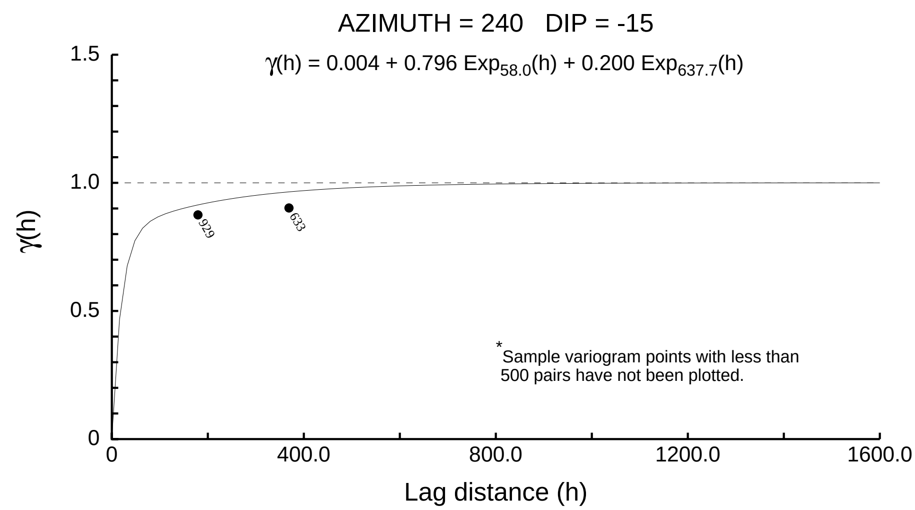
AZIMUTH = 150   DIP = -15

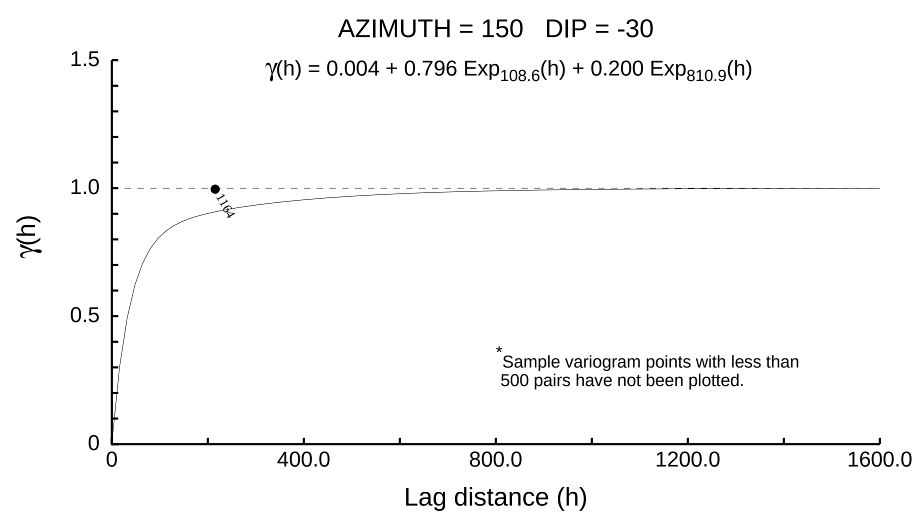


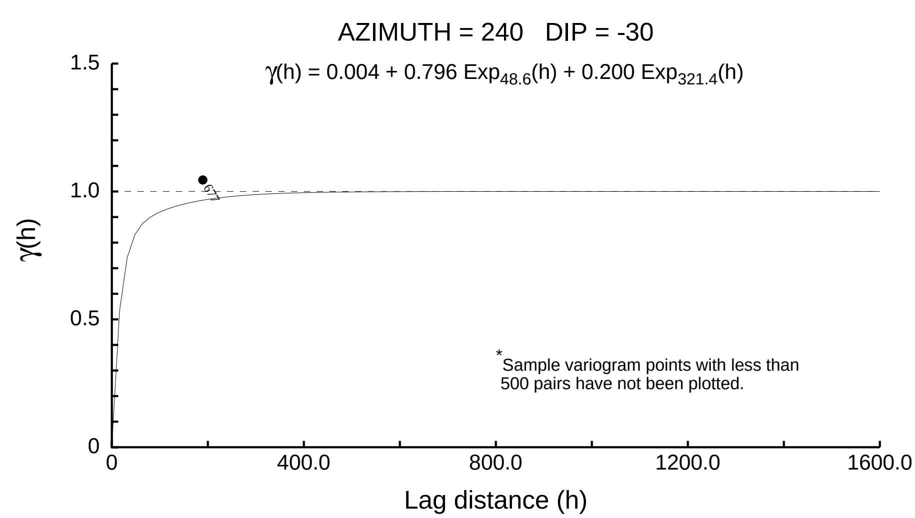
AZIMUTH = 180   DIP = -15



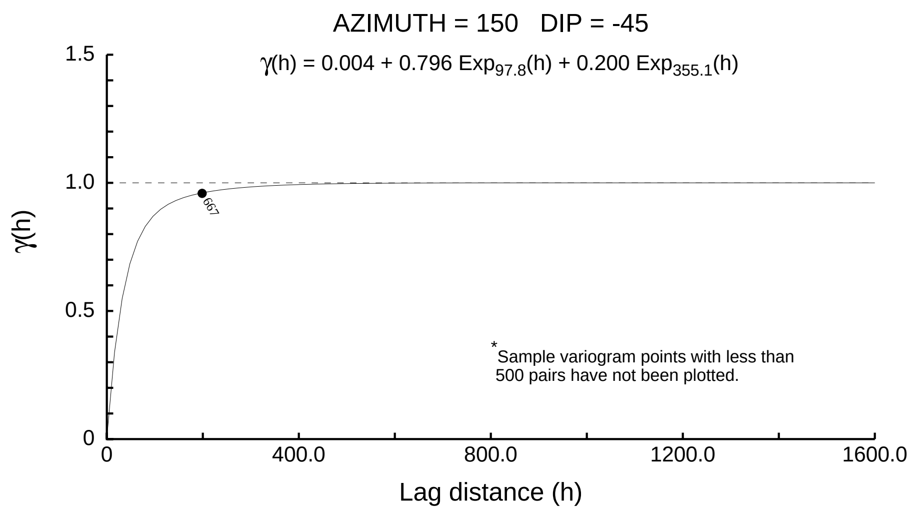
Downhole 2000 - Au

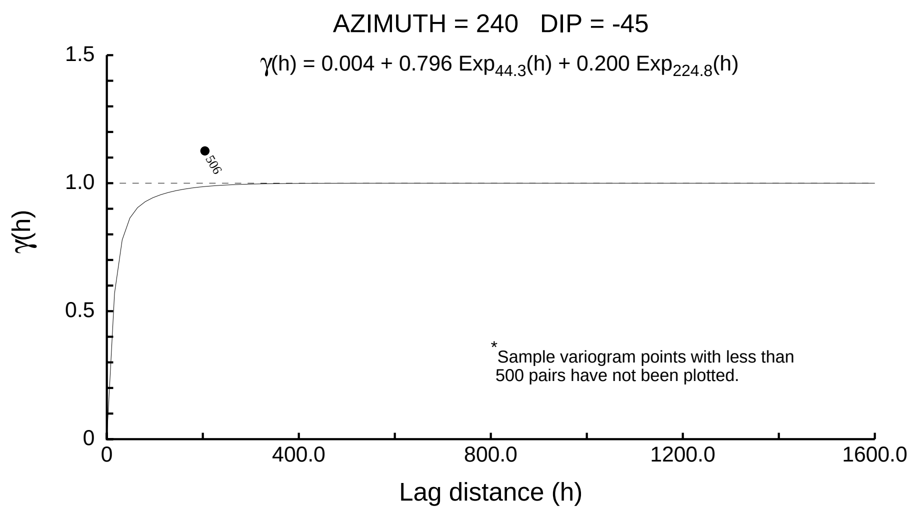


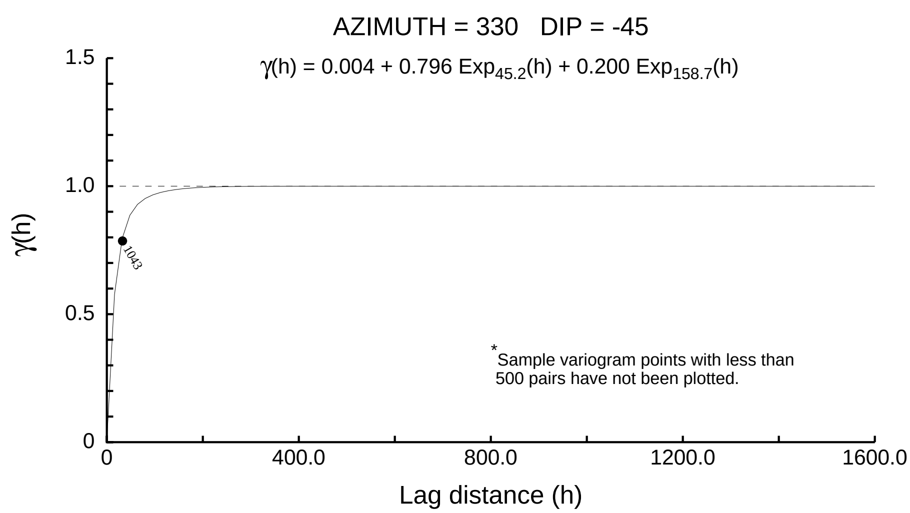




Downhole 2000 - Au

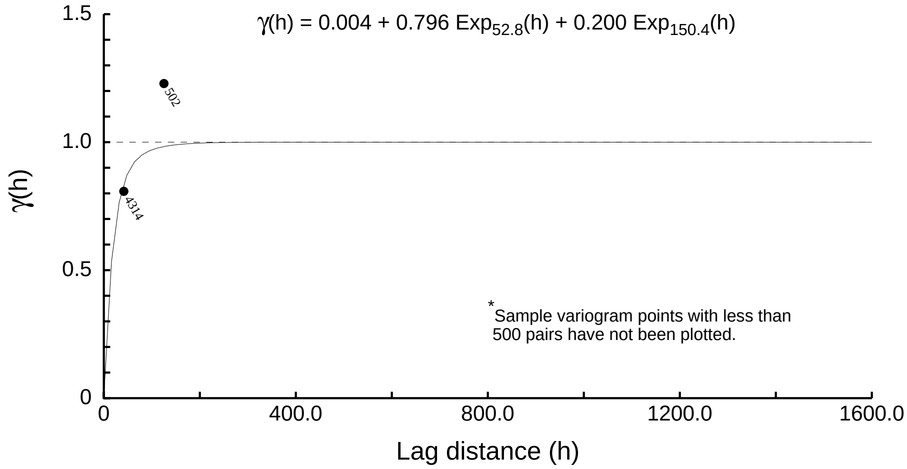




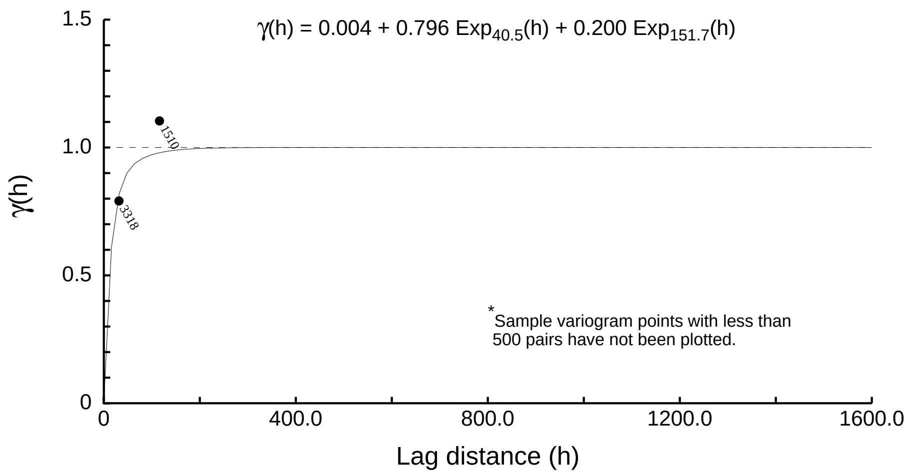


Downhole 2000 - Au

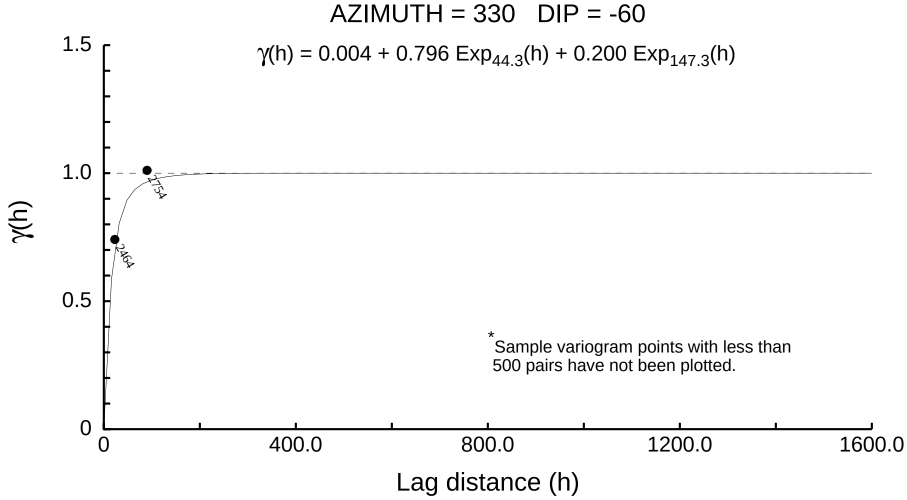
AZIMUTH = 0   DIP = -60



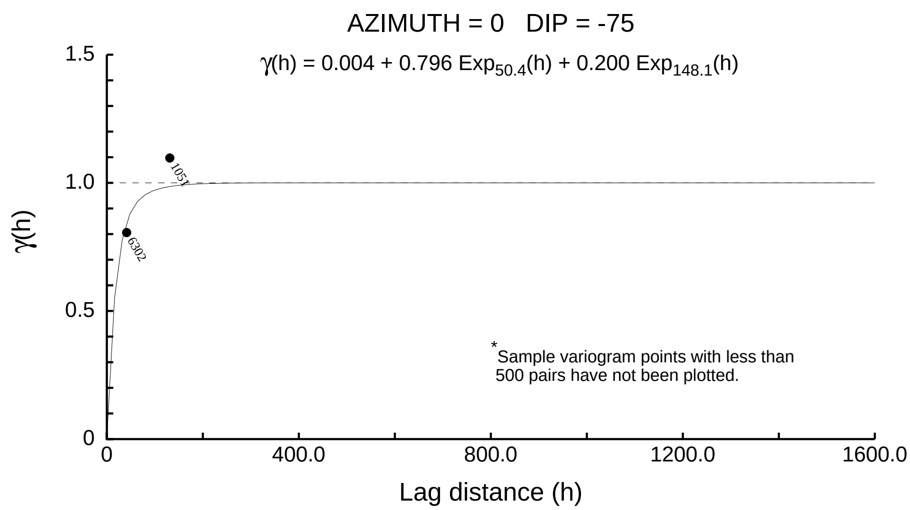
AZIMUTH = 300   DIP = -60

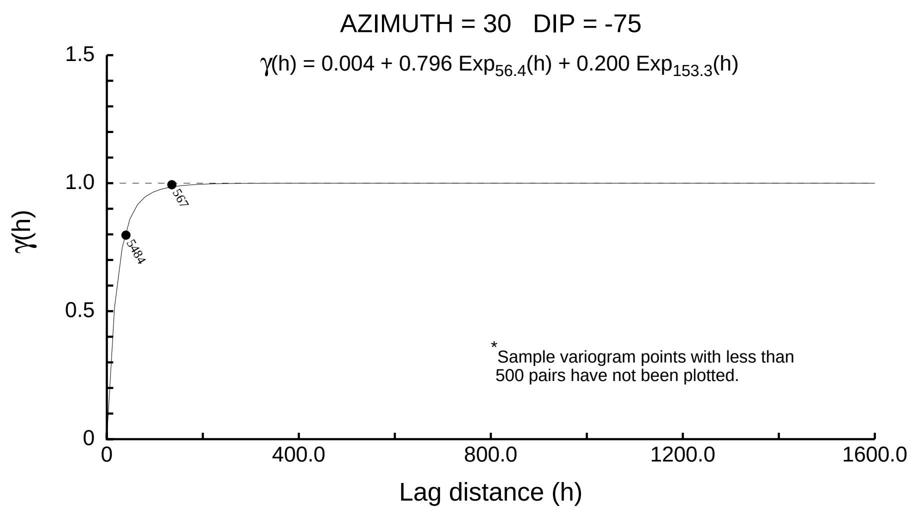


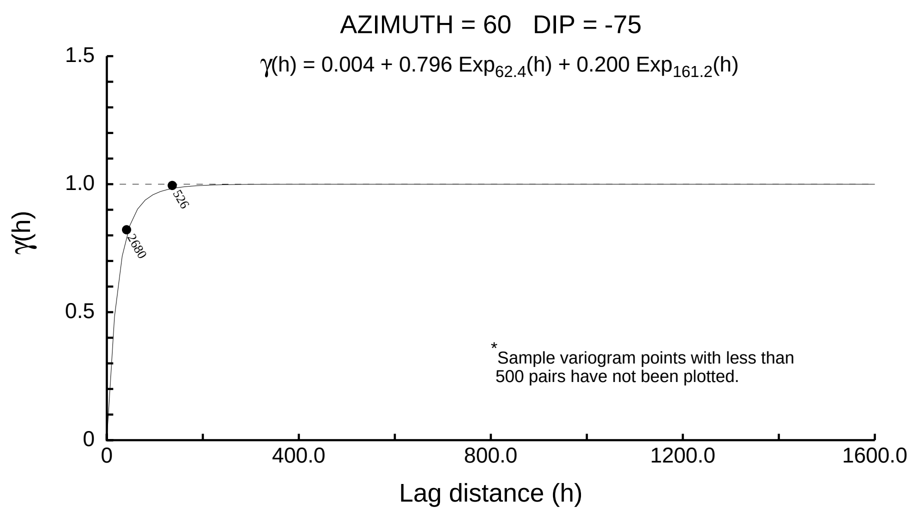
AZIMUTH = 330   DIP = -60



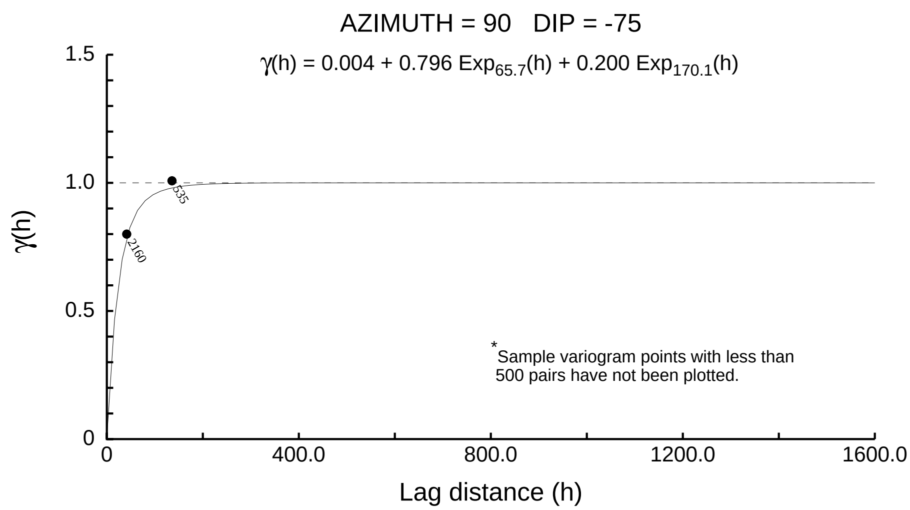
Downhole 2000 - Au

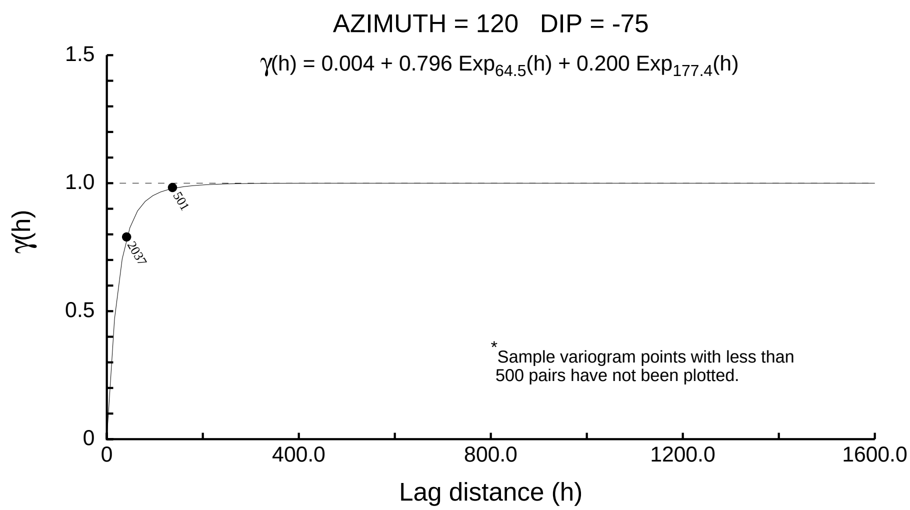


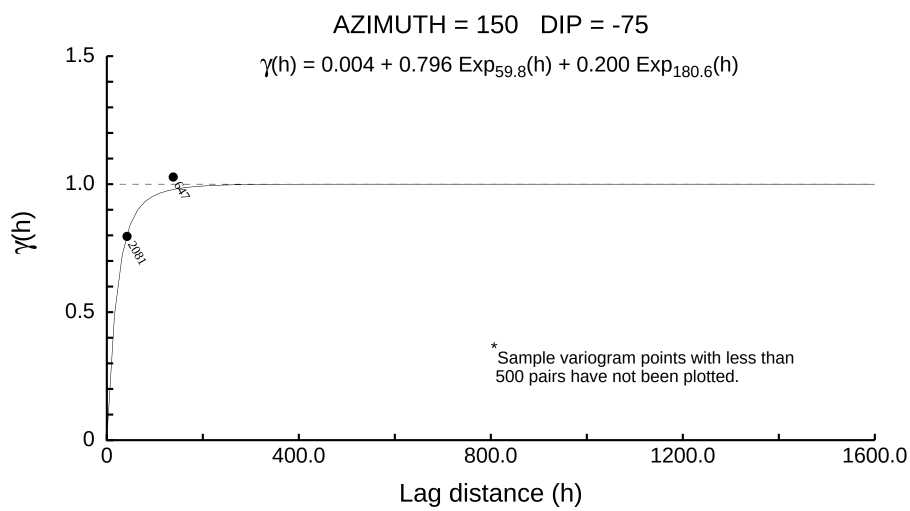




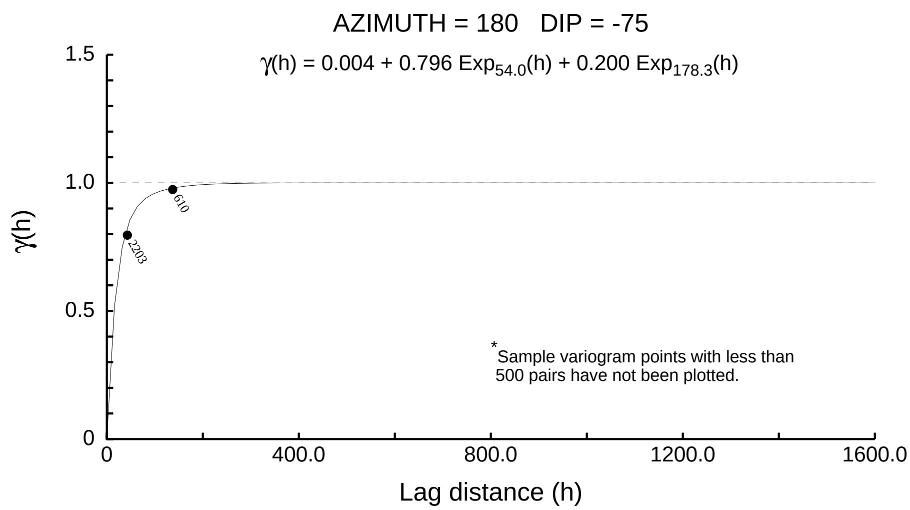
Downhole 2000 - Au

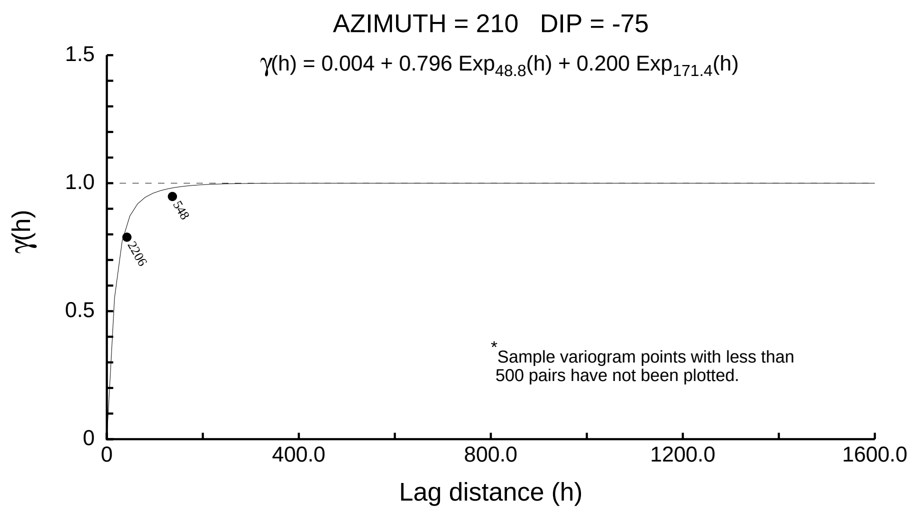


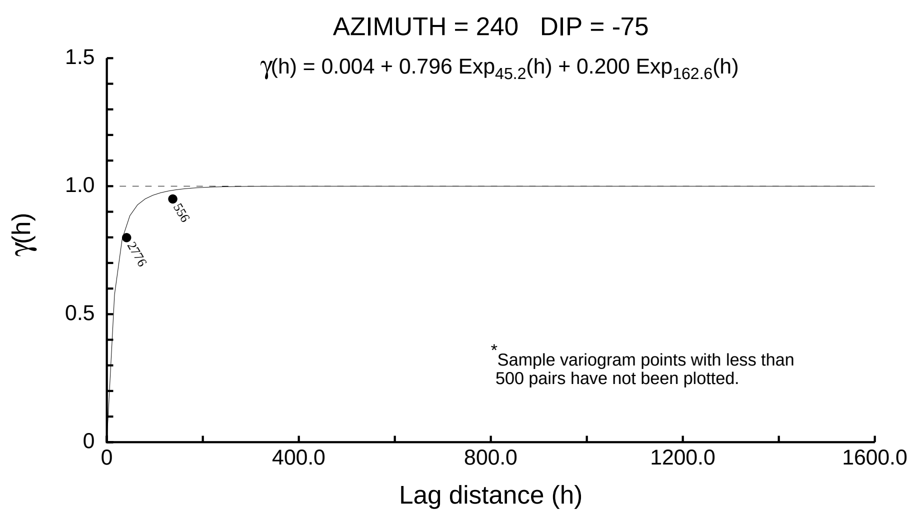




Downhole 2000 - Au

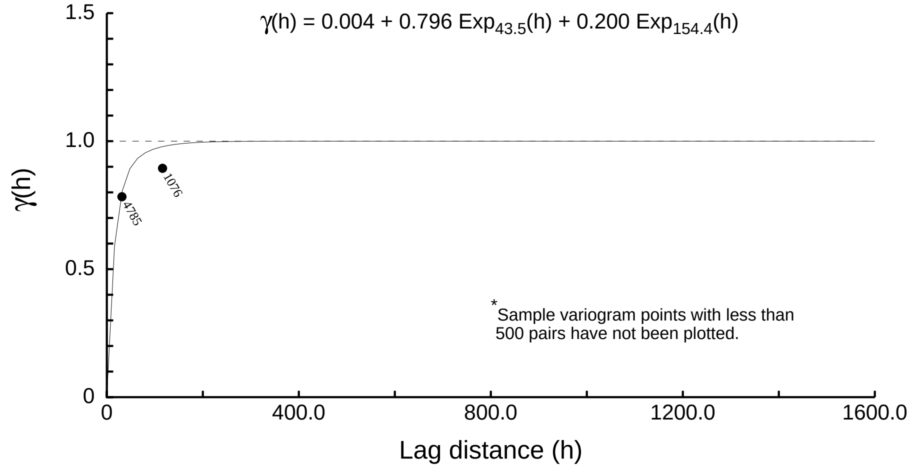




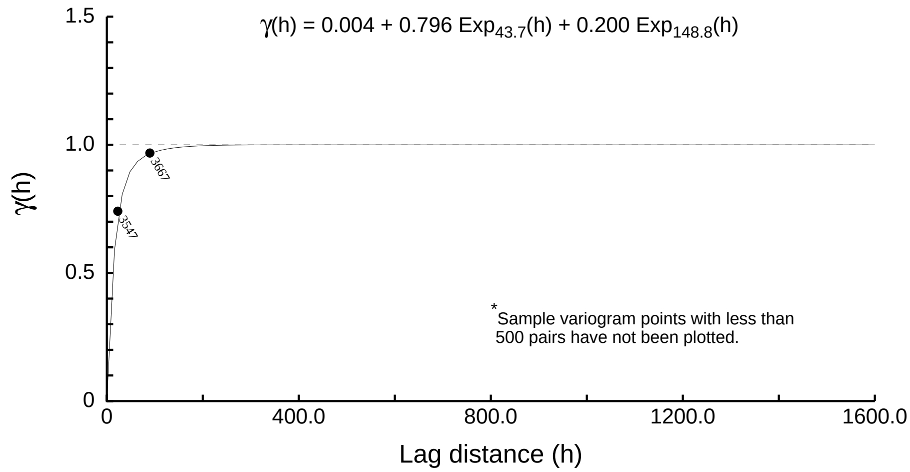


Downhole 2000 - Au

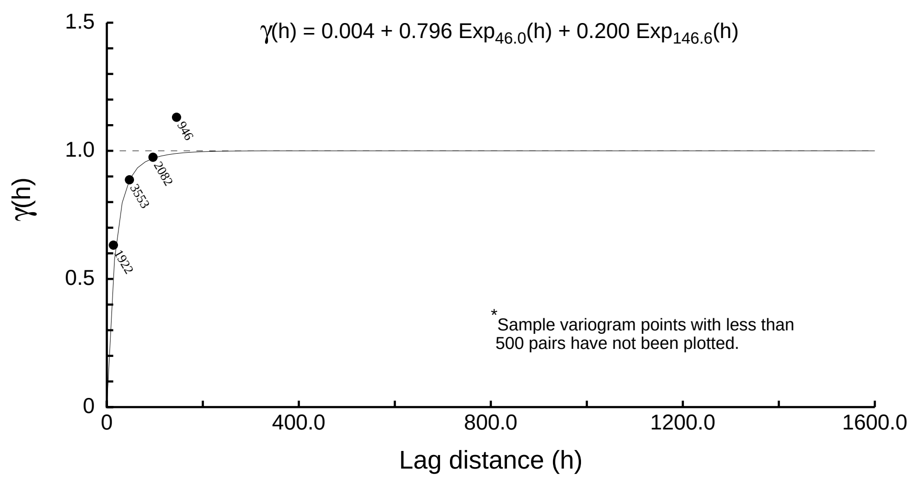
AZIMUTH = 270 DIP = -75



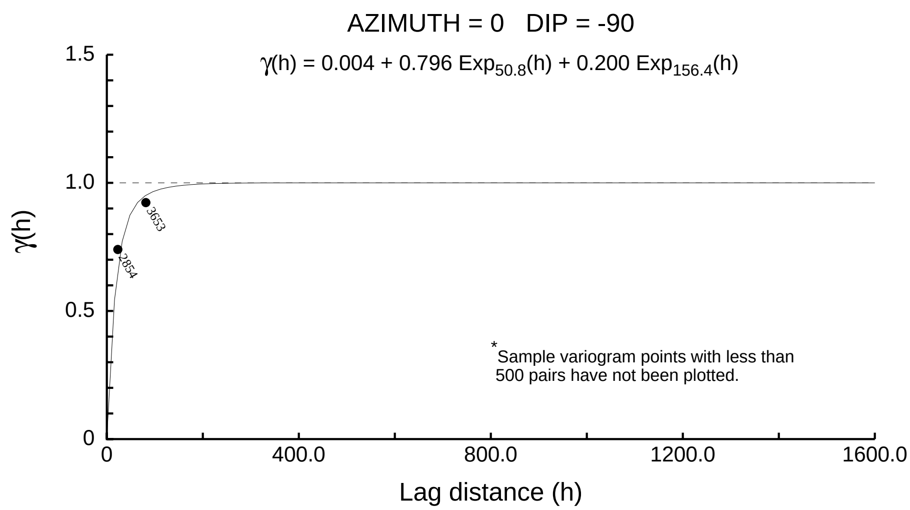
AZIMUTH = 300 DIP = -75



AZIMUTH = 330 DIP = -75



Downhole 2000 - Au



Downhole 2000 - Co

User Defined Rotation Conventions

Nugget ==> 0.003
C1 ==> 0.695
C2 ==> 0.302

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -35
RH Rotation about the Y' axis ==> 83
RH Rotation about the Z' axis ==> -14
Range along the Z' axis ==> 25.8 Azimuth ==> 125 Dip ==> 7
Range along the Y' axis ==> 274.5 Azimuth ==> 37 Dip ==> -14
Range along the X' axis ==> 49.9 Azimuth ==> 190 Dip ==> -74

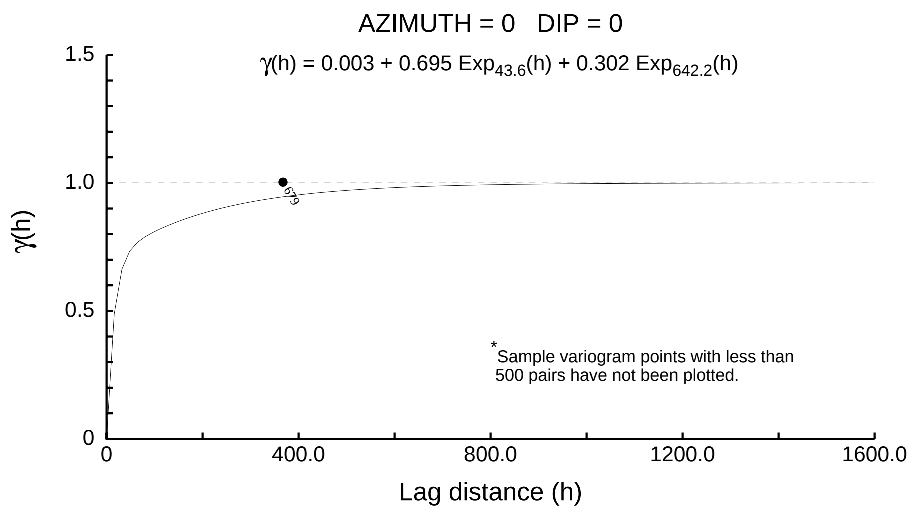
Second Structure -- Exponential with Practical Range

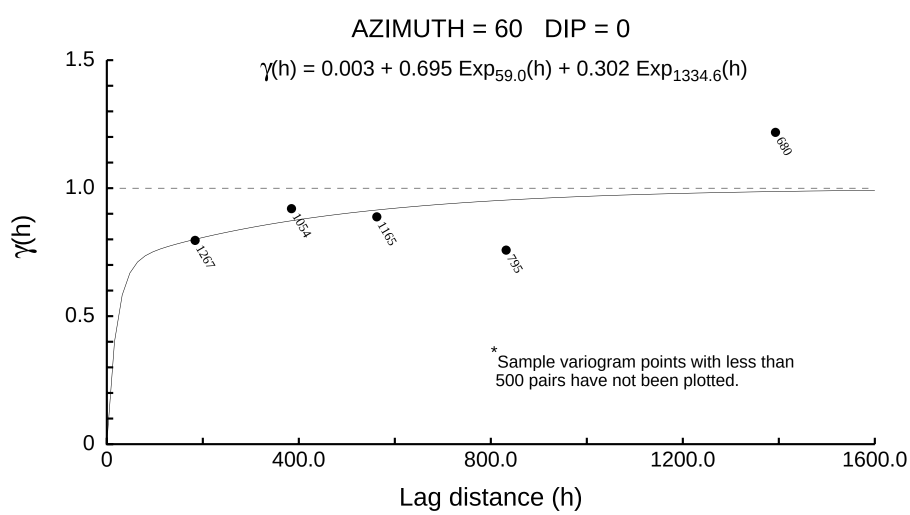
RH Rotation about the Z axis ==> -58
RH Rotation about the Y' axis ==> 35
RH Rotation about the Z' axis ==> 48
Range along the Z' axis ==> 404.1 Azimuth ==> 148 Dip ==> 55
Range along the Y' axis ==> 891.5 Azimuth ==> 16 Dip ==> 25
Range along the X' axis ==> 4245.7 Azimuth ==> 94 Dip ==> -23

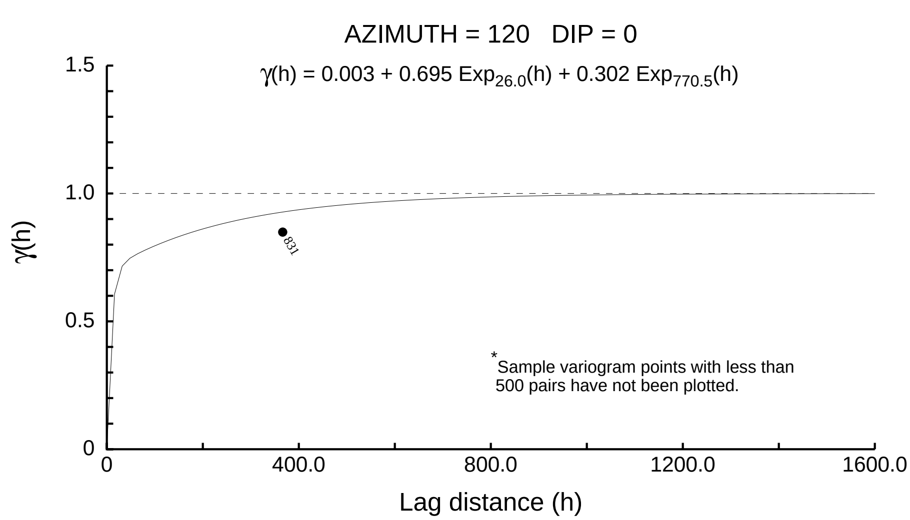
Modeling Criteria

Minimum number pairs req'd ==> 500
Sample variogram points weighted by # pairs

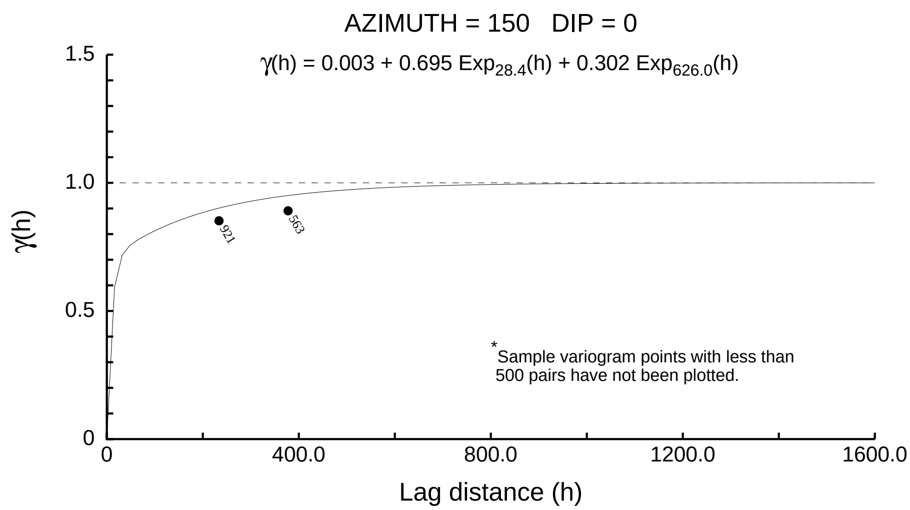
Downhole 2000 - Co

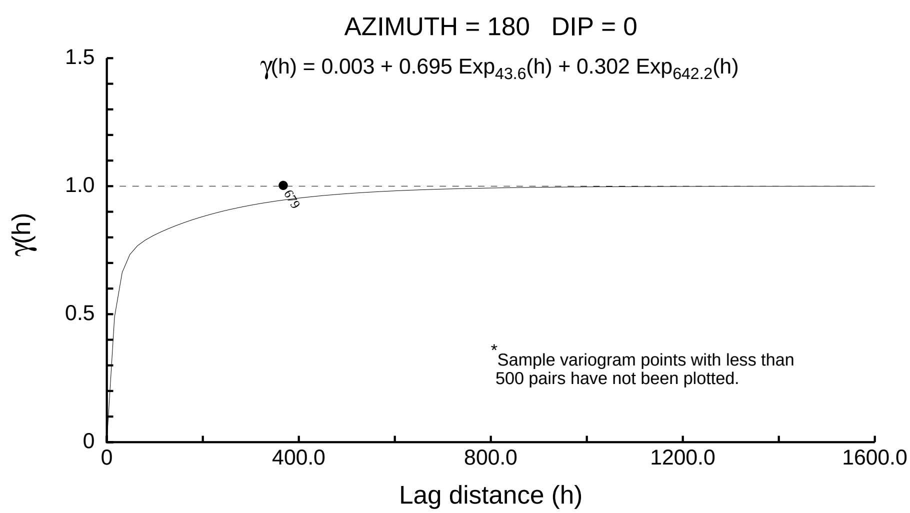


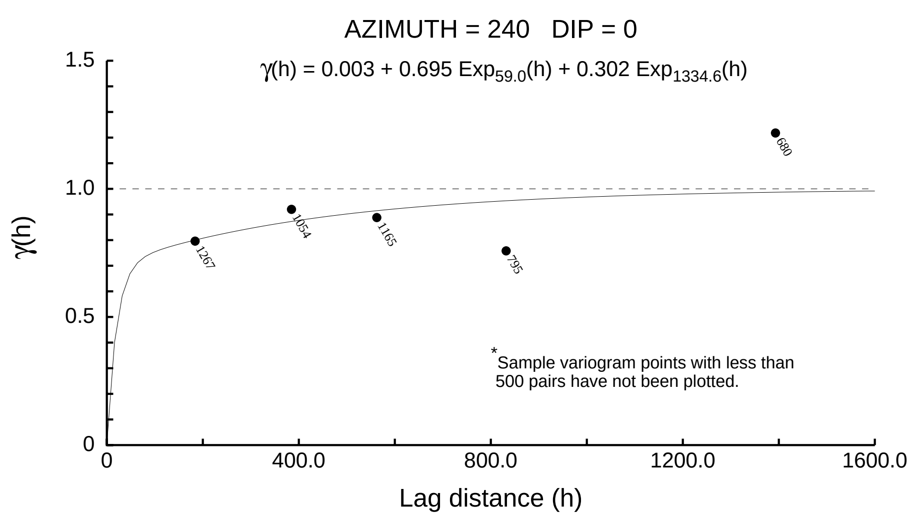




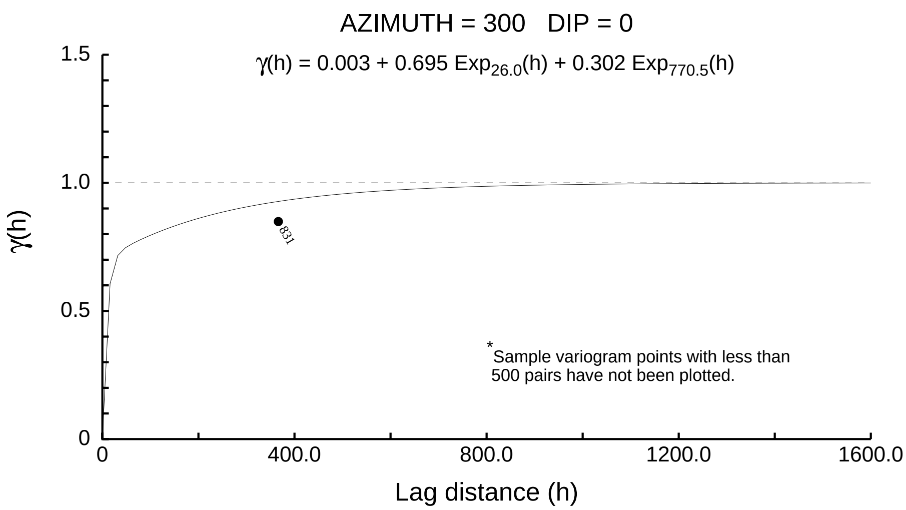
Downhole 2000 - Co

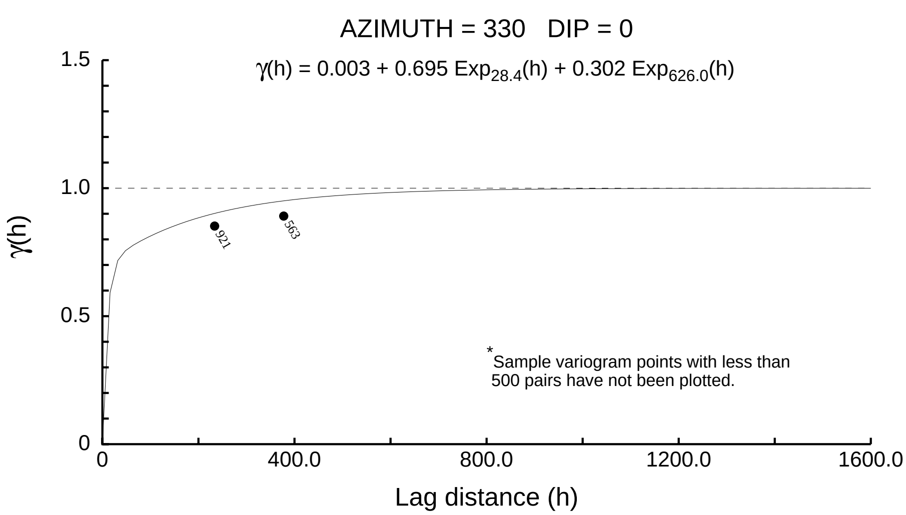


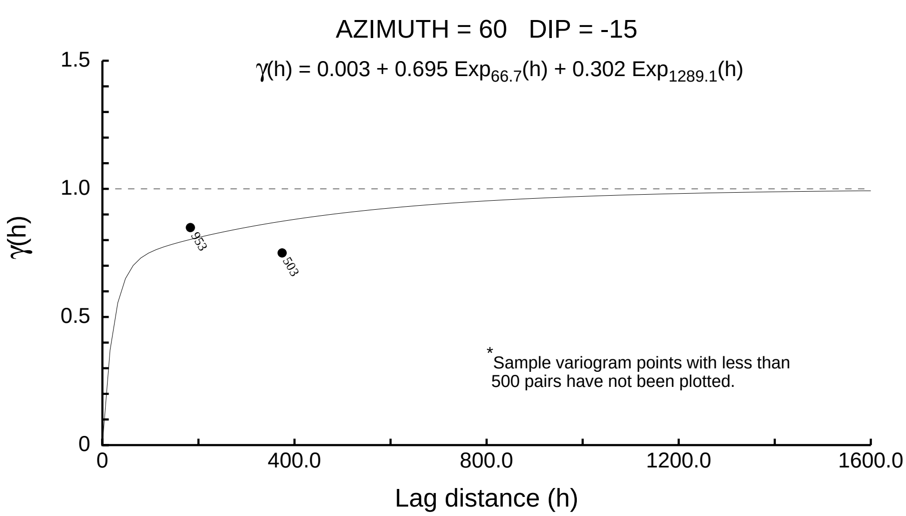




Downhole 2000 - Co







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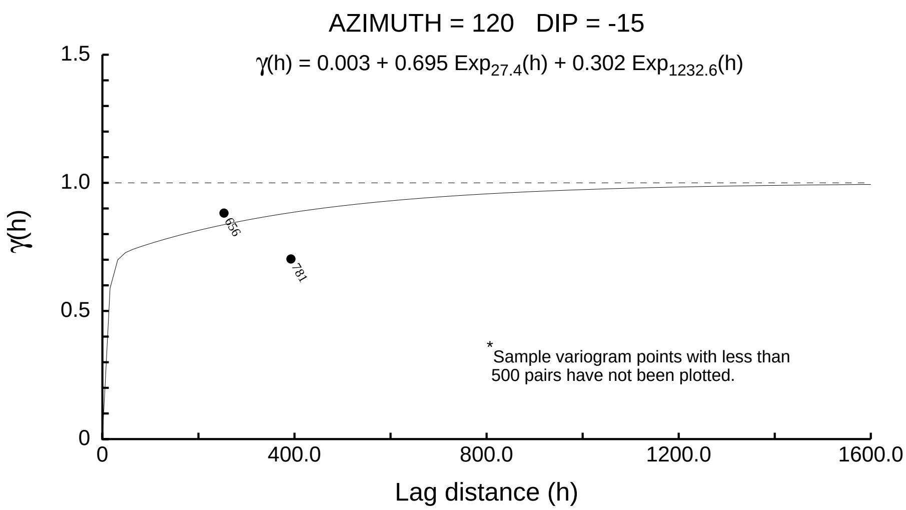
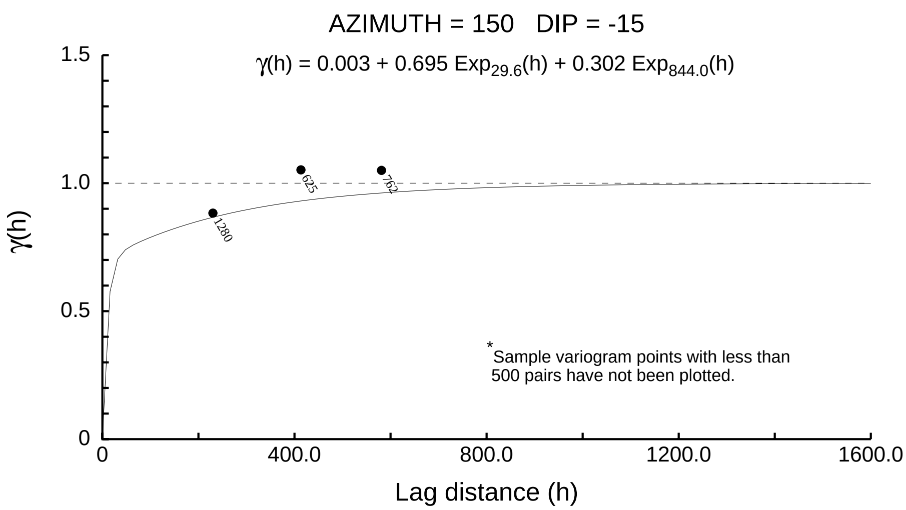
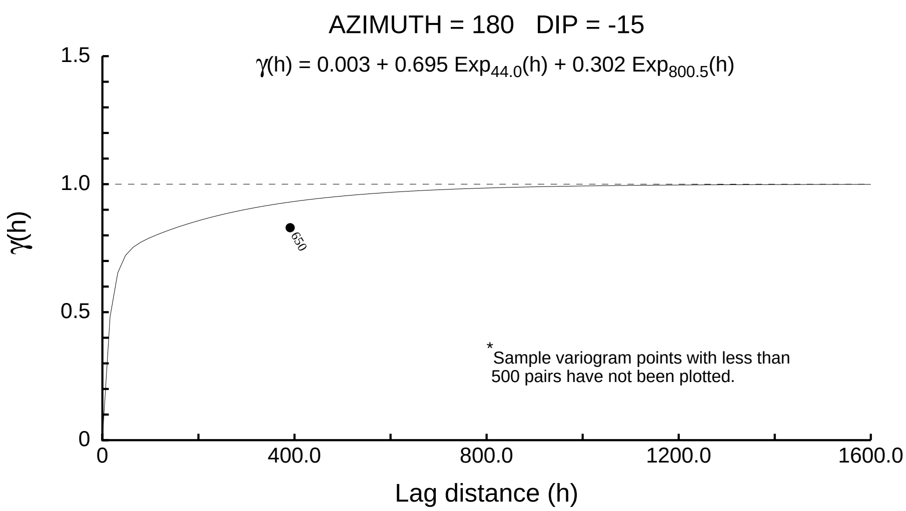
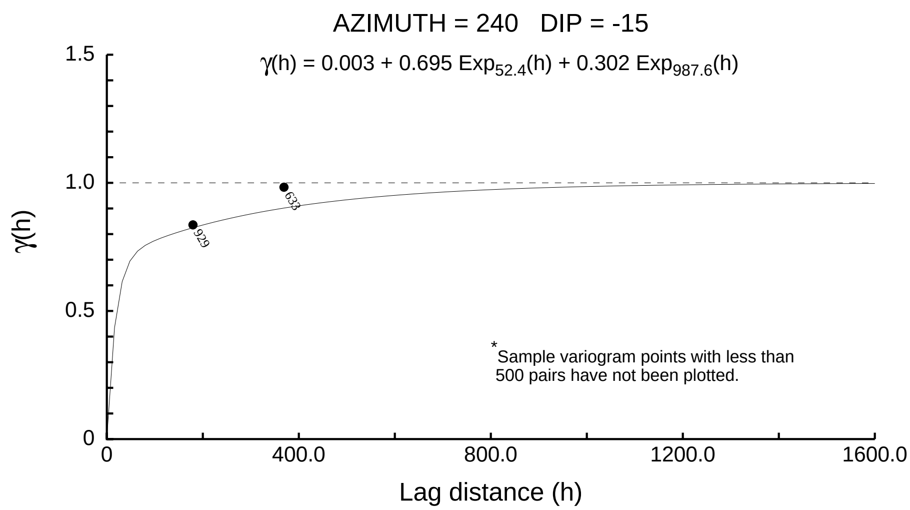
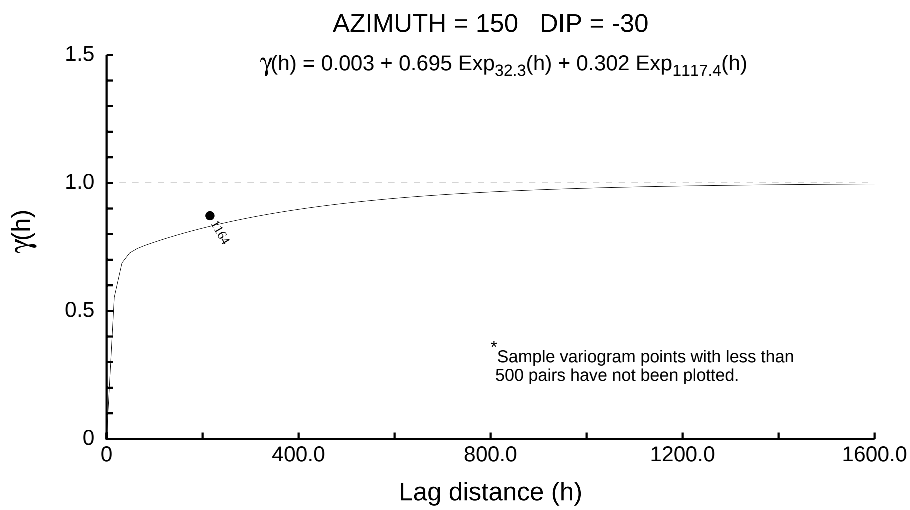


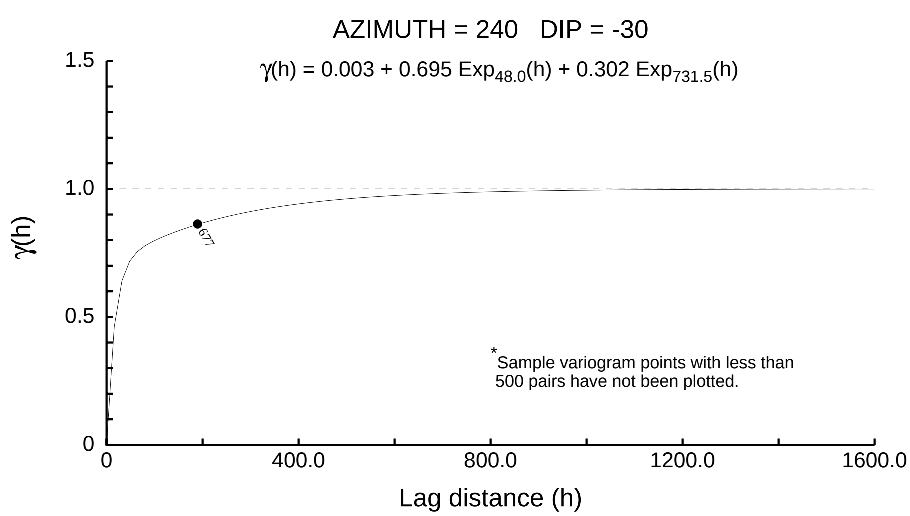




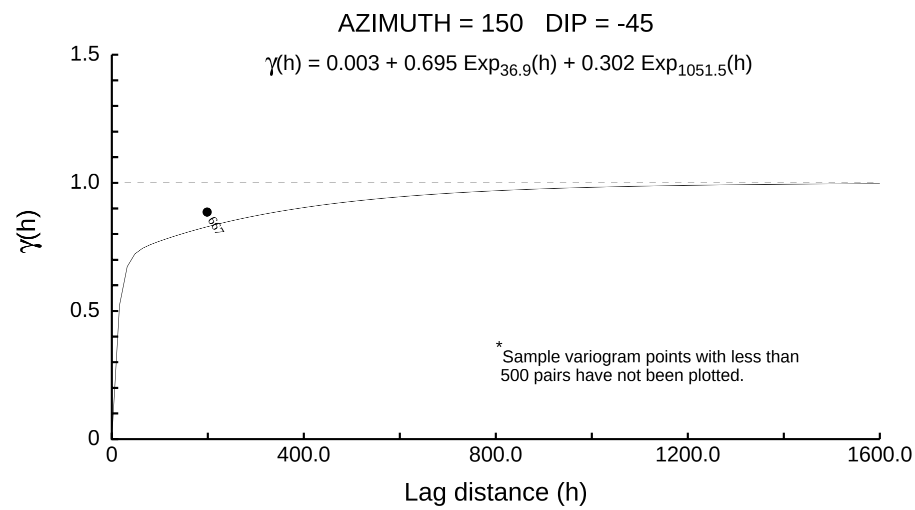
Downhole 2000 - Co

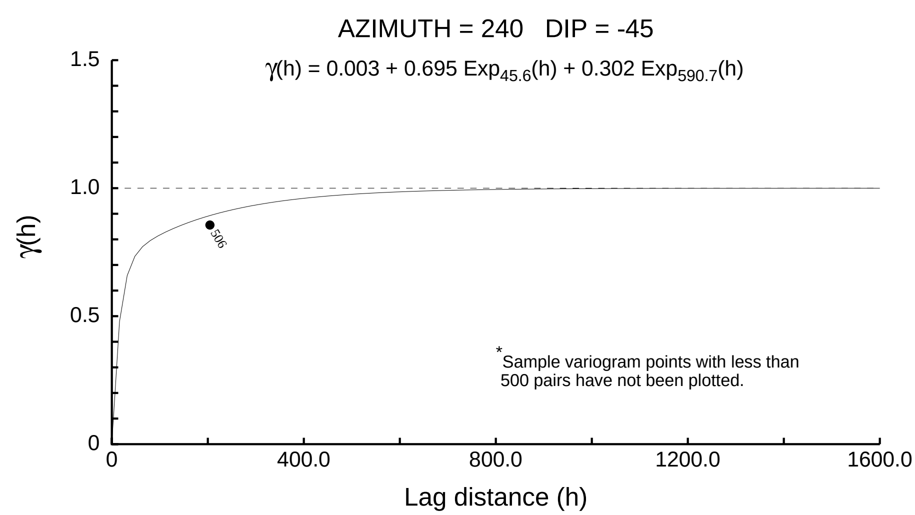


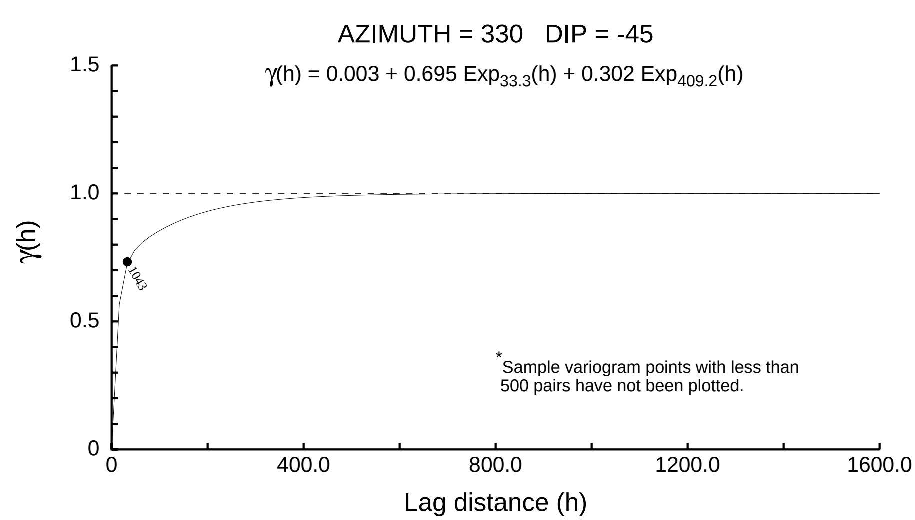




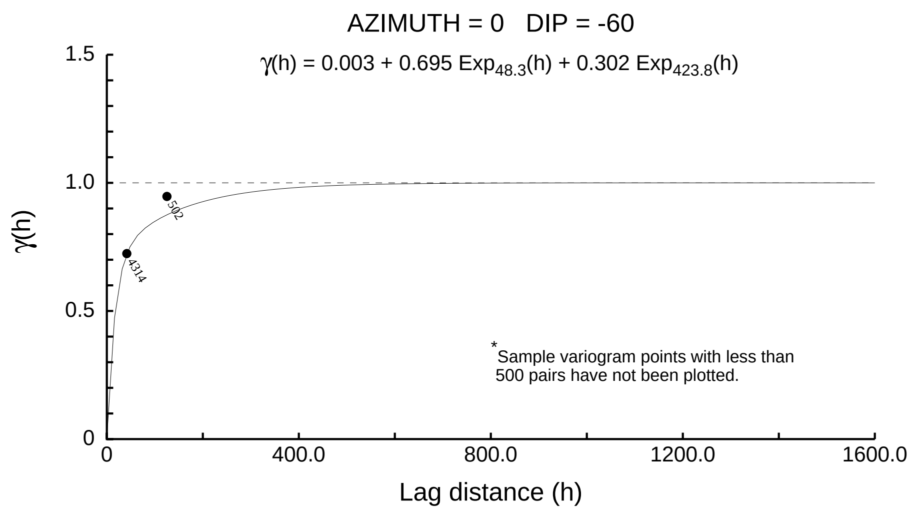
Downhole 2000 - Co

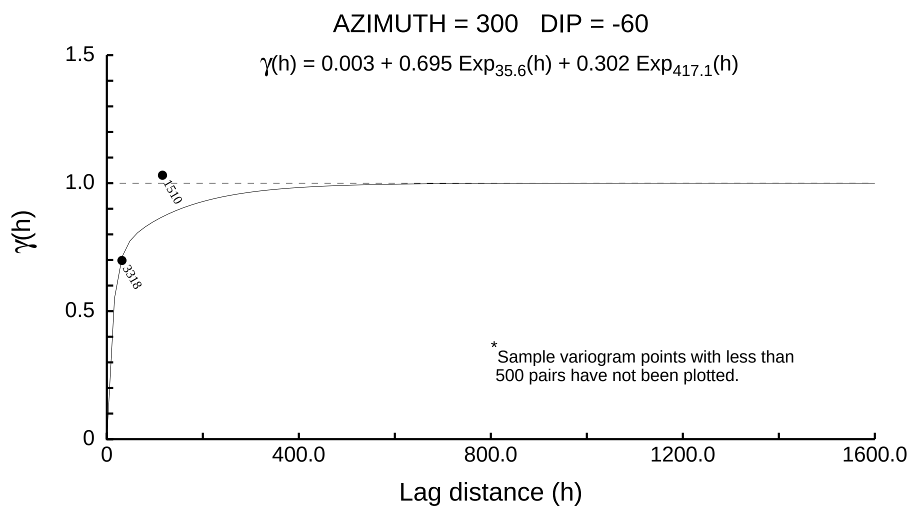


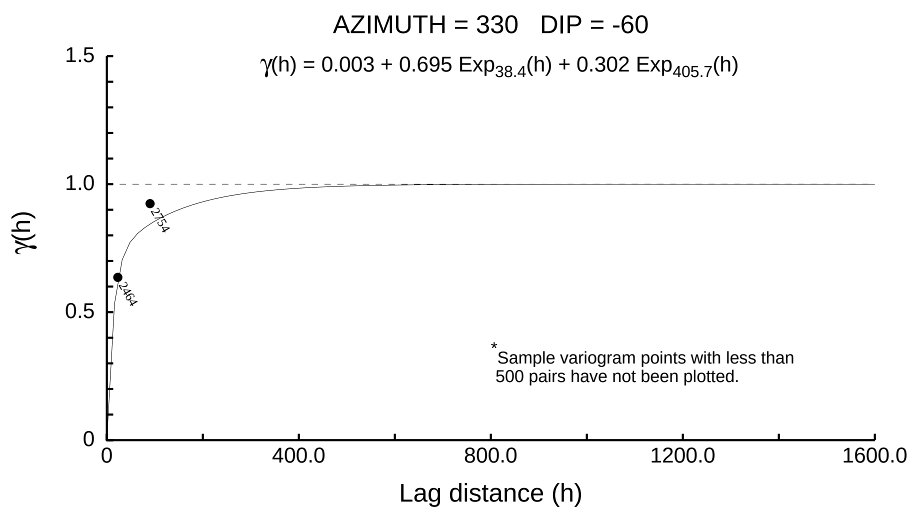




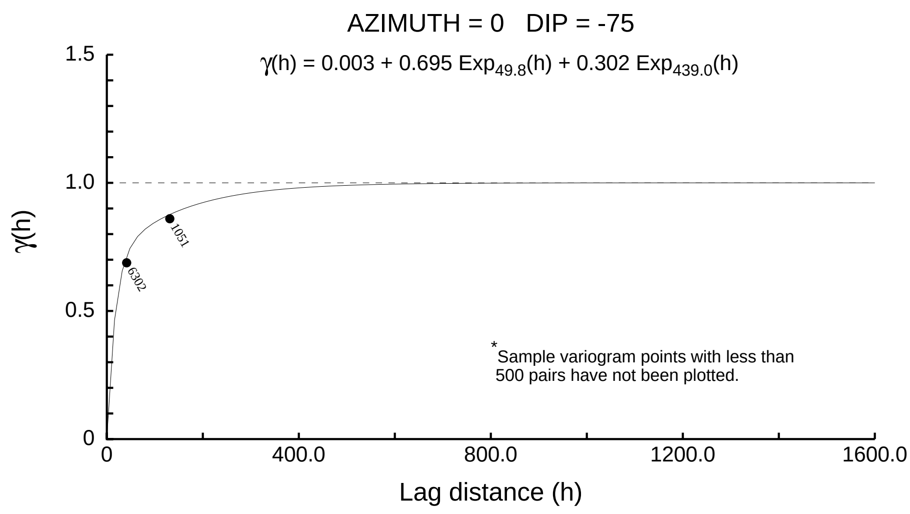
Downhole 2000 - Co

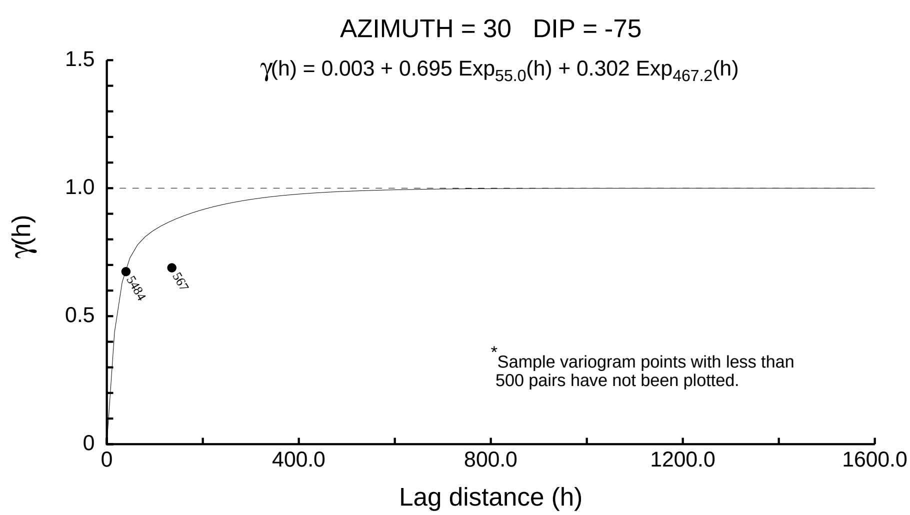


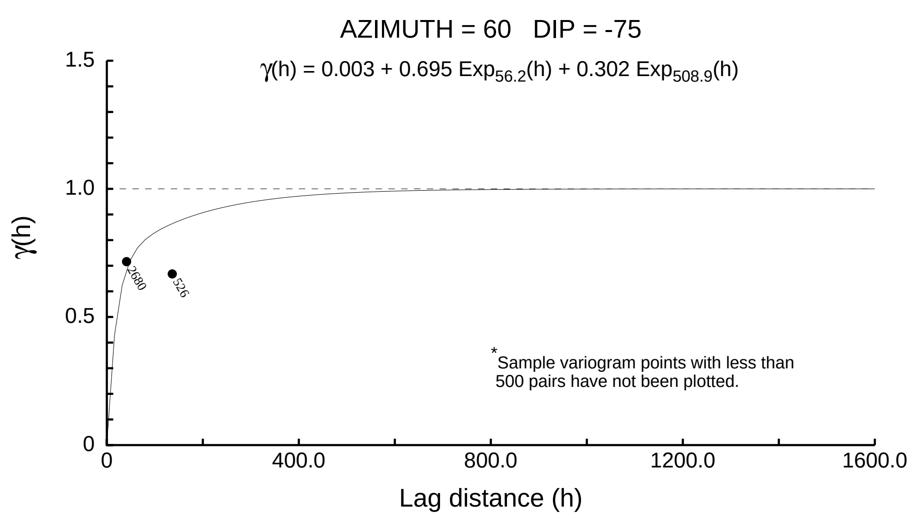




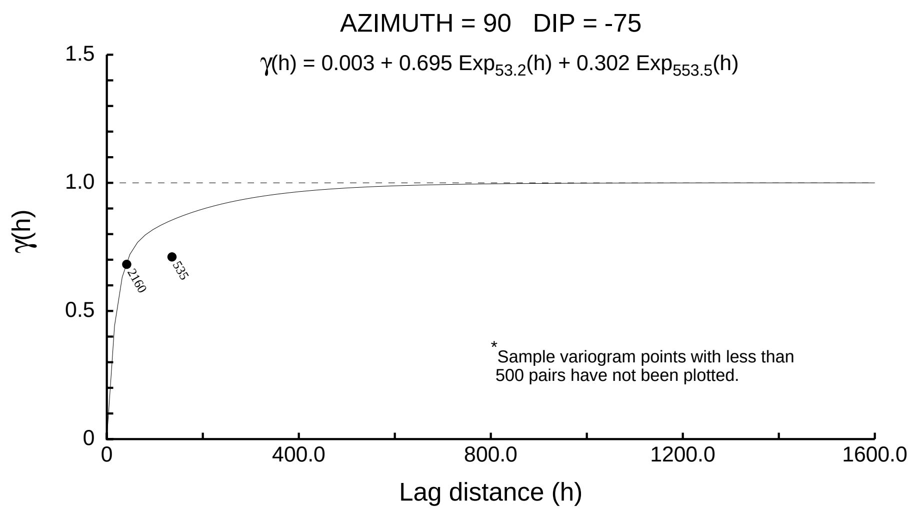
Downhole 2000 - Co

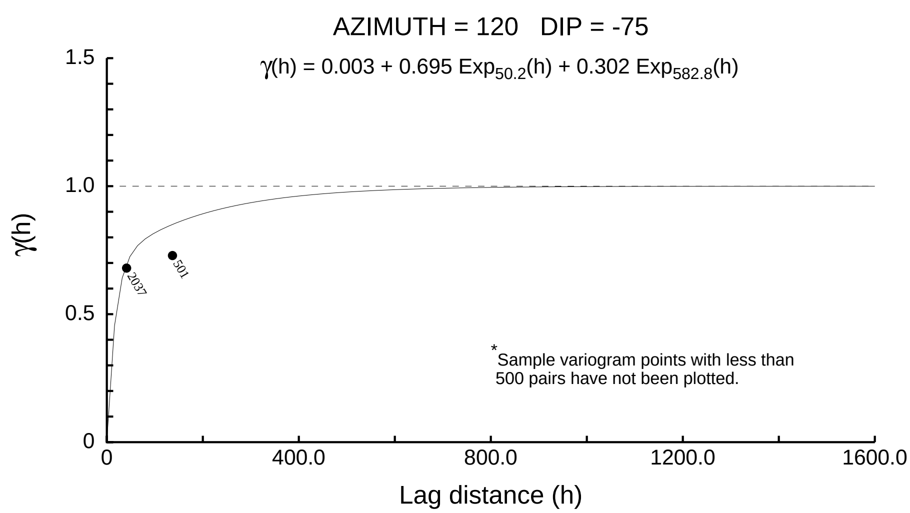


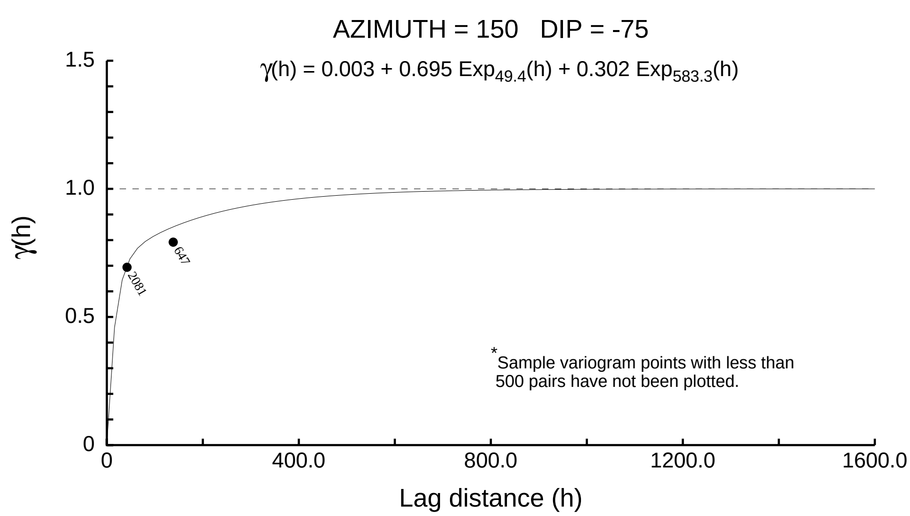




Downhole 2000 - Co





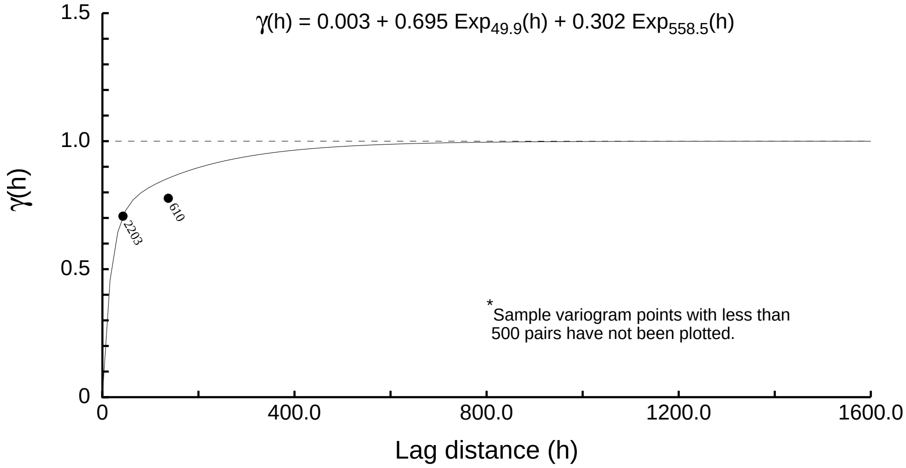


Isaaks & Co.
Consultants in Spatial Statistics

Downhole 2000 - Co

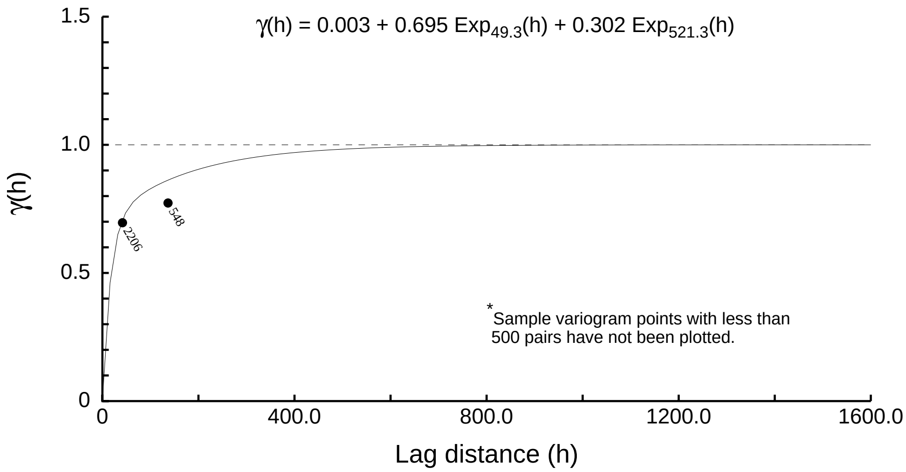
AZIMUTH = 180 DIP = -75

$\gamma(h) = 0.003 + 0.695\ \mathrm{Exp}_{49.9}(h) + 0.302\ \mathrm{Exp}_{558.5}(h)$



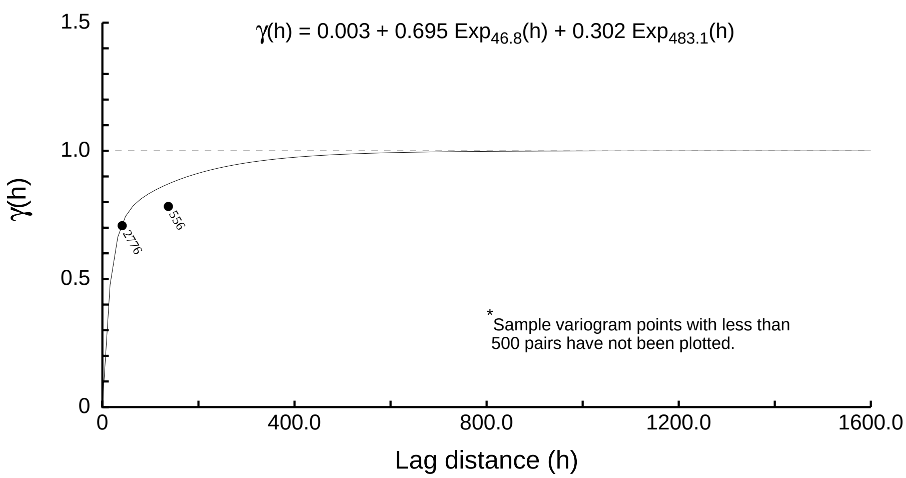
AZIMUTH = 210 DIP = -75

$\gamma(h) = 0.003 + 0.695\ \mathrm{Exp}_{49.3}(h) + 0.302\ \mathrm{Exp}_{521.3}(h)$

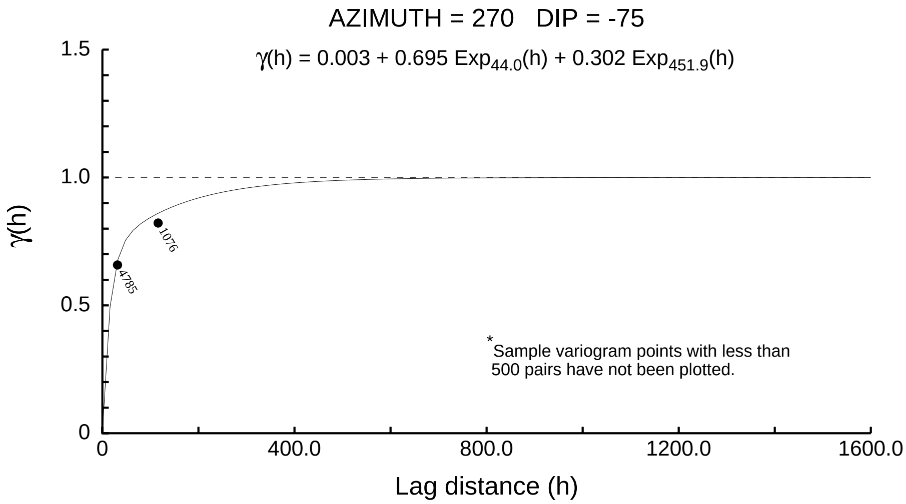


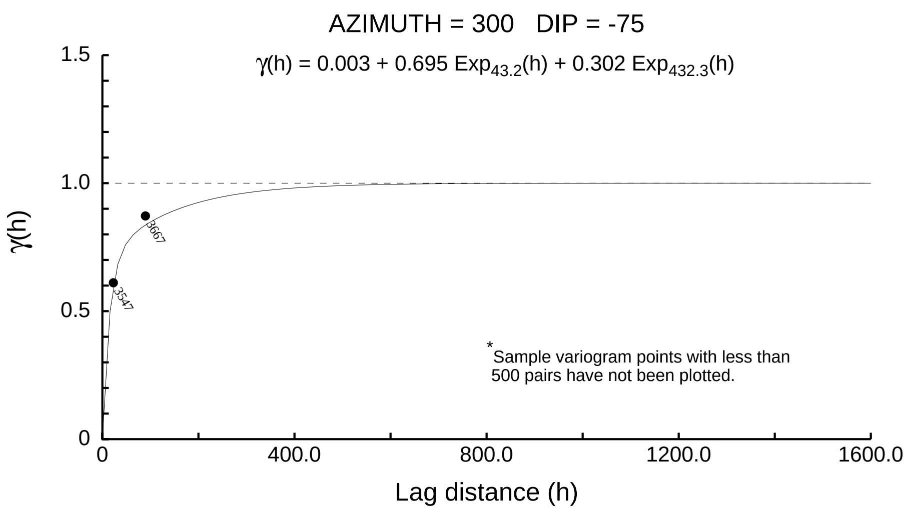
AZIMUTH = 240 DIP = -75

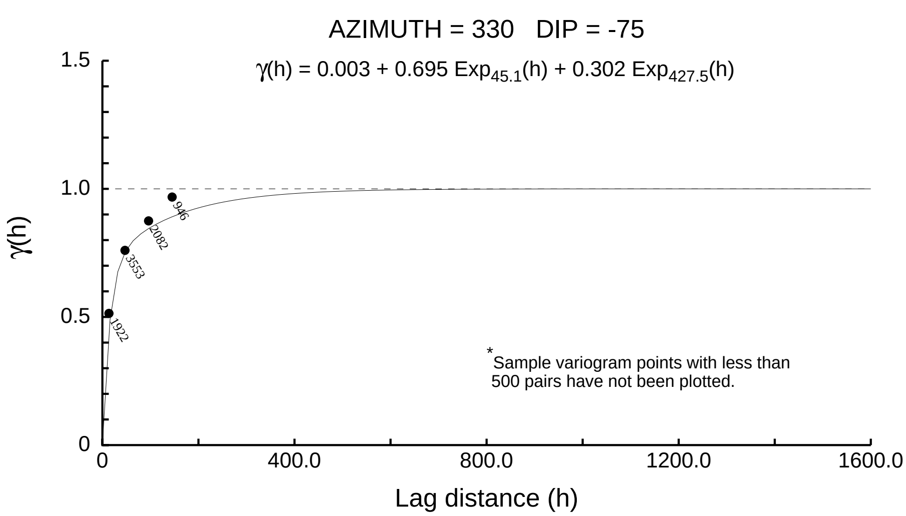
$\gamma(h) = 0.003 + 0.695\ \mathrm{Exp}_{46.8}(h) + 0.302\ \mathrm{Exp}_{483.1}(h)$



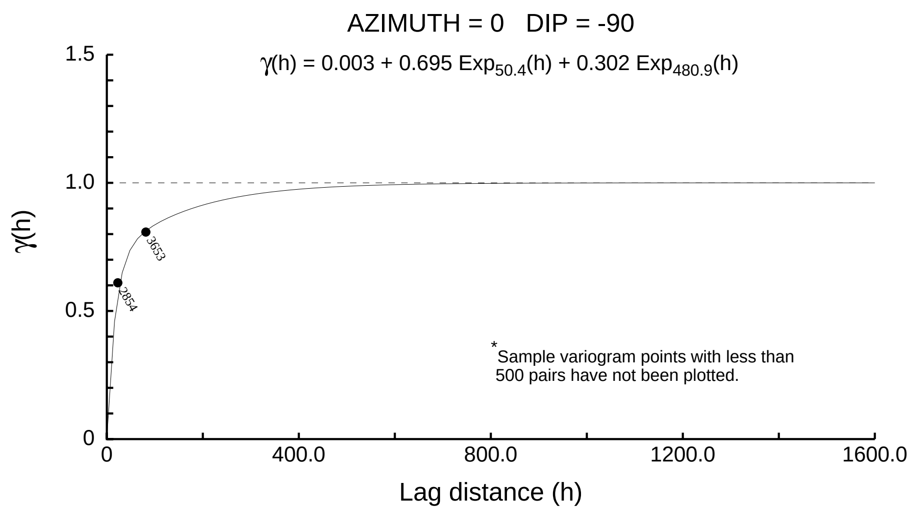
Downhole 2000 - Co







Downhole 2000 - Co



Directional 2000 - Cu

User Defined Rotation Conventions

Nugget ==> 0.004
C1 ==> 0.810
C2 ==> 0.186

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> 23
RH Rotation about the Y' axis ==> 20
RH Rotation about the Z' axis ==> -54
Range along the Z' axis ==> 59.6 Azimuth ==> 67 Dip ==> 70
Range along the Y' axis ==> 202.3 Azimuth ==> 29 Dip ==> -16
Range along the X' axis ==> 510.3 Azimuth ==> 123 Dip ==> -12

Second Structure -- Exponential with Practical Range

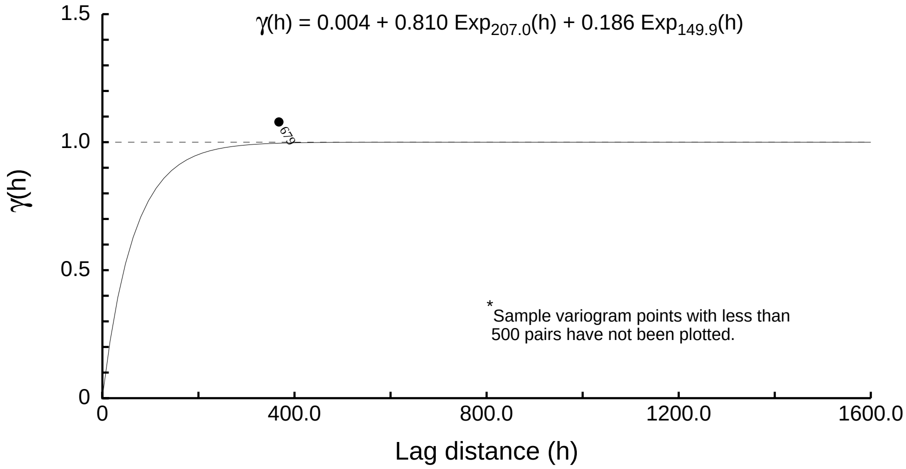
RH Rotation about the Z axis ==> -54
RH Rotation about the Y' axis ==> -53
RH Rotation about the Z' axis ==> -4
Range along the Z' axis ==> 2733.2 Azimuth ==> 324 Dip ==> 37
Range along the Y' axis ==> 3012.8 Azimuth ==> 56 Dip ==> 3
Range along the X' axis ==> 79.3 Azimuth ==> 150 Dip ==> 52

Modeling Criteria

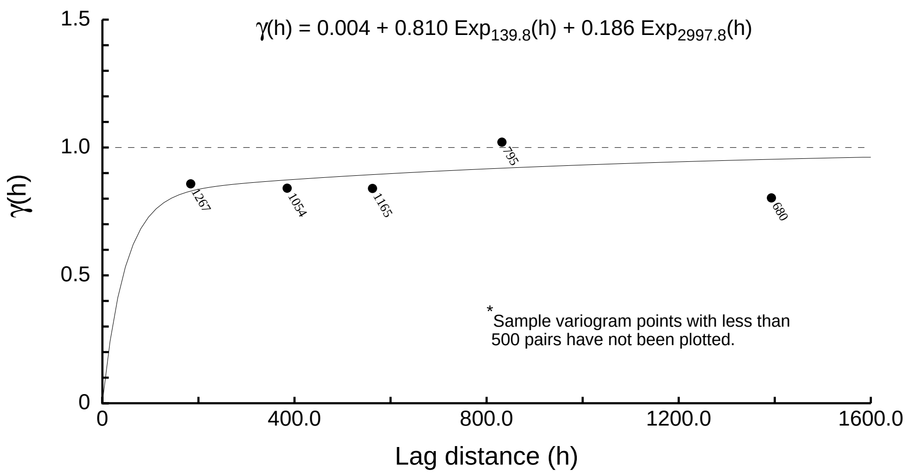
Minimum number pairs req'd ==> 500
Sample variogram points weighted by # pairs

Directional 2000 - Cu

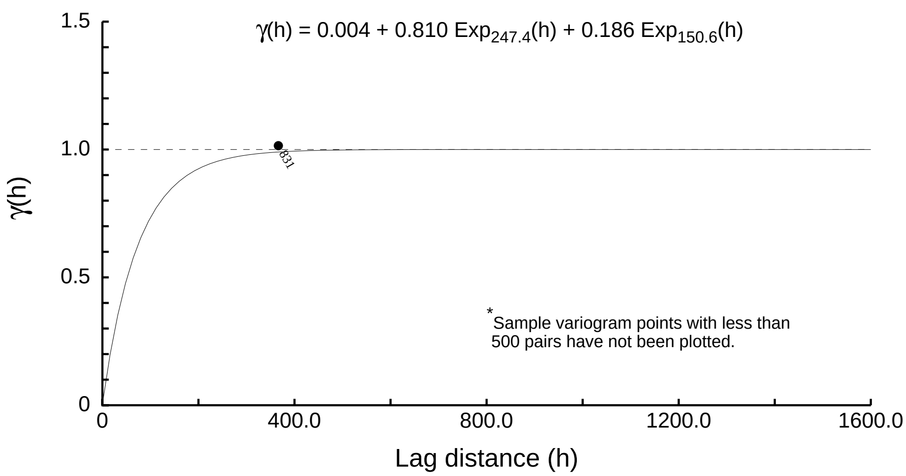
AZIMUTH = 0   DIP = 0



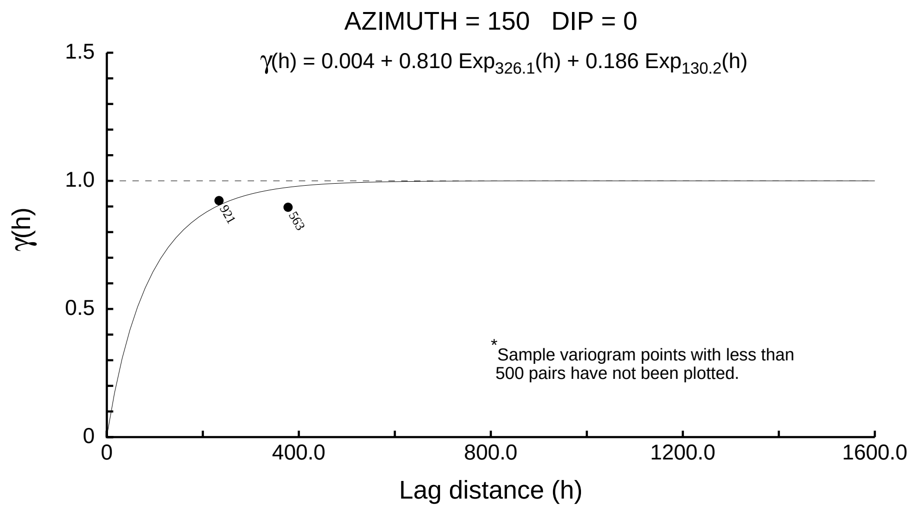
AZIMUTH = 60   DIP = 0

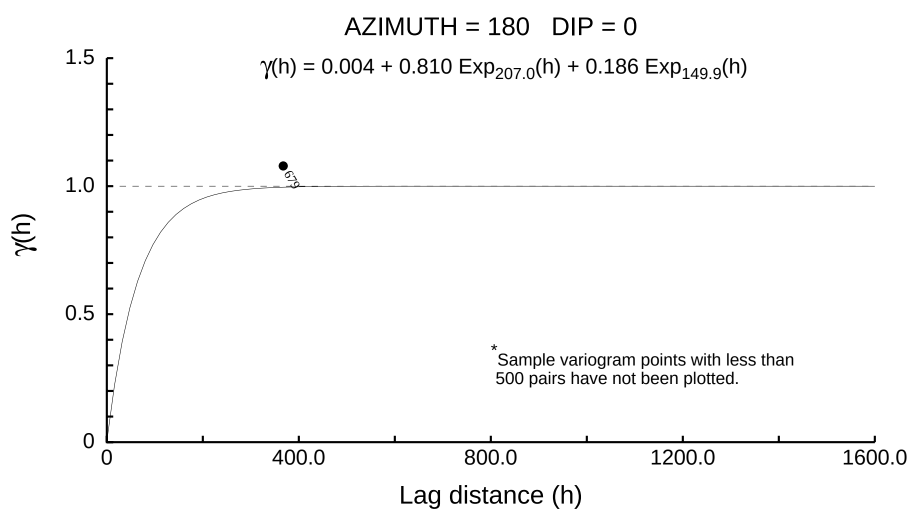


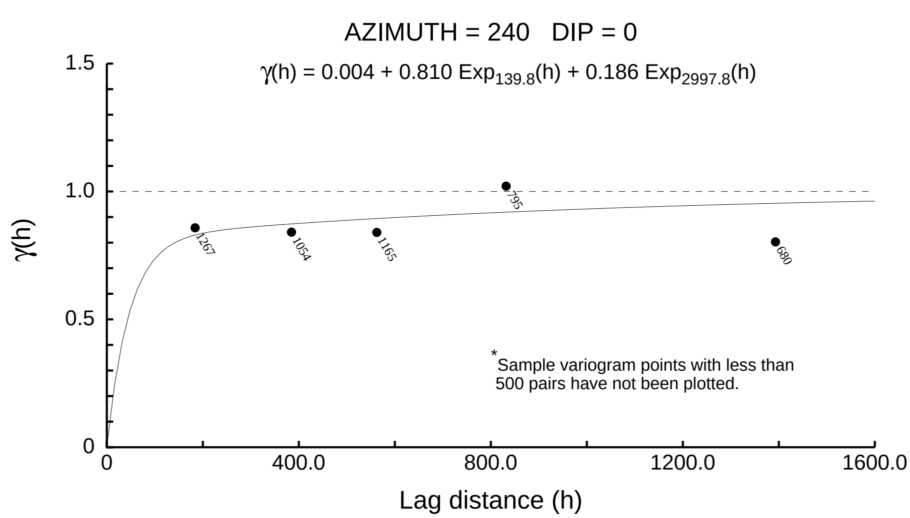
AZIMUTH = 120   DIP = 0



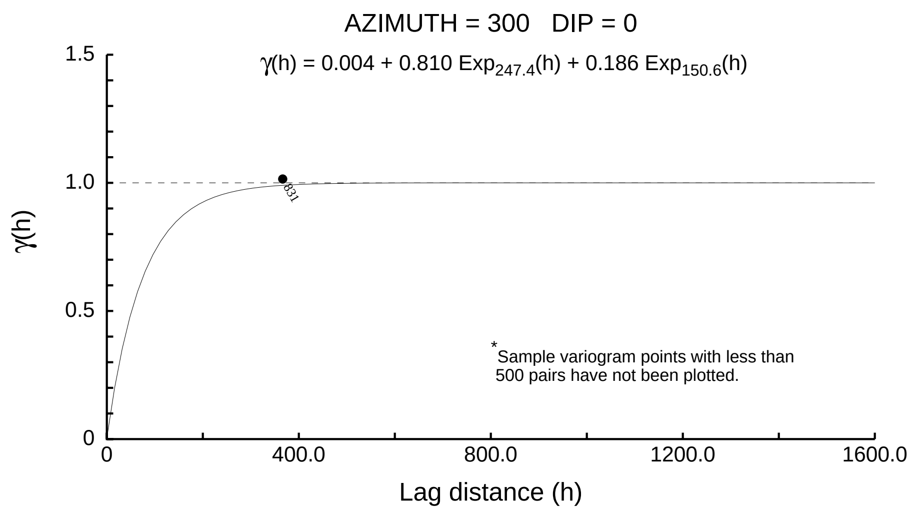
Directional 2000 - Cu

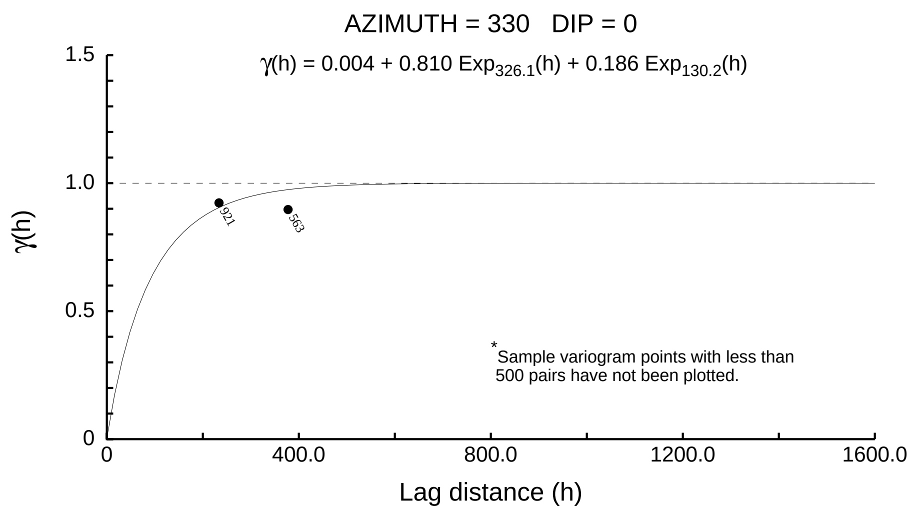


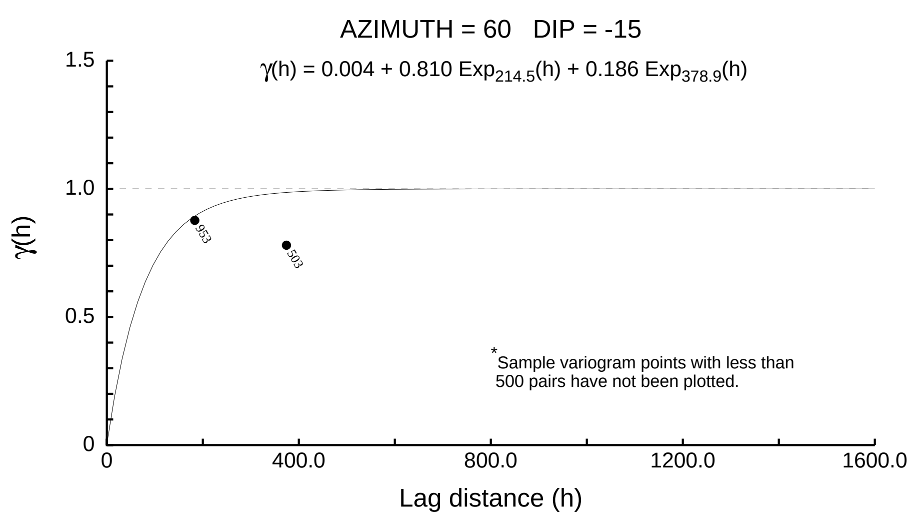




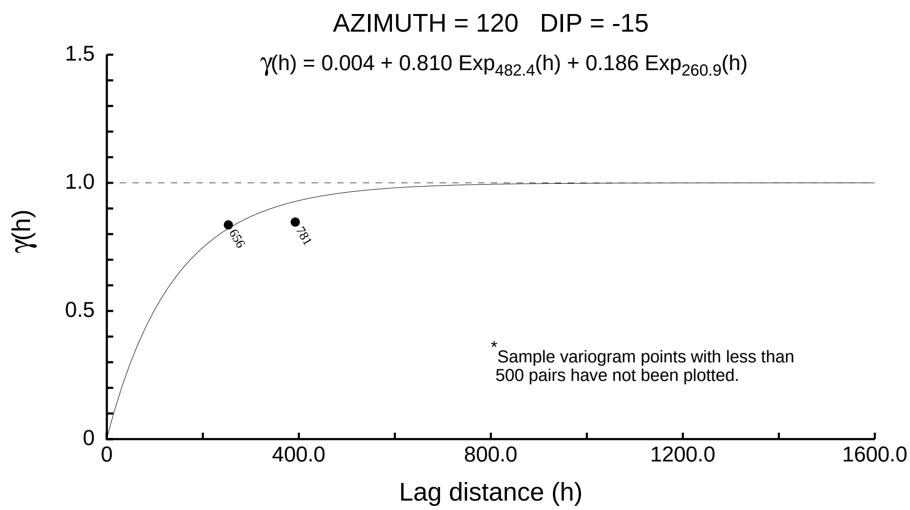
Directional 2000 - Cu

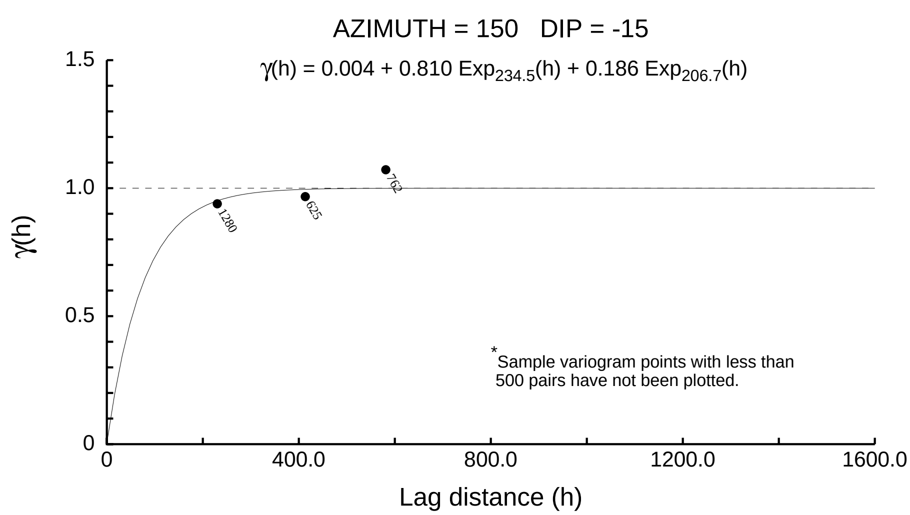


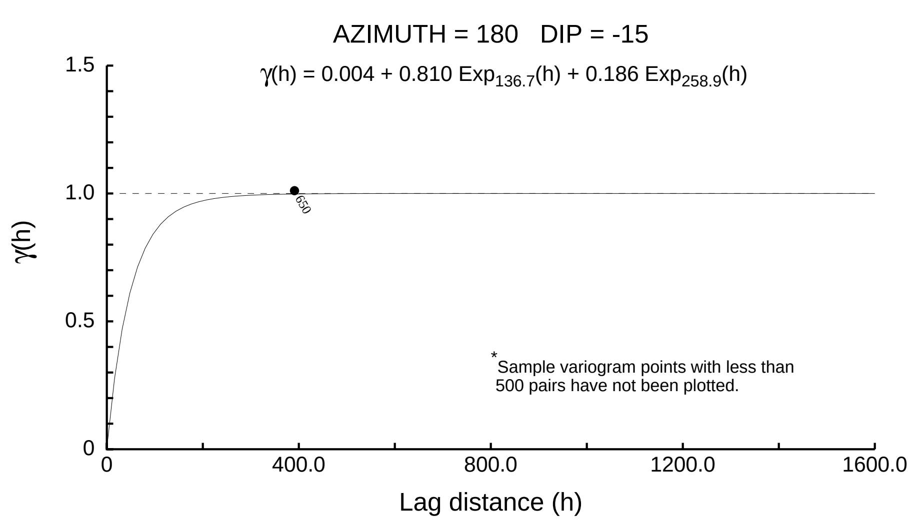




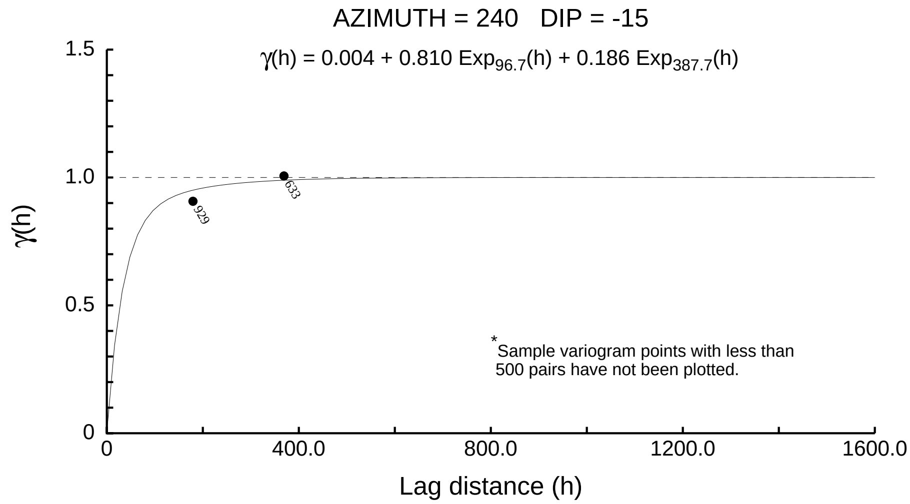
Directional 2000 - Cu

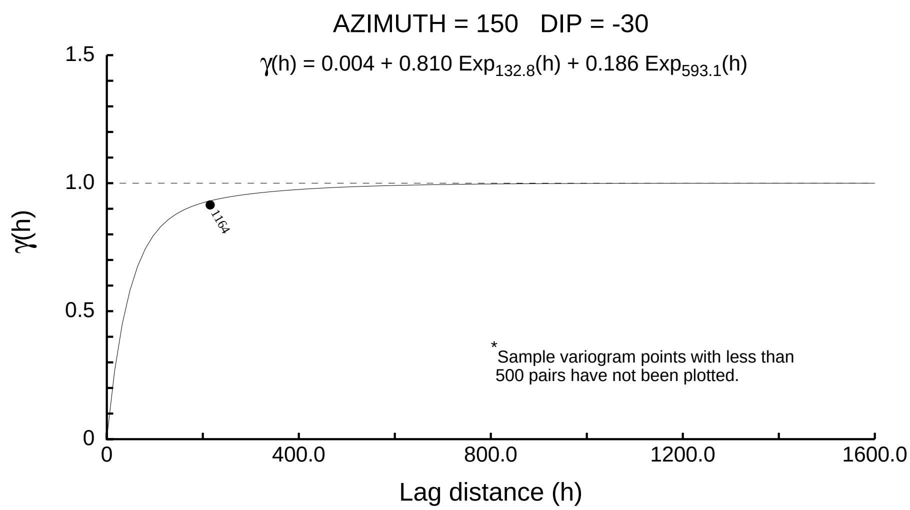


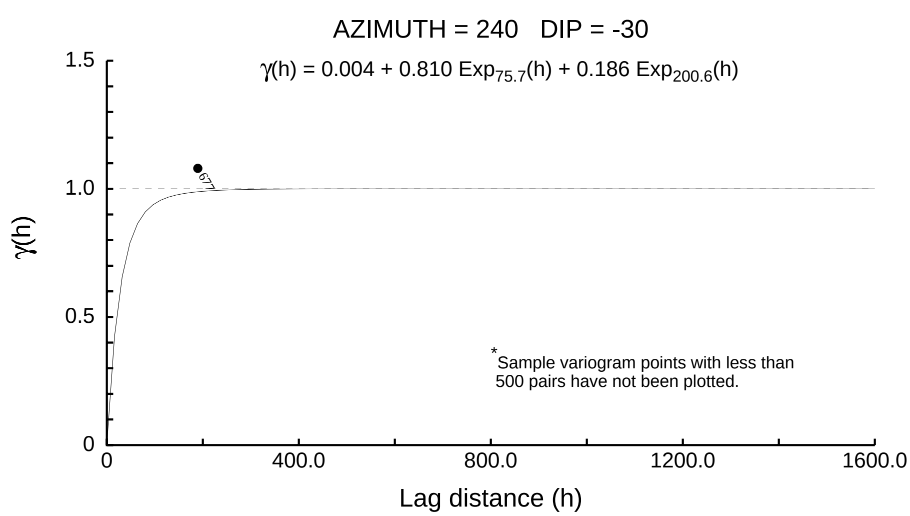




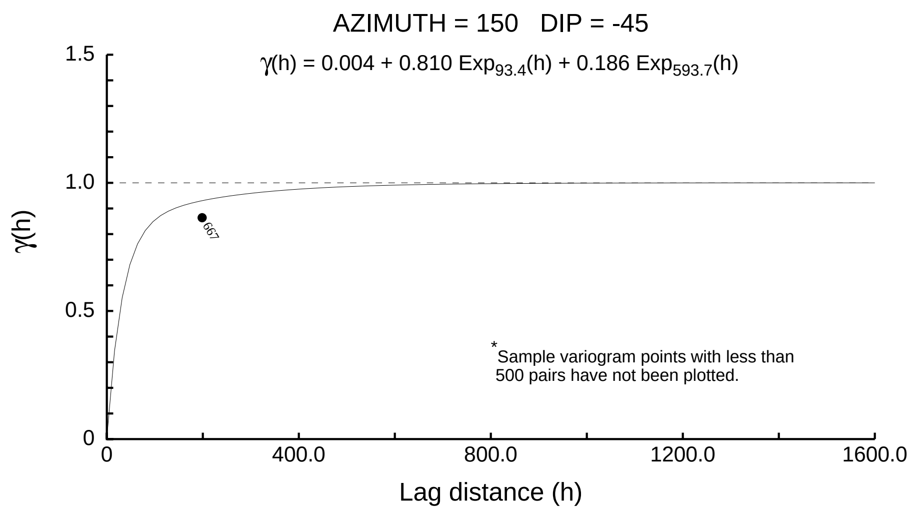
Directional 2000 - Cu

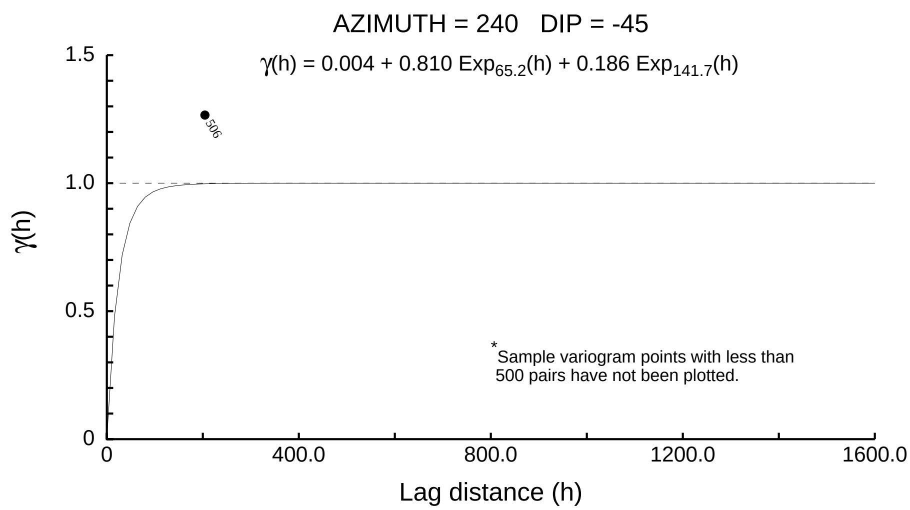


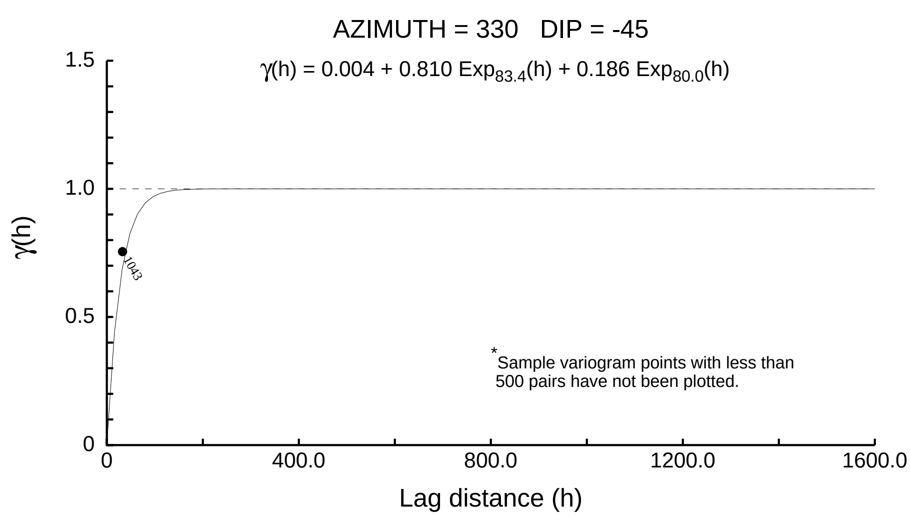




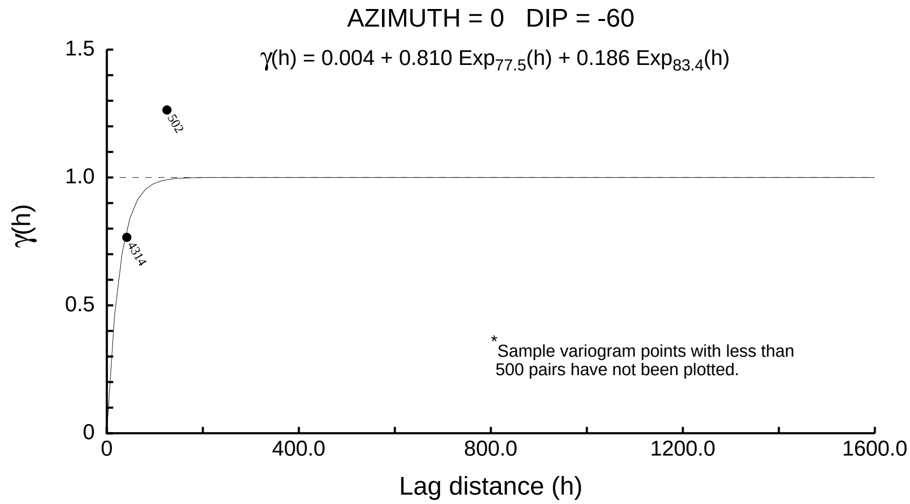
Directional 2000 - Cu

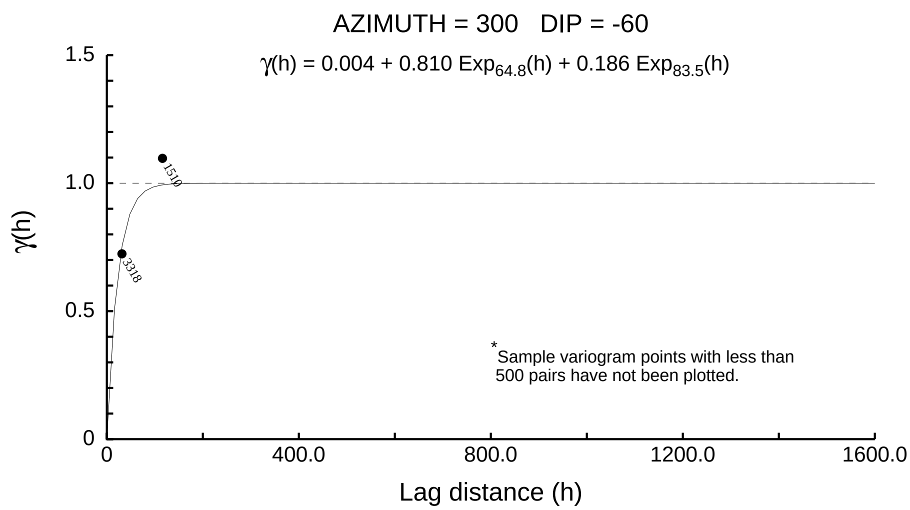


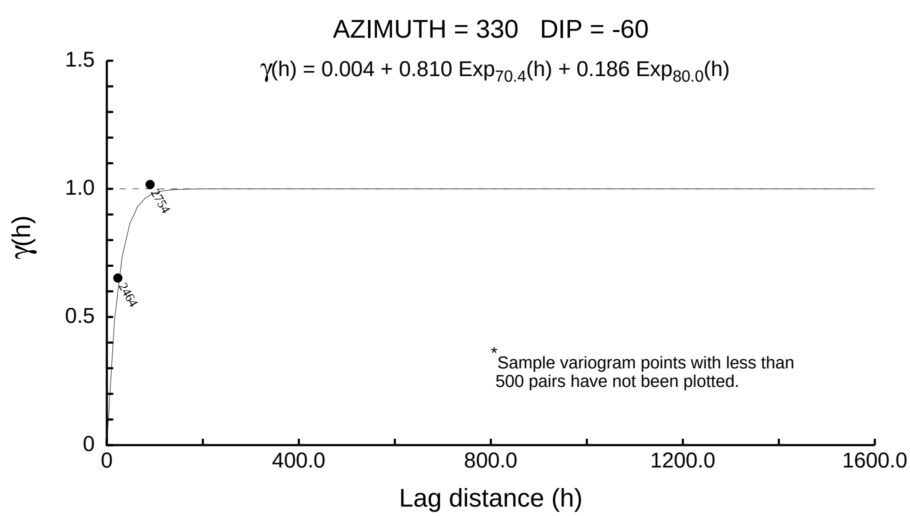




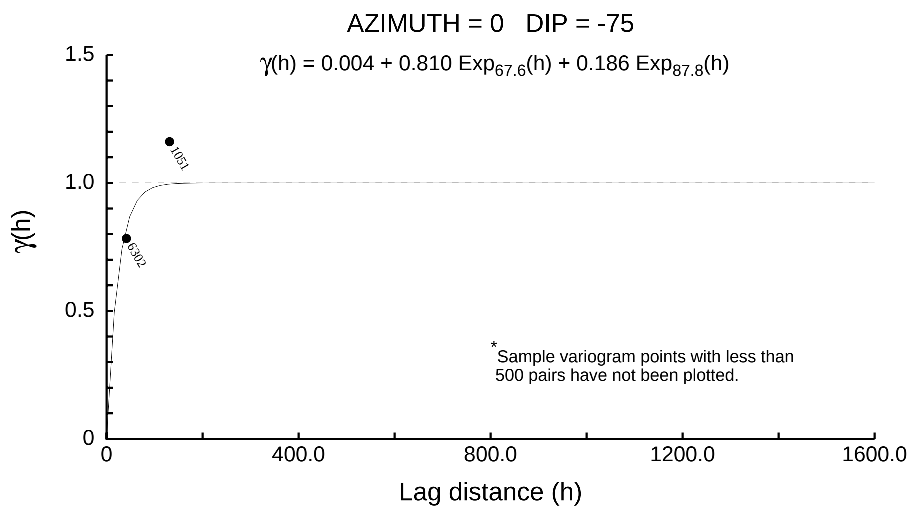
Directional 2000 - Cu

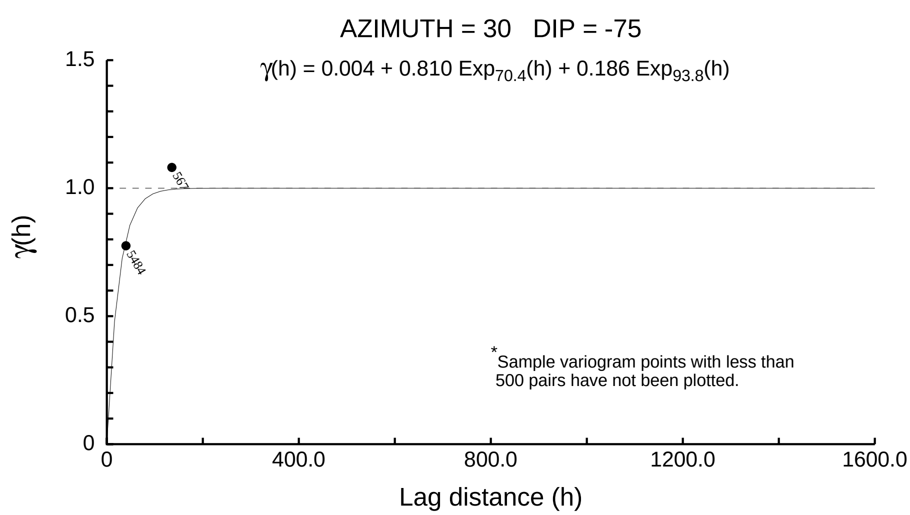


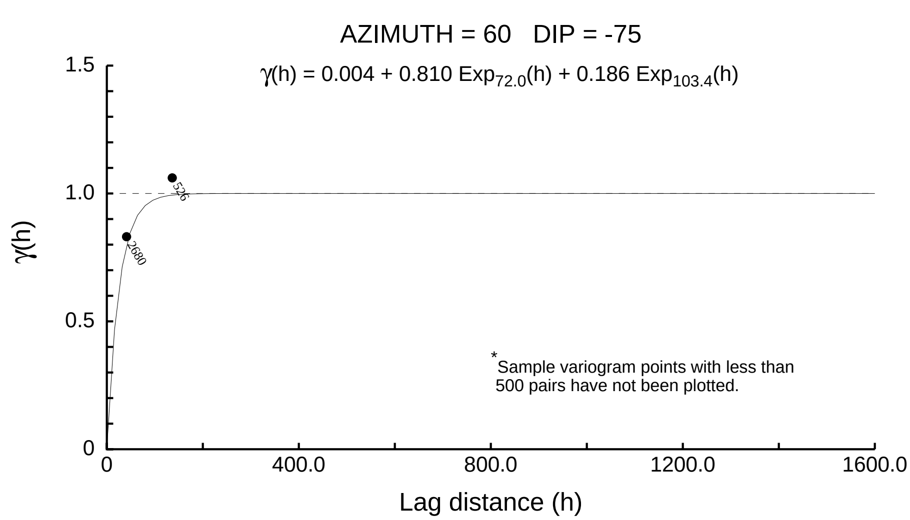




Directional 2000 - Cu







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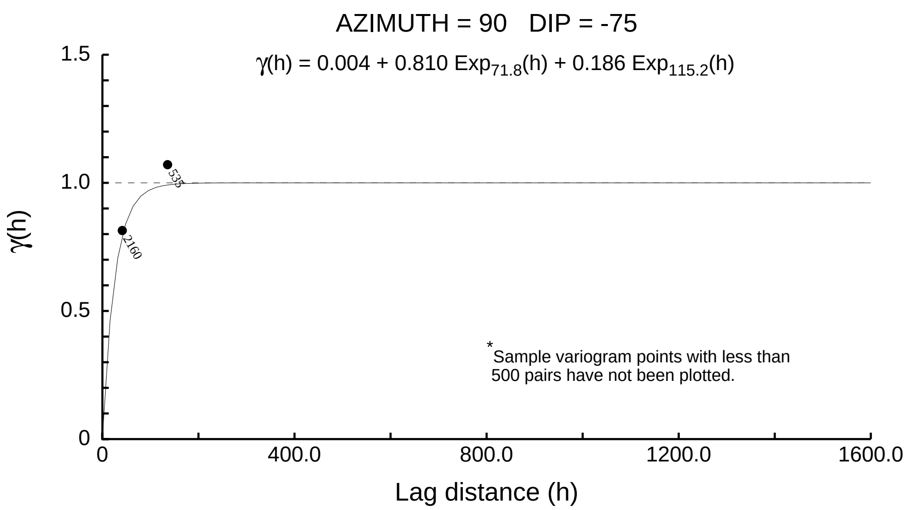
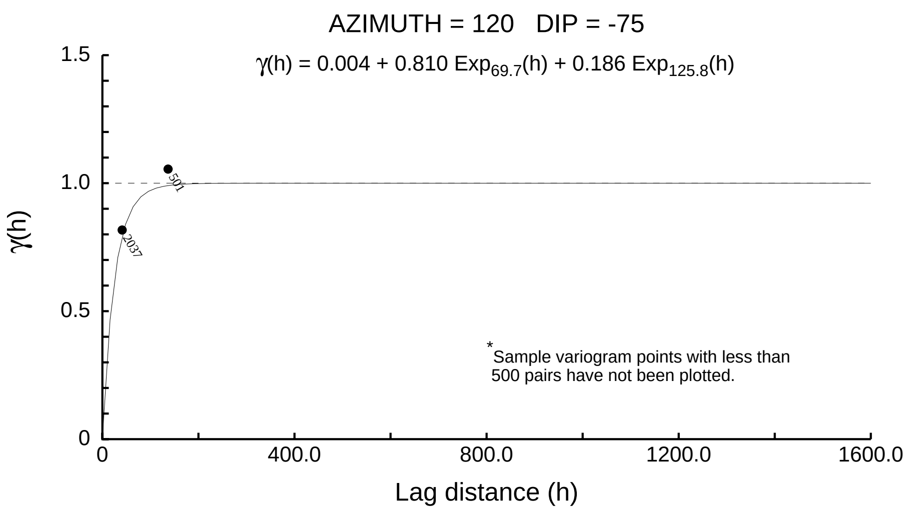
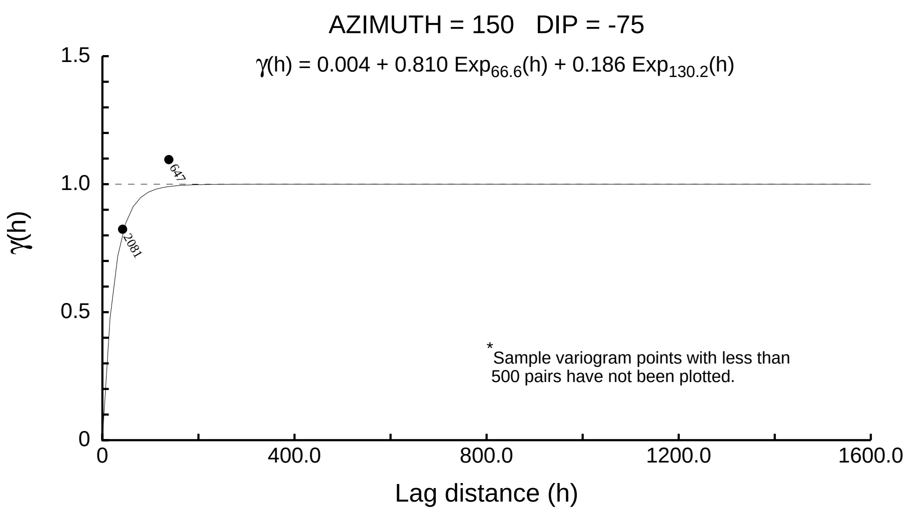
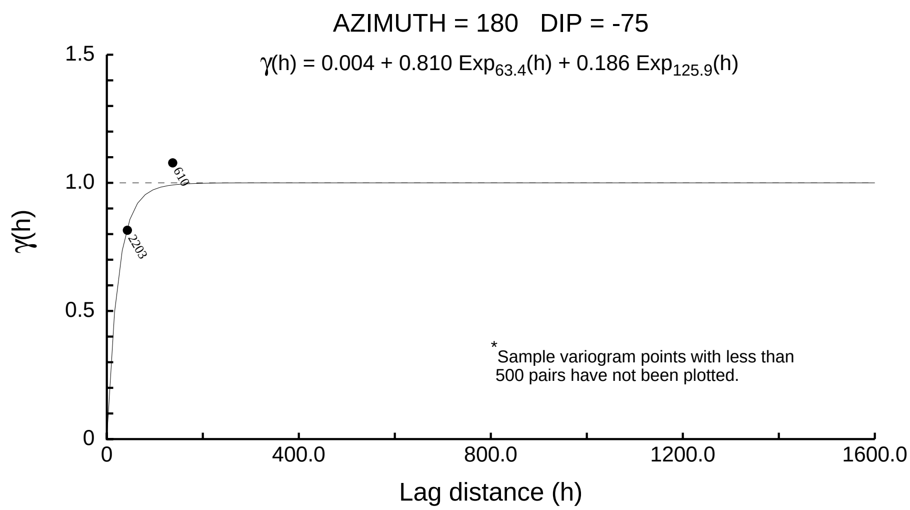
Directional 2000 - Cu

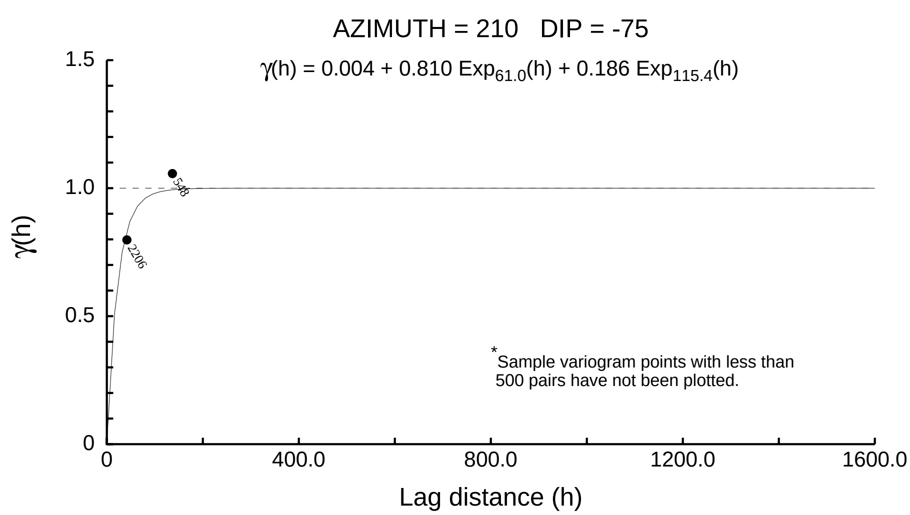


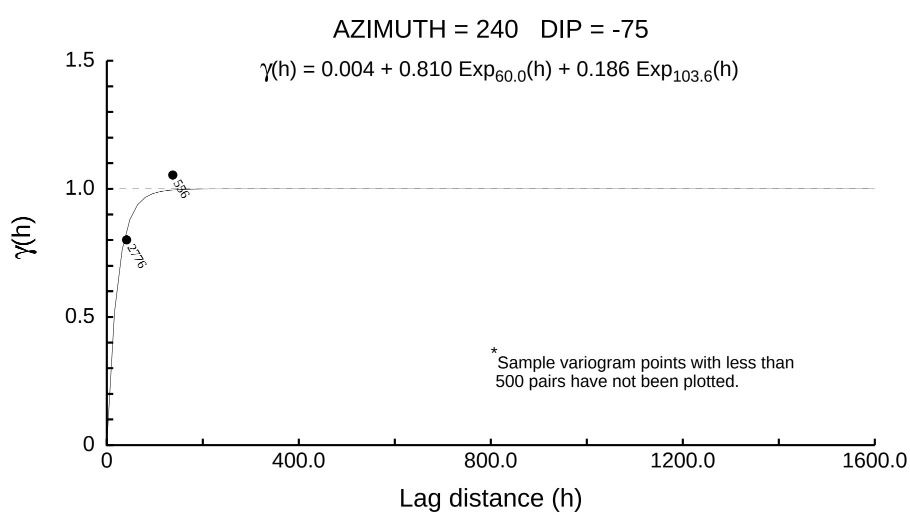




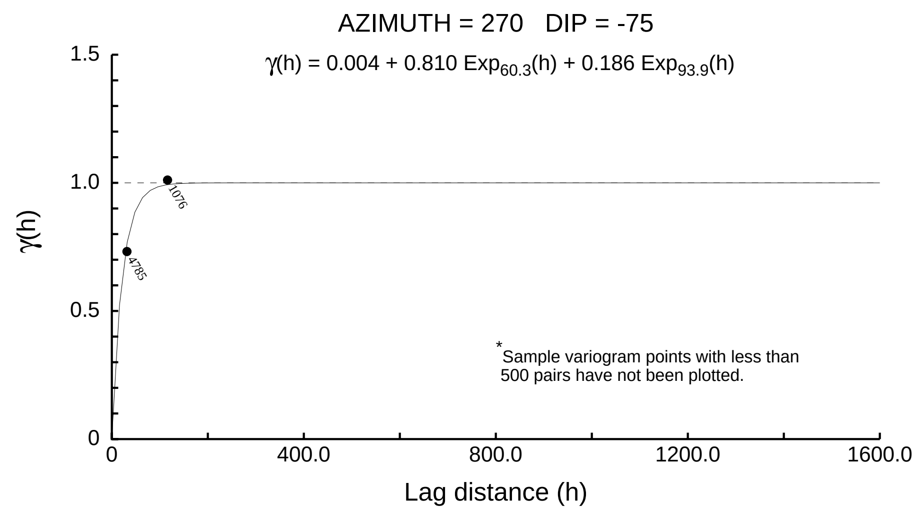
Directional 2000 - Cu

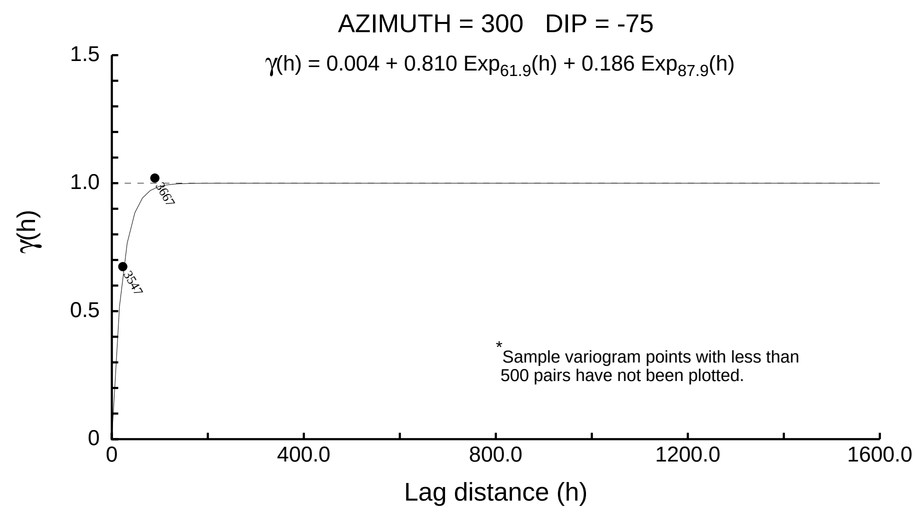


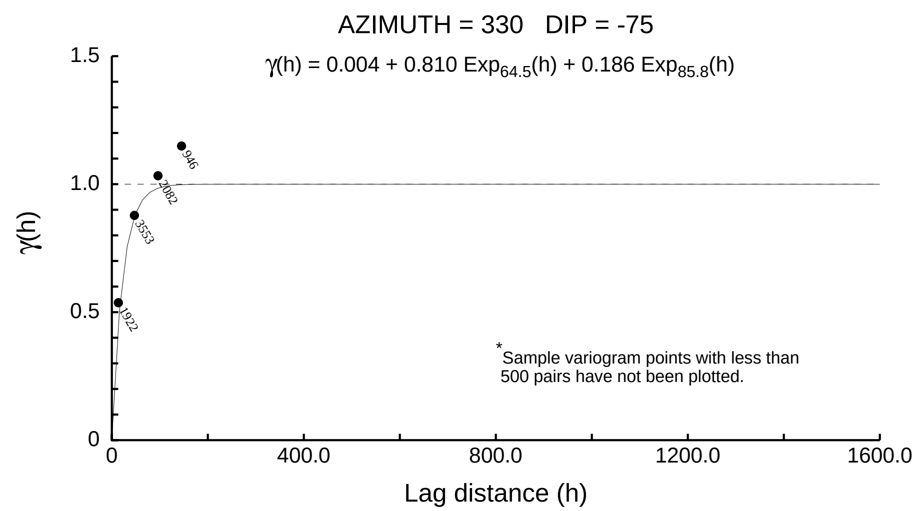




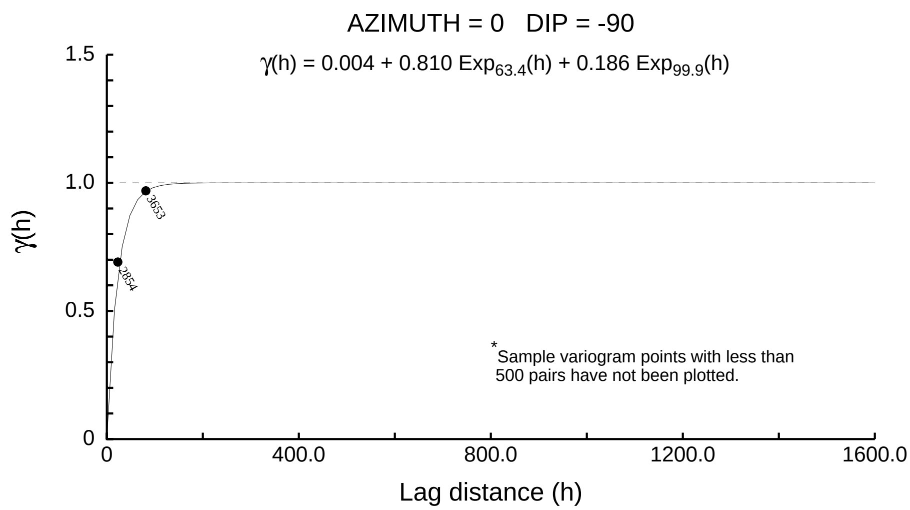
Directional 2000 - Cu







Directional 2000 - Cu



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Consultants in Spatial Statistics

Downhole 2000 - Ni

User Defined Rotation Conventions

Nugget ==> 0.006
C1 ==> 0.816
C2 ==> 0.178

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> 21
RH Rotation about the Y' axis ==> 27
RH Rotation about the Z' axis ==> -63
Range along the Z' axis ==> 57.0 Azimuth ==> 69 Dip ==> 63
Range along the Y' axis ==> 266.9 Azimuth ==> 39 Dip ==> -24
Range along the X' axis ==> 469.1 Azimuth ==> 135 Dip ==> -12

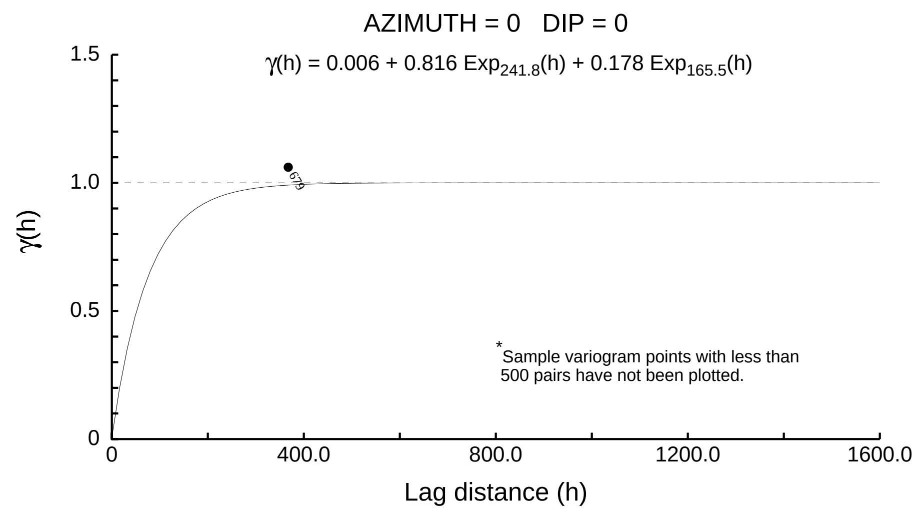
Second Structure -- Exponential with Practical Range

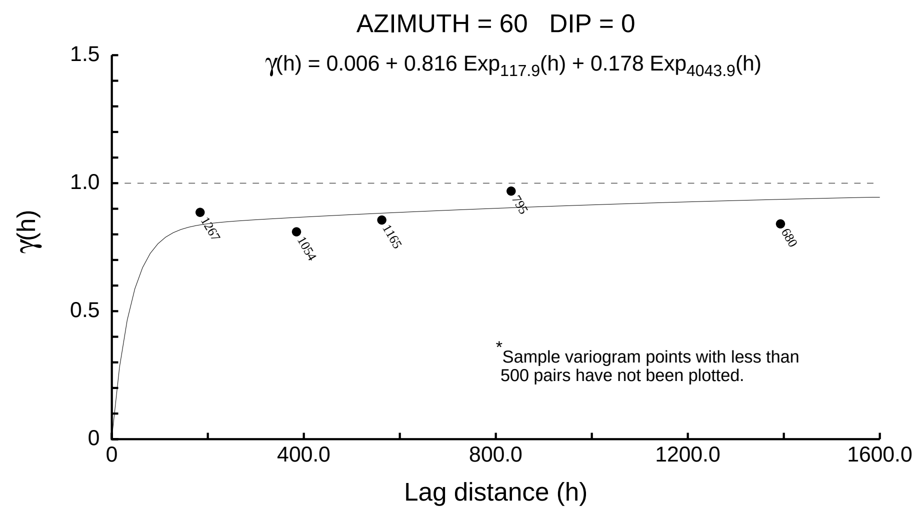
RH Rotation about the Z axis ==> -55
RH Rotation about the Y' axis ==> -53
RH Rotation about the Z' axis ==> -3
Range along the Z' axis ==> 1273.5 Azimuth ==> 325 Dip ==> 37
Range along the Y' axis ==> 4188.6 Azimuth ==> 57 Dip ==> 2
Range along the X' axis ==> 86.2 Azimuth ==> 150 Dip ==> 53

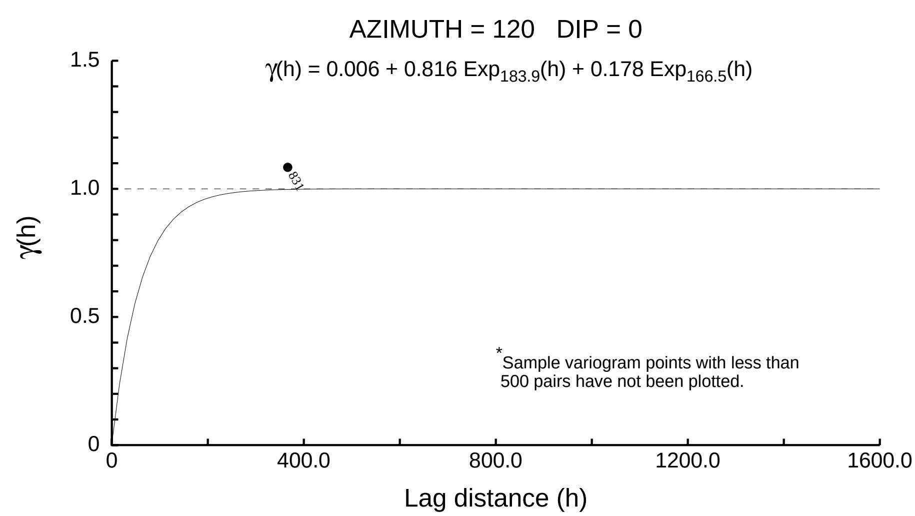
Modeling Criteria

Minimum number pairs req'd ==> 500
Sample variogram points weighted by # pairs

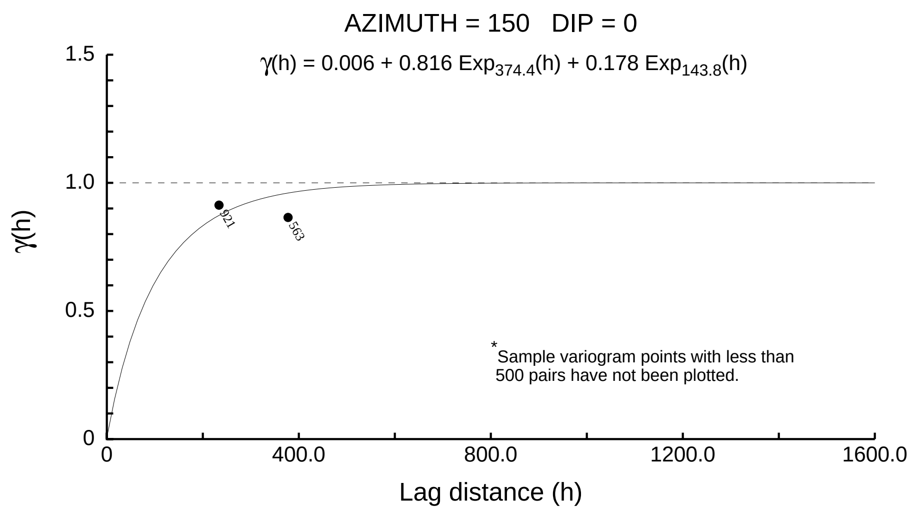
Downhole 2000 - Ni

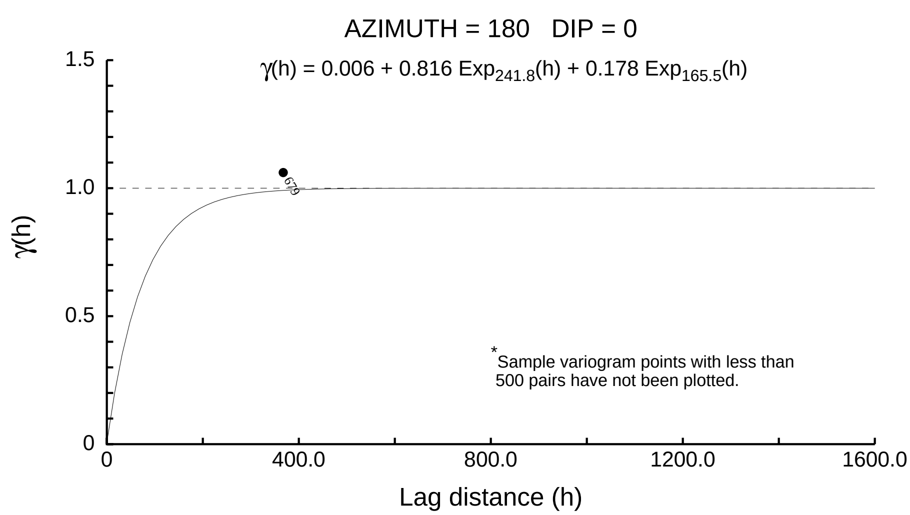


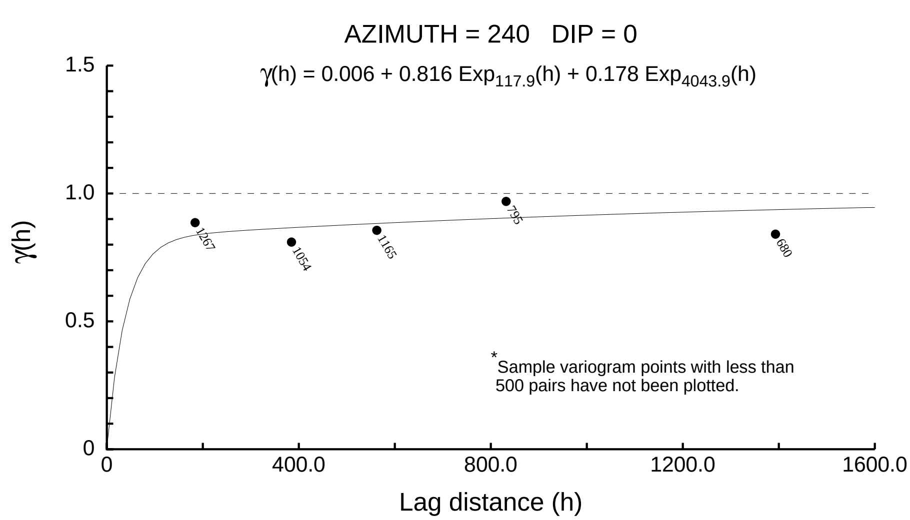




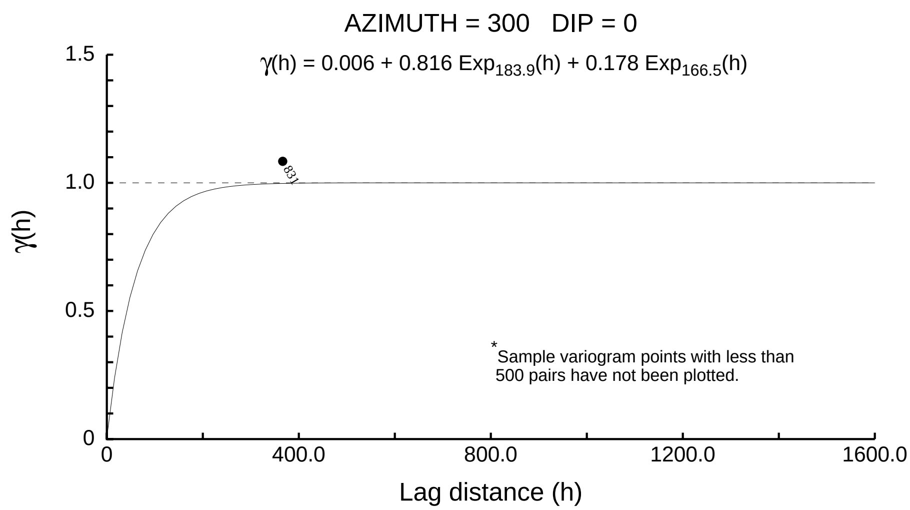
Downhole 2000 - Ni

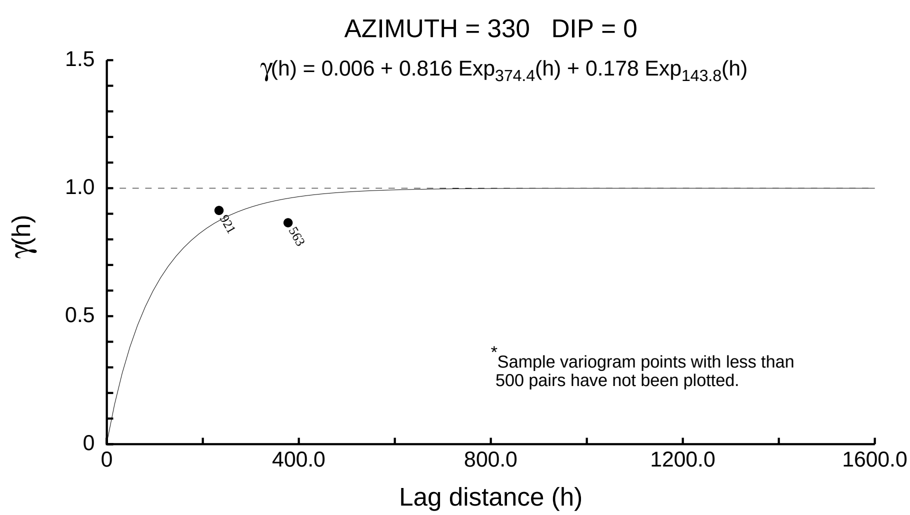


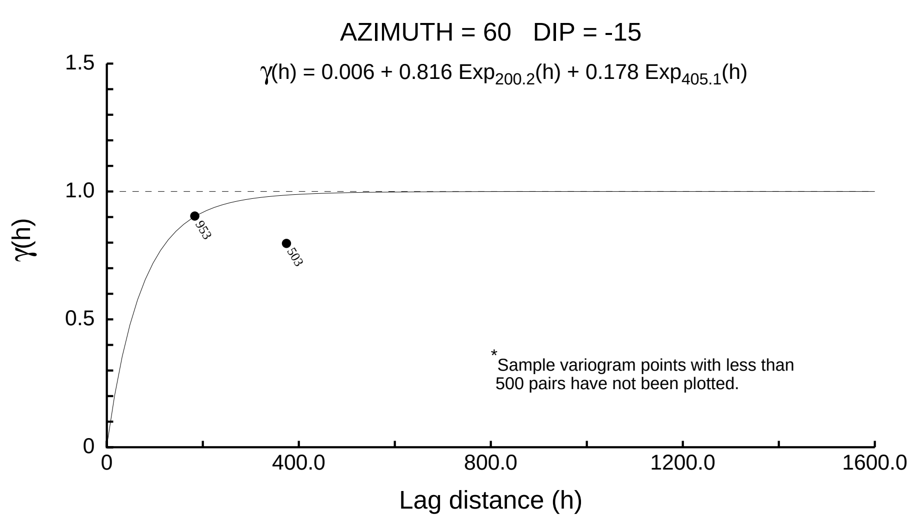




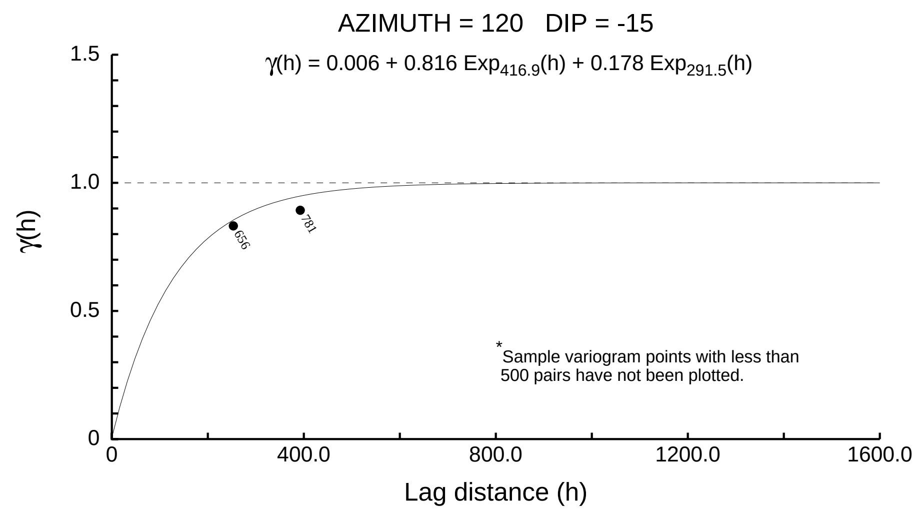
Downhole 2000 - Ni

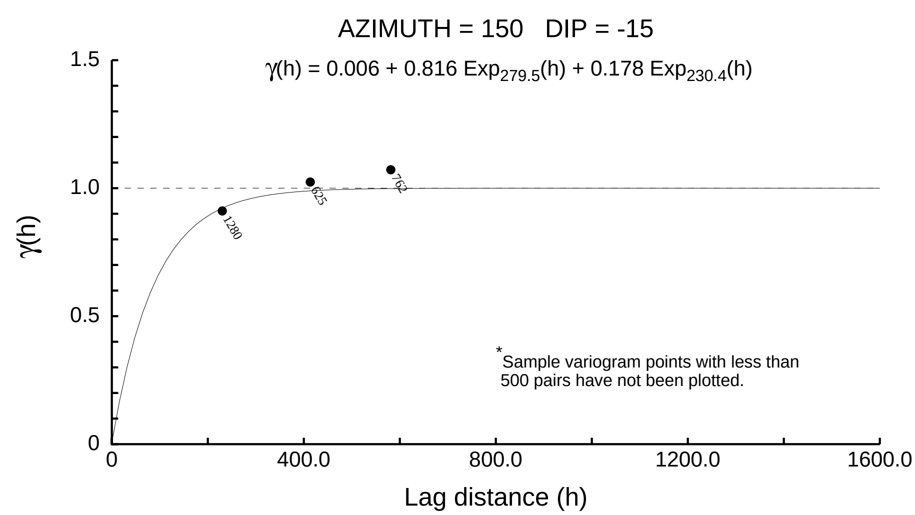


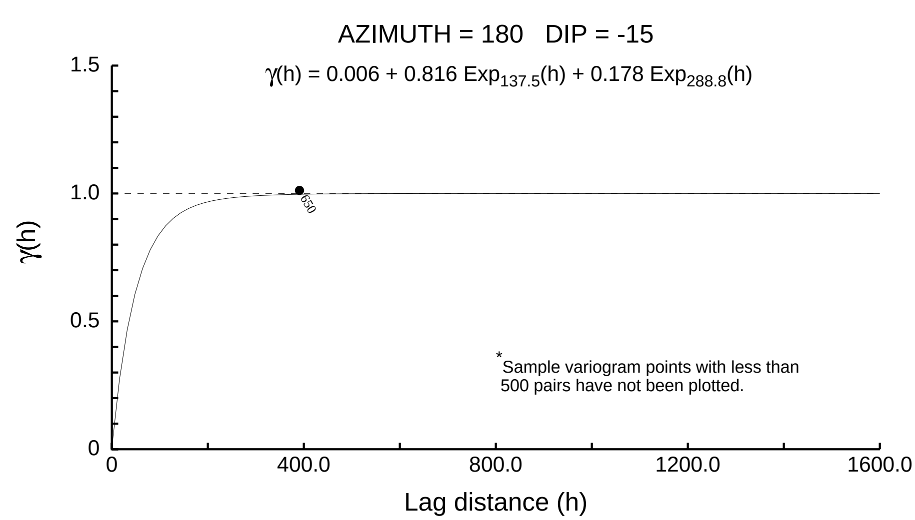




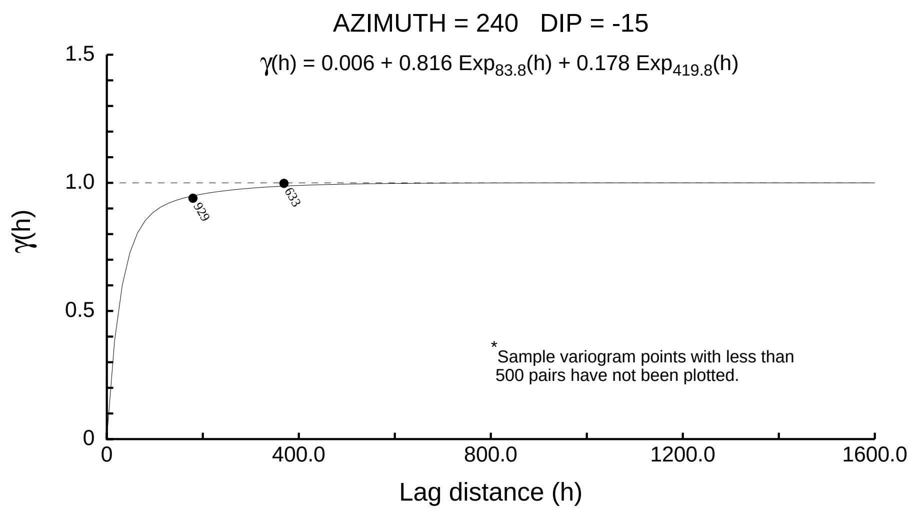
Downhole 2000 - Ni

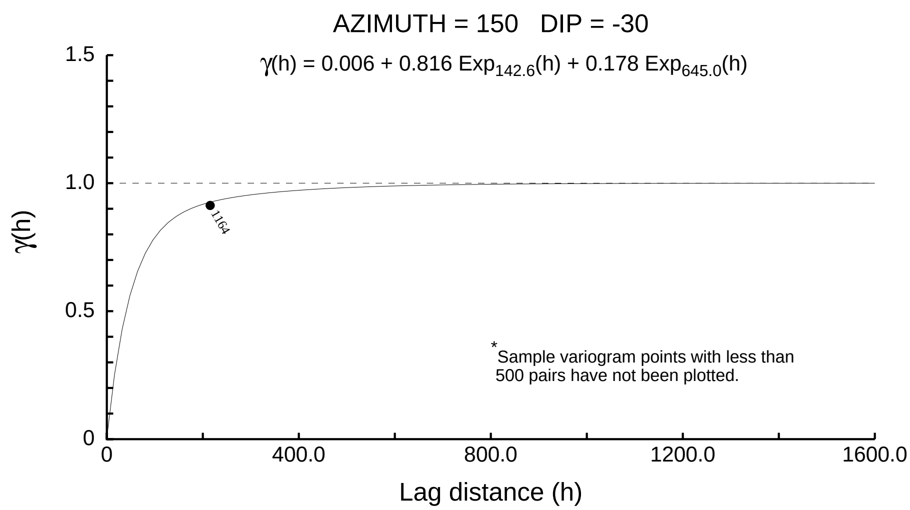


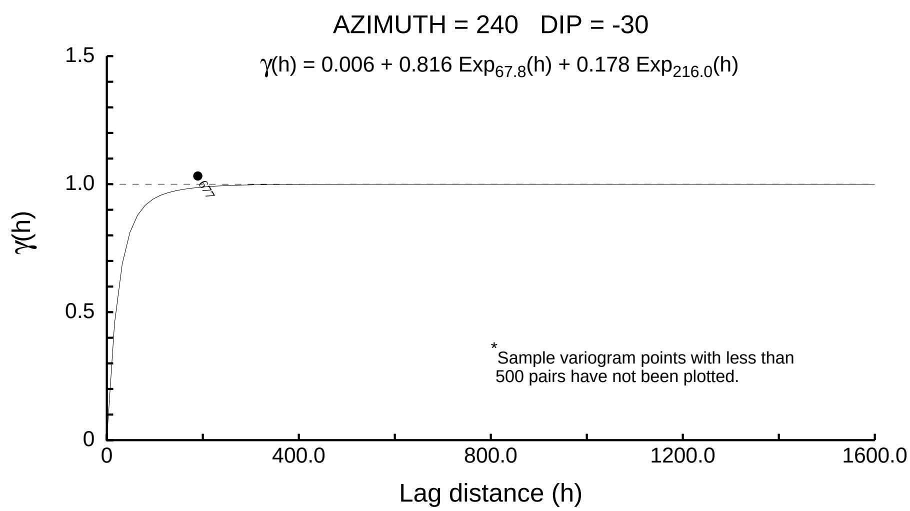




Downhole 2000 - Ni



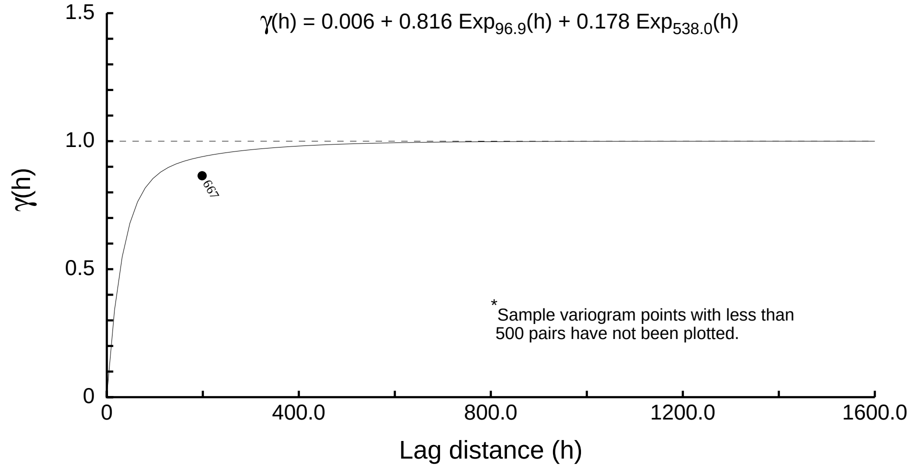




Downhole 2000 - Ni

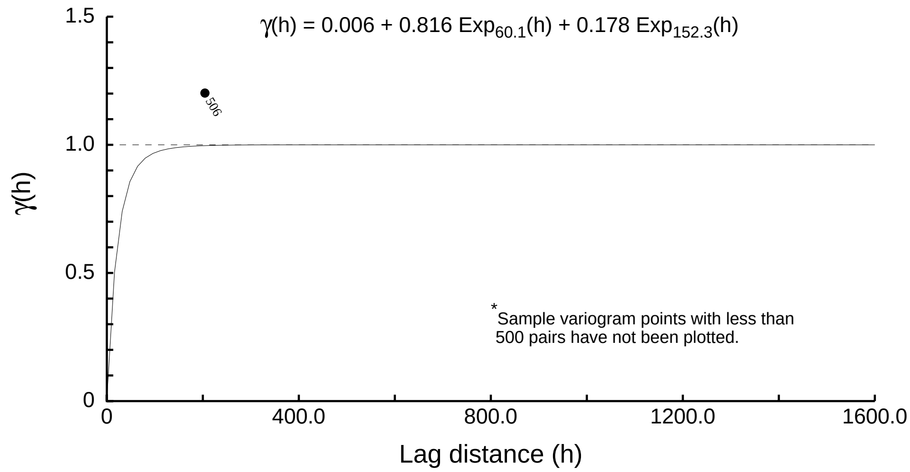
AZIMUTH = 150 DIP = -45

$\gamma(h) = 0.006 + 0.816\ \mathrm{Exp}_{96.9}(h) + 0.178\ \mathrm{Exp}_{538.0}(h)$



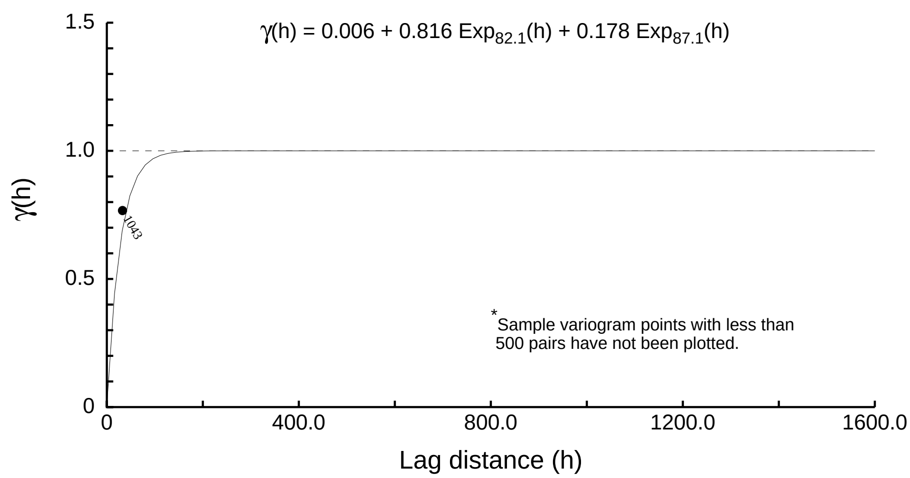
AZIMUTH = 240 DIP = -45

$\gamma(h) = 0.006 + 0.816\ \mathrm{Exp}_{60.1}(h) + 0.178\ \mathrm{Exp}_{152.3}(h)$

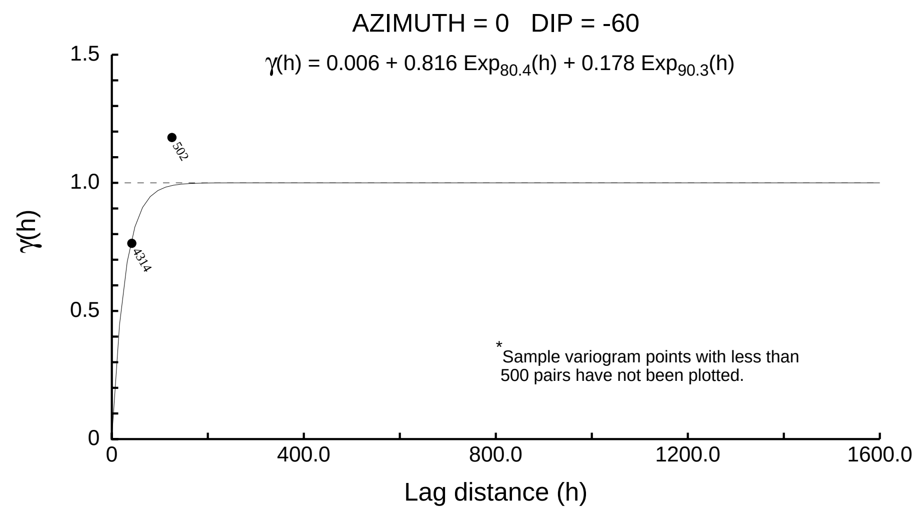


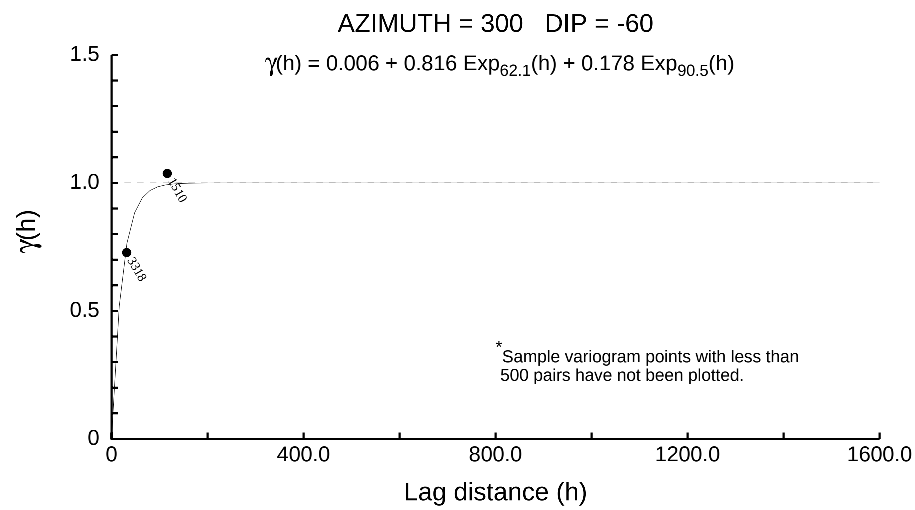
AZIMUTH = 330 DIP = -45

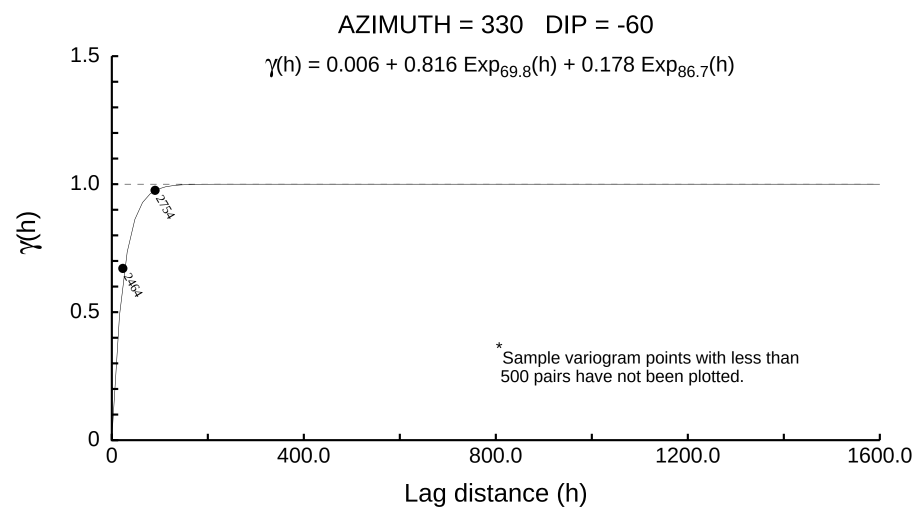
$\gamma(h) = 0.006 + 0.816\ \mathrm{Exp}_{82.1}(h) + 0.178\ \mathrm{Exp}_{87.1}(h)$



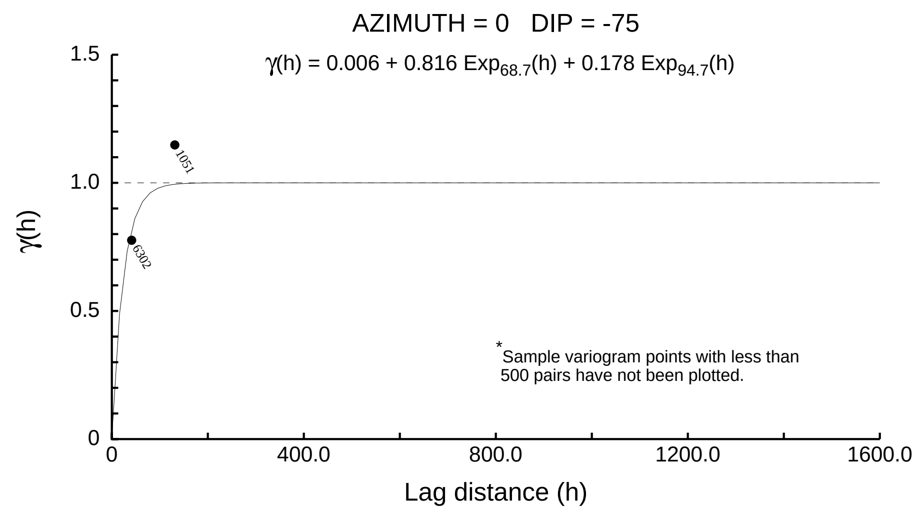
Downhole 2000 - Ni

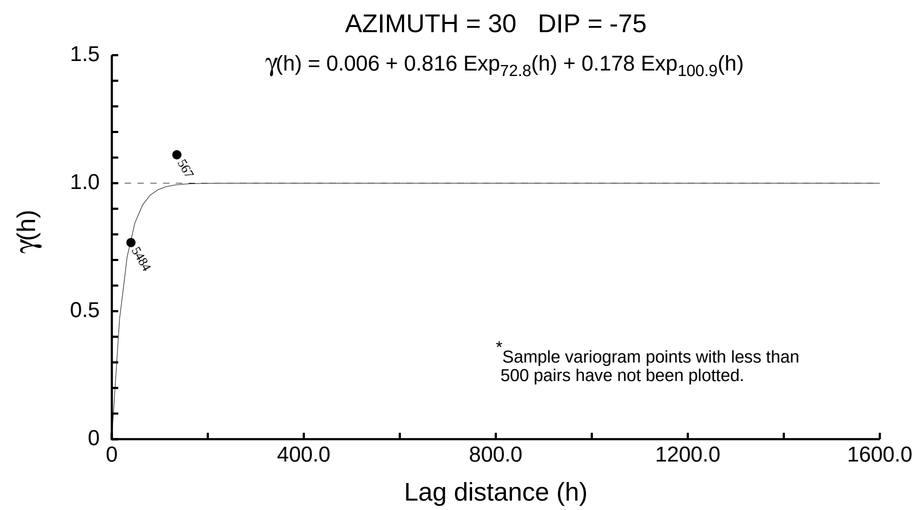


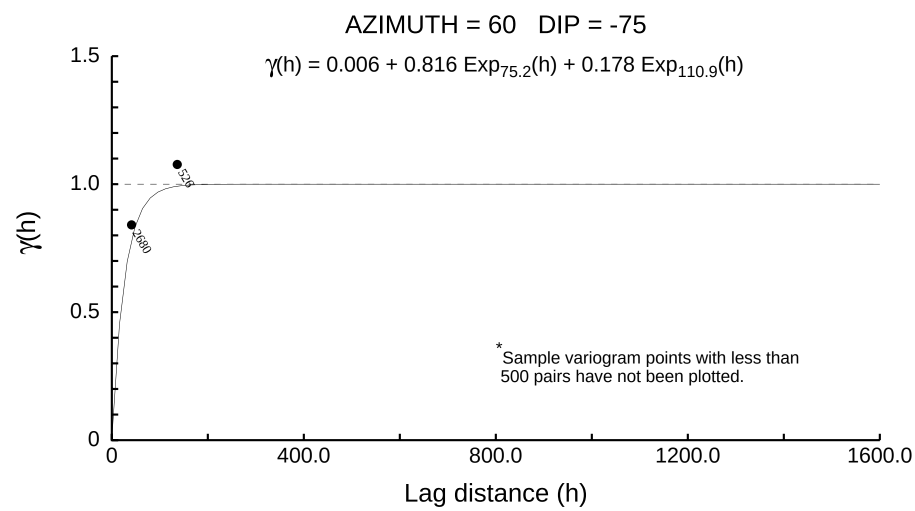




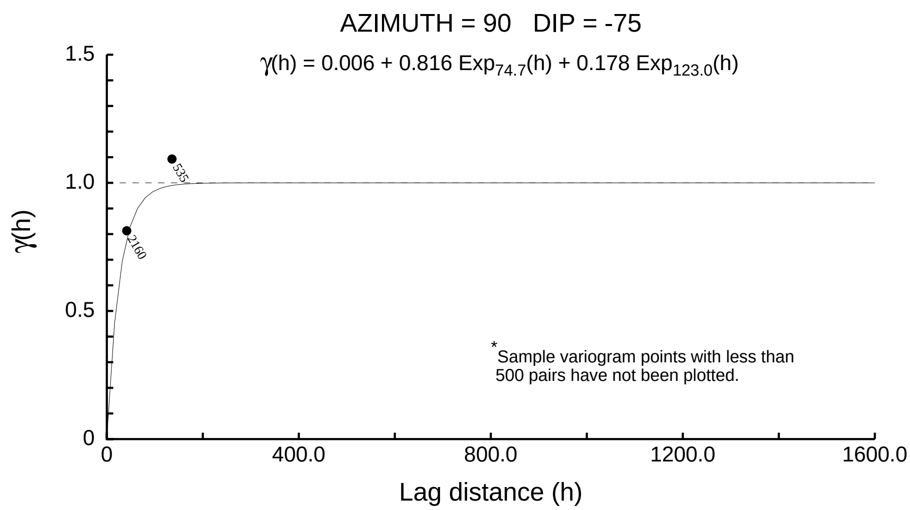
Downhole 2000 - Ni

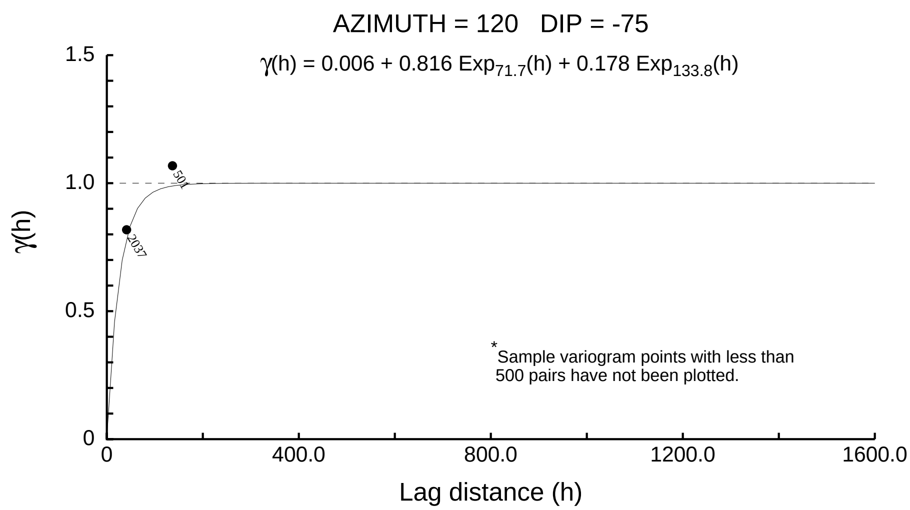


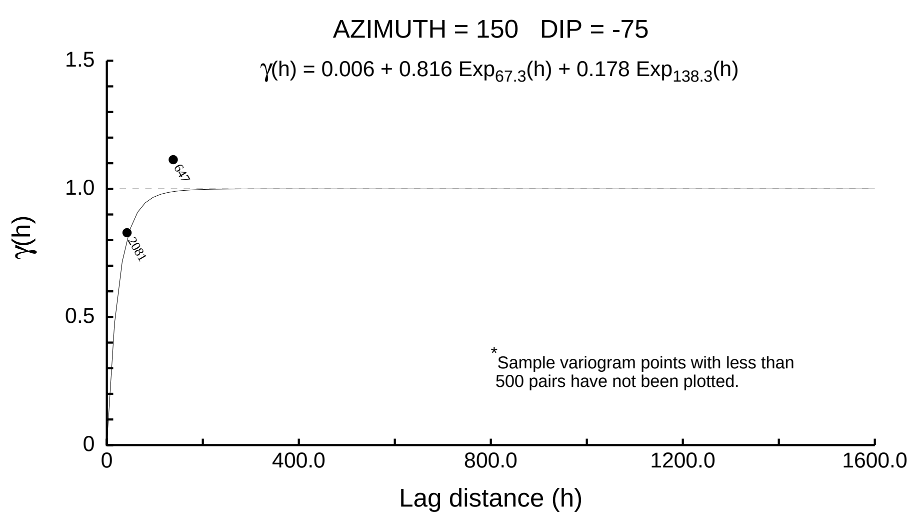




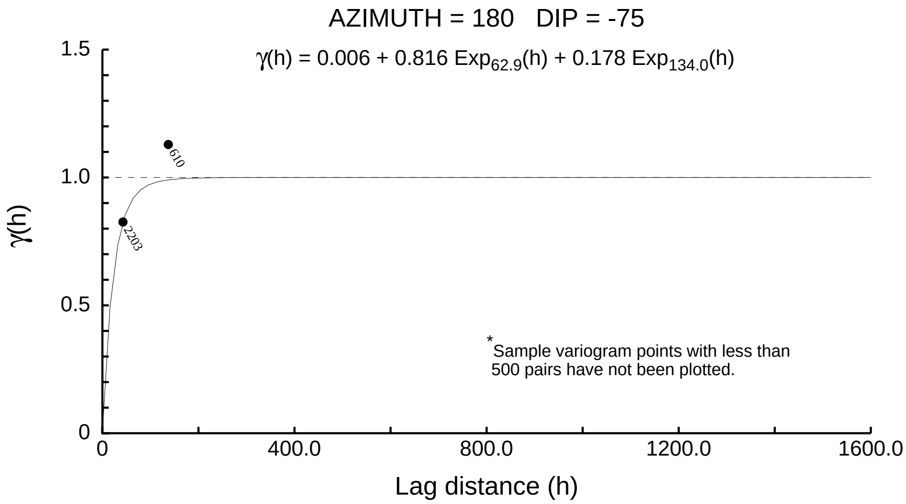
Downhole 2000 - Ni

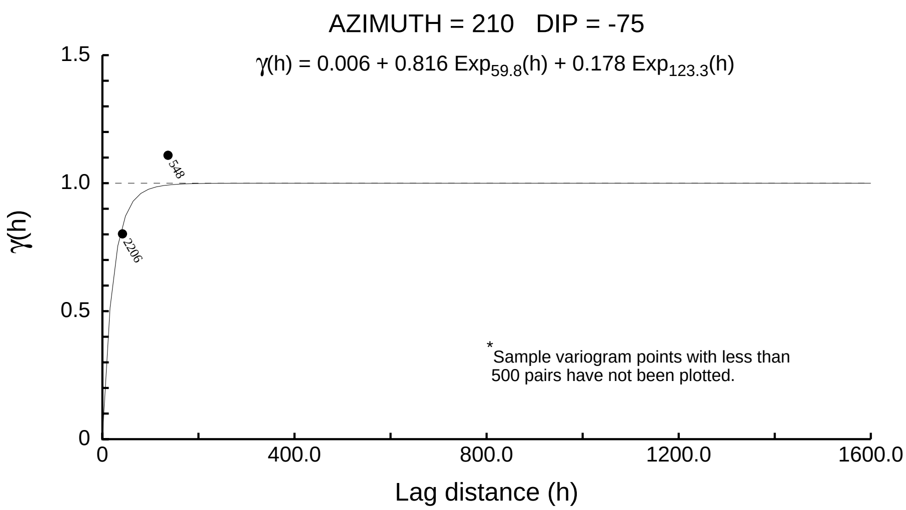


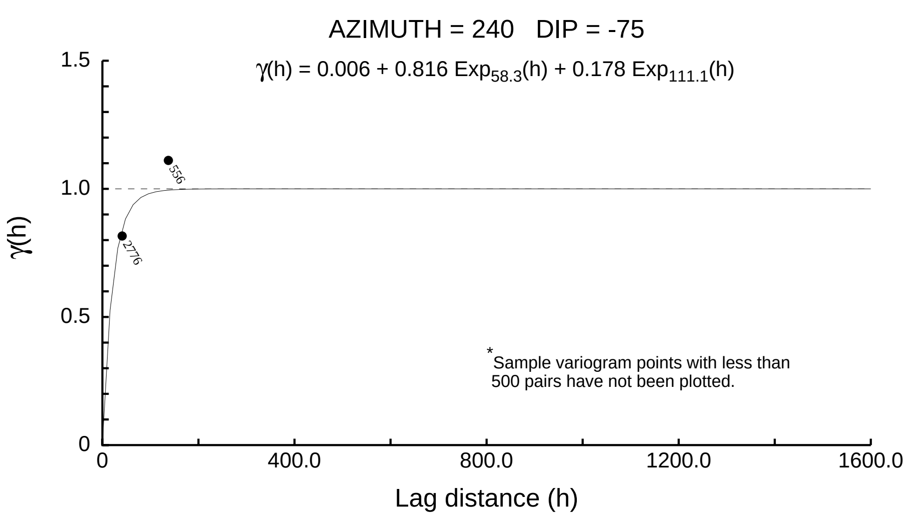




Downhole 2000 - Ni



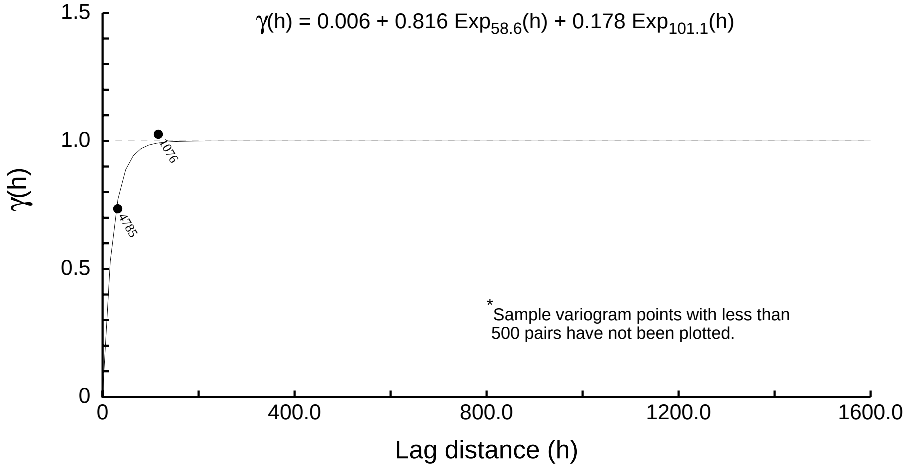




Downhole 2000 - Ni

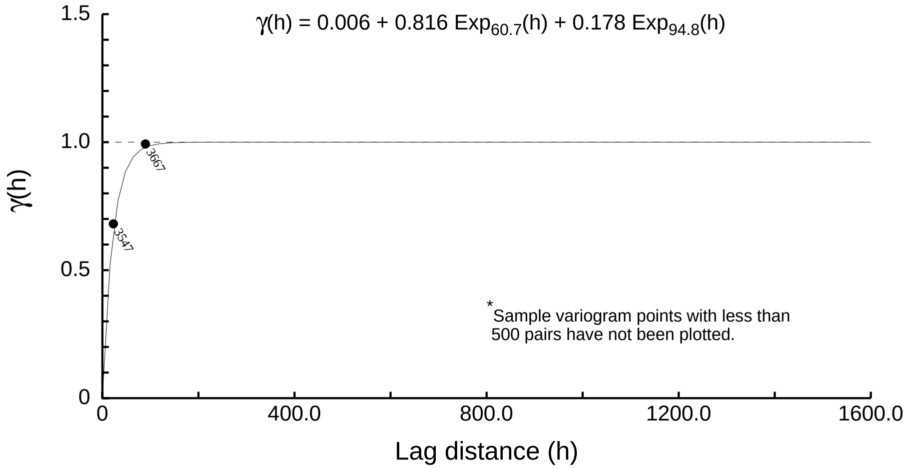
AZIMUTH = 270   DIP = -75

$\gamma(h) = 0.006 + 0.816\ Exp_{58.6}(h) + 0.178\ Exp_{101.1}(h)$



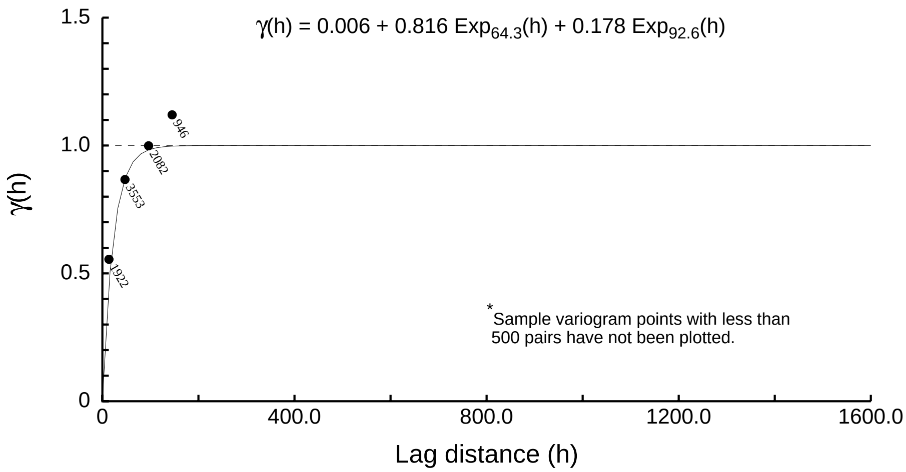
AZIMUTH = 300   DIP = -75

$\gamma(h) = 0.006 + 0.816\ Exp_{60.7}(h) + 0.178\ Exp_{94.8}(h)$

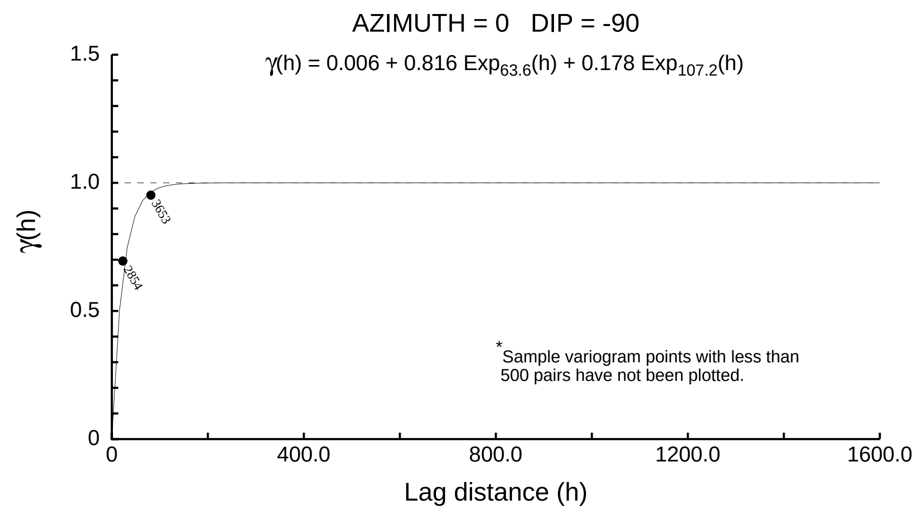


AZIMUTH = 330   DIP = -75

$\gamma(h) = 0.006 + 0.816\ Exp_{64.3}(h) + 0.178\ Exp_{92.6}(h)$



Downhole 2000 - Ni



Downhole 2000 - Pd

User Defined Rotation Conventions

Nugget ==> 0.003
C1 ==> 0.744
C2 ==> 0.253

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -30
RH Rotation about the Y' axis ==> 57
RH Rotation about the Z' axis ==> 11
Range along the Z' axis ==> 34.4 Azimuth ==> 120 Dip ==> 33
Range along the Y' axis ==> 237.4 Azimuth ==> 24 Dip ==> 9
Range along the X' axis ==> 106.4 Azimuth ==> 100 Dip ==> -56

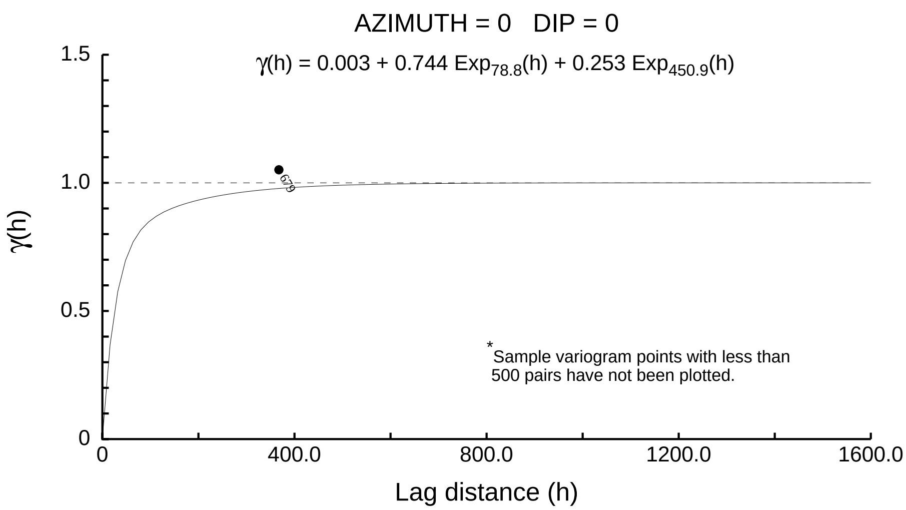
Second Structure -- Exponential with Practical Range

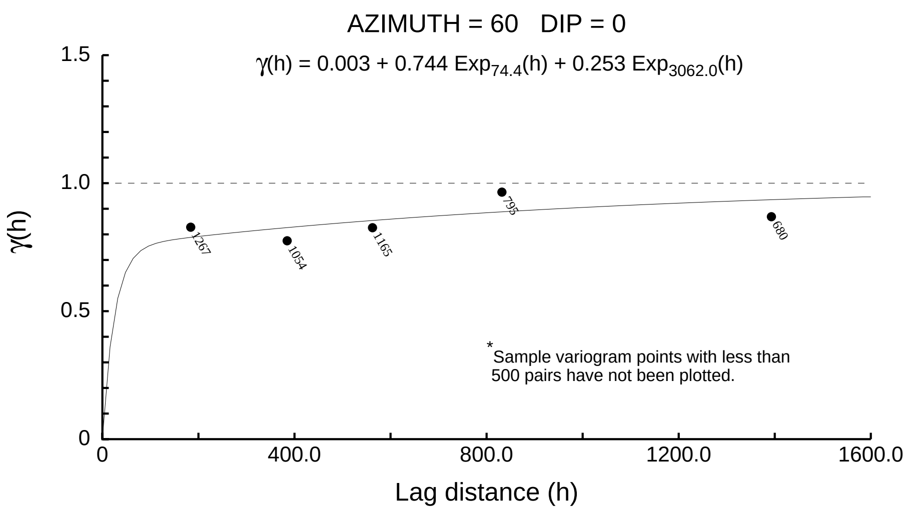
RH Rotation about the Z axis ==> 28
RH Rotation about the Y' axis ==> -88
RH Rotation about the Z' axis ==> -25
Range along the Z' axis ==> 3204.4 Azimuth ==> 242 Dip ==> 2
Range along the Y' axis ==> 818.3 Azimuth ==> 333 Dip ==> 25
Range along the X' axis ==> 180.5 Azimuth ==> 148 Dip ==> 65

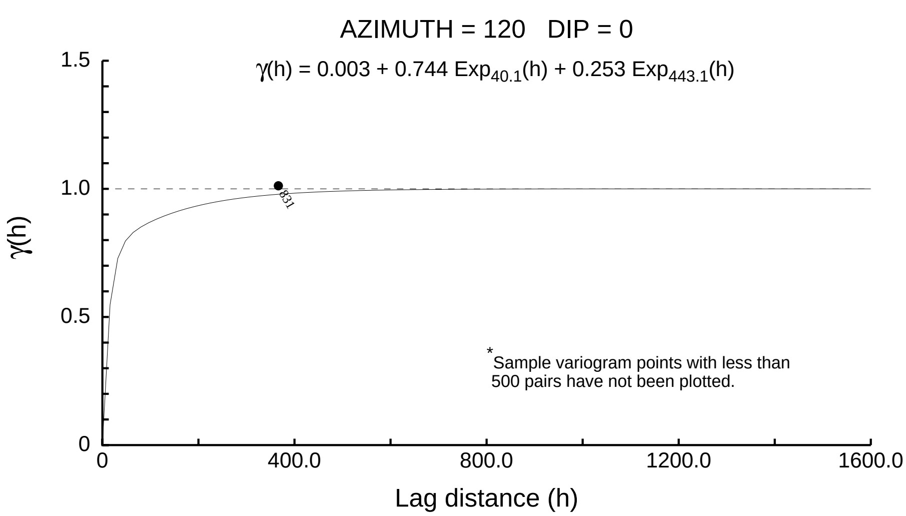
Modeling Criteria

Minimum number pairs req'd ==> 500
Sample variogram points weighted by # pairs

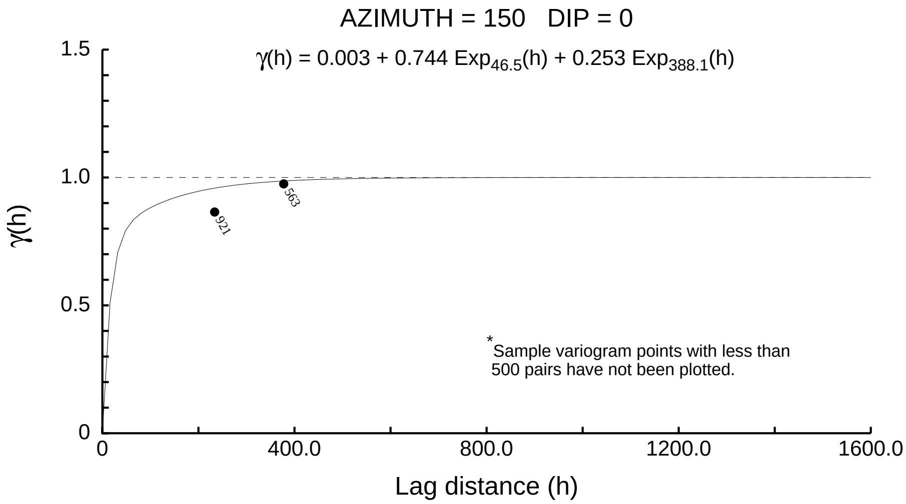
Downhole 2000 - Pd

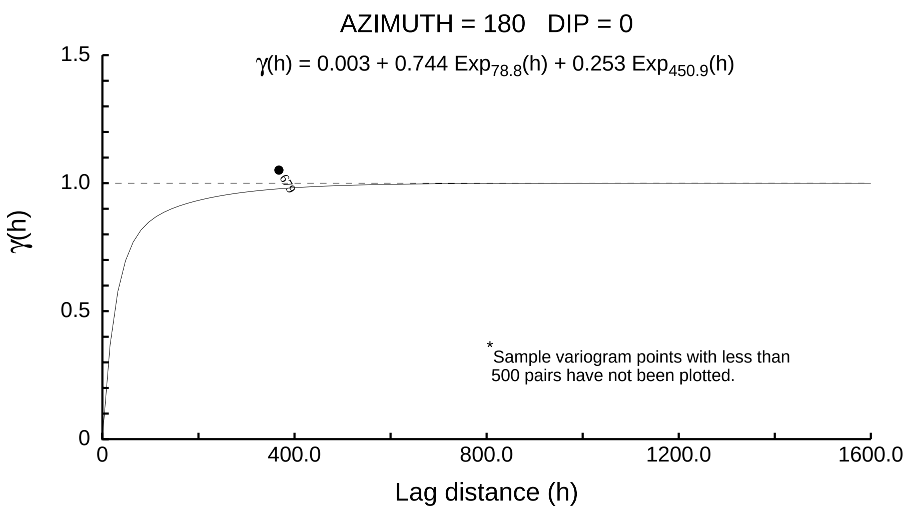


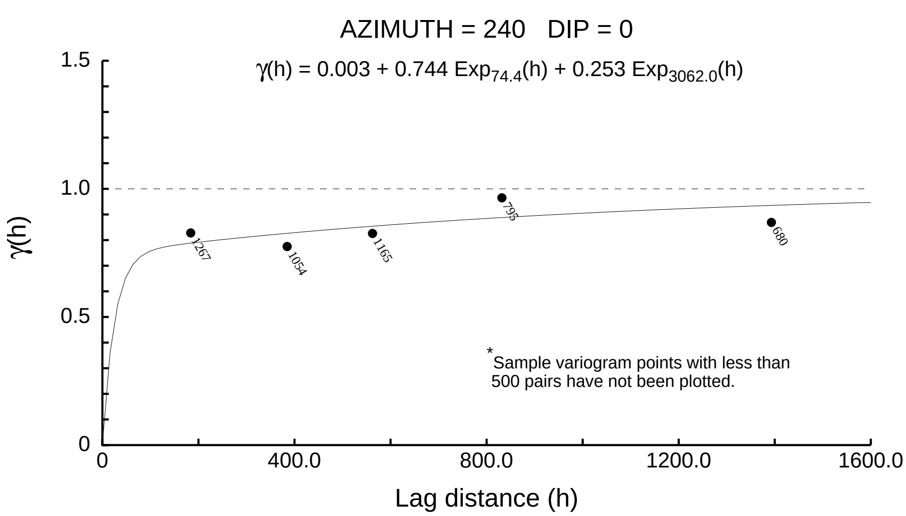




Downhole 2000 - Pd







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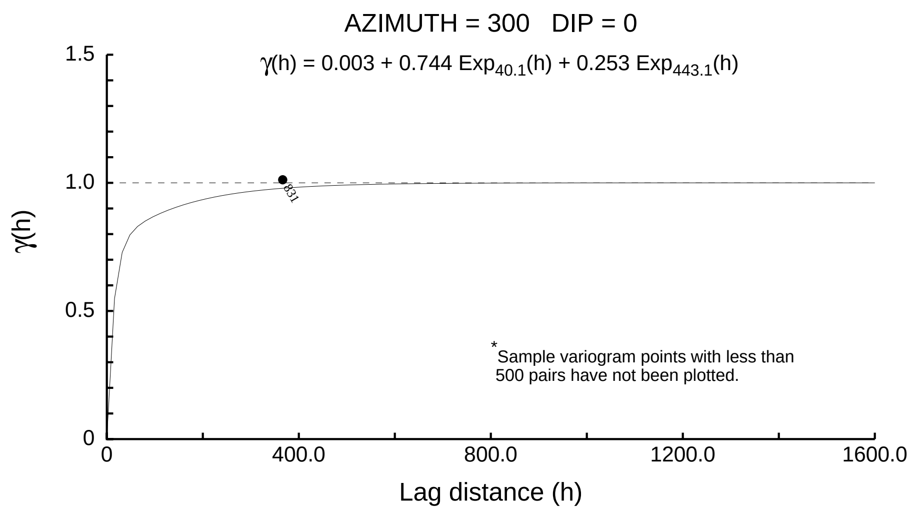
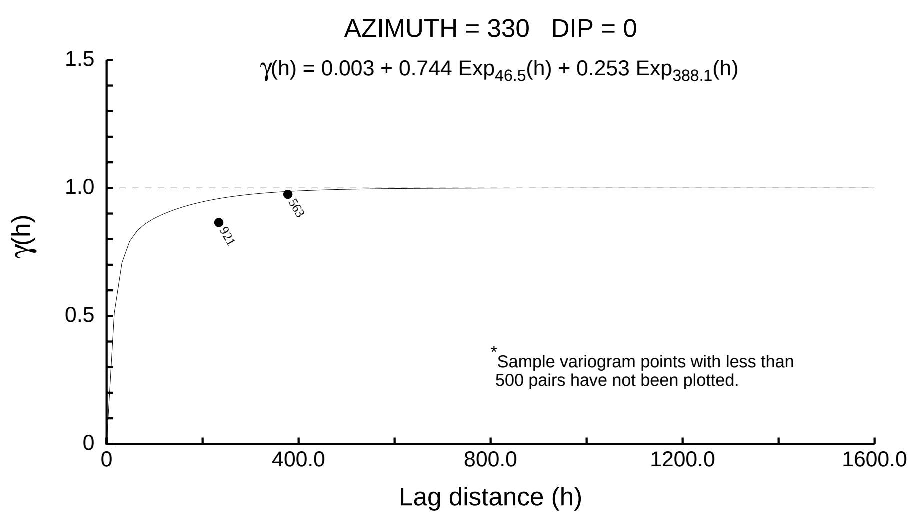
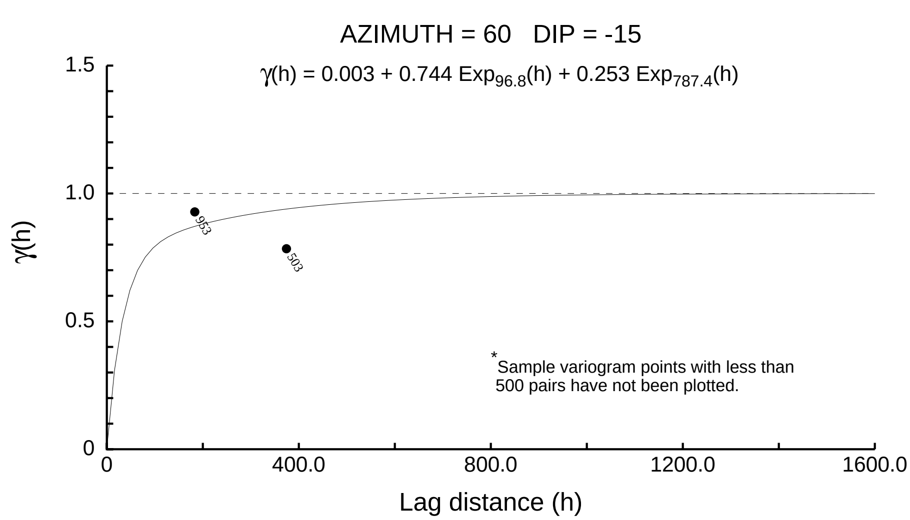
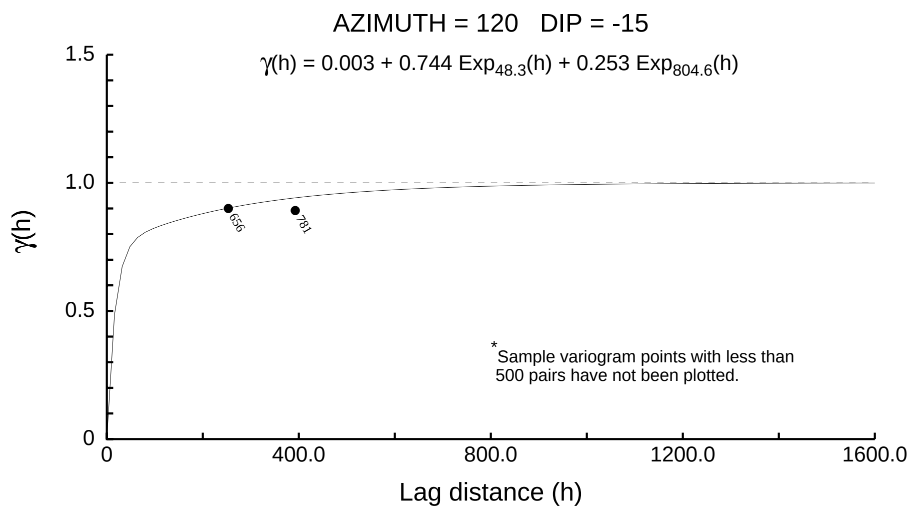
Downhole 2000 - Pd

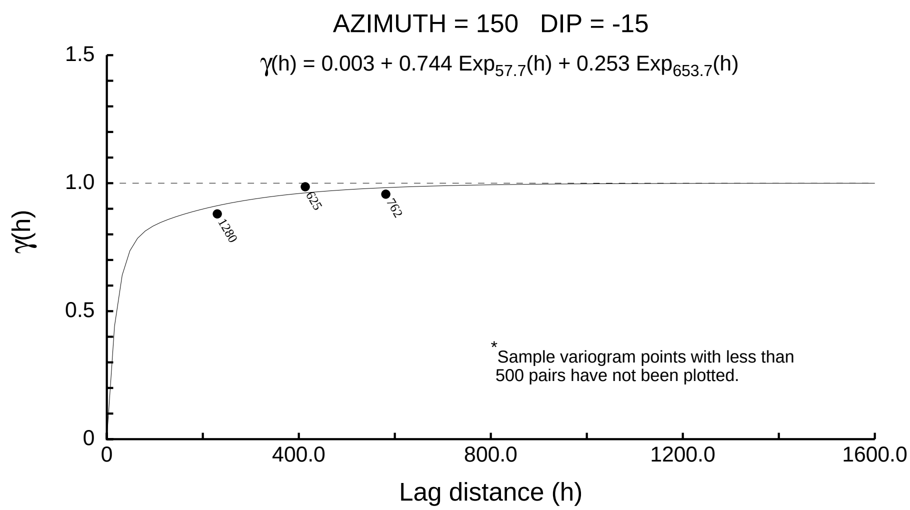


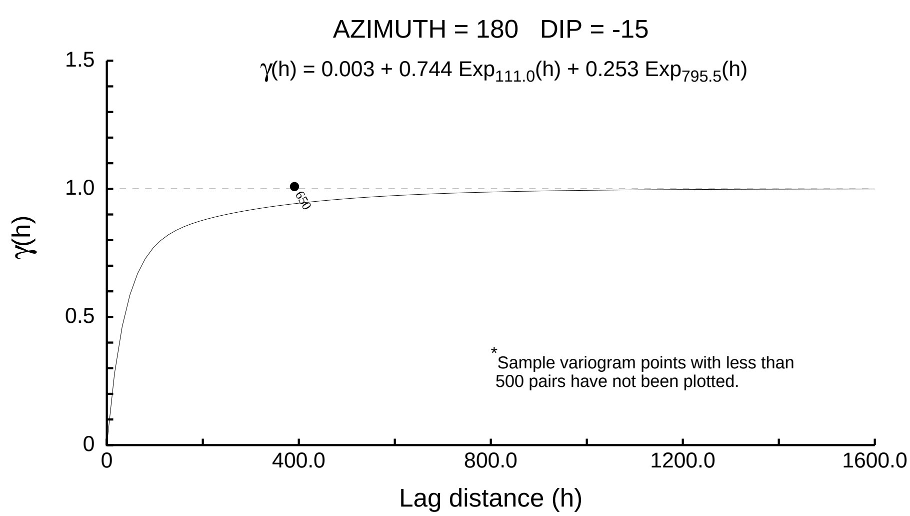




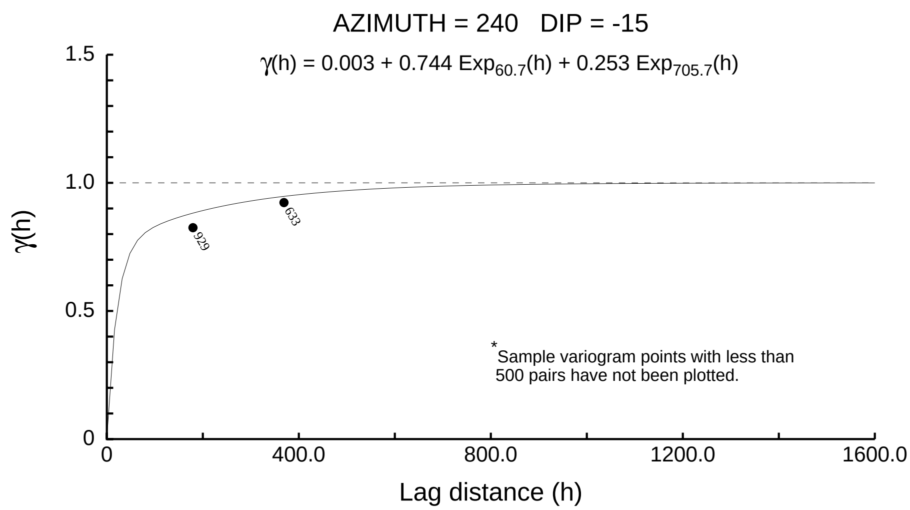
Downhole 2000 - Pd

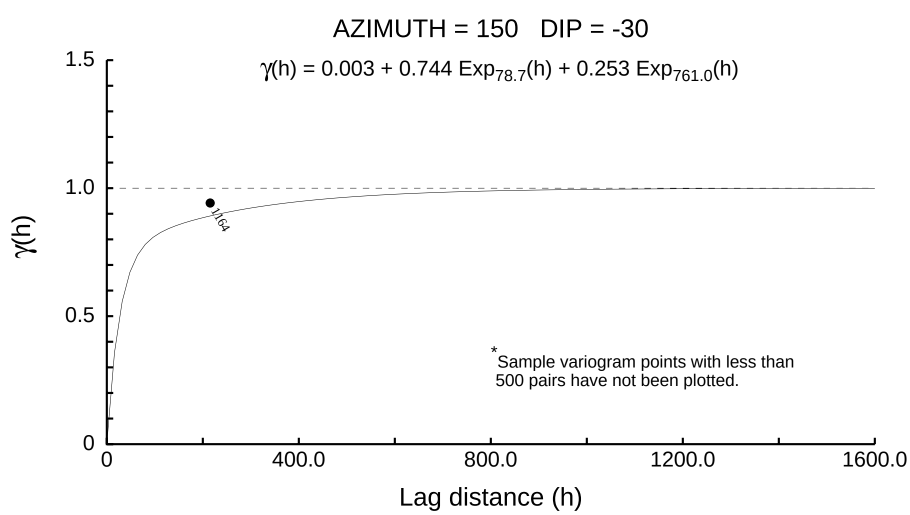


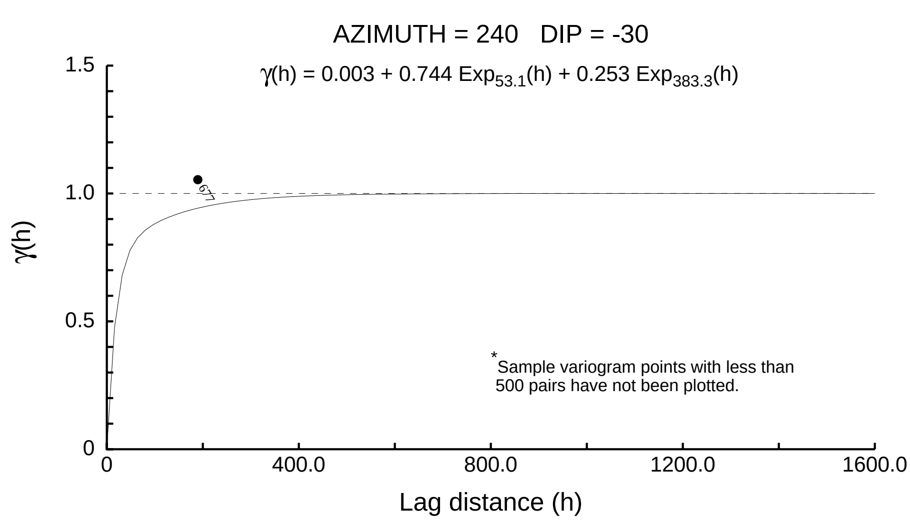




Downhole 2000 - Pd

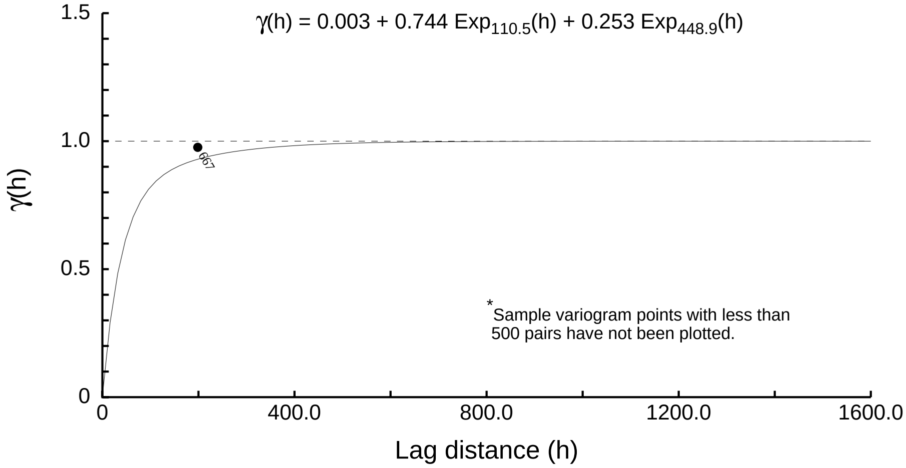




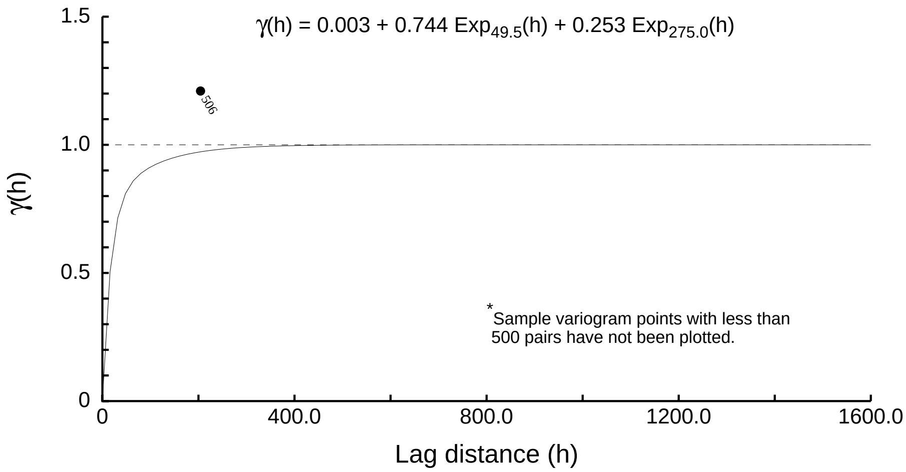


Downhole 2000 - Pd

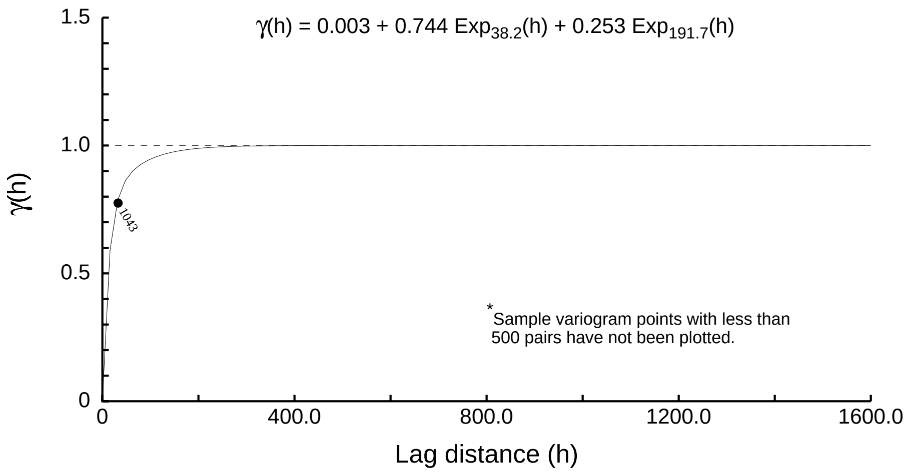
AZIMUTH = 150   DIP = -45



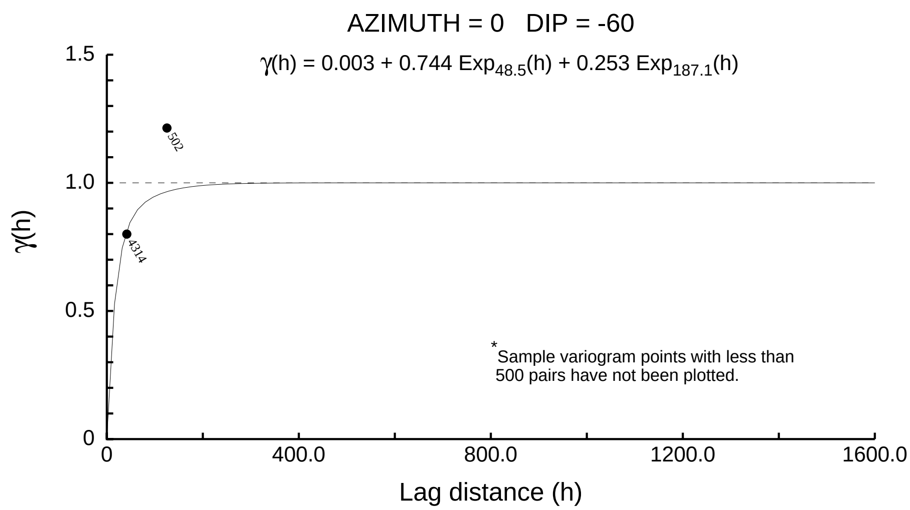
AZIMUTH = 240   DIP = -45

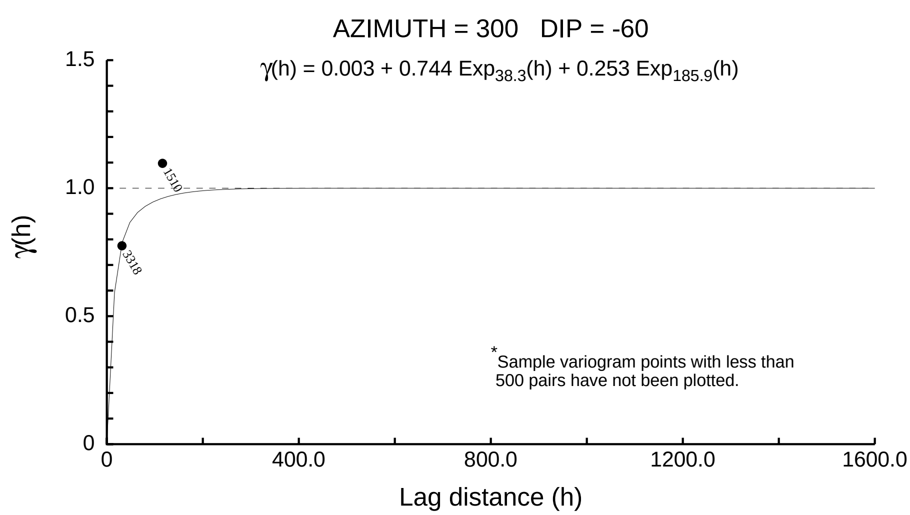


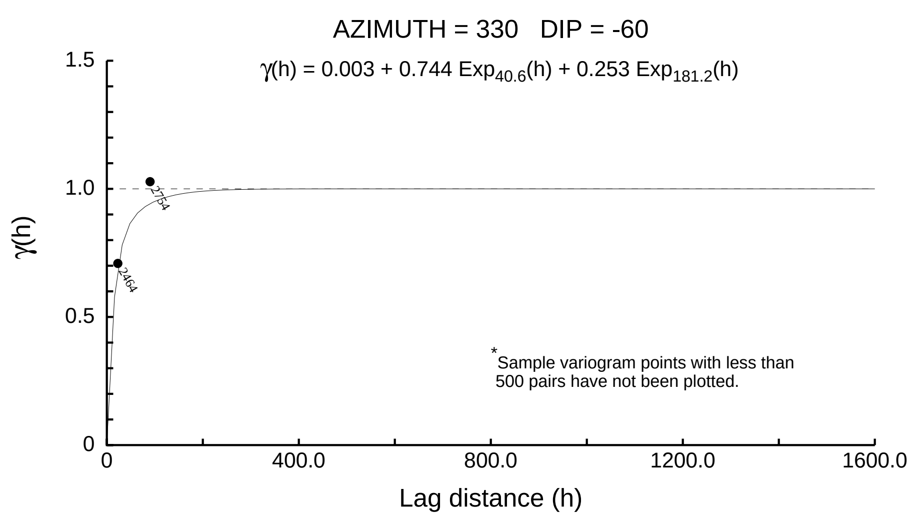
AZIMUTH = 330   DIP = -45



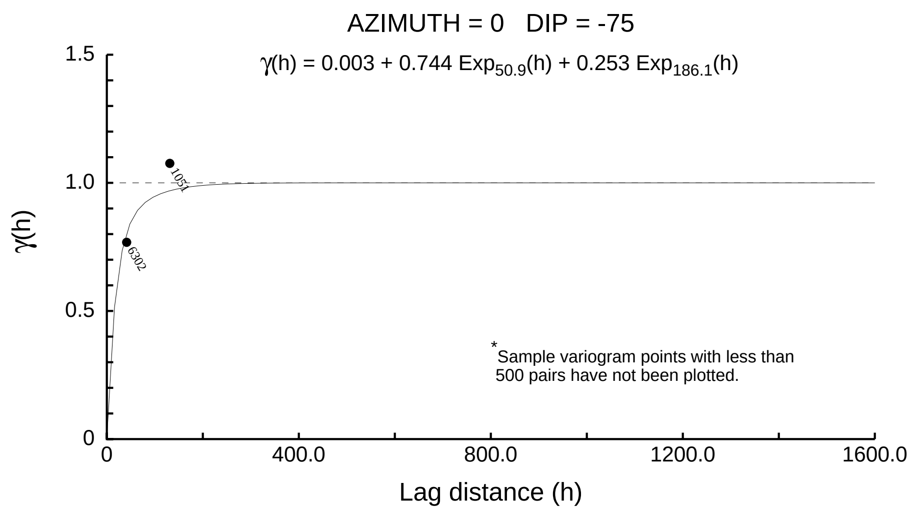
Downhole 2000 - Pd

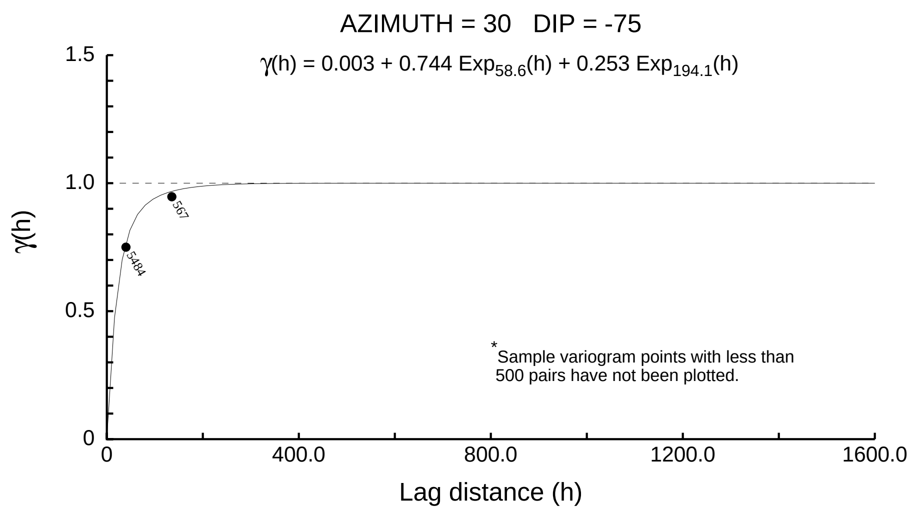


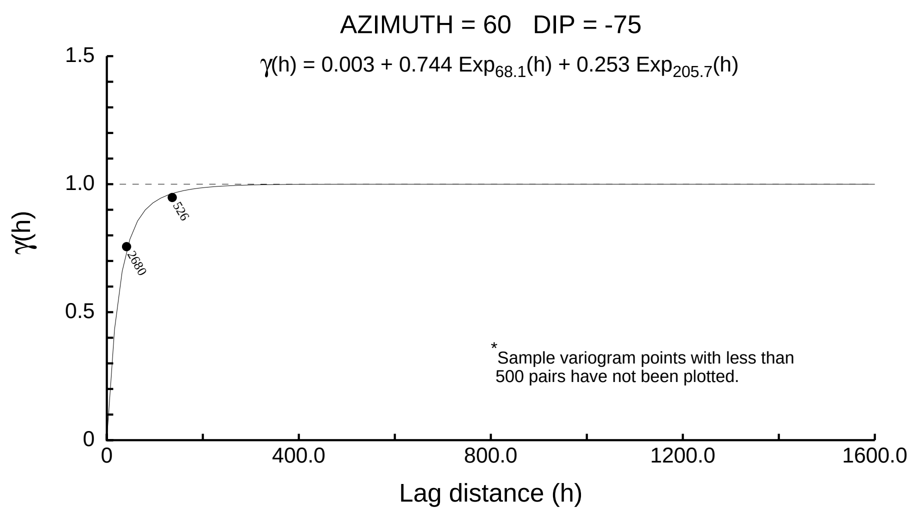




Downhole 2000 - Pd







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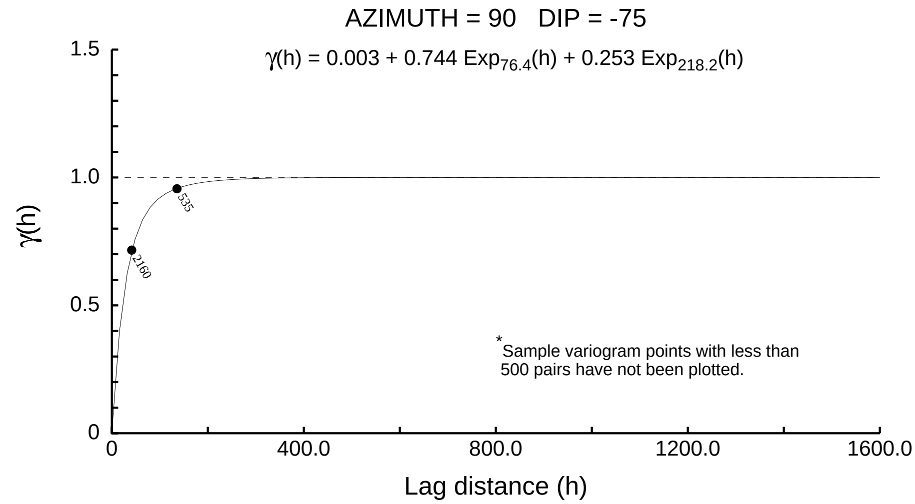
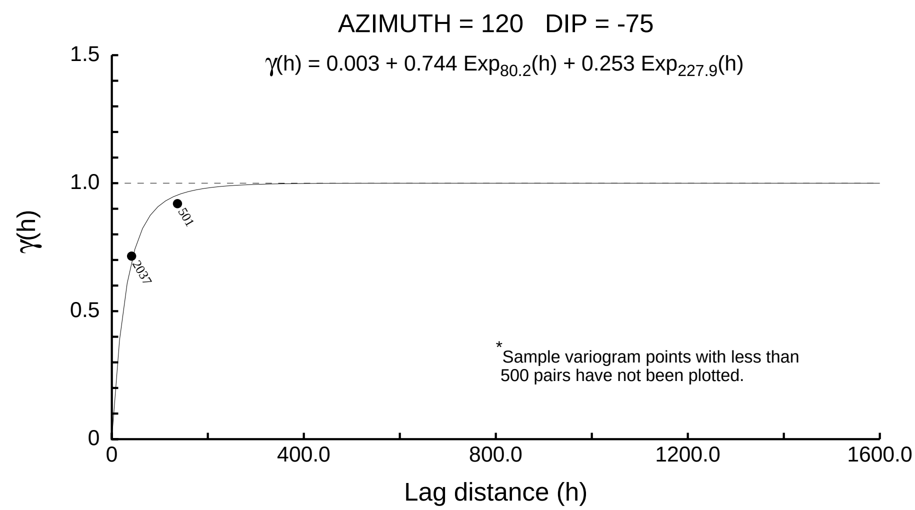
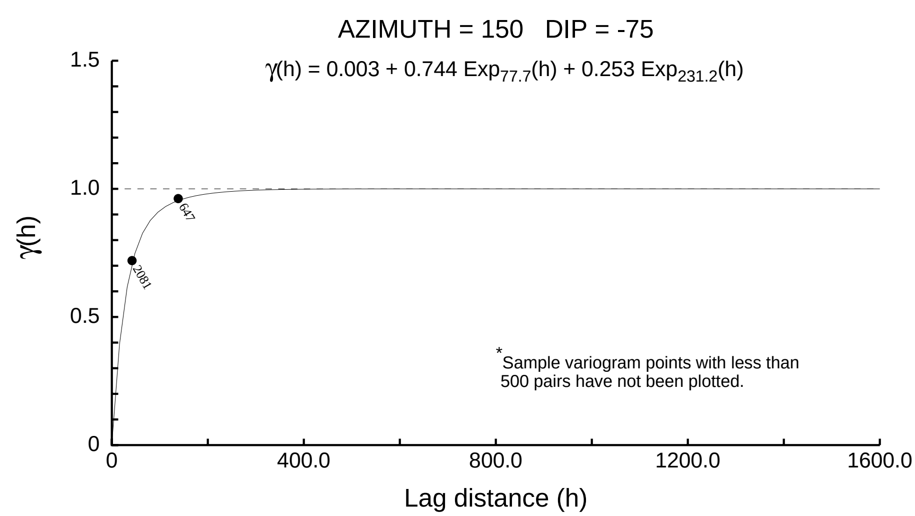
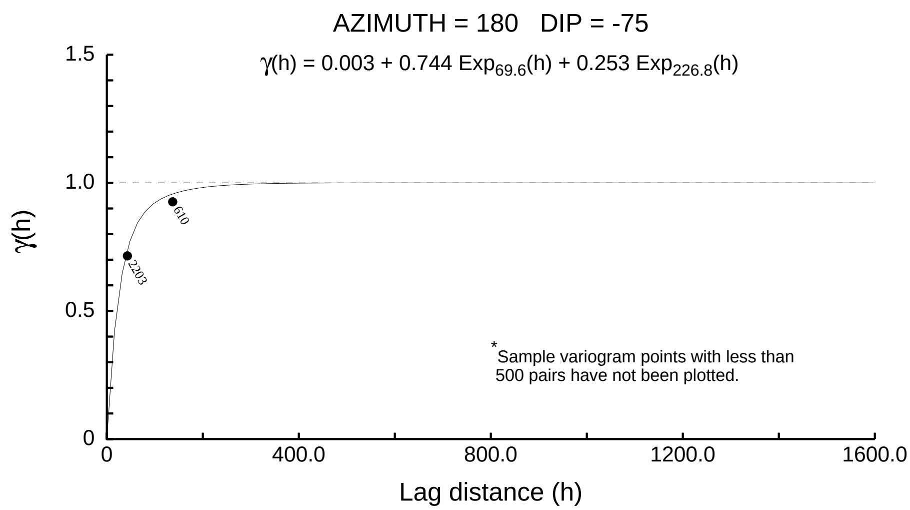
Downhole 2000 - Pd

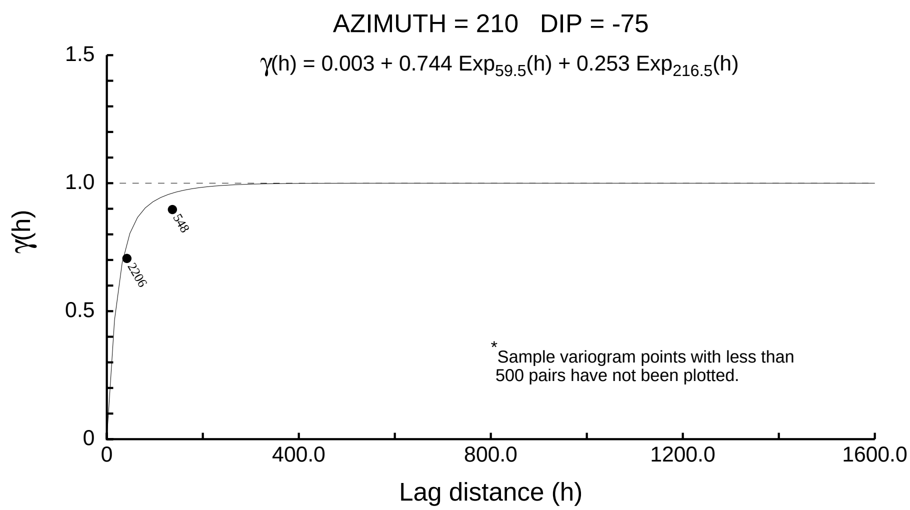


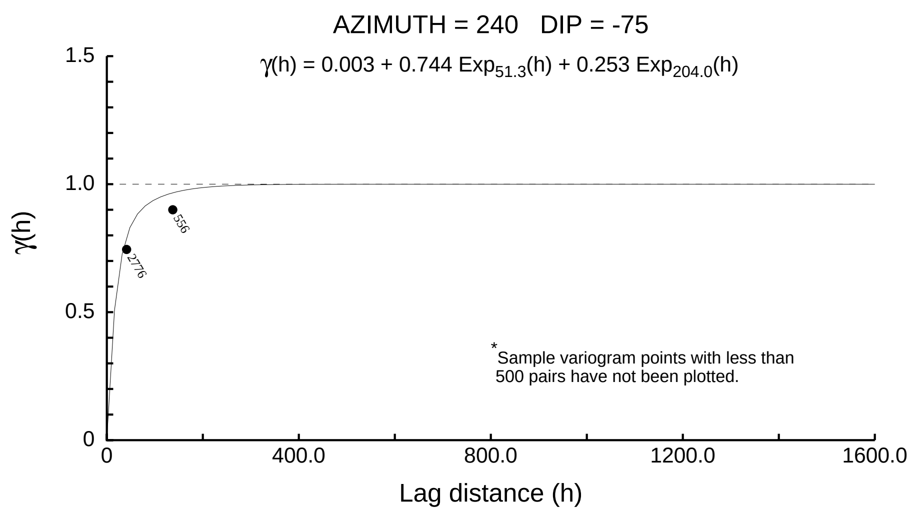




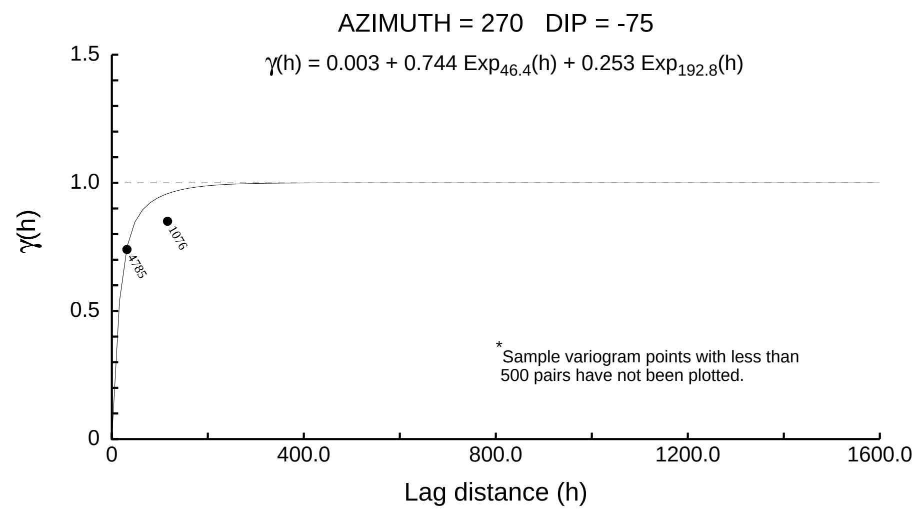
Downhole 2000 - Pd

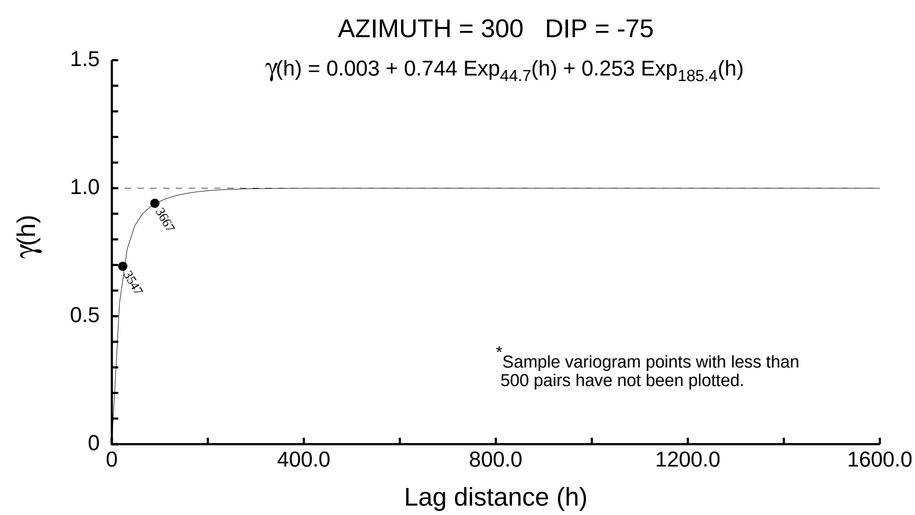


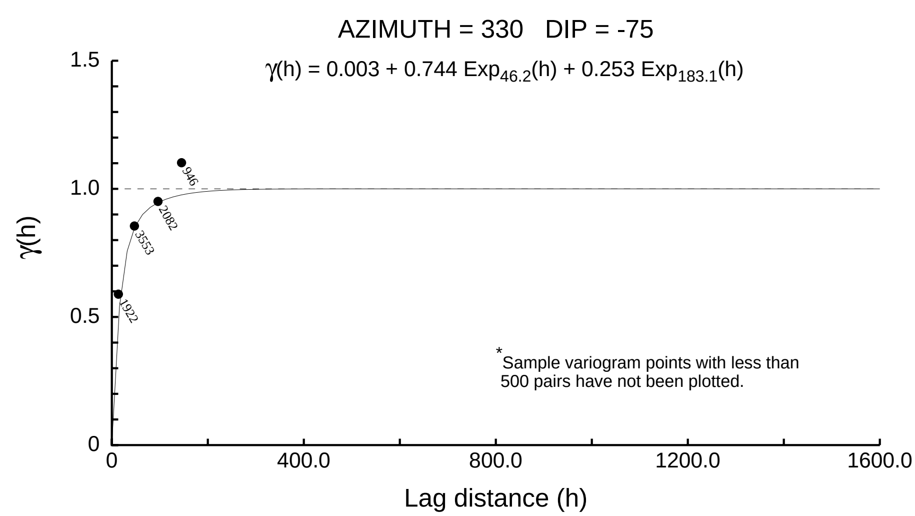




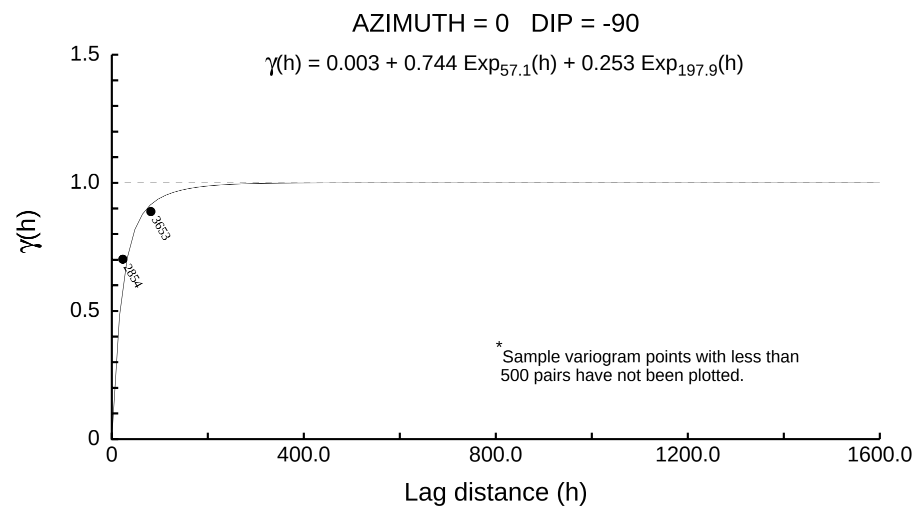
Downhole 2000 - Pd







Downhole 2000 - Pd



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Downhole 2000 - Pt

User Defined Rotation Conventions

Nugget ==> 0.004
C1 ==> 0.727
C2 ==> 0.269

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> -26
RH Rotation about the Y' axis ==> 59
RH Rotation about the Z' axis ==> 8

Range along the Z' axis	==> 35.8	Azimuth ==> 116	Dip ==> 31
Range along the Y' axis	==> 311.2	Azimuth ==> 22	Dip ==> 7
Range along the X' axis	==> 84.9	Azimuth ==> 100	Dip ==> -58

Second Structure -- Exponential with Practical Range

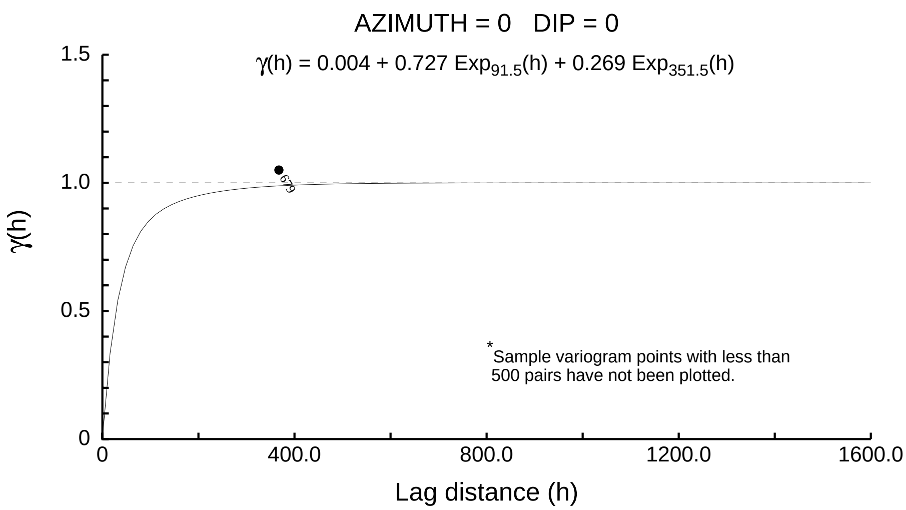
RH Rotation about the Z axis ==> -72
RH Rotation about the Y' axis ==> -74
RH Rotation about the Z' axis ==> 2

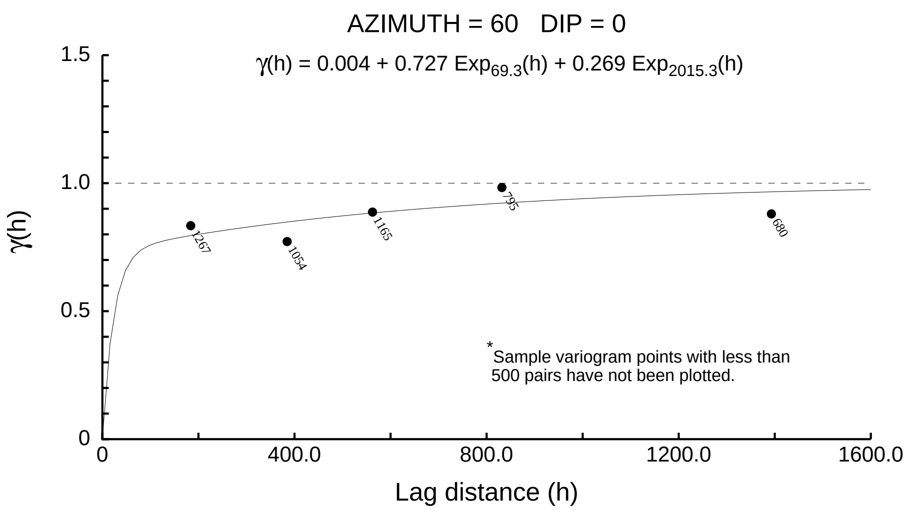
Range along the Z' axis	==> 738.3	Azimuth ==> 342	Dip ==> 16
Range along the Y' axis	==> 2812.6	Azimuth ==> 71	Dip ==> -2
Range along the X' axis	==> 99.5	Azimuth ==> 155	Dip ==> 74

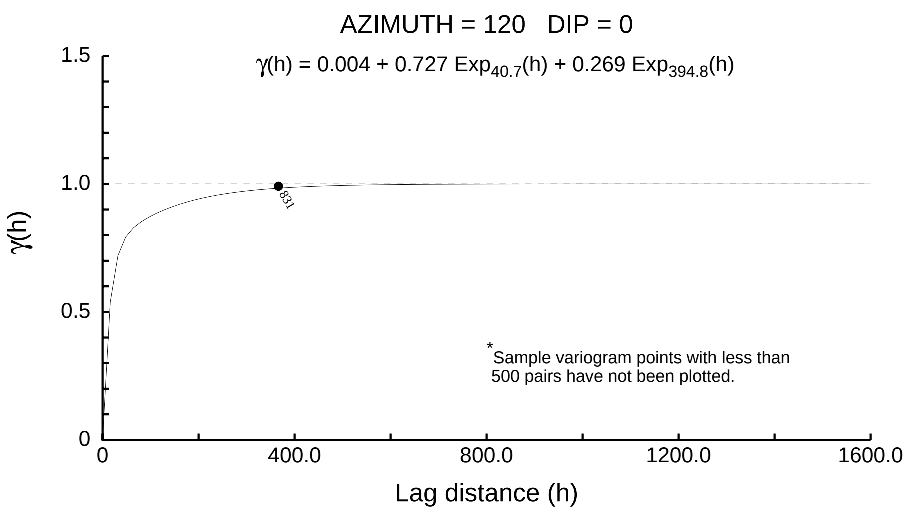
Modeling Criteria

Minimum number pairs req'd ==> 500
Sample variogram points weighted by # pairs

Downhole 2000 - Pt

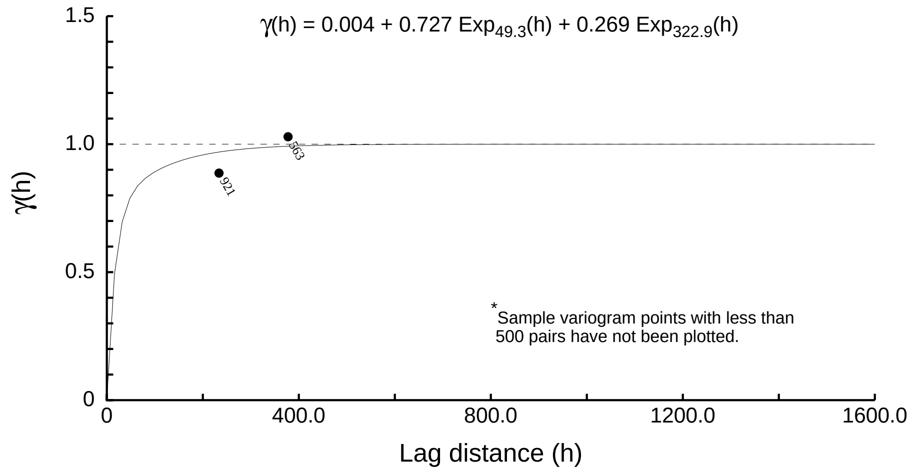




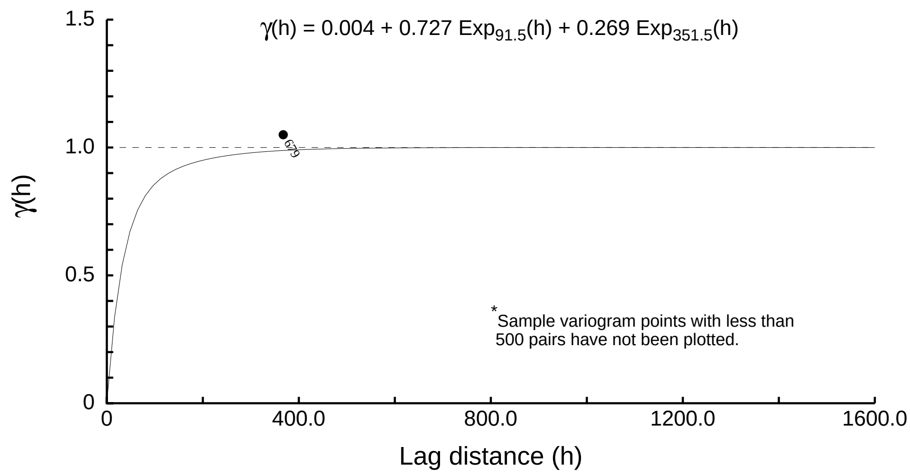


Downhole 2000 - Pt

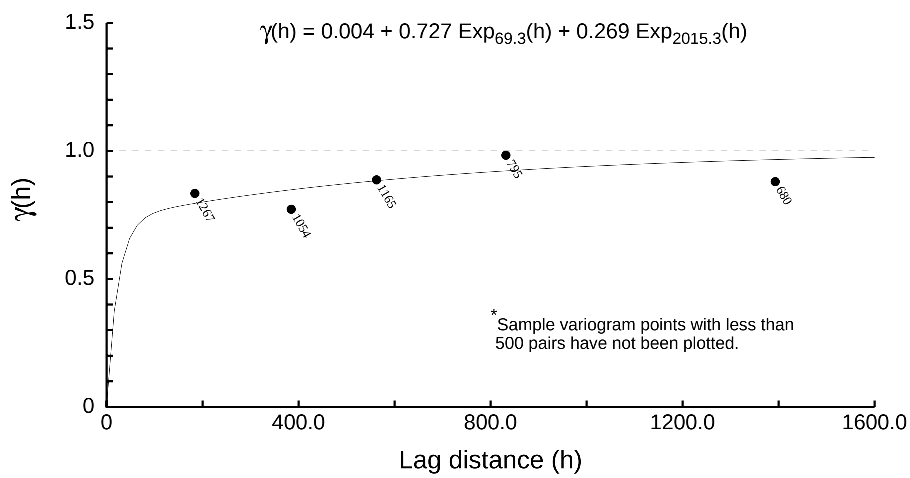
AZIMUTH = 150 DIP = 0



AZIMUTH = 180 DIP = 0

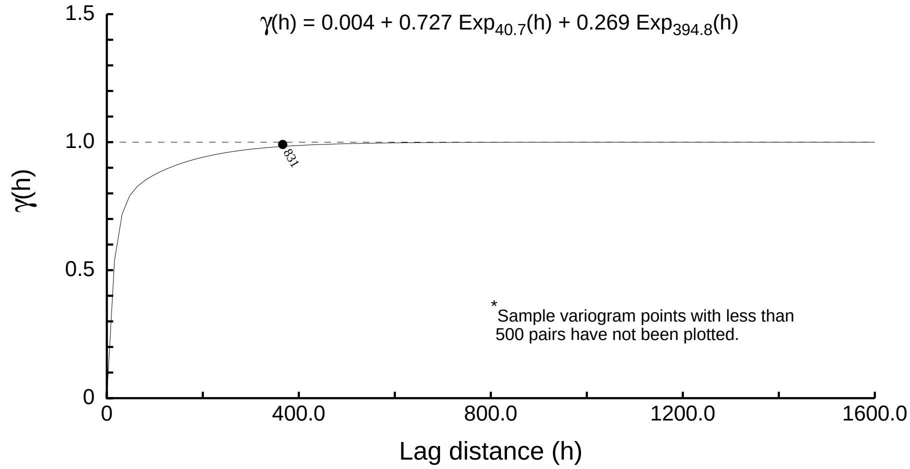


AZIMUTH = 240 DIP = 0

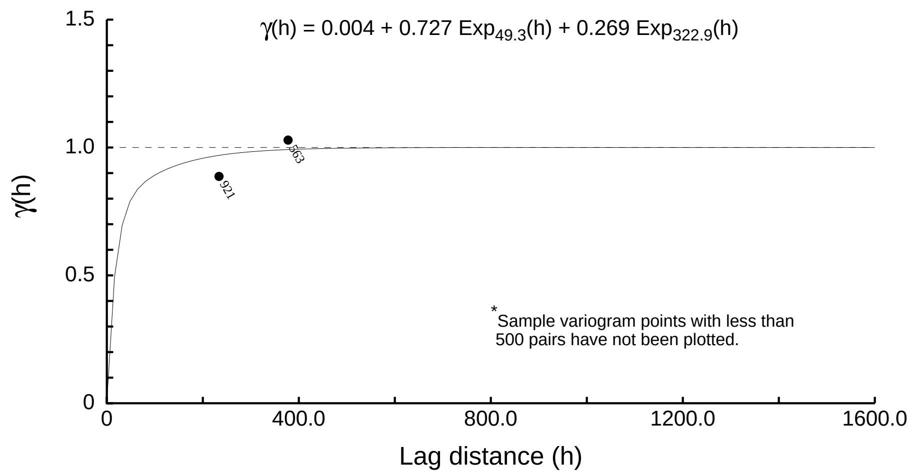


Downhole 2000 - Pt

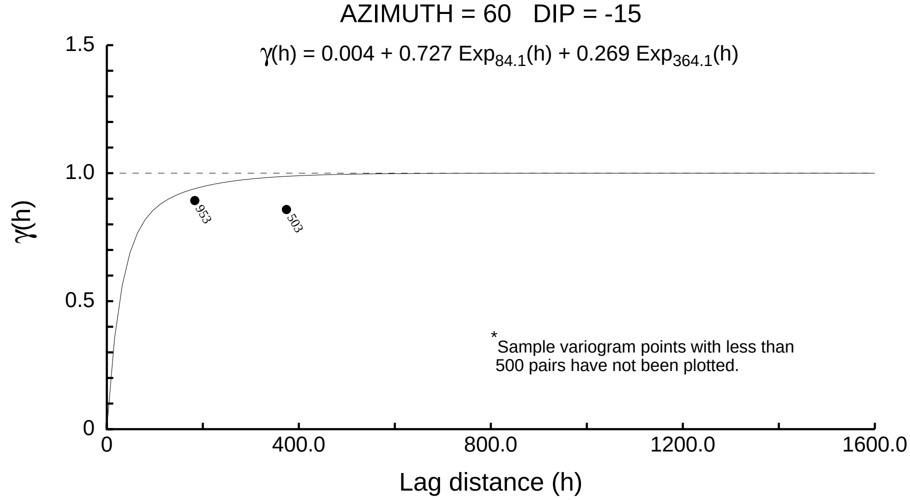
AZIMUTH = 300   DIP = 0



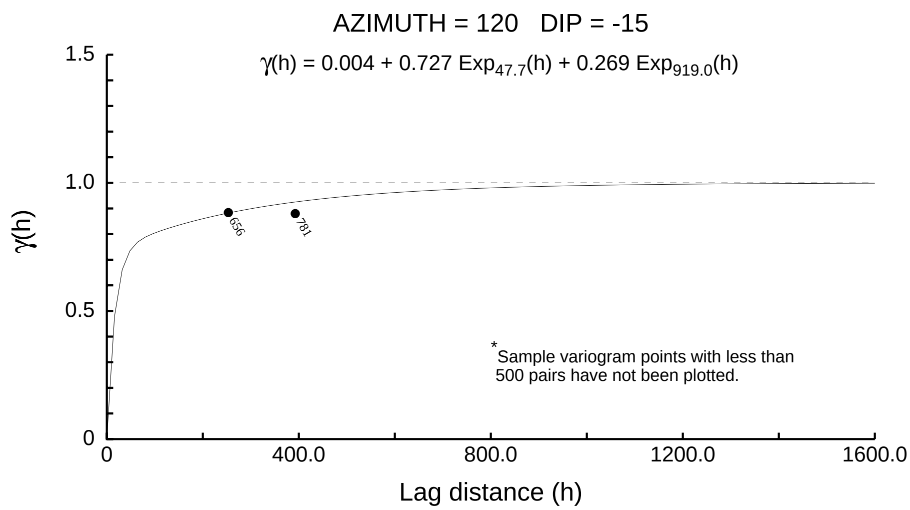
AZIMUTH = 330   DIP = 0

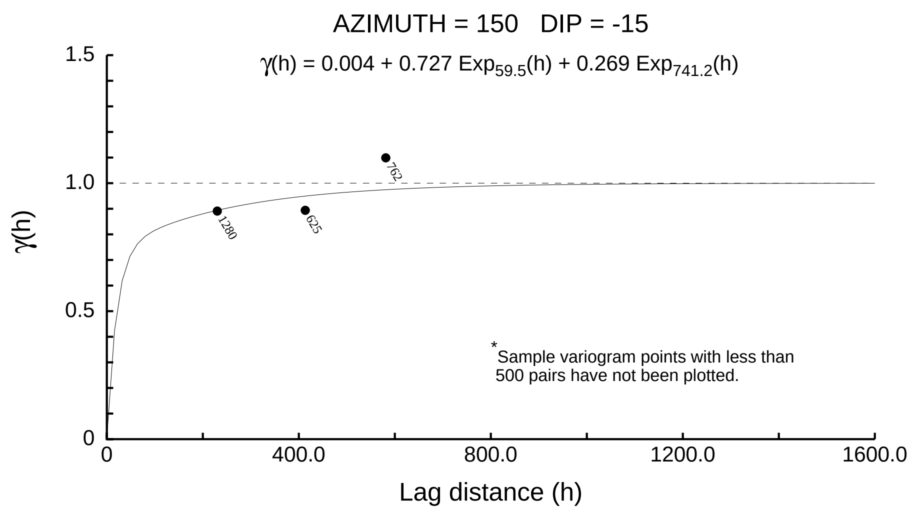


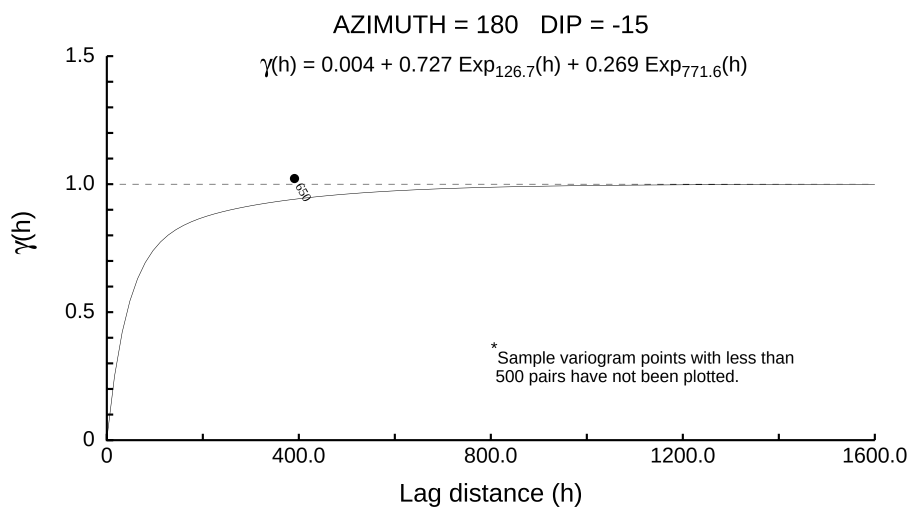
AZIMUTH = 60   DIP = -15



Downhole 2000 - Pt



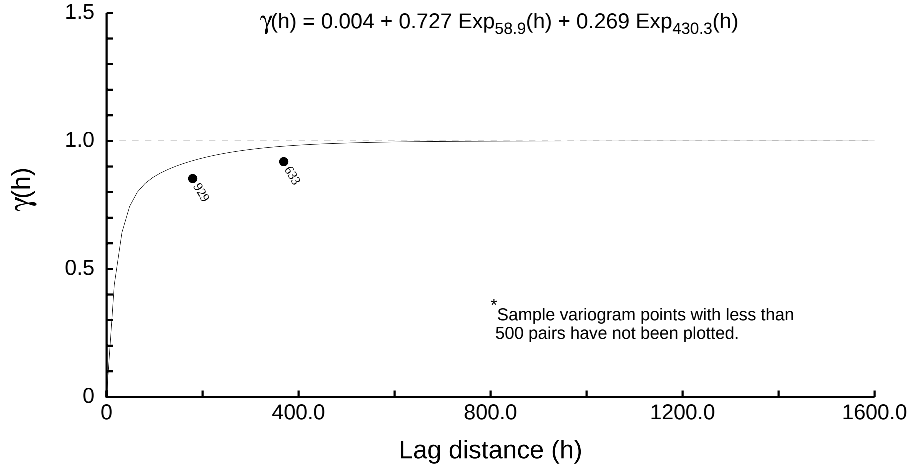




Downhole 2000 - Pt

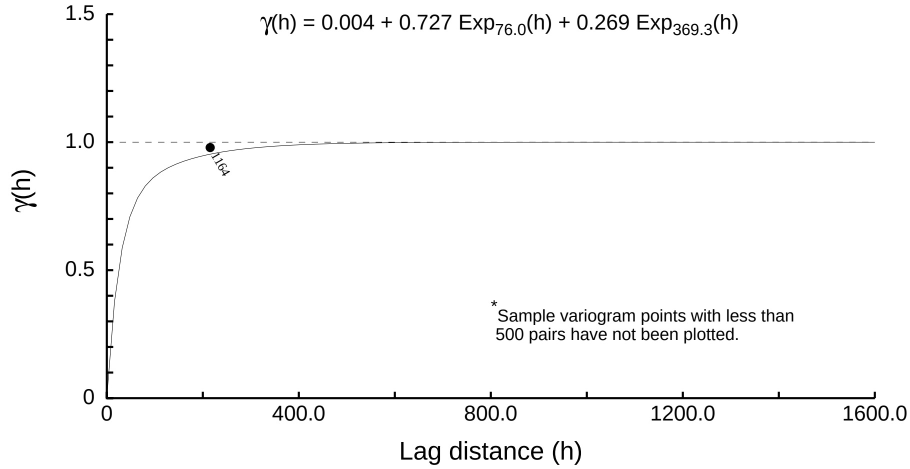
AZIMUTH = 240   DIP = -15

$\gamma(h) = 0.004 + 0.727\ Exp_{58.9}(h) + 0.269\ Exp_{430.3}(h)$



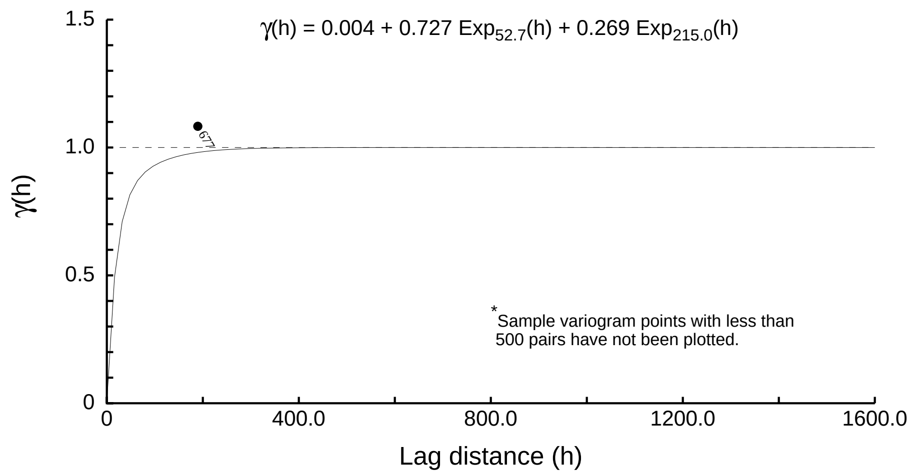
AZIMUTH = 150   DIP = -30

$\gamma(h) = 0.004 + 0.727\ Exp_{76.0}(h) + 0.269\ Exp_{369.3}(h)$

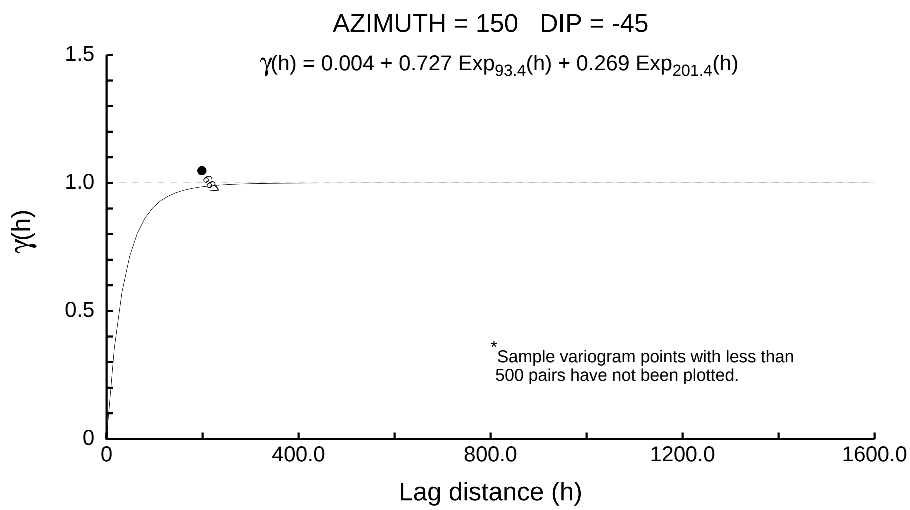


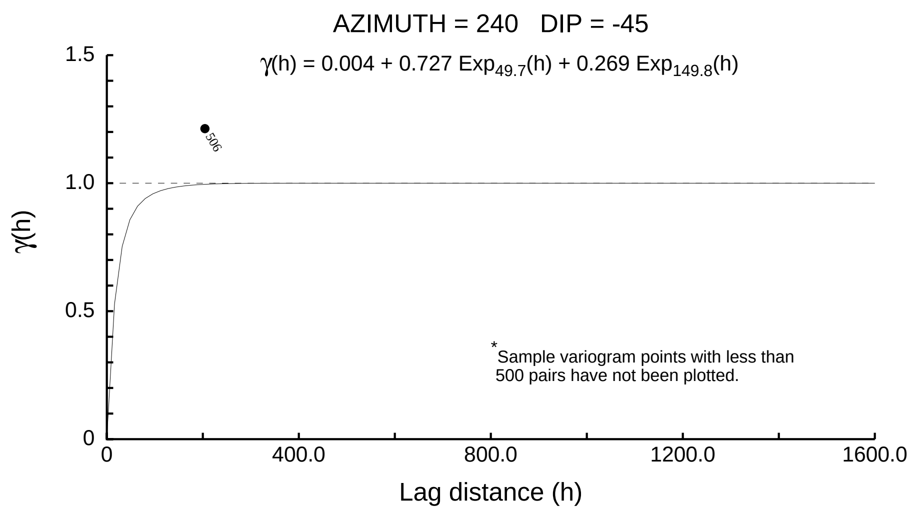
AZIMUTH = 240   DIP = -30

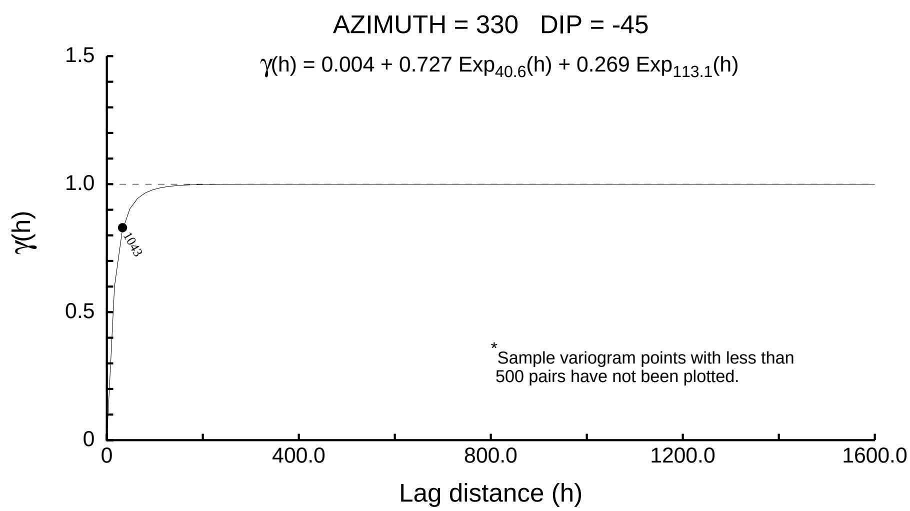
$\gamma(h) = 0.004 + 0.727\ Exp_{52.7}(h) + 0.269\ Exp_{215.0}(h)$



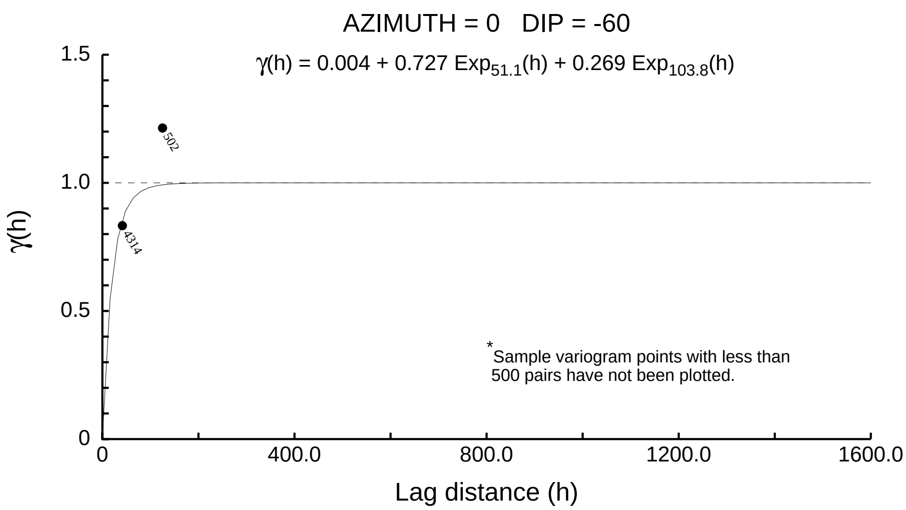
Downhole 2000 - Pt

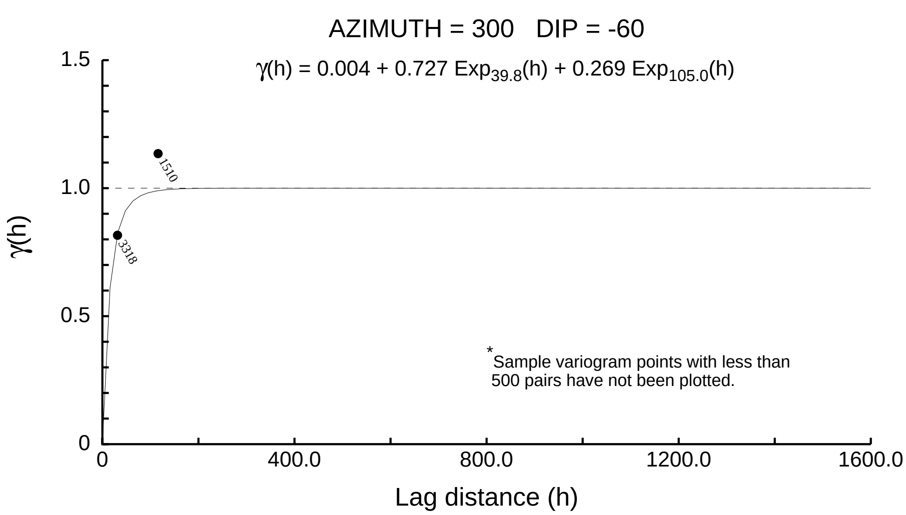


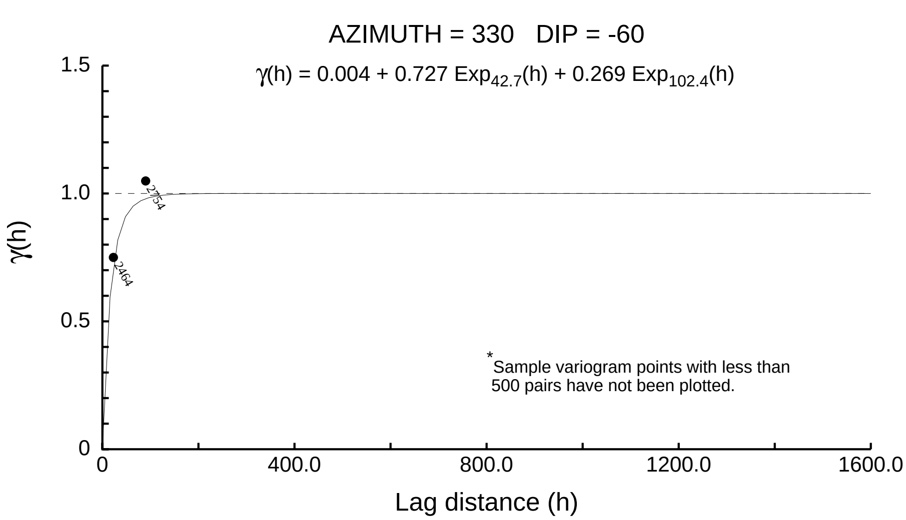




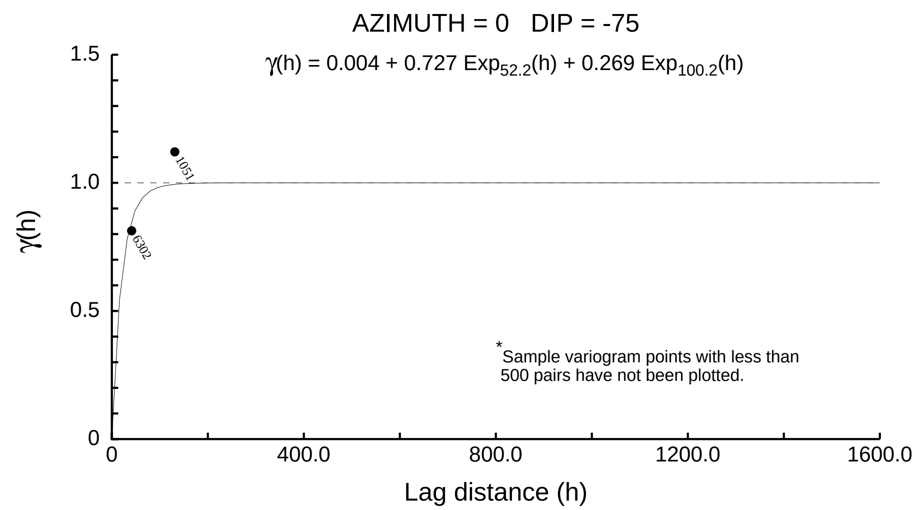
Downhole 2000 - Pt

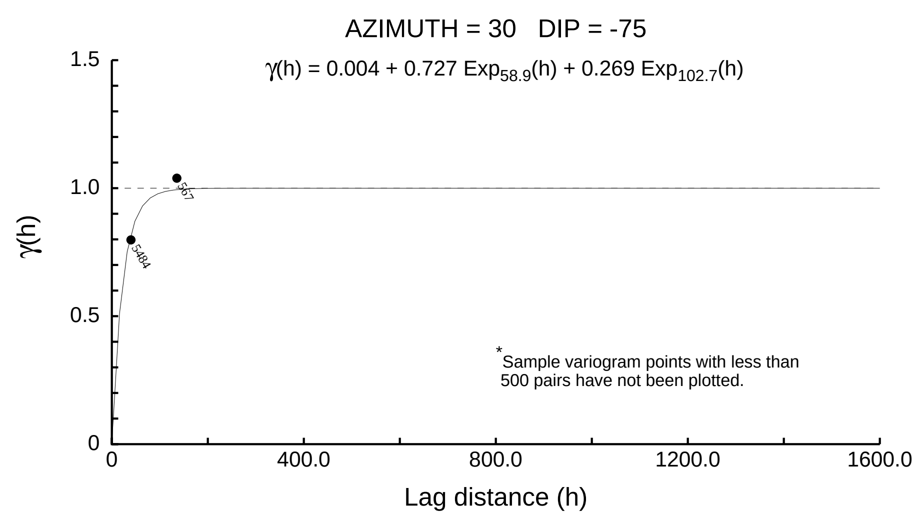


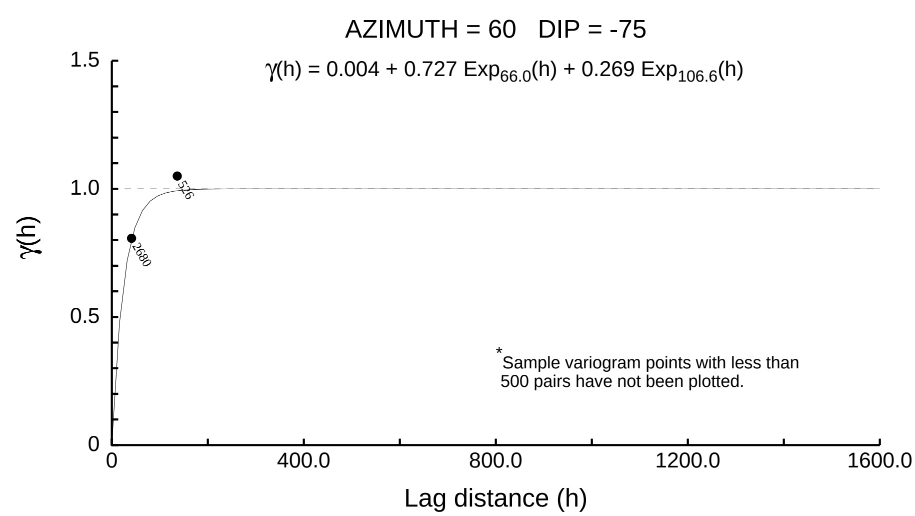




Downhole 2000 - Pt



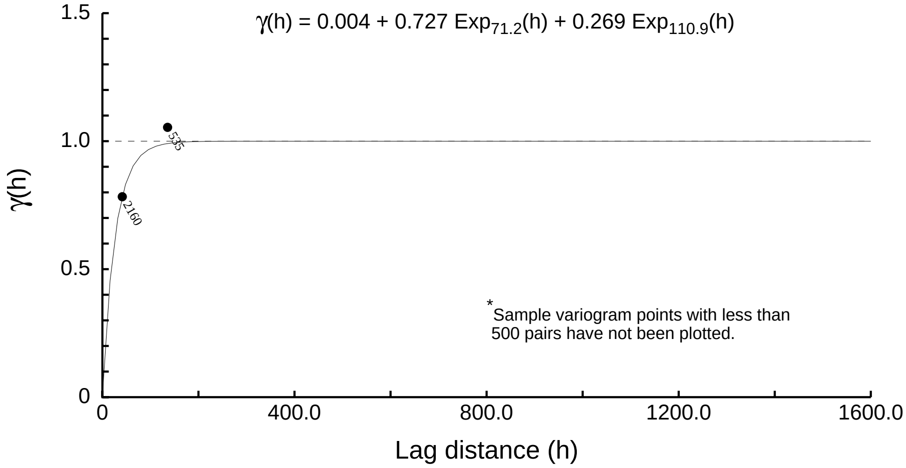




Downhole 2000 - Pt

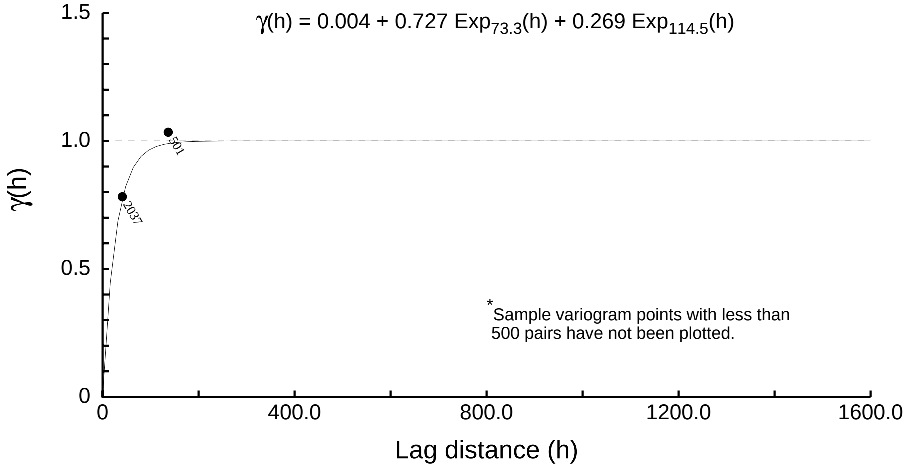
AZIMUTH = 90   DIP = -75

$\gamma(h) = 0.004 + 0.727\ Exp_{71.2}(h) + 0.269\ Exp_{110.9}(h)$



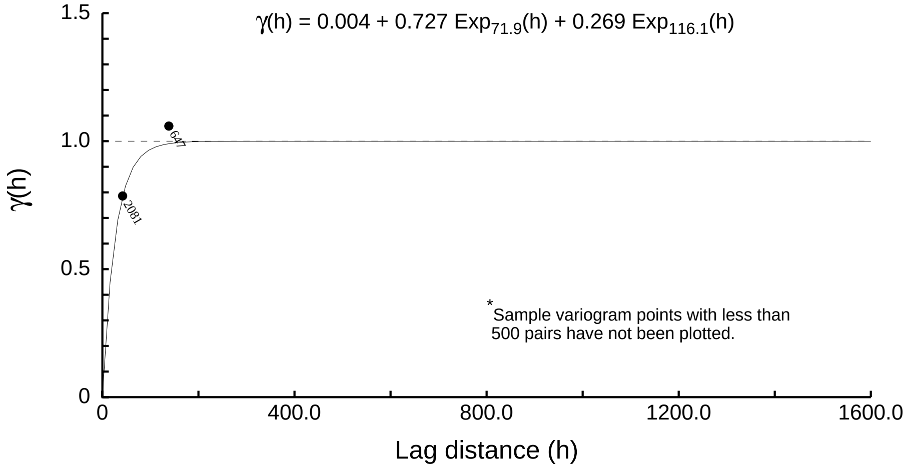
AZIMUTH = 120   DIP = -75

$\gamma(h) = 0.004 + 0.727\ Exp_{73.3}(h) + 0.269\ Exp_{114.5}(h)$

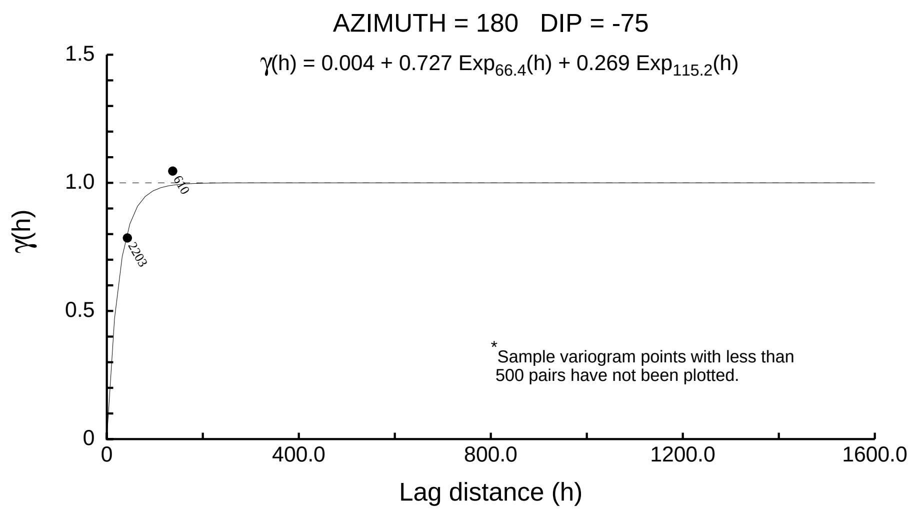


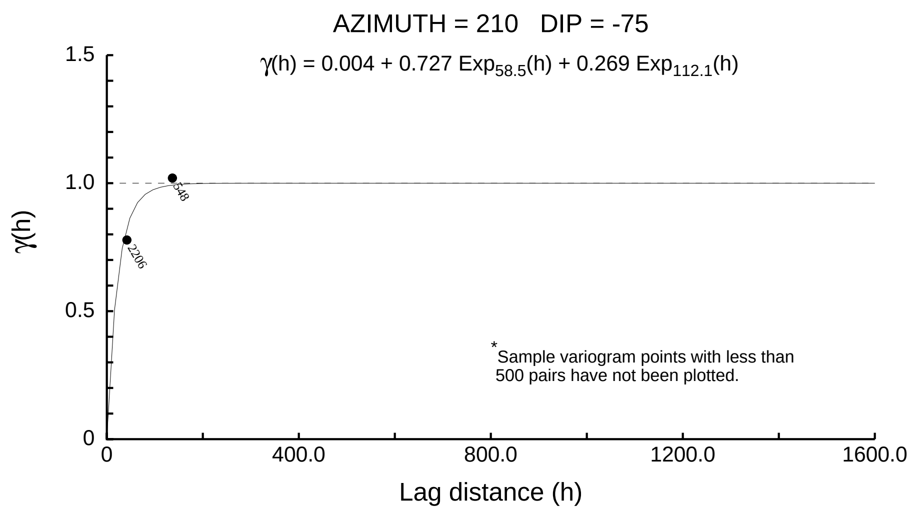
AZIMUTH = 150   DIP = -75

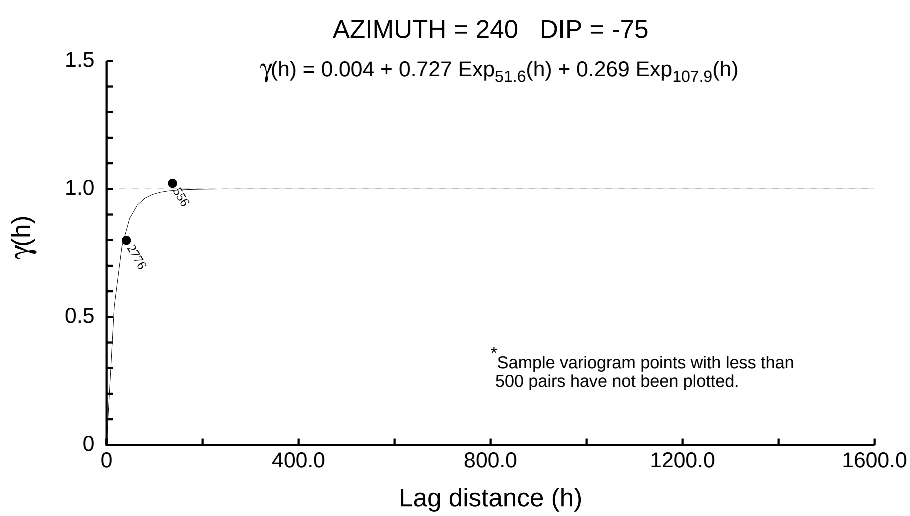
$\gamma(h) = 0.004 + 0.727\ Exp_{71.9}(h) + 0.269\ Exp_{116.1}(h)$



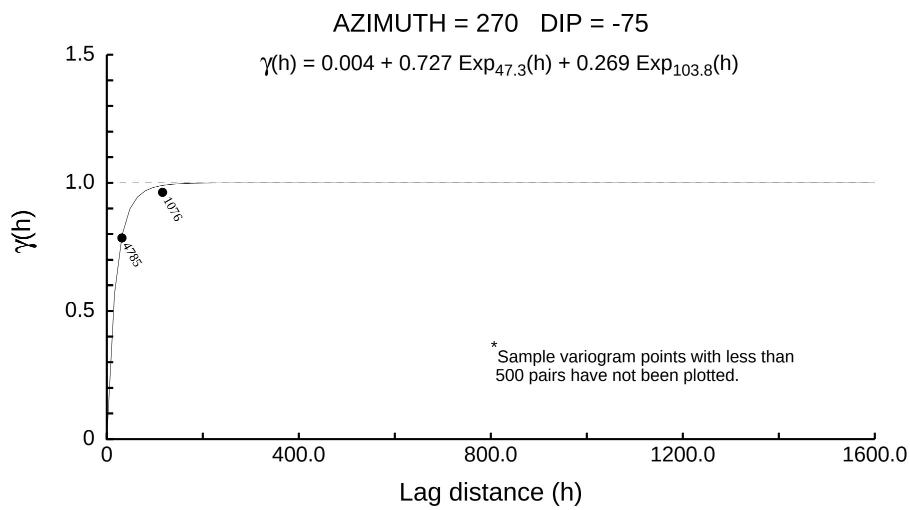
Downhole 2000 - Pt

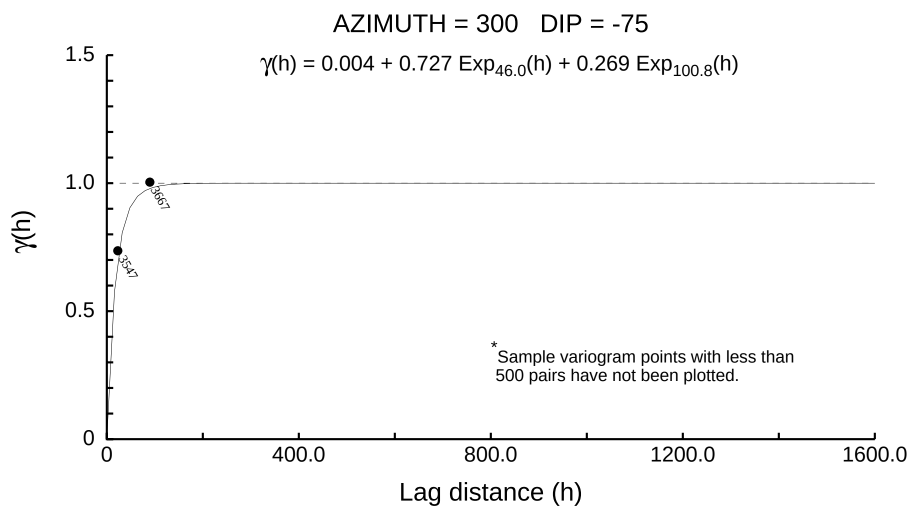


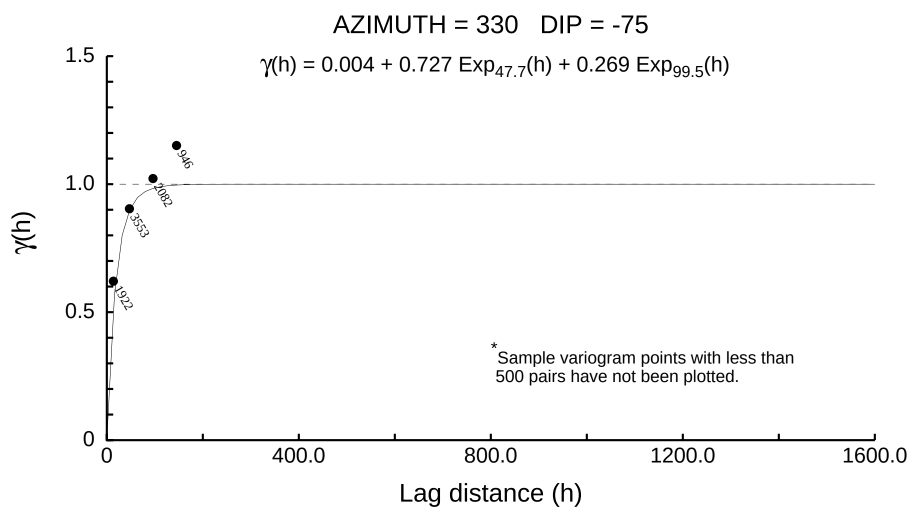




Downhole 2000 - Pt







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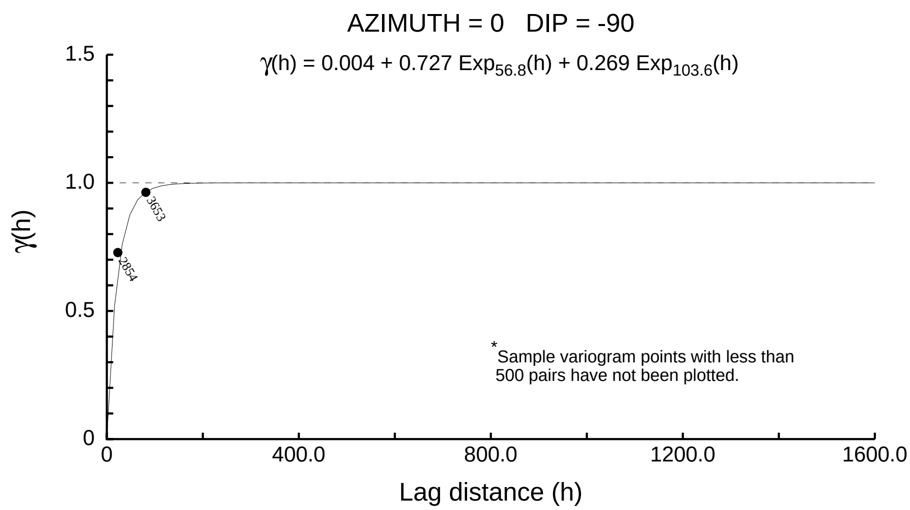
Downhole 2000 - Pt



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Downhole 2000 - S

User Defined Rotation Conventions

Nugget ==> 0.082
C1 ==> 0.723
C2 ==> 0.195

First Structure -- Exponential with Practical Range

RH Rotation about the Z axis ==> 29
RH Rotation about the Y’ axis ==> 21
RH Rotation about the Z’ axis ==> -97
Range along the Z’ axis ==> 57.1 Azimuth ==> 61 Dip ==> 69
Range along the Y’ axis ==> 261.2 Azimuth ==> 68 Dip ==> -20
Range along the X’ axis ==> 447.7 Azimuth ==> 157 Dip ==> 2

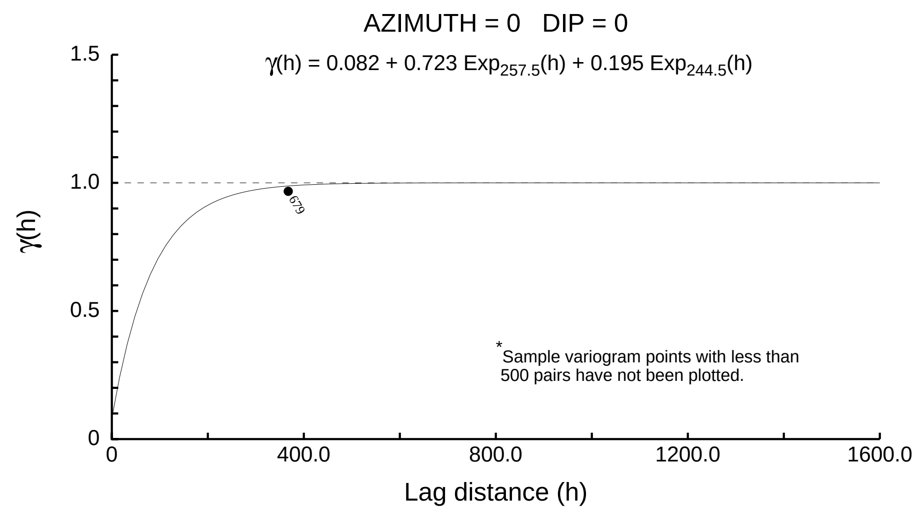
Second Structure -- Exponential with Practical Range

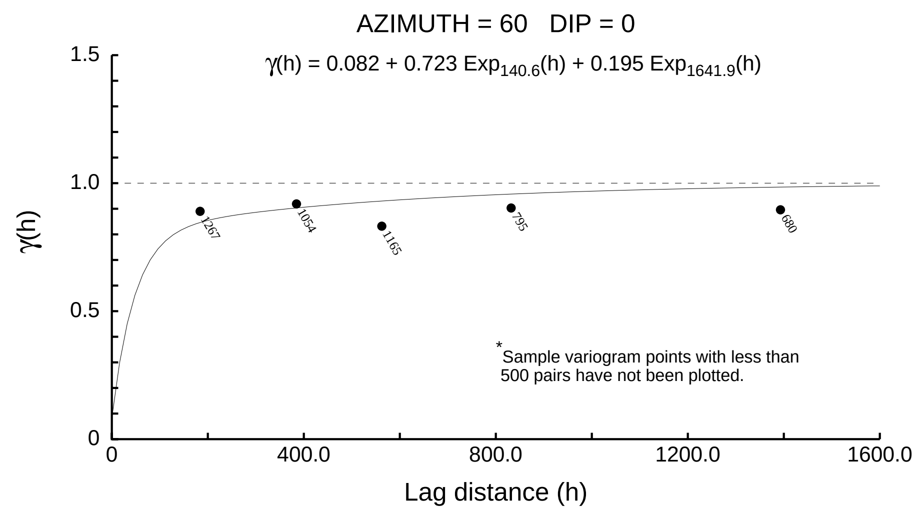
RH Rotation about the Z axis ==> -55
RH Rotation about the Y’ axis ==> -68
RH Rotation about the Z’ axis ==> -2
Range along the Z’ axis ==> 996.7 Azimuth ==> 325 Dip ==> 22
Range along the Y’ axis ==> 1655.6 Azimuth ==> 55 Dip ==> 2
Range along the X’ axis ==> 79.6 Azimuth ==> 150 Dip ==> 68

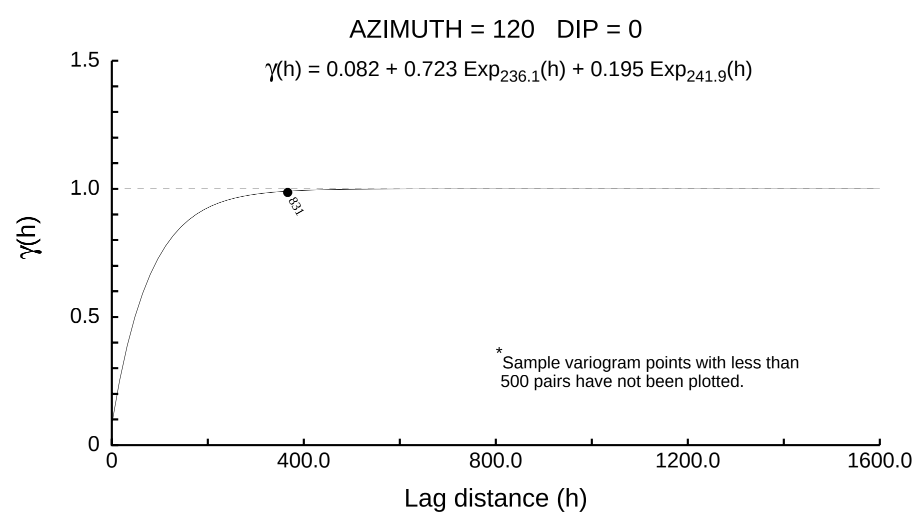
Modeling Criteria

Minimum number pairs req’d ==> 500
Sample variogram points weighted by # pairs

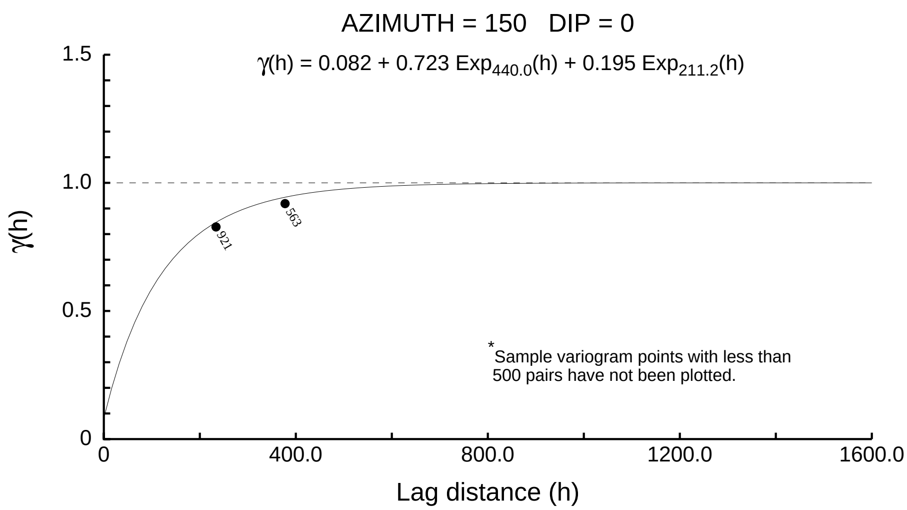
Downhole 2000 - S

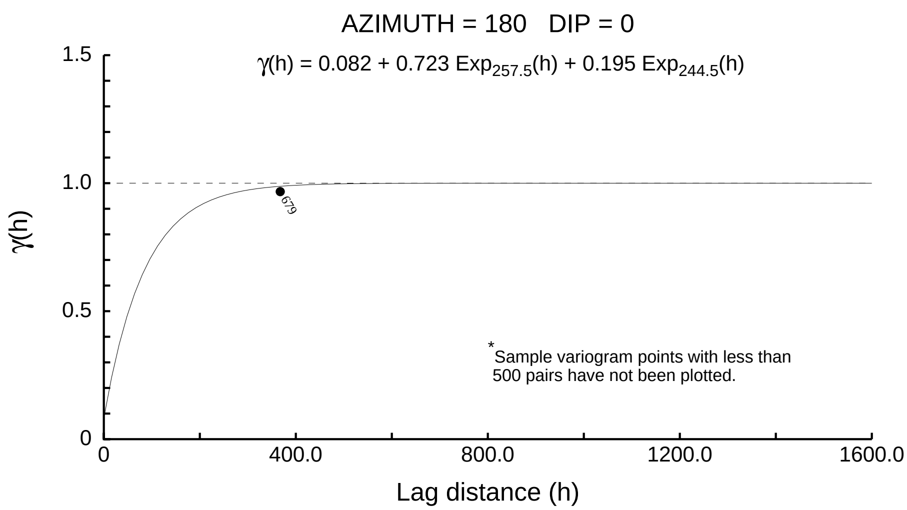


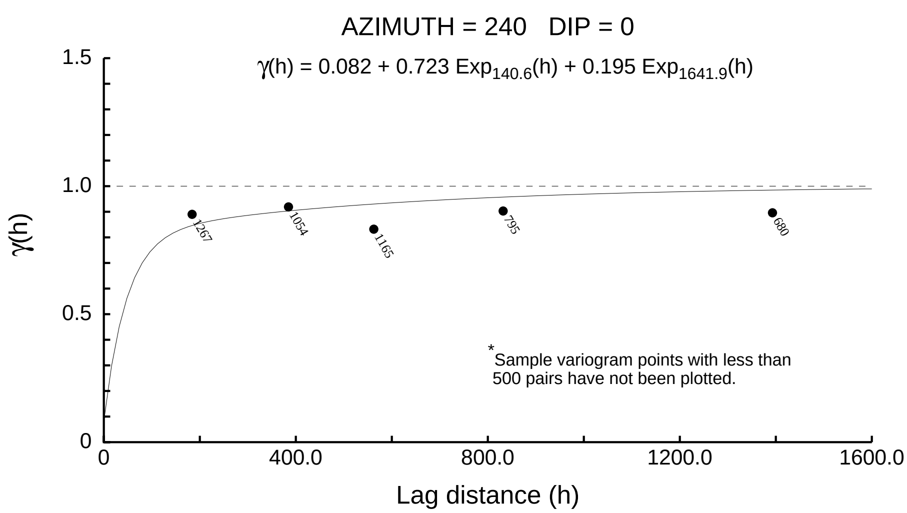




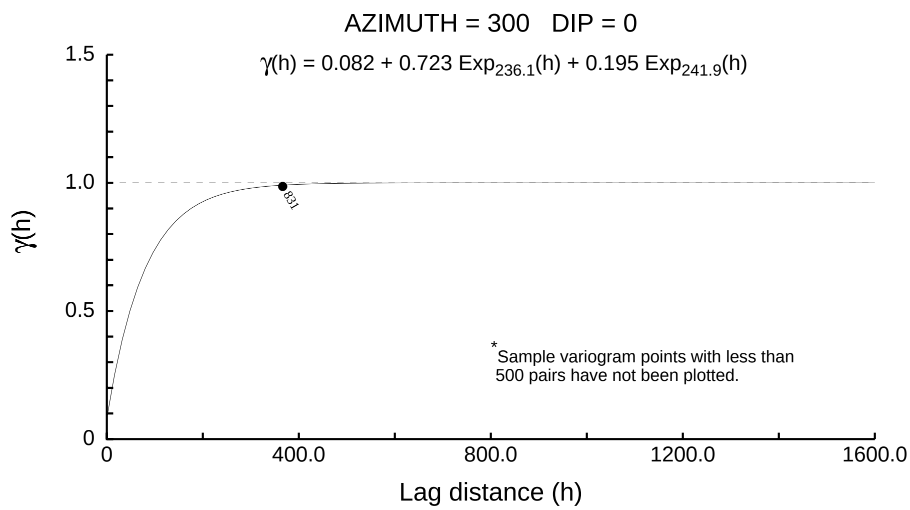
Downhole 2000 - S

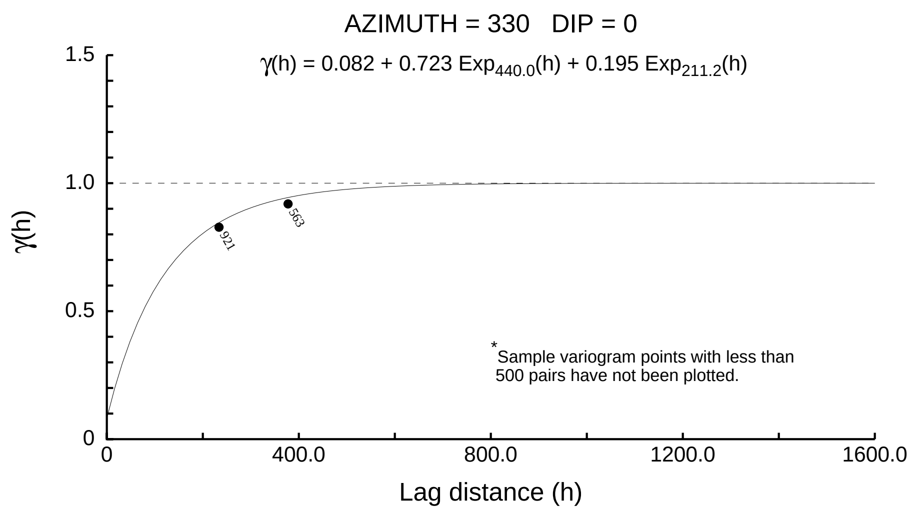


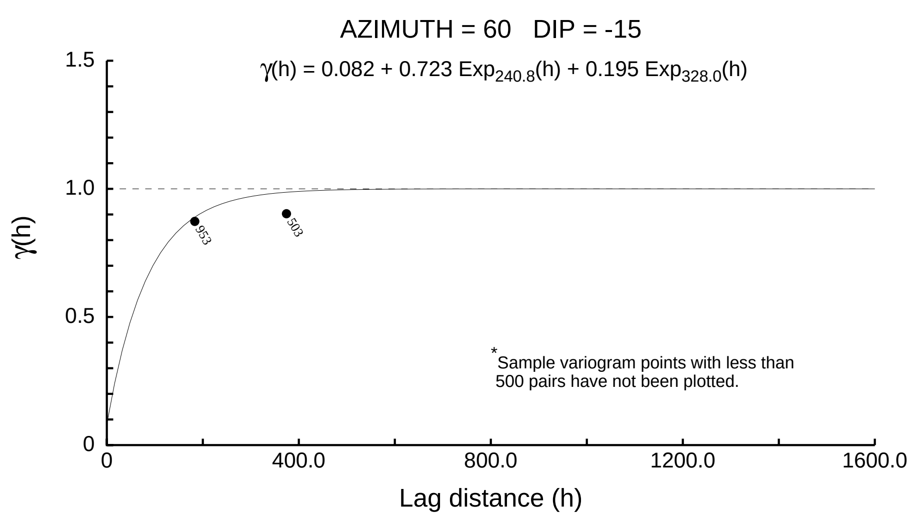




Downhole 2000 - S







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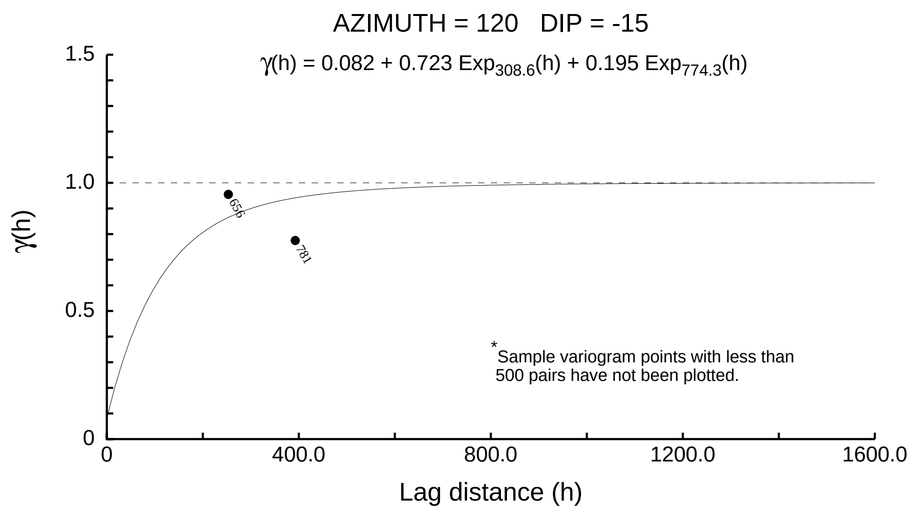
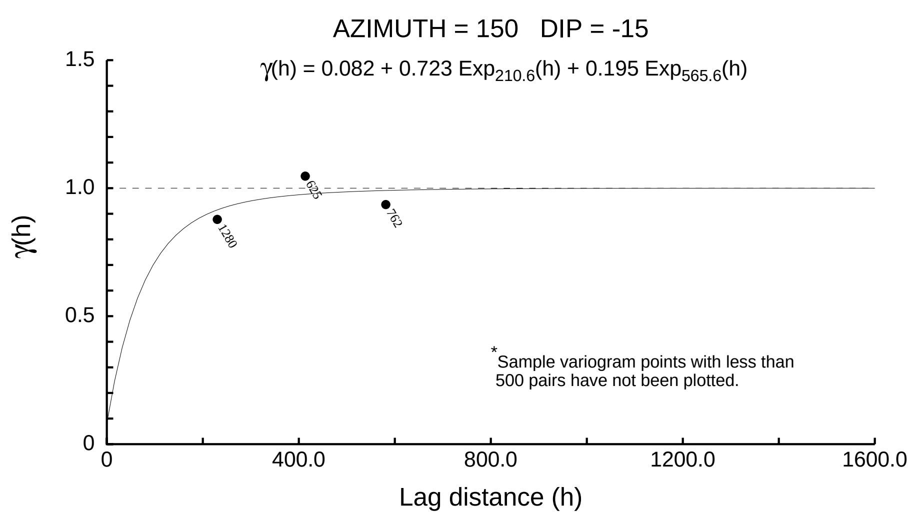
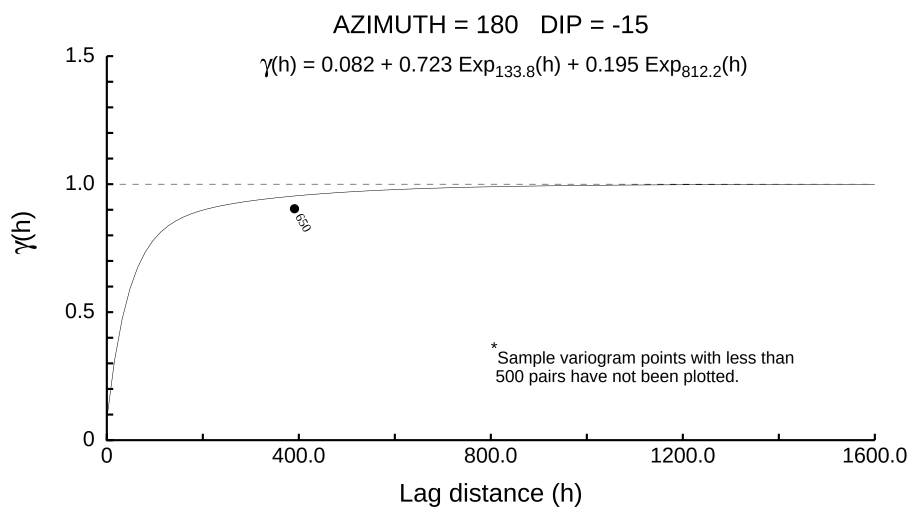
Downhole 2000 - S

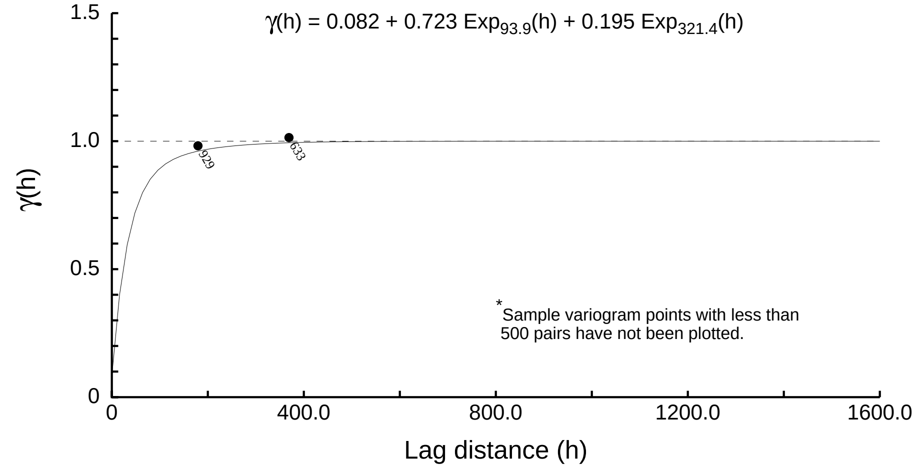




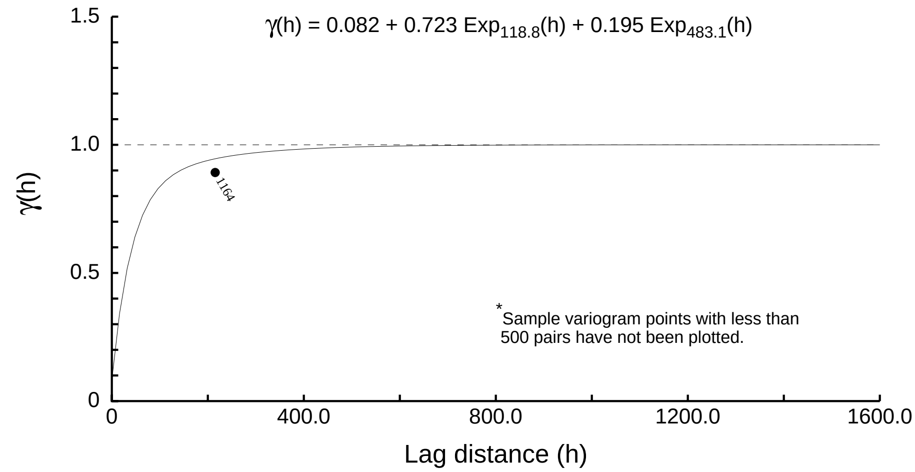


Downhole 2000 - S

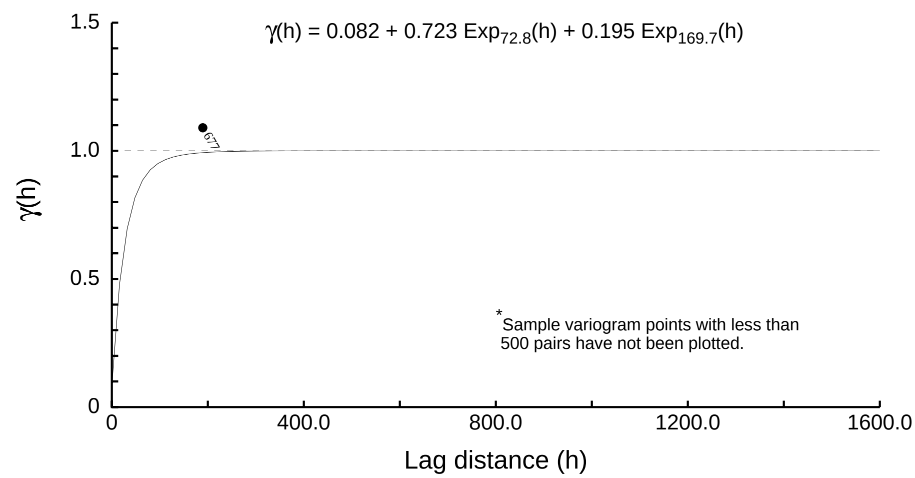
AZIMUTH = 240   DIP = -15



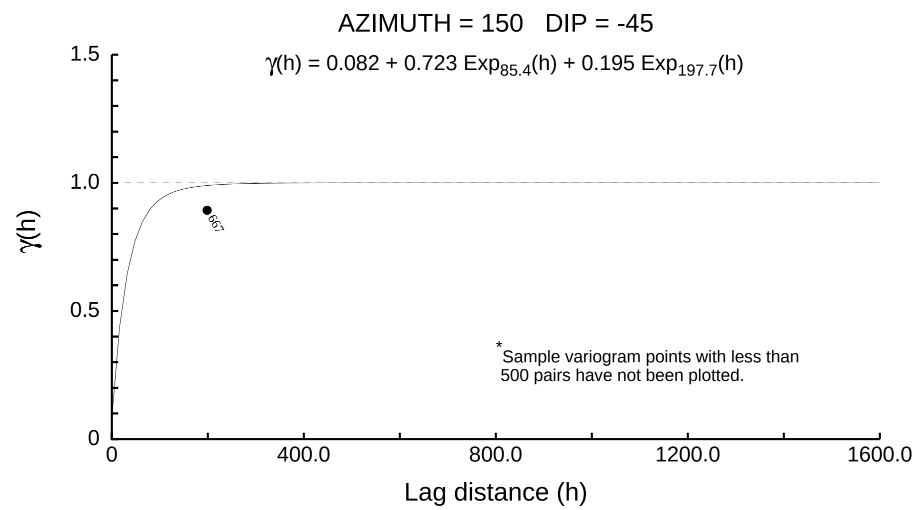
AZIMUTH = 150   DIP = -30

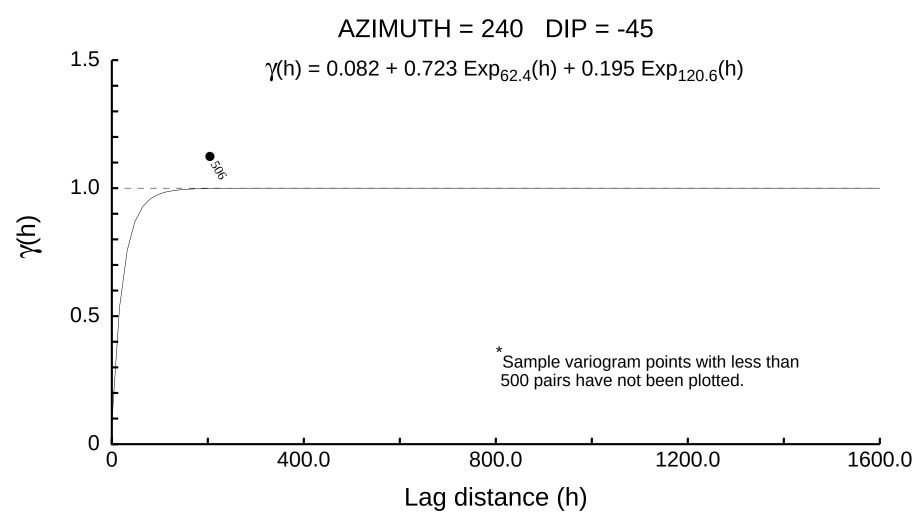


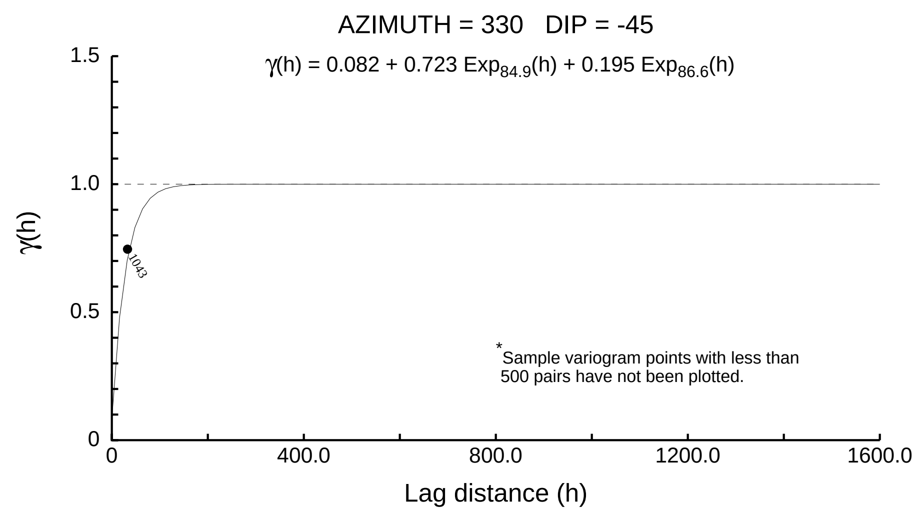
AZIMUTH = 240   DIP = -30



Downhole 2000 - S

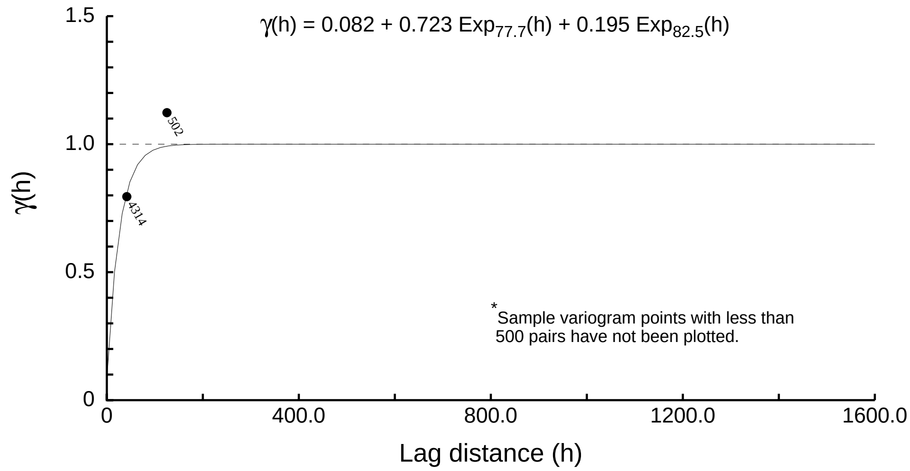




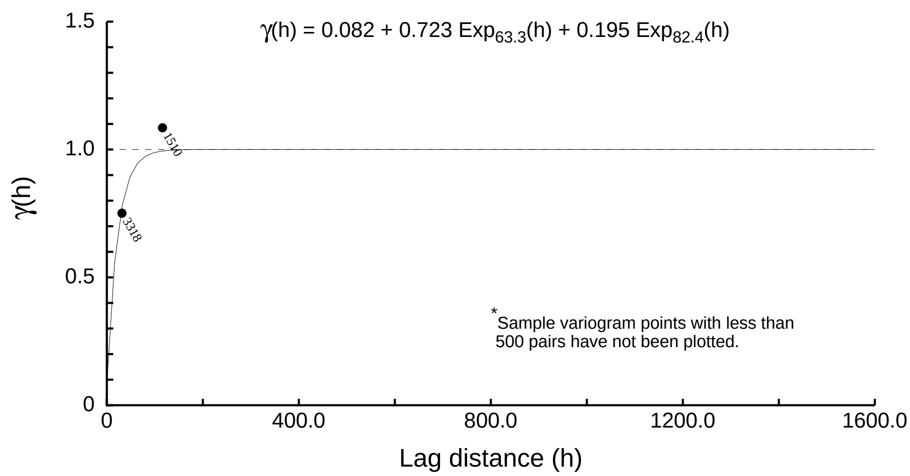


Downhole 2000 - S

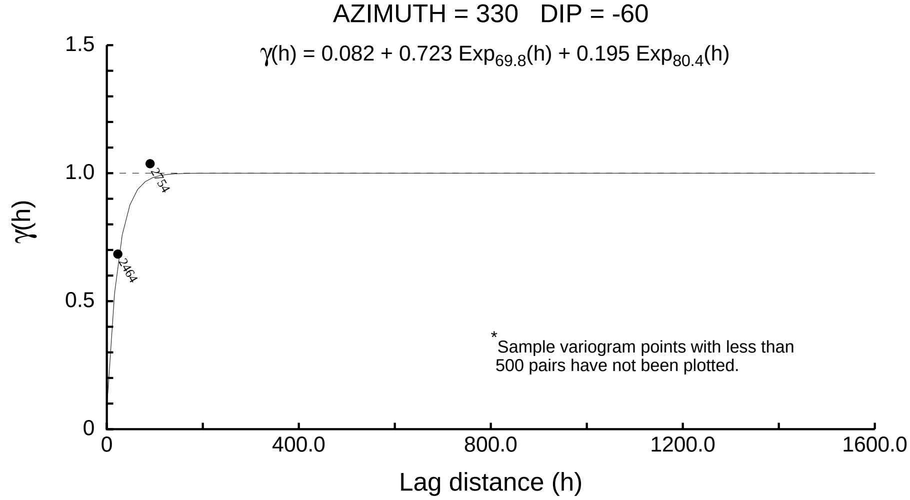
AZIMUTH = 0   DIP = -60



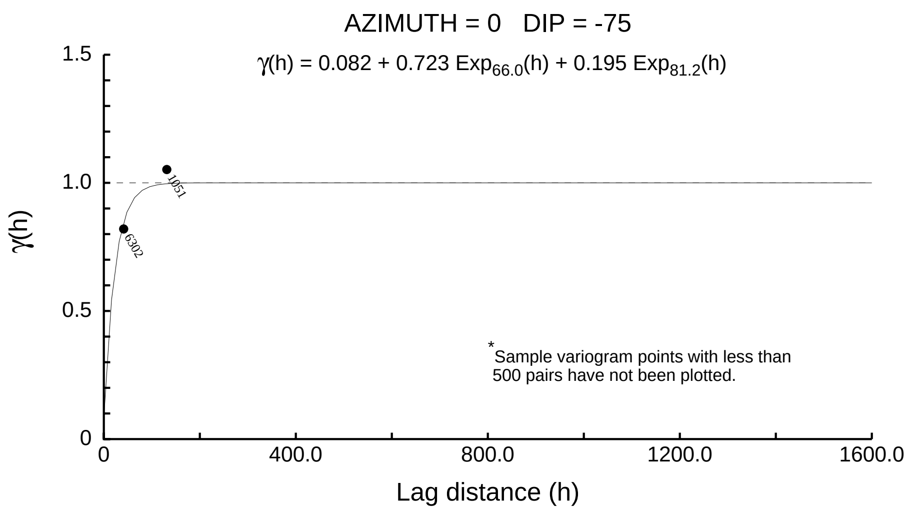
AZIMUTH = 300   DIP = -60

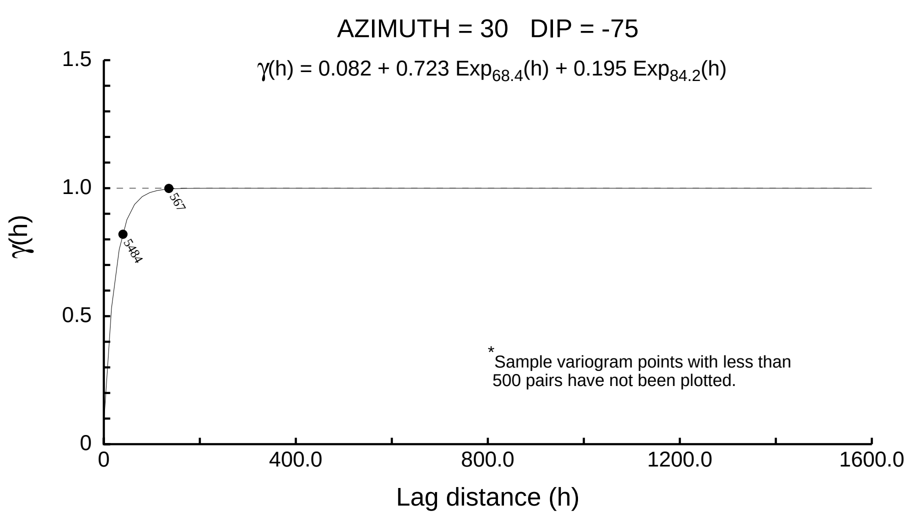


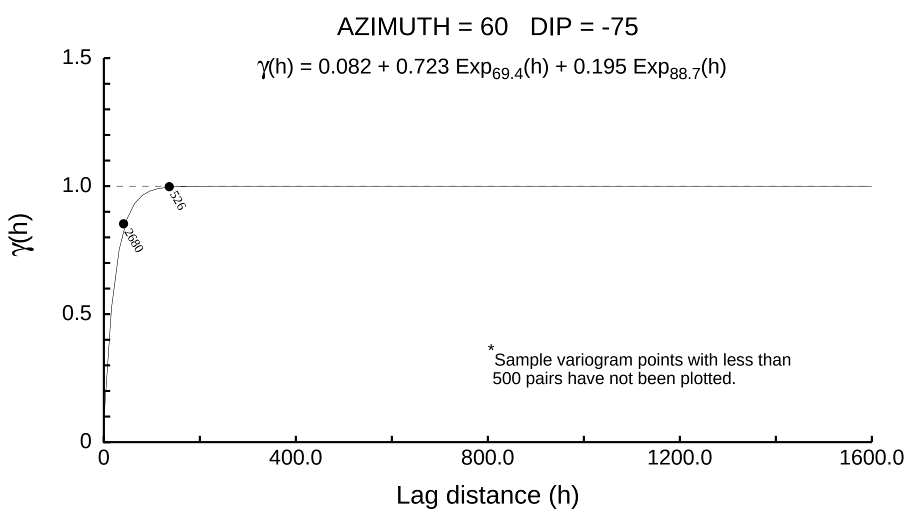
AZIMUTH = 330   DIP = -60



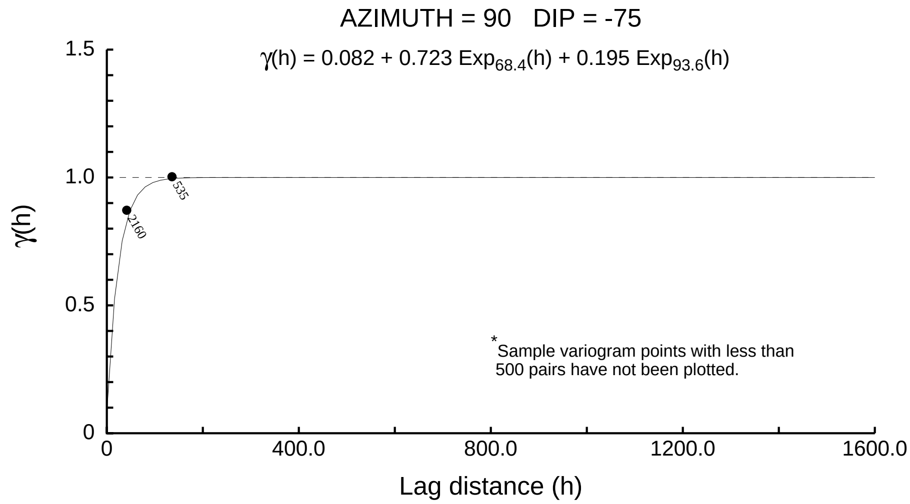
Downhole 2000 - S

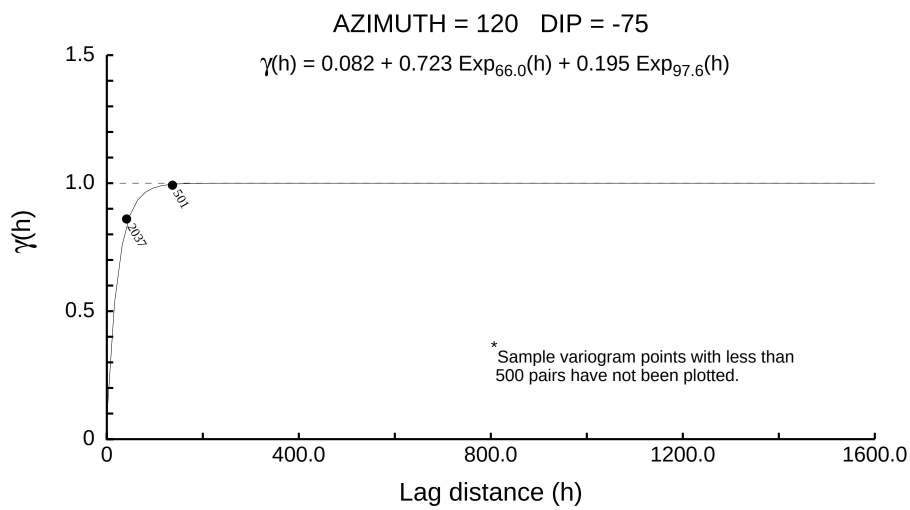


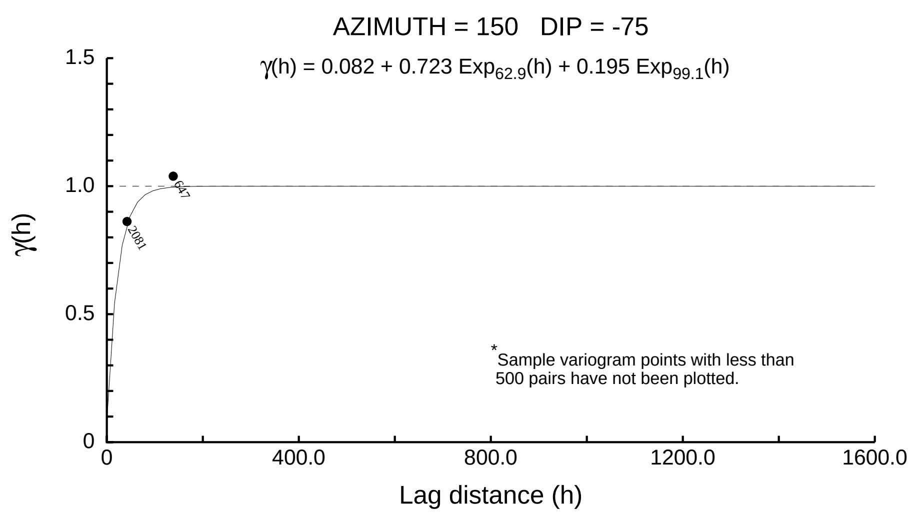




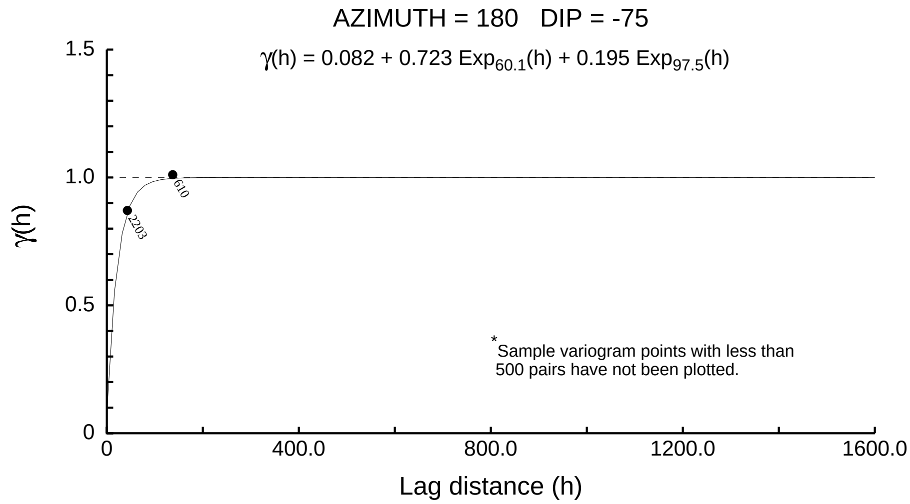
Downhole 2000 - S

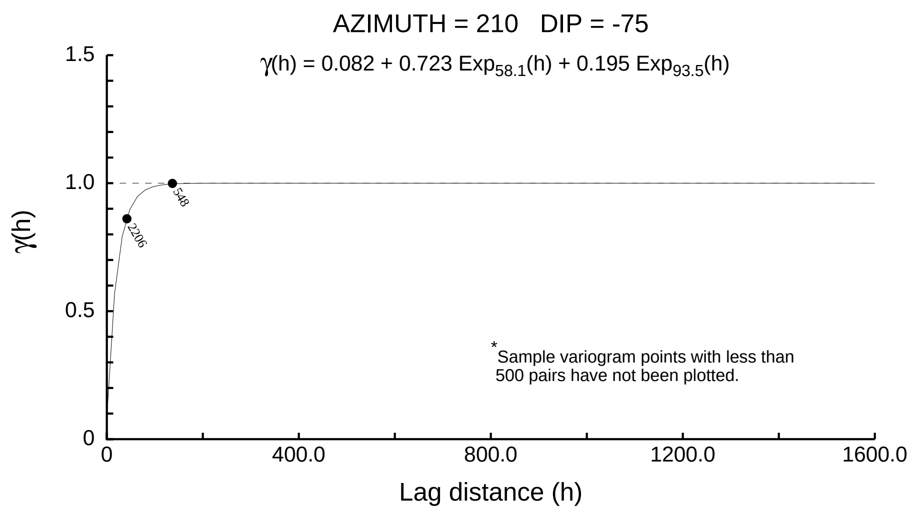


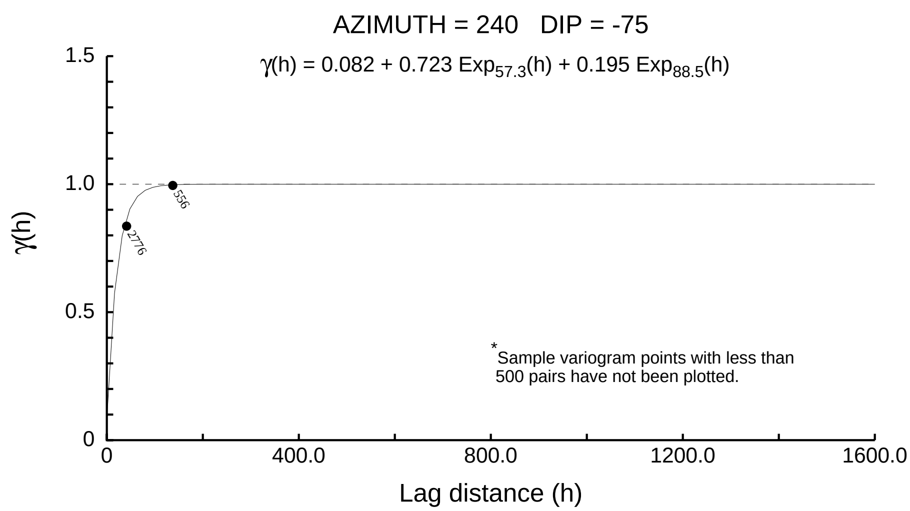




Downhole 2000 - S

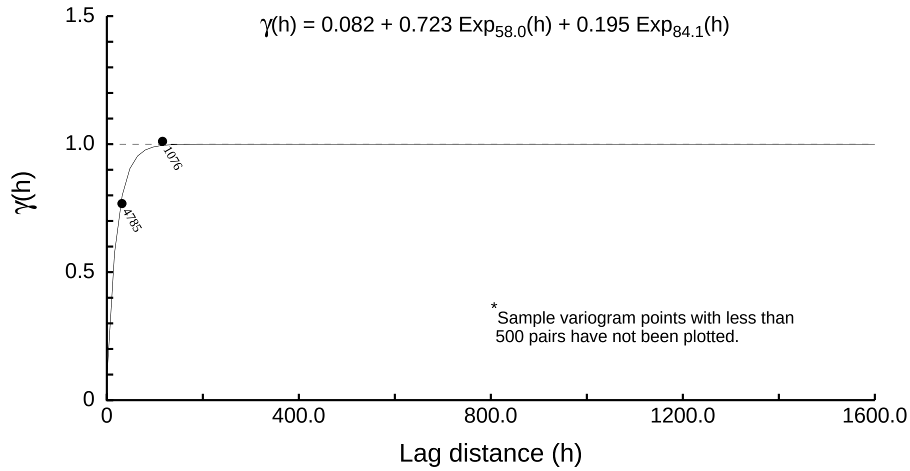




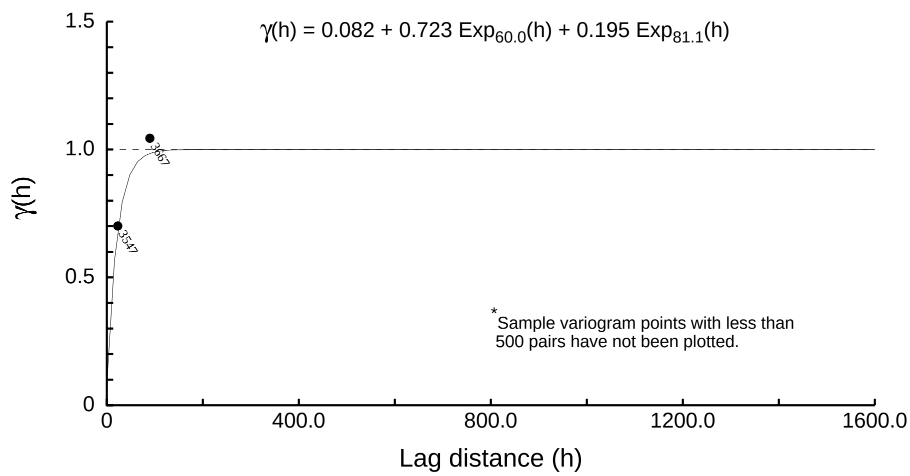


Downhole 2000 - S

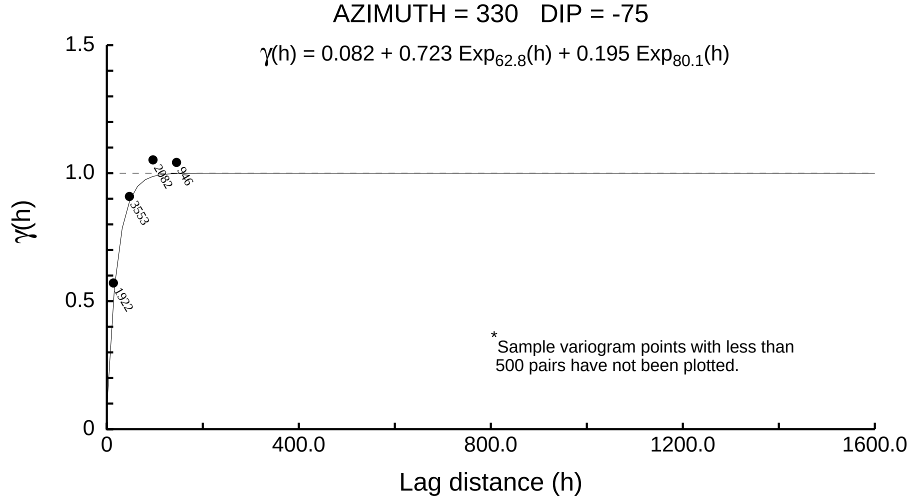
AZIMUTH = 270   DIP = -75



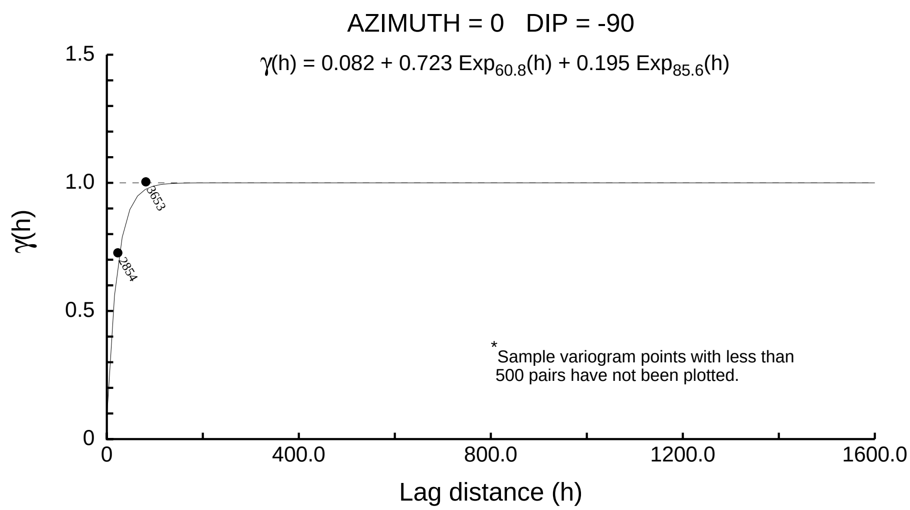
AZIMUTH = 300   DIP = -75



AZIMUTH = 330   DIP = -75



Downhole 2000 - S



Directional 3000 - Au

User Defined Rotation Conventions

Nugget ==> 0.300
C1 ==> 0.700

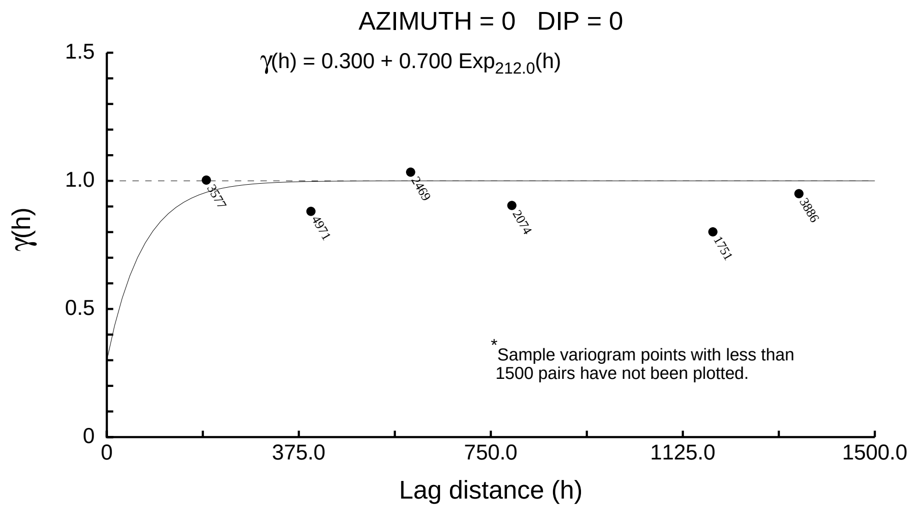
First Structure -- Exponential with Practical Range

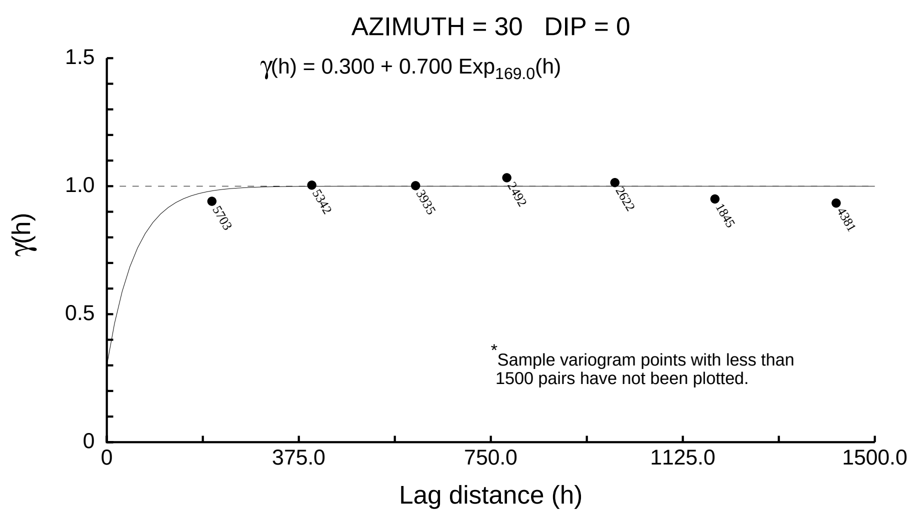
RH Rotation about the Z axis ==> 39
RH Rotation about the Y’ axis ==> -22
RH Rotation about the Z’ axis ==> 18
Range along the Z’ axis ==> 60.6 Azimuth ==> 231 Dip ==> 68
Range along the Y’ axis ==> 235.6 Azimuth ==> 304 Dip ==> -6
Range along the X’ axis ==> 631.9 Azimuth ==> 32 Dip ==> 21

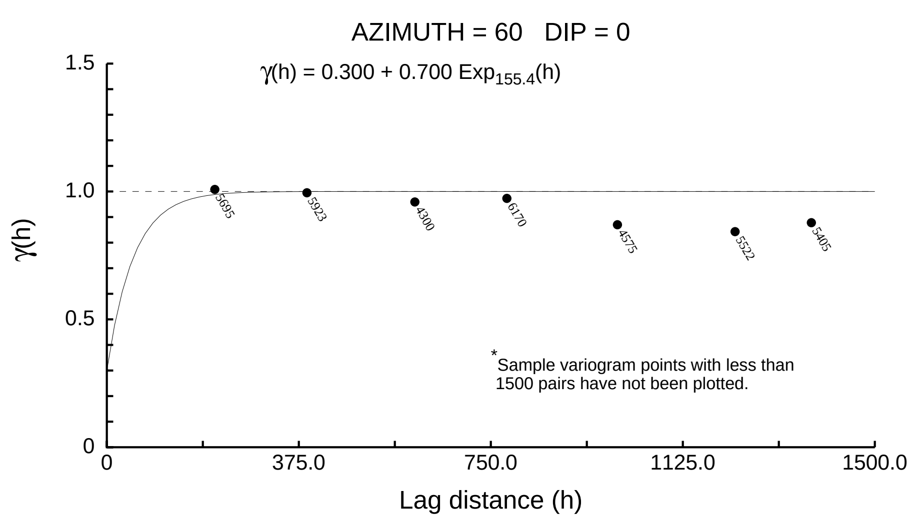
Modeling Criteria

Minimum number pairs req’d ==> 1500
Sample variogram points weighted by # pairs

Directional 3000 - Au







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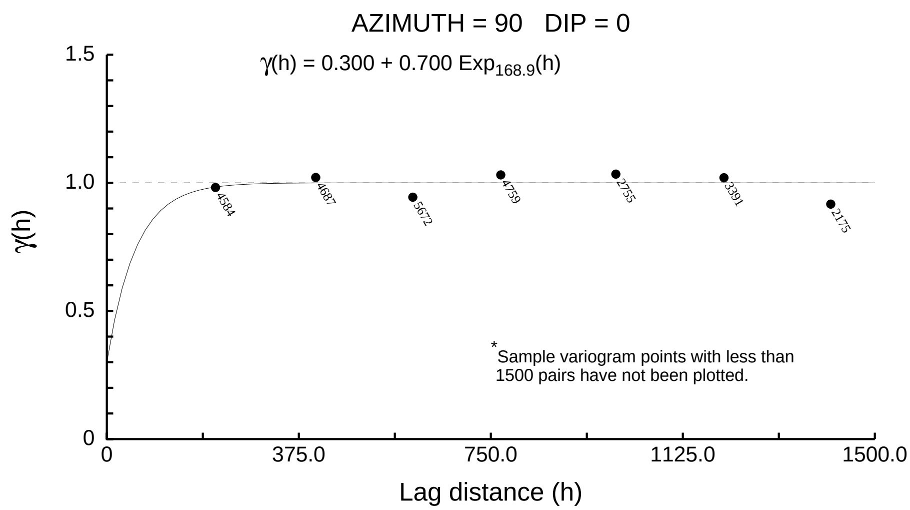
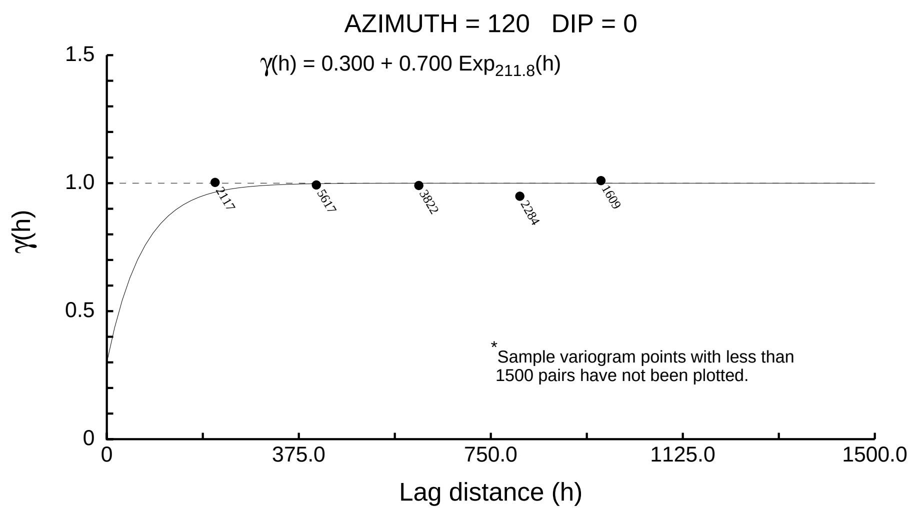
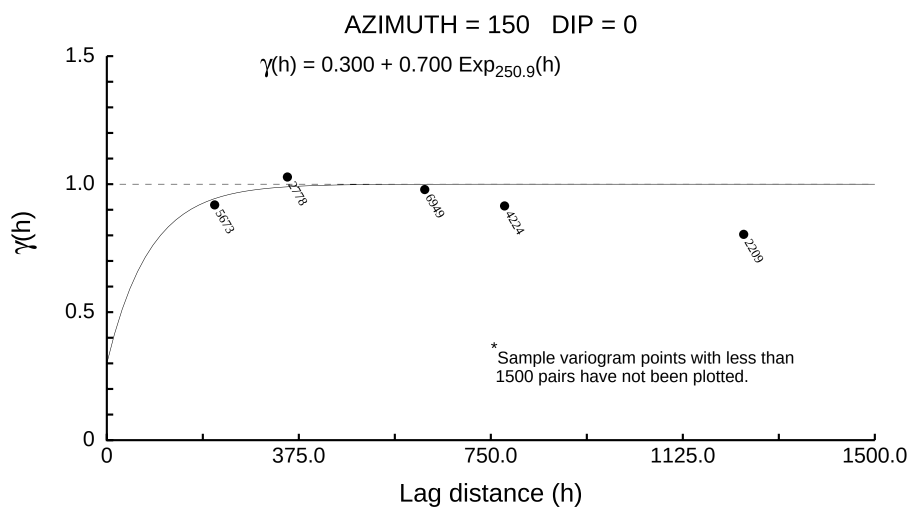
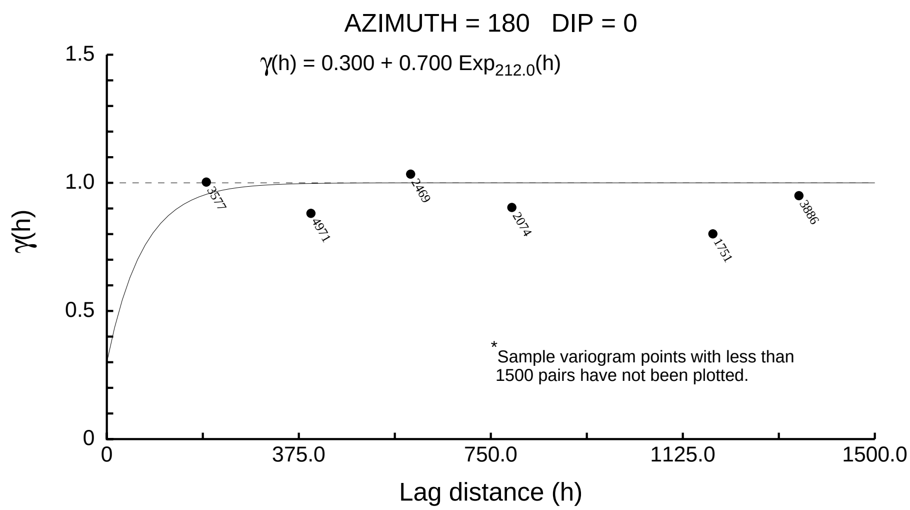
Directional 3000 - Au

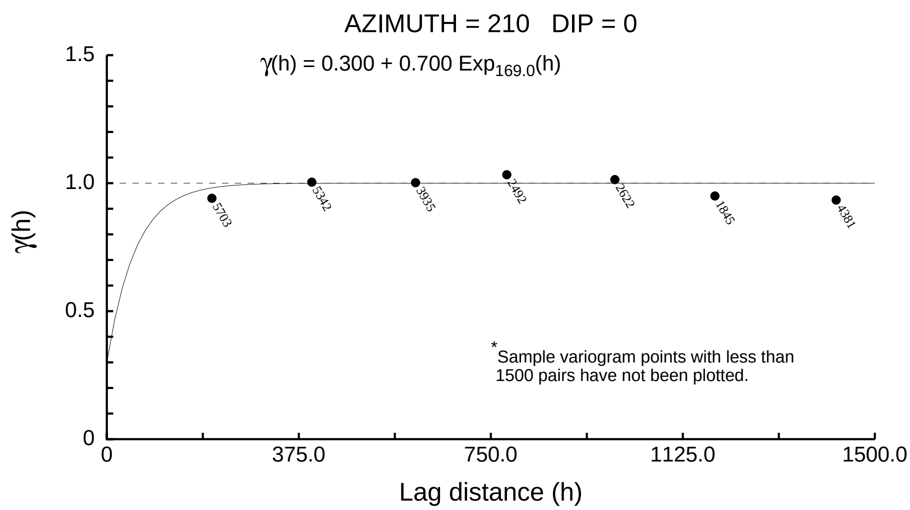


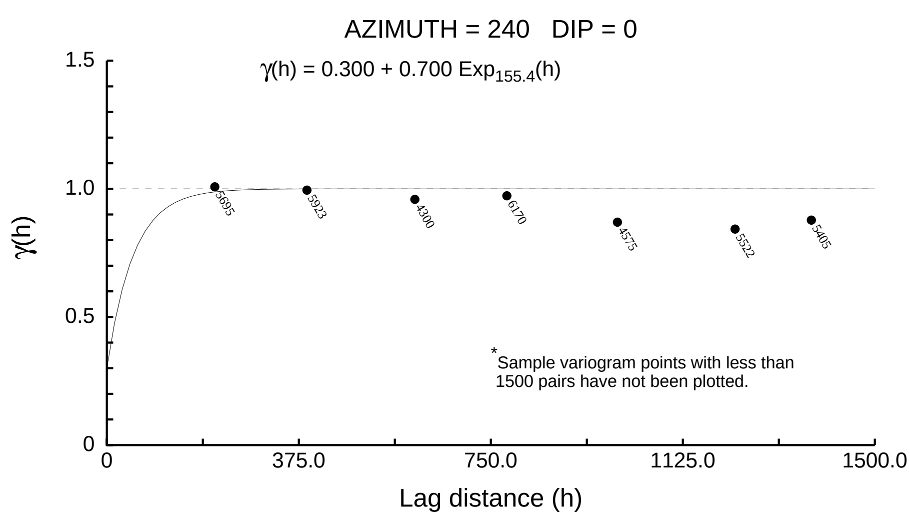




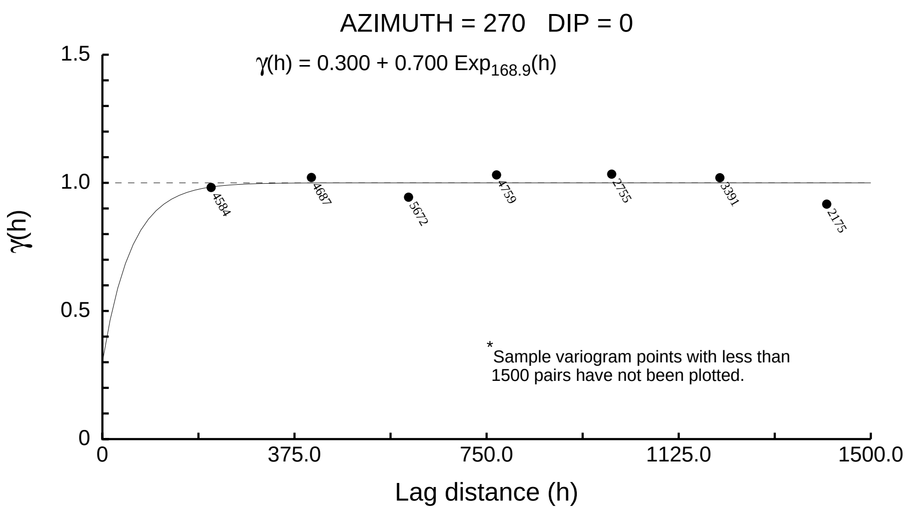
Directional 3000 - Au

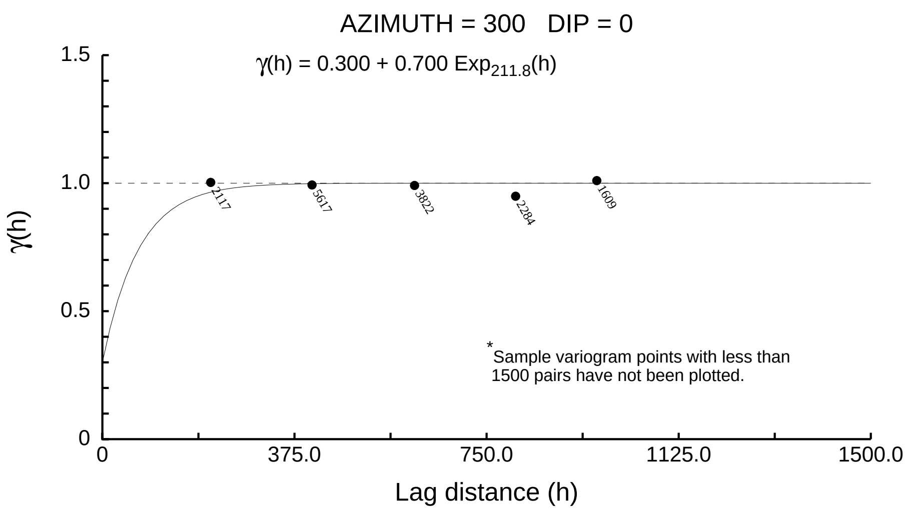


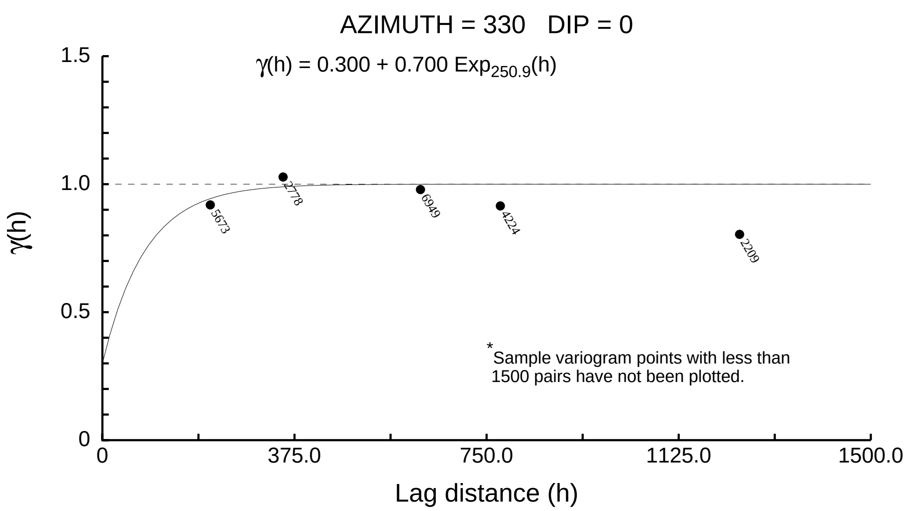




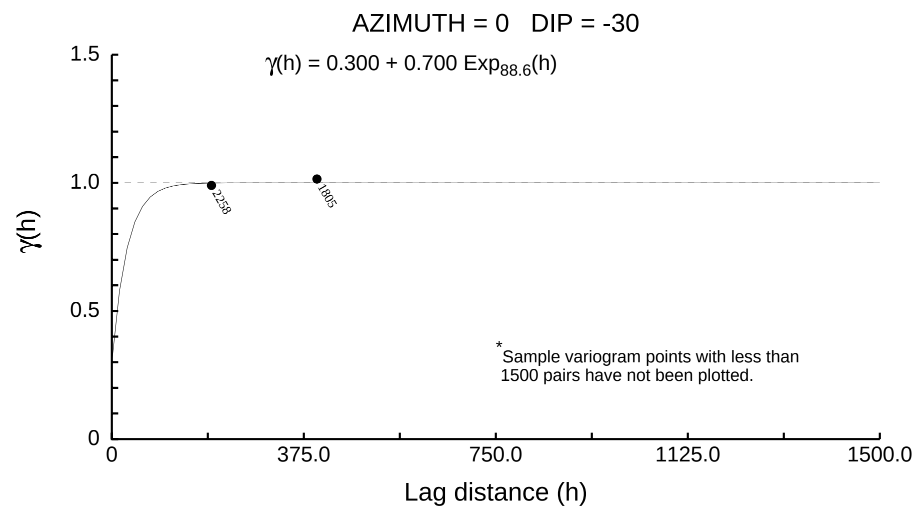
Directional 3000 - Au

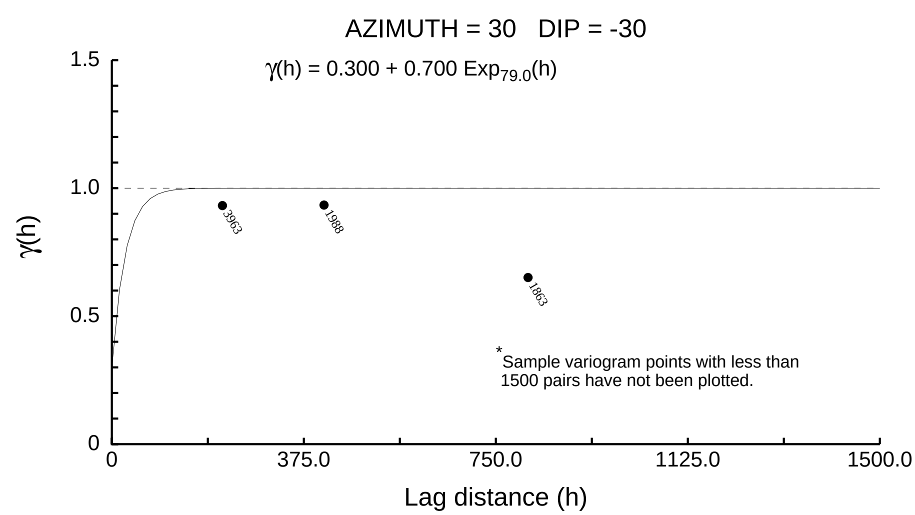


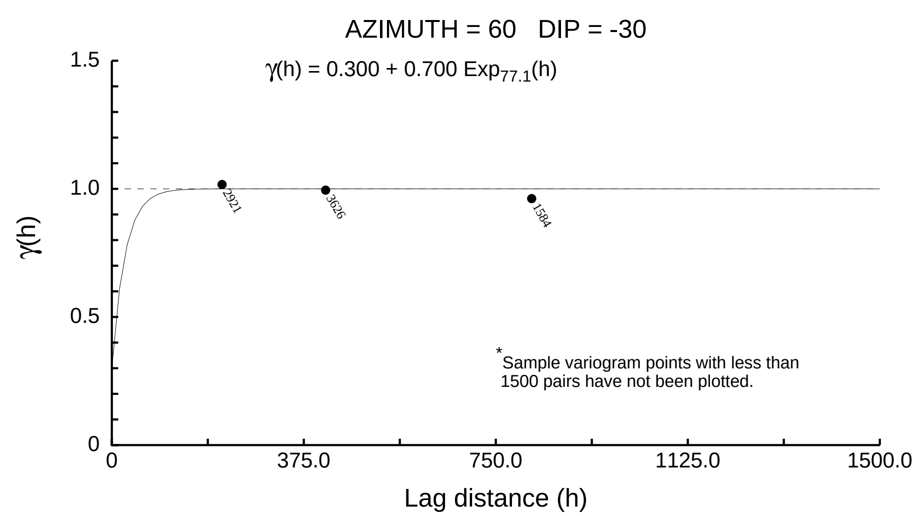




Directional 3000 - Au







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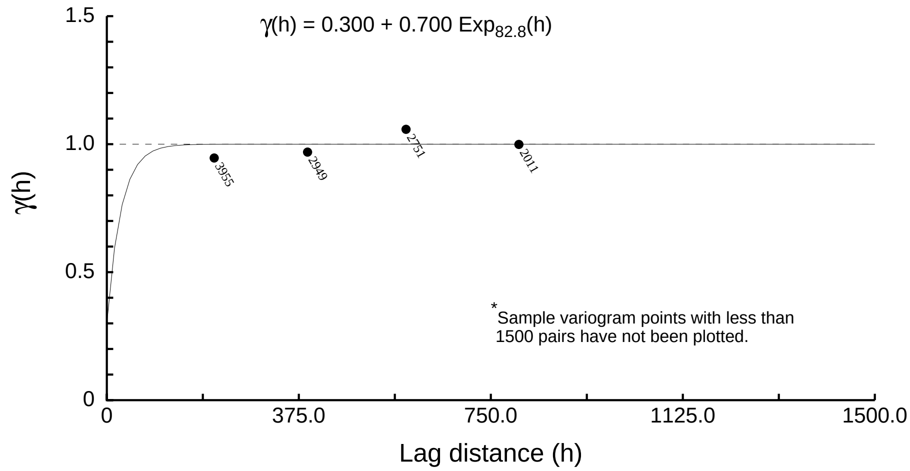
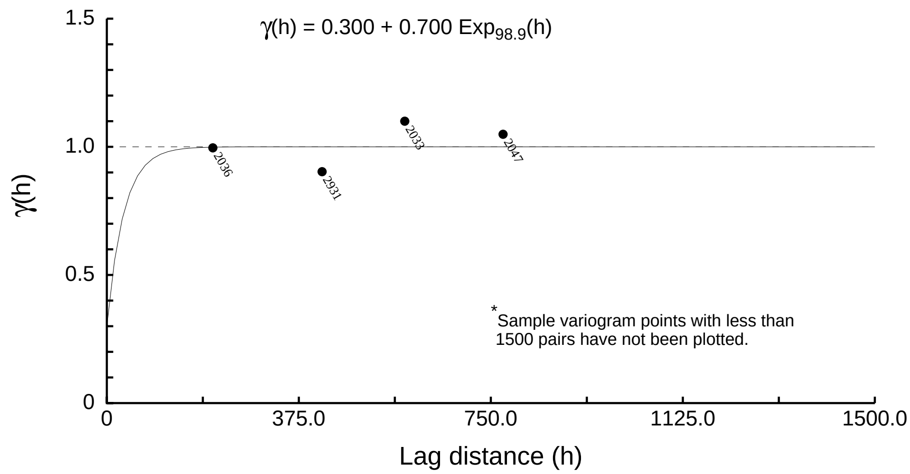
Directional 3000 - Au

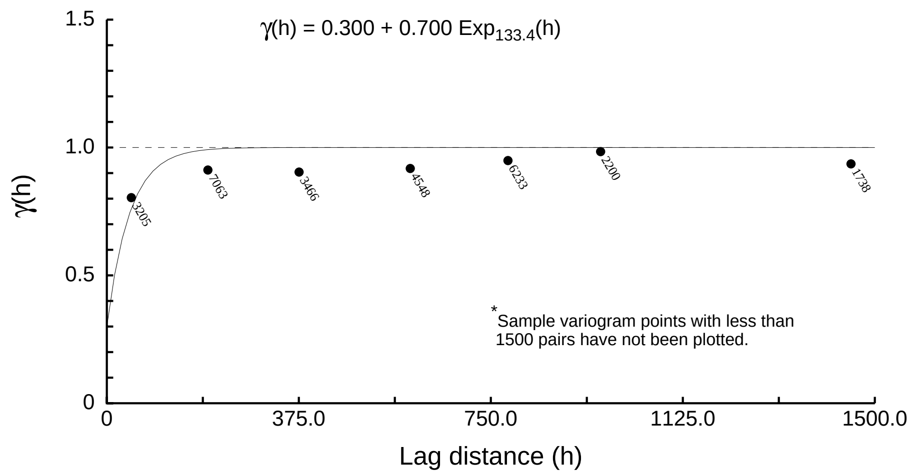
AZIMUTH = 90   DIP = -30



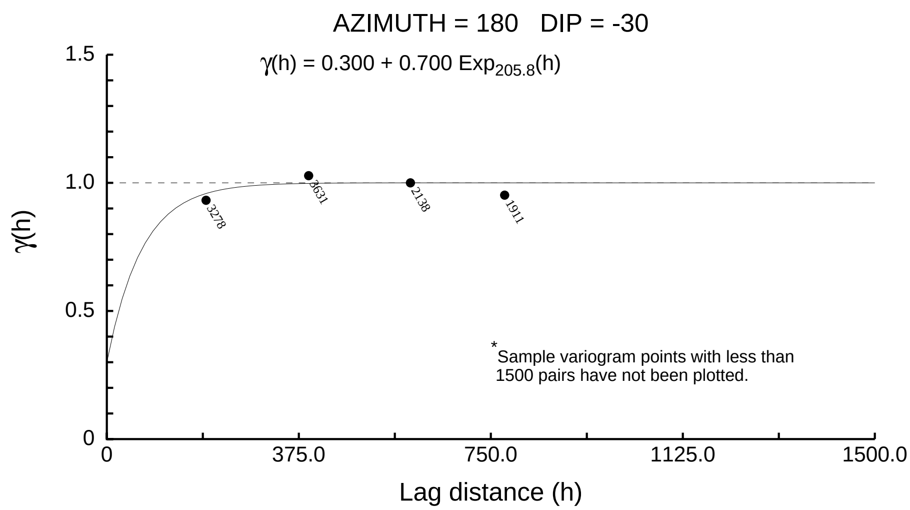
AZIMUTH = 120   DIP = -30

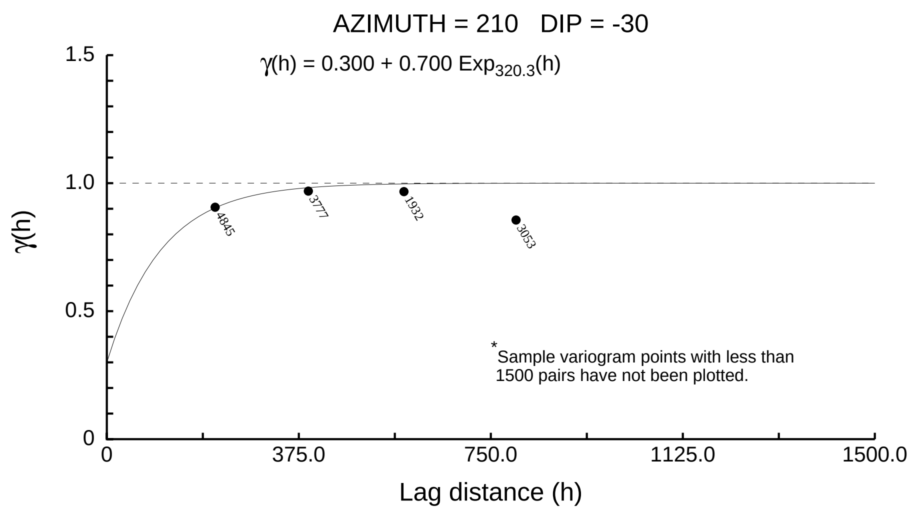


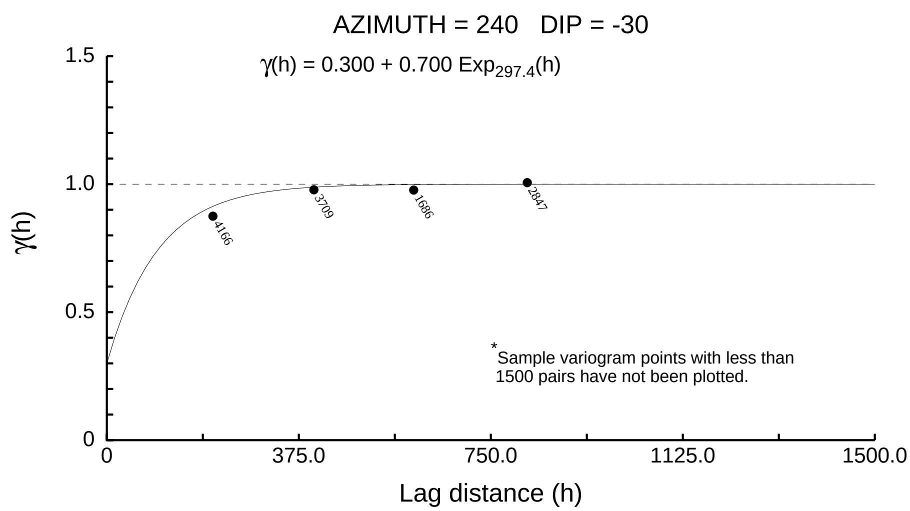
AZIMUTH = 150   DIP = -30



Directional 3000 - Au







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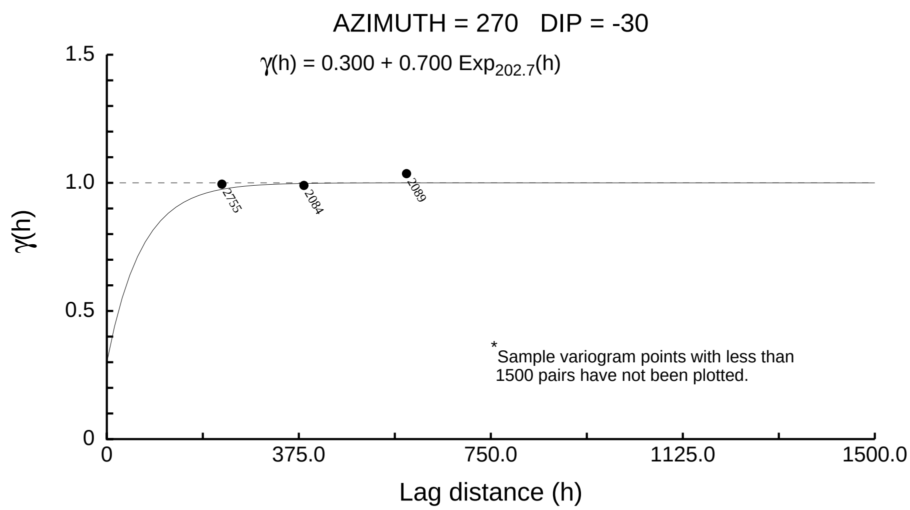
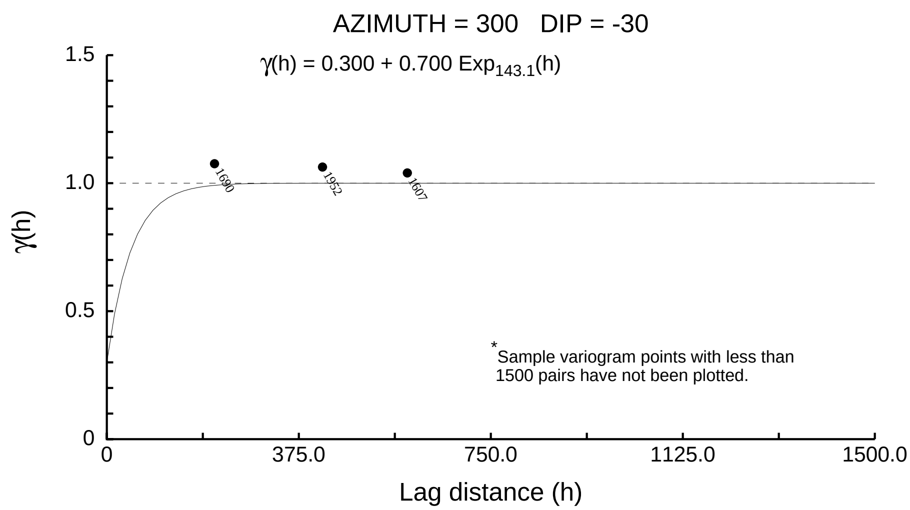
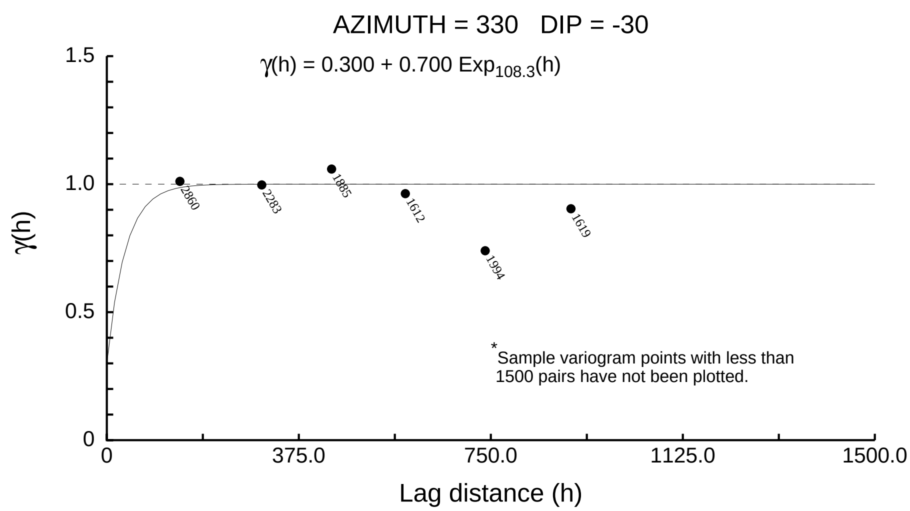
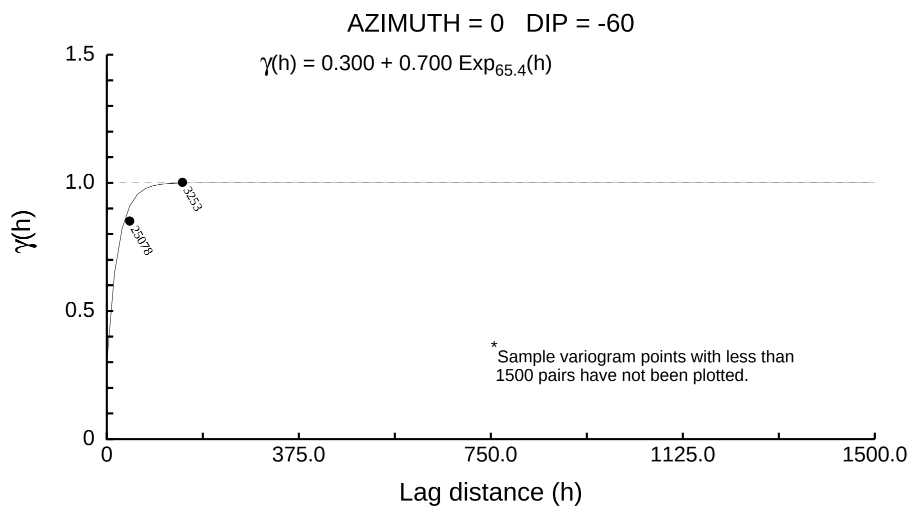
Directional 3000 - Au

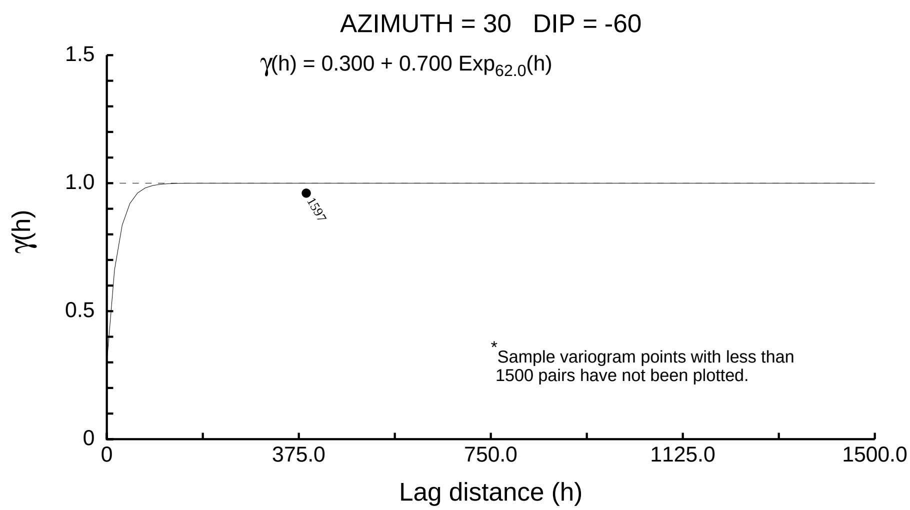


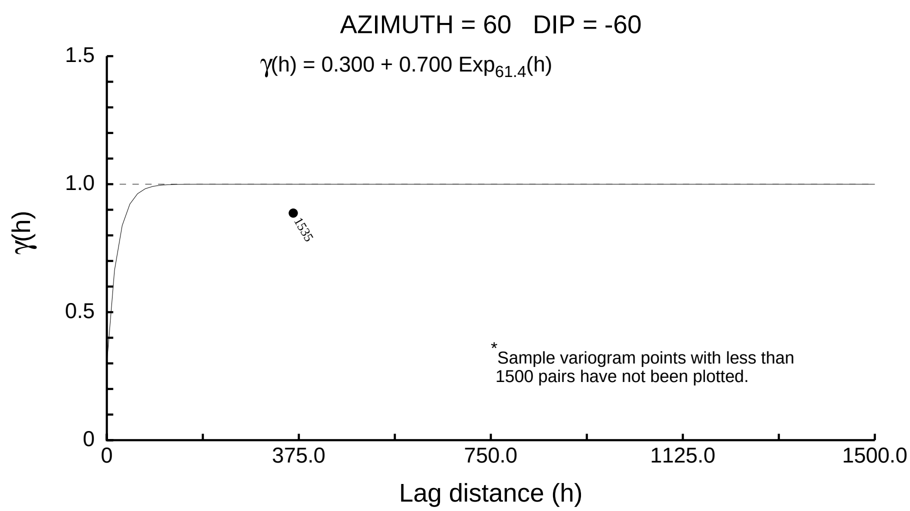




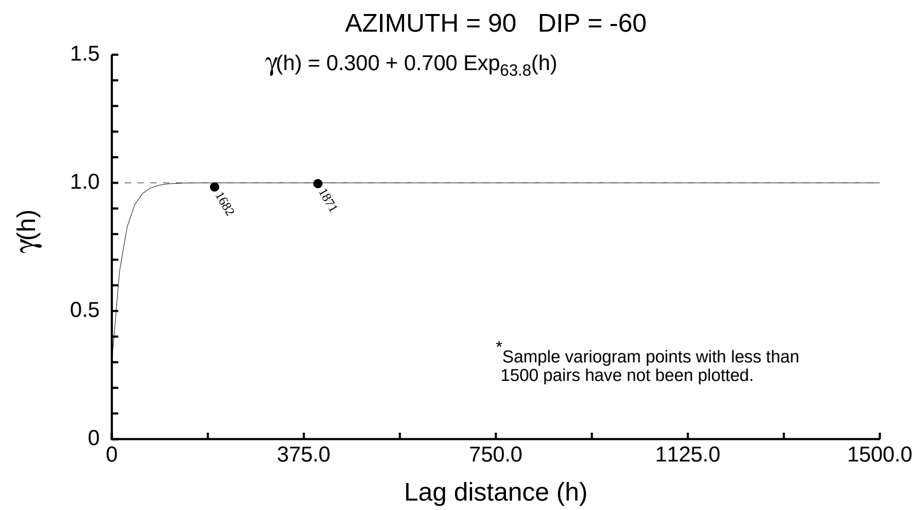
Directional 3000 - Au

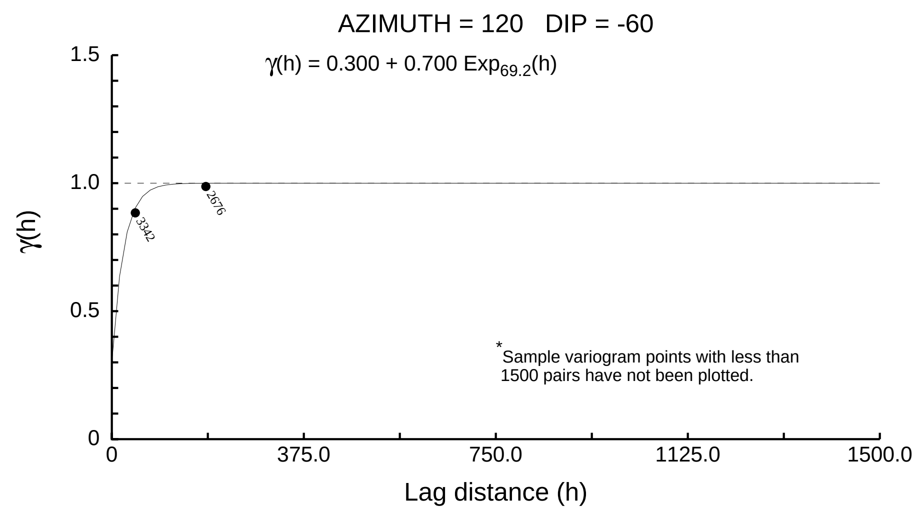


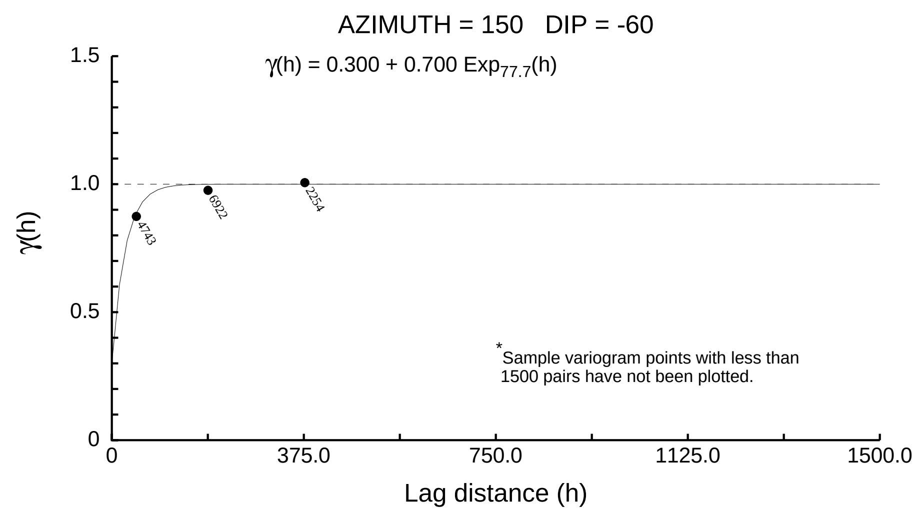




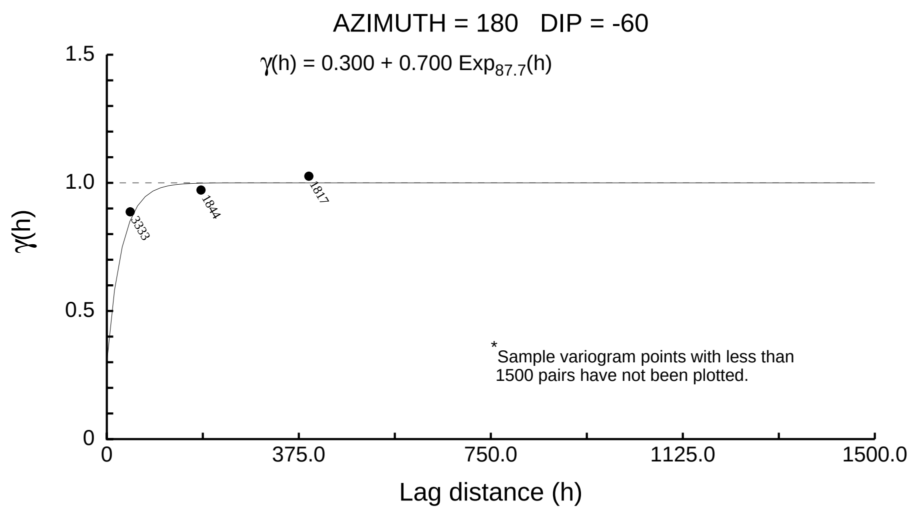
Directional 3000 - Au

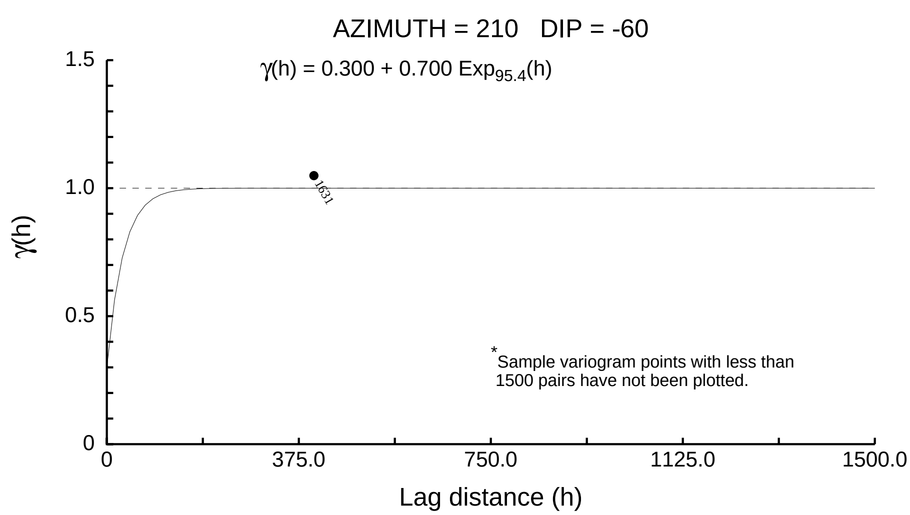


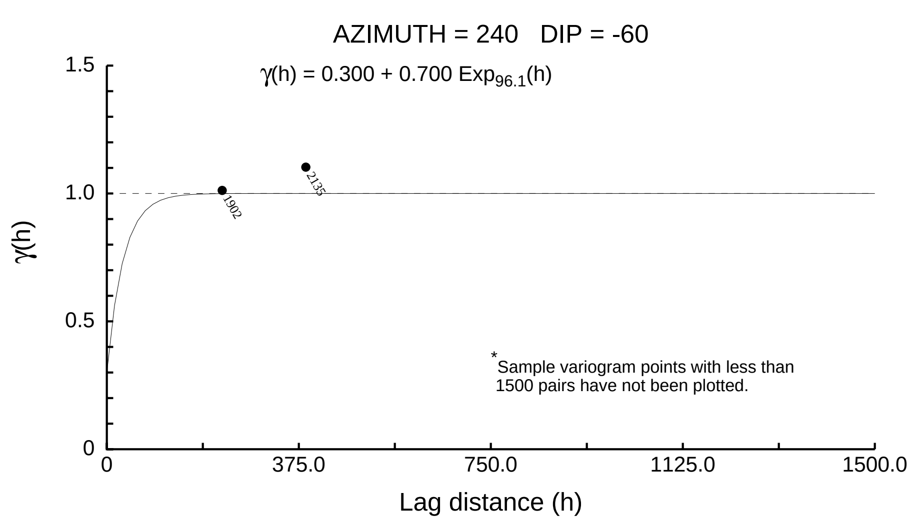




Directional 3000 - Au







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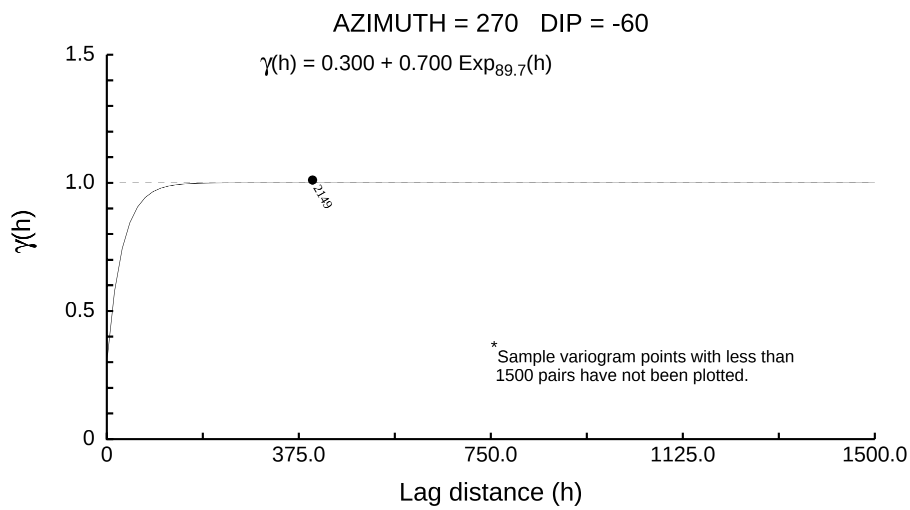
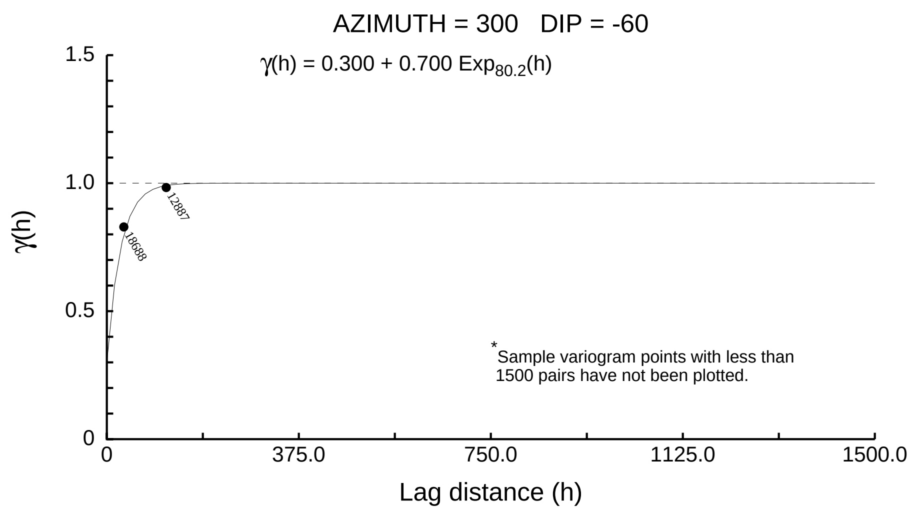
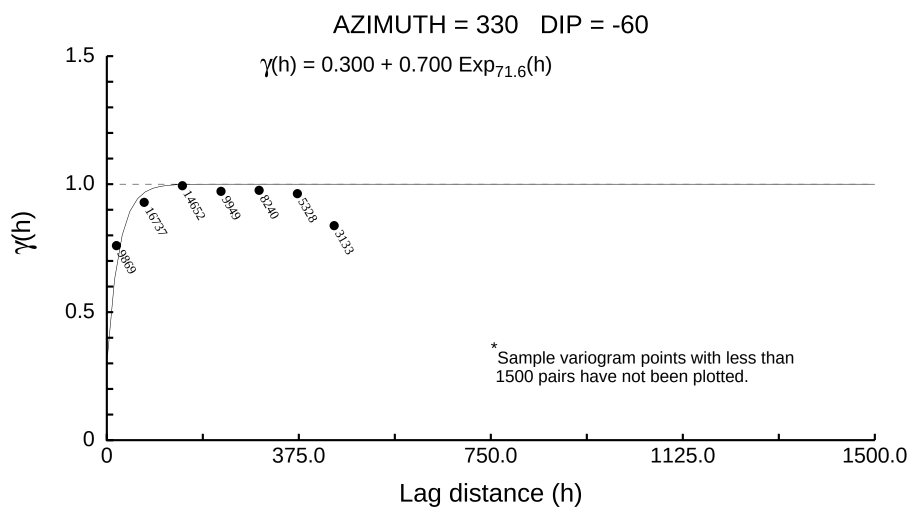
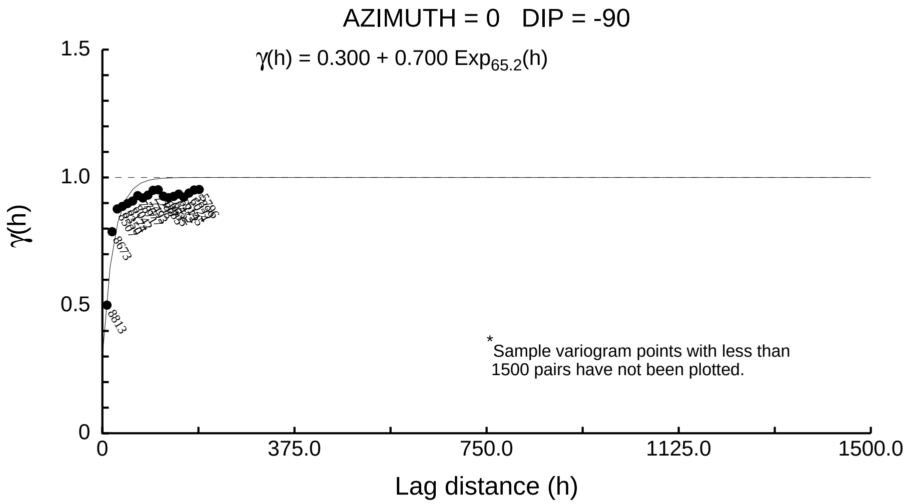
Directional 3000 - Au







Directional 3000 - Au



Directional 3000 - Co

User Defined Rotation Conventions

Nugget ==> 0.152
C1 ==> 0.848

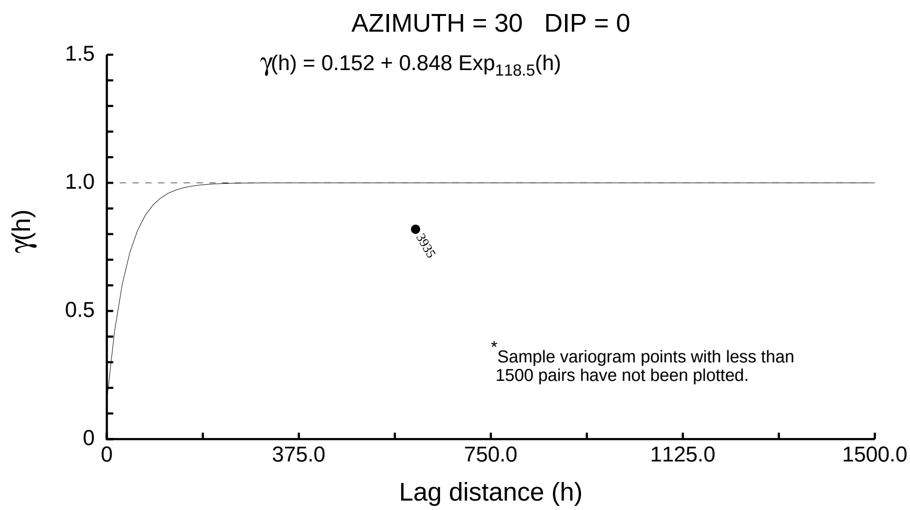
First Structure -- Exponential with Practical Range

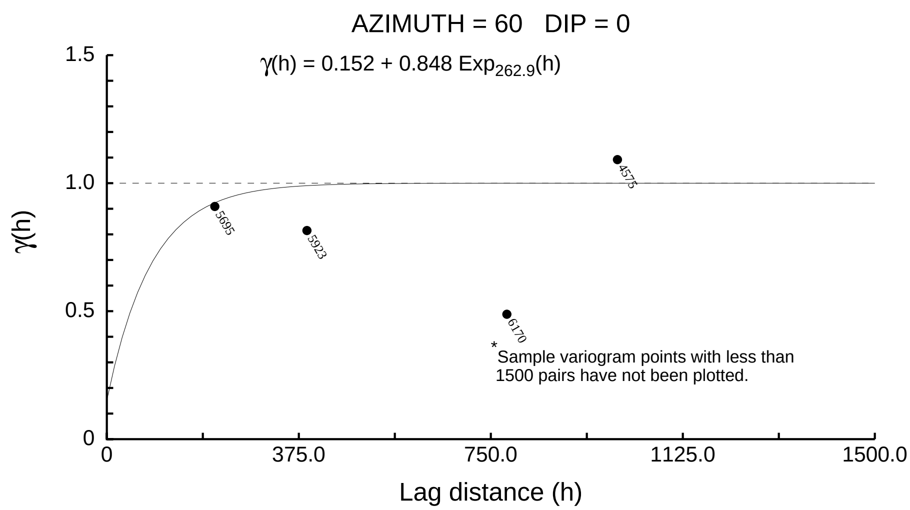
RH Rotation about the Z axis ==> 28
RH Rotation about the Y’ axis ==> 0
RH Rotation about the Z’ axis ==> 7
Range along the Z’ axis ==> 3965.4 Azimuth ==> 62 Dip ==> 90
Range along the Y’ axis ==> 51.8 Azimuth ==> 324 Dip ==> 0
Range along the X’ axis ==> 305.6 Azimuth ==> 54 Dip ==> -0

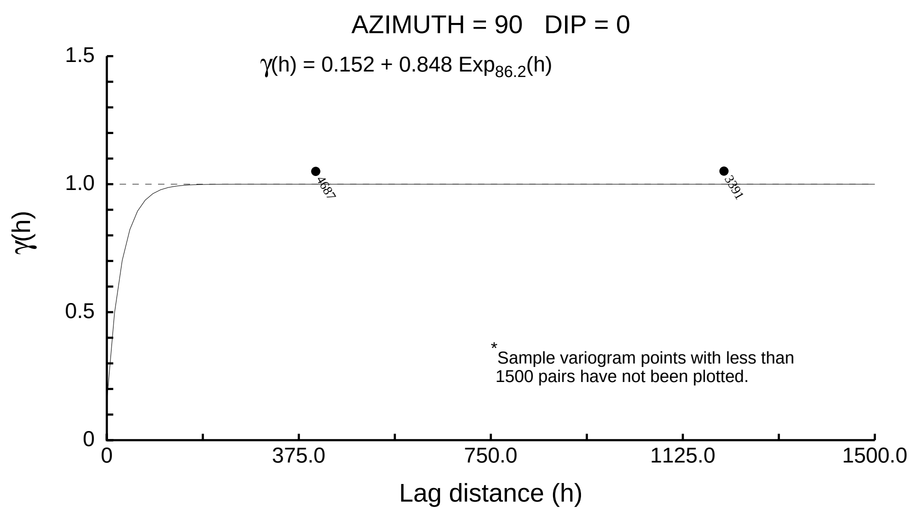
Modeling Criteria

Minimum number pairs req’d ==> 1500
Sample variogram points weighted by # pairs
Max allowable drift on head and tail means ==> 1.8

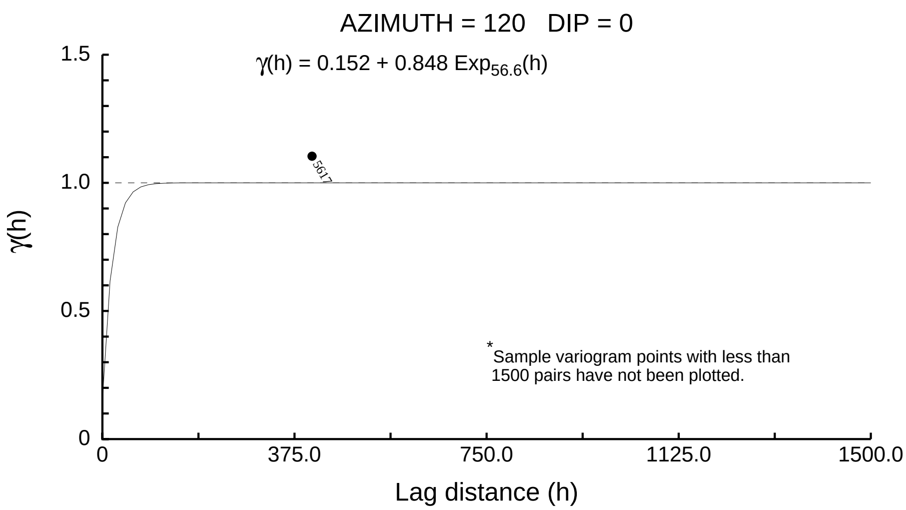
Directional 3000 - Co

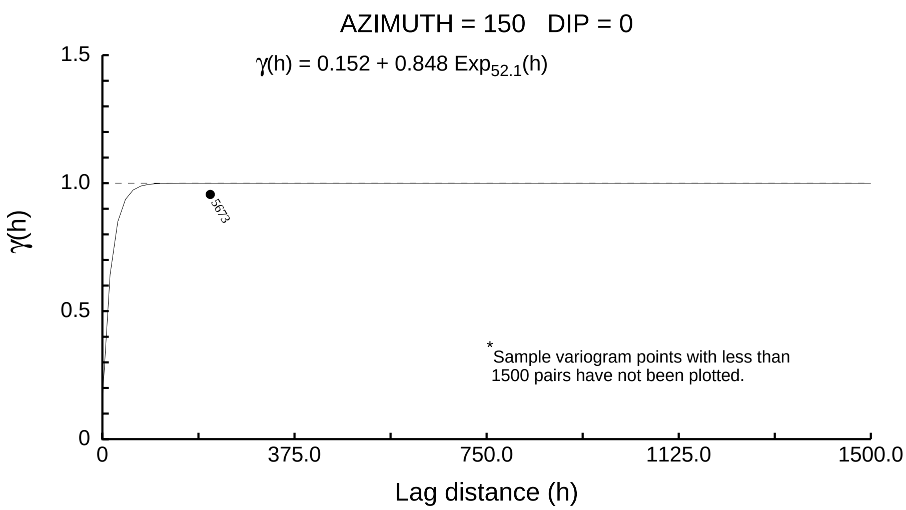


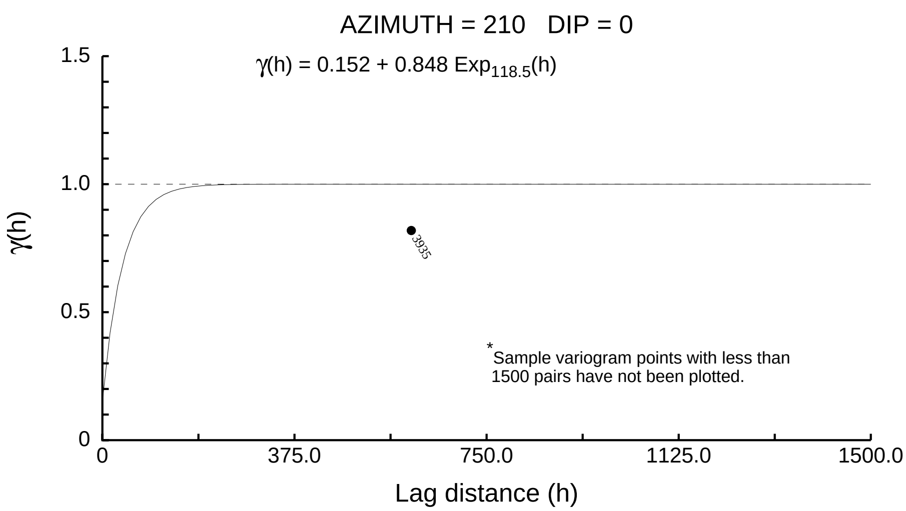




Directional 3000 - Co







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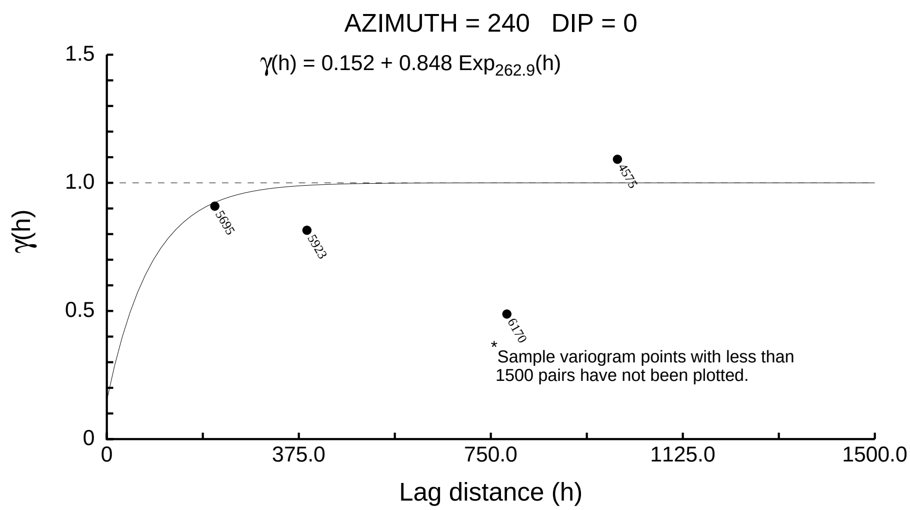
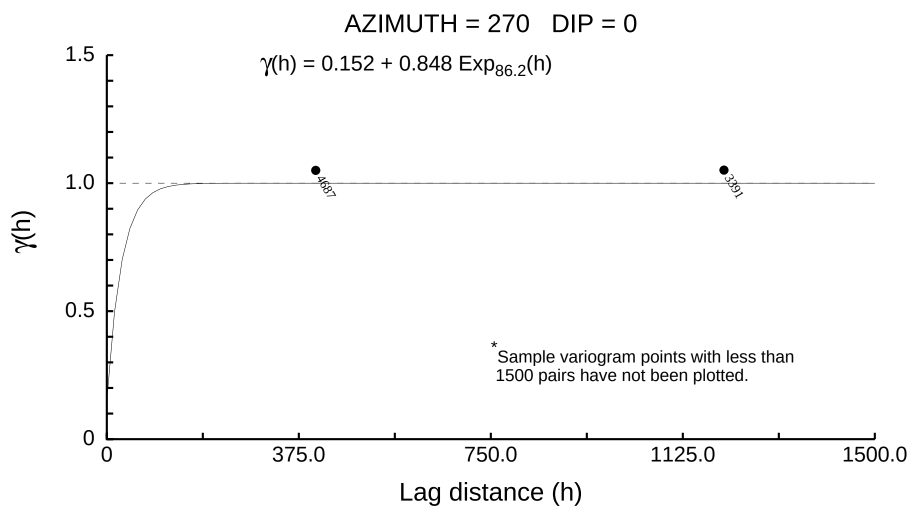
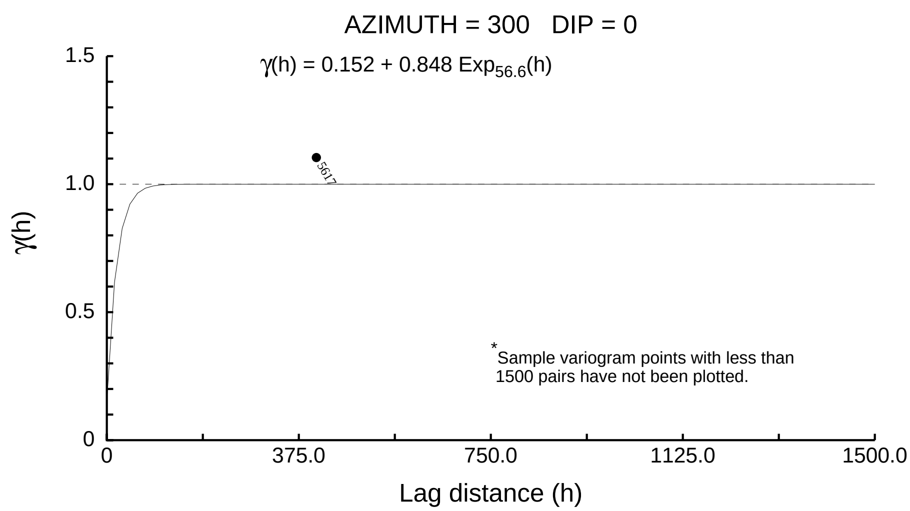
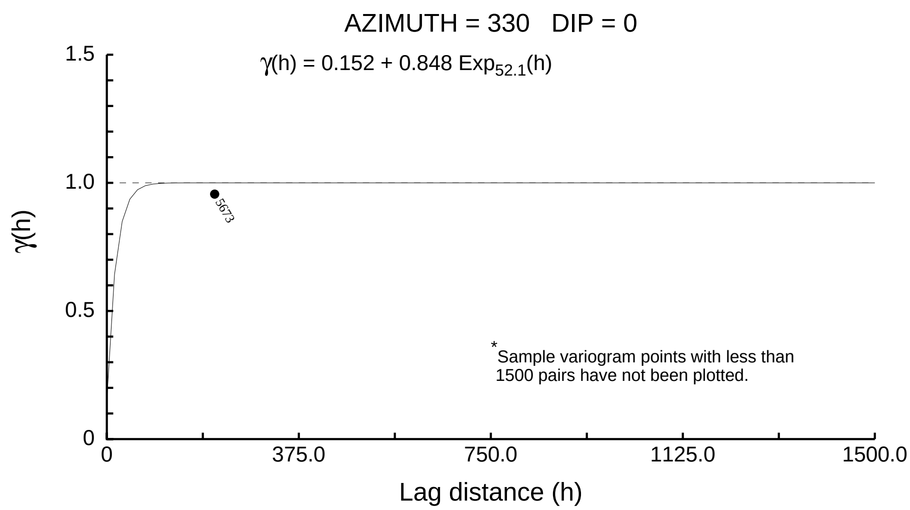
Directional 3000 - Co

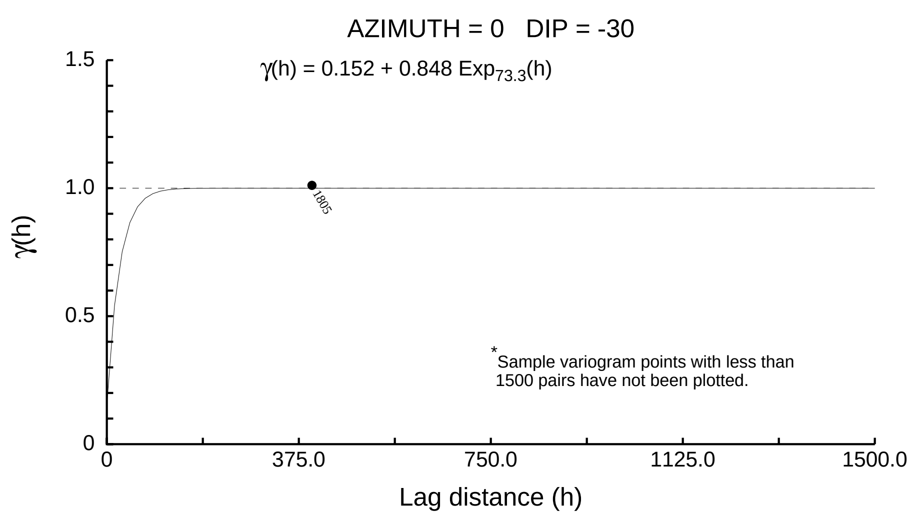


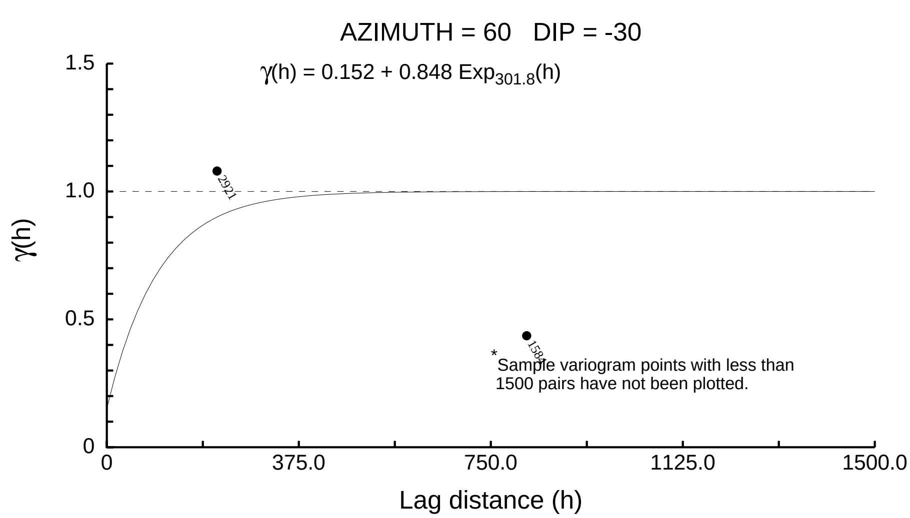




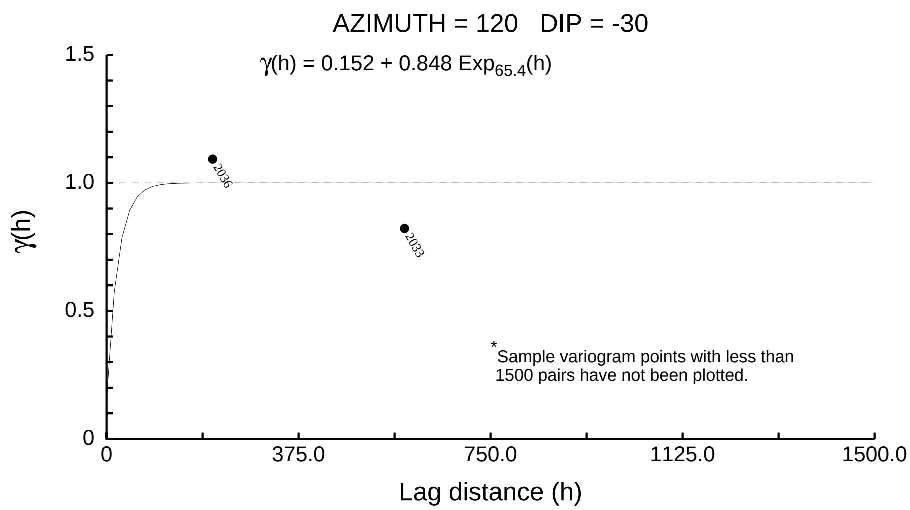
Directional 3000 - Co

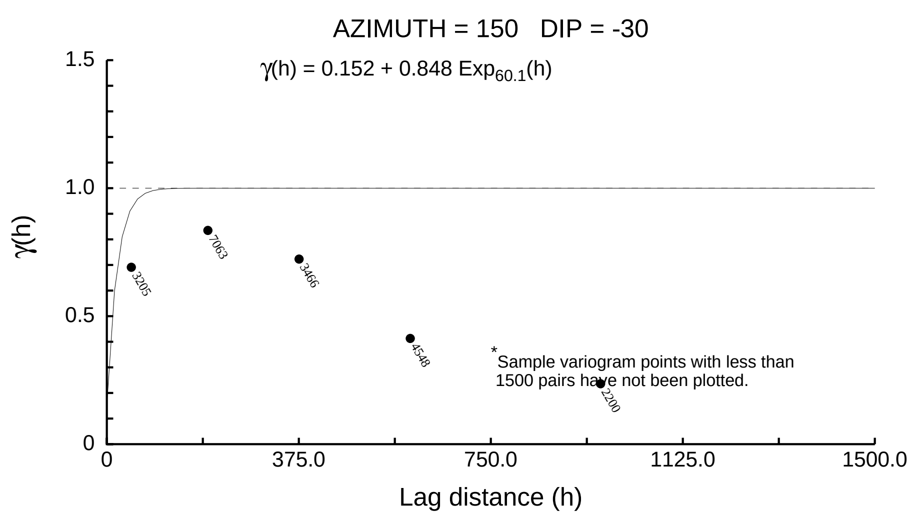


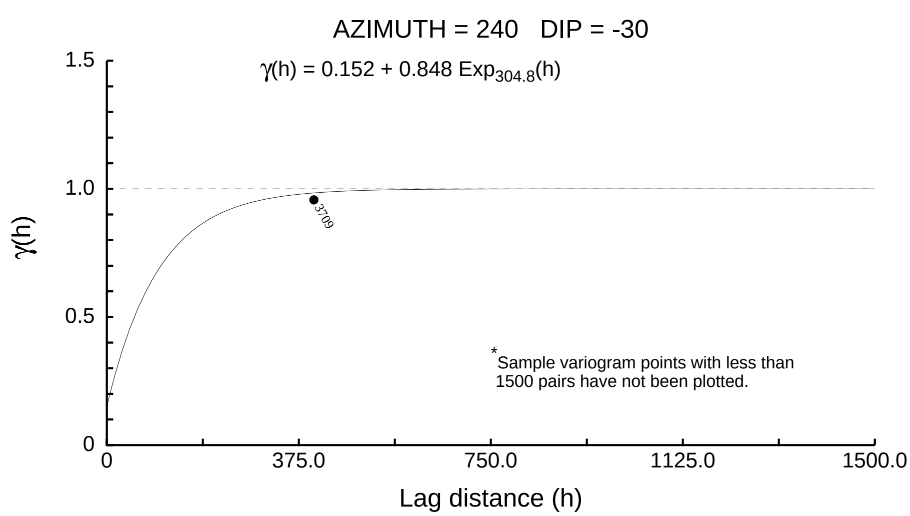




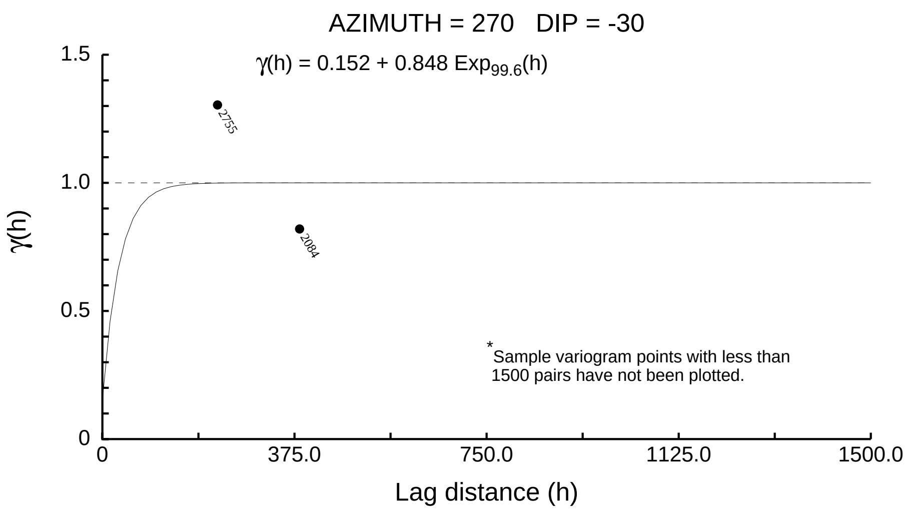
Directional 3000 - Co

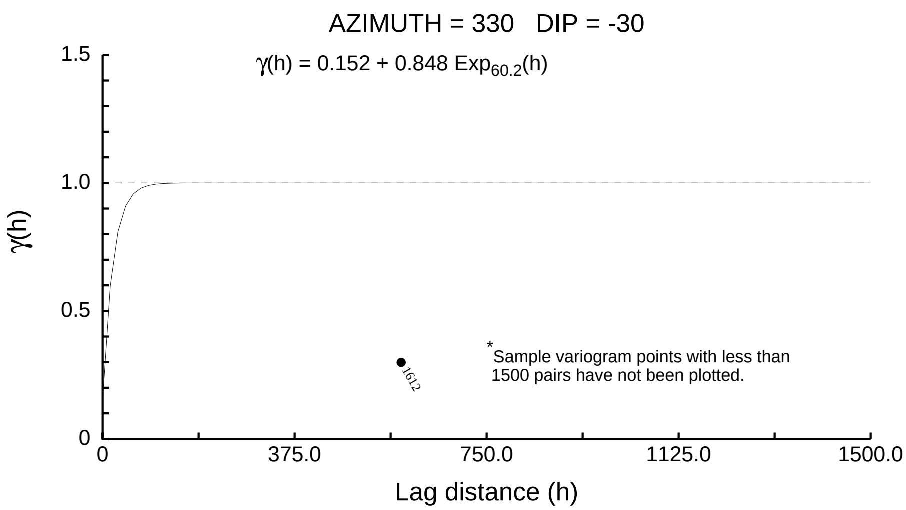


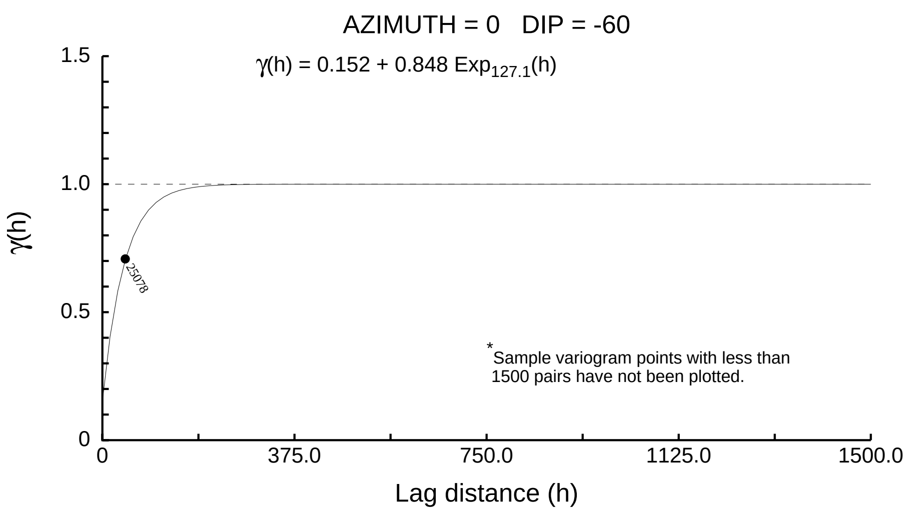




Directional 3000 - Co

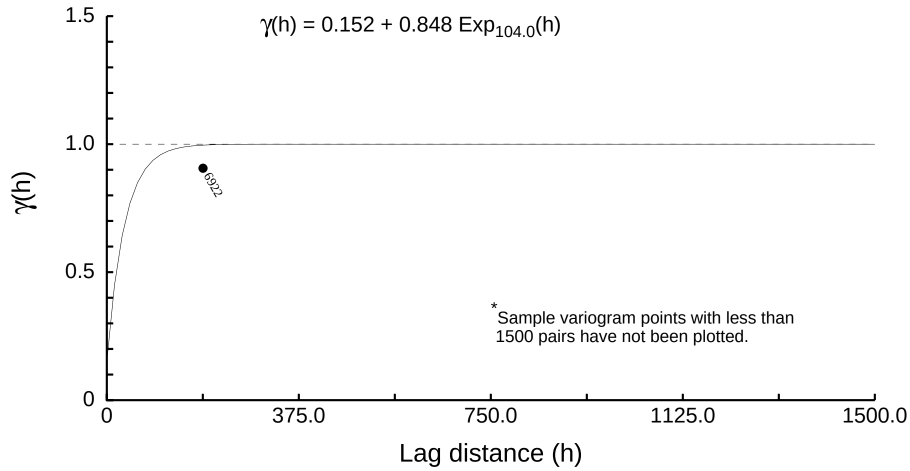




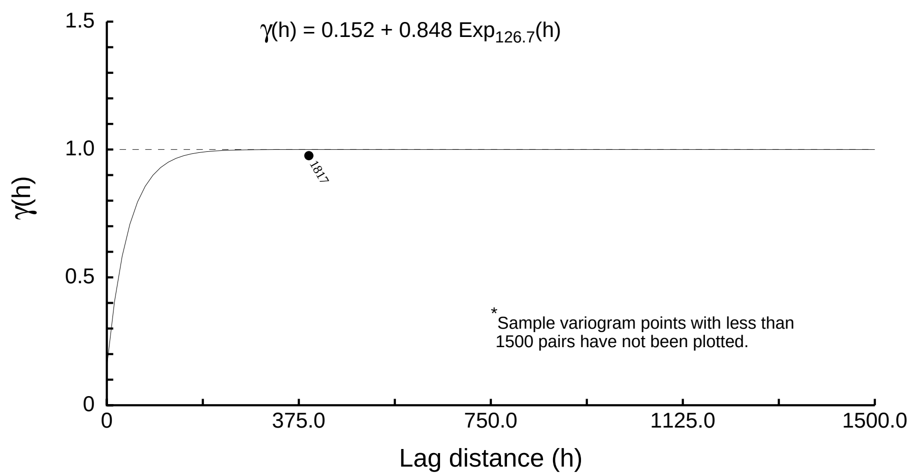


Directional 3000 - Co

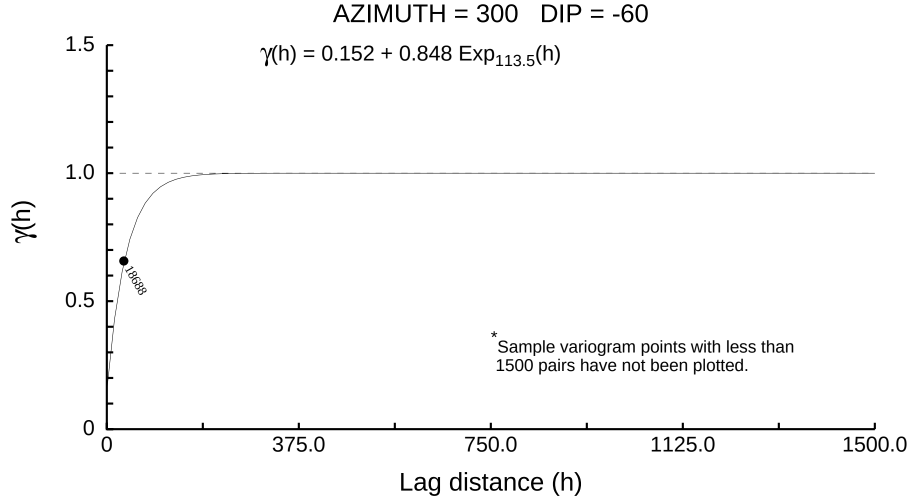
AZIMUTH = 150   DIP = -60



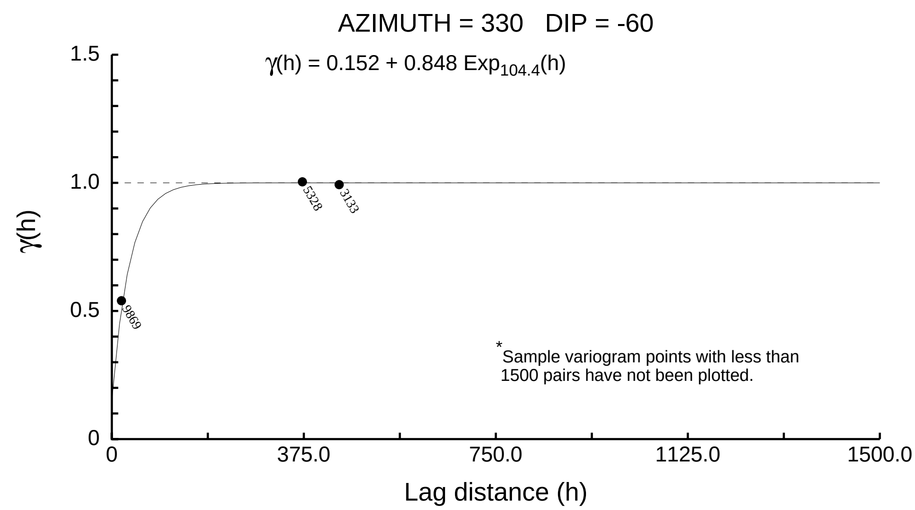
AZIMUTH = 180   DIP = -60

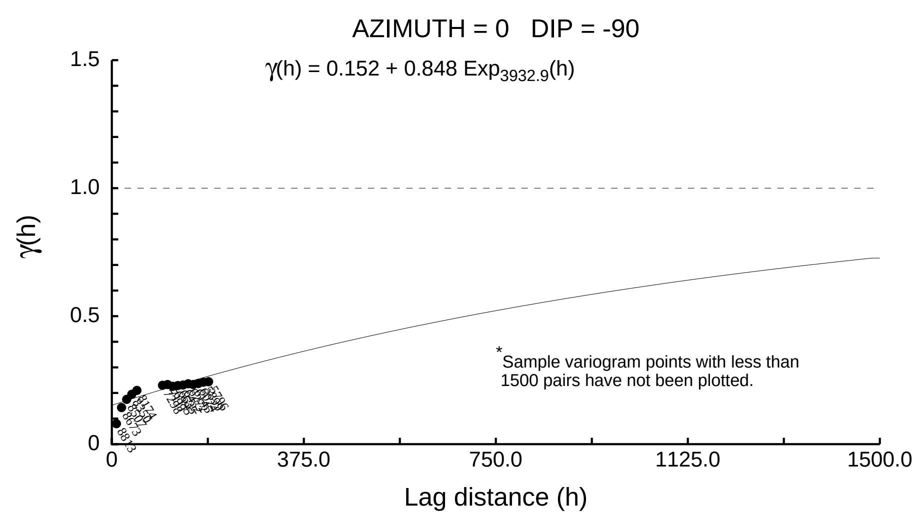


AZIMUTH = 300   DIP = -60



Directional 3000 - Co





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Directional 3000 - Cu

User Defined Rotation Conventions

Nugget ==> 0.006
C1 ==> 0.994

First Structure -- Exponential with Practical Range

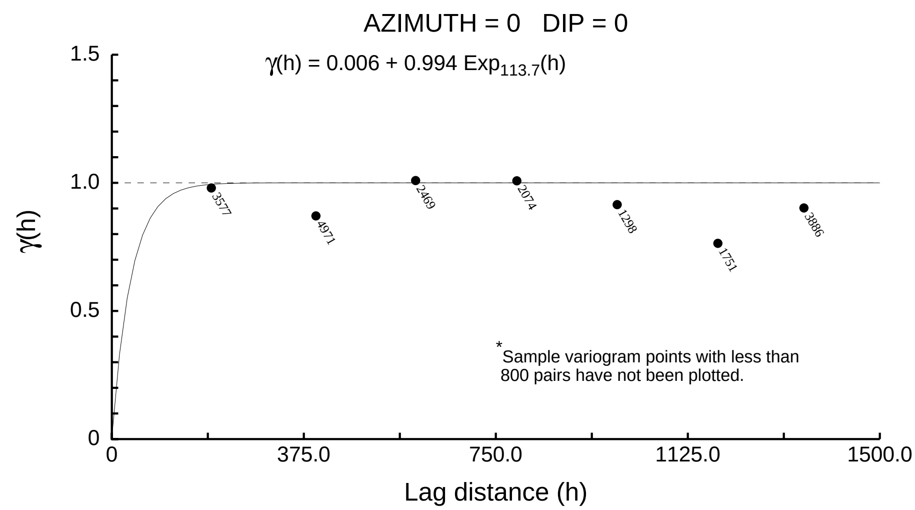
RH Rotation about the Z axis ==> 103
RH Rotation about the Y' axis ==> 20
RH Rotation about the Z' axis ==> -55

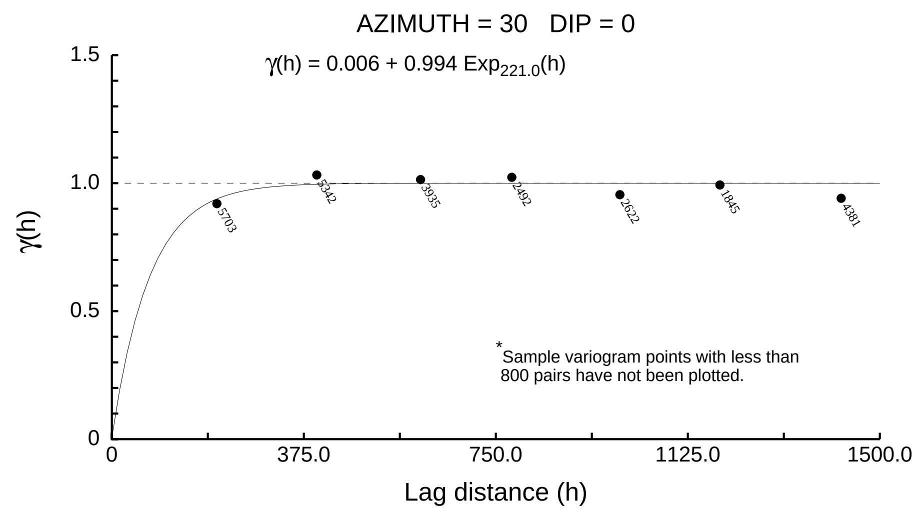
Range along the Z' axis ==> 63.0	Azimuth ==> 347	Dip ==> 70
Range along the Y' axis ==> 89.1	Azimuth ==> 310	Dip ==> -16
Range along the X' axis ==> 1229.9	Azimuth ==> 44	Dip ==> -12

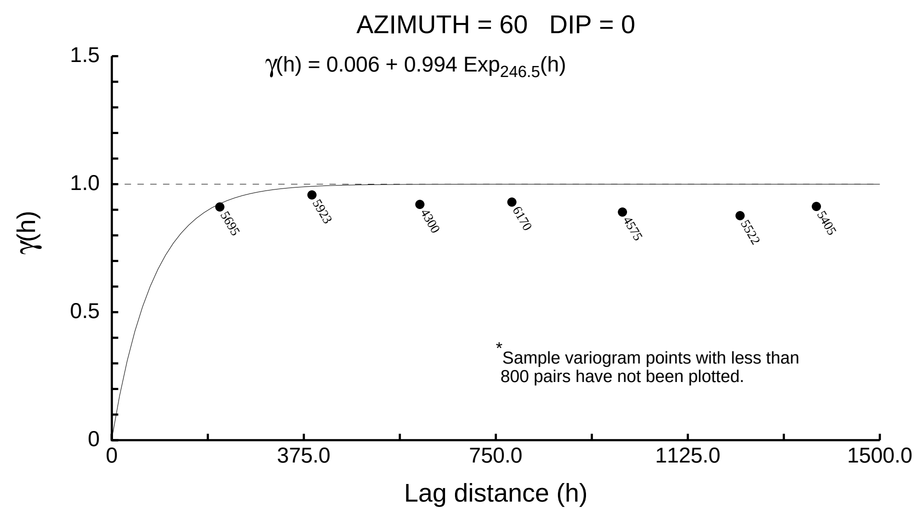
Modeling Criteria

Minimum number pairs req'd ==> 800
Sample variogram points weighted by # pairs
Max allowable drift on head and tail means ==> 0.5

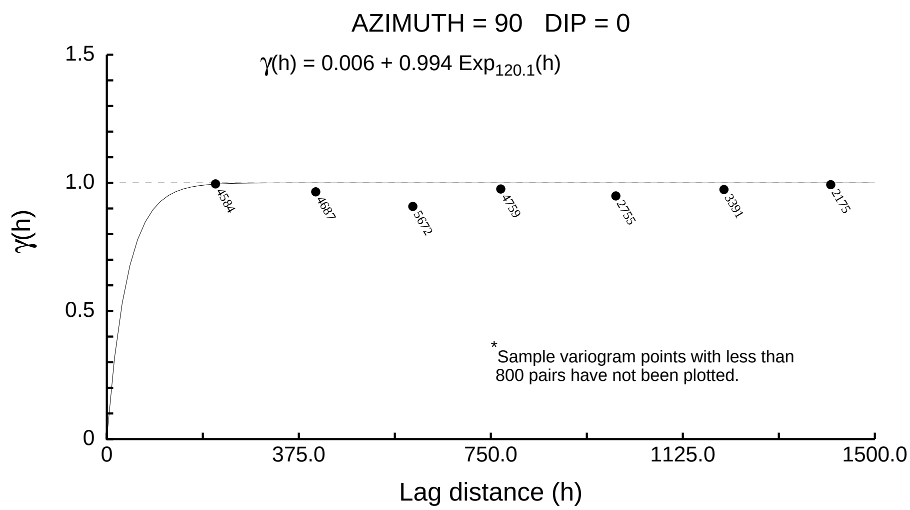
Directional 3000 - Cu

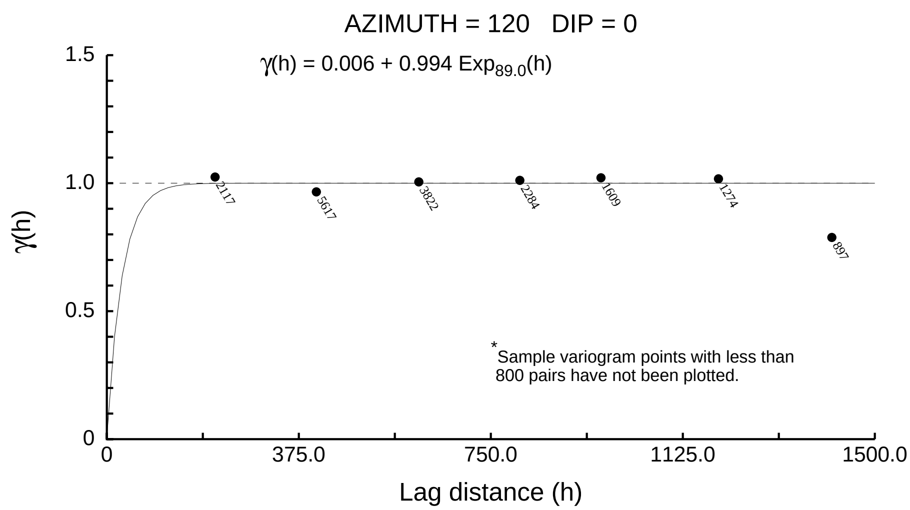


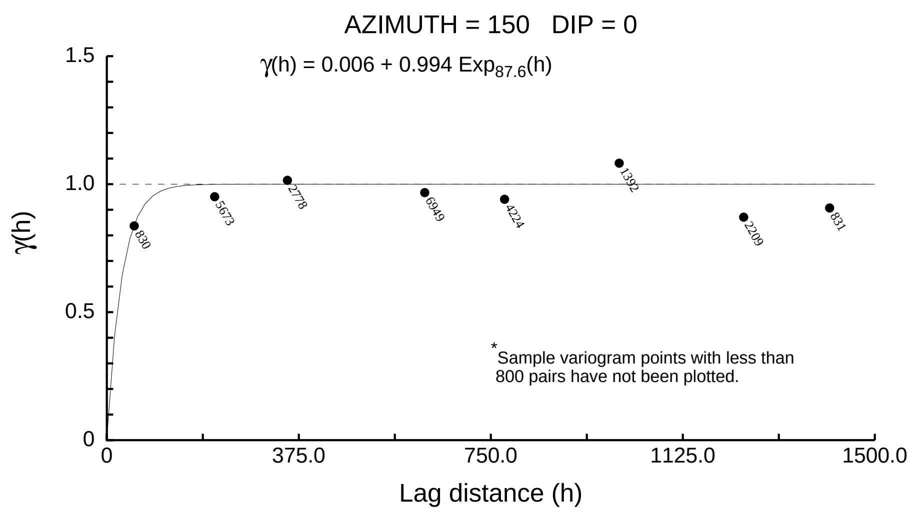




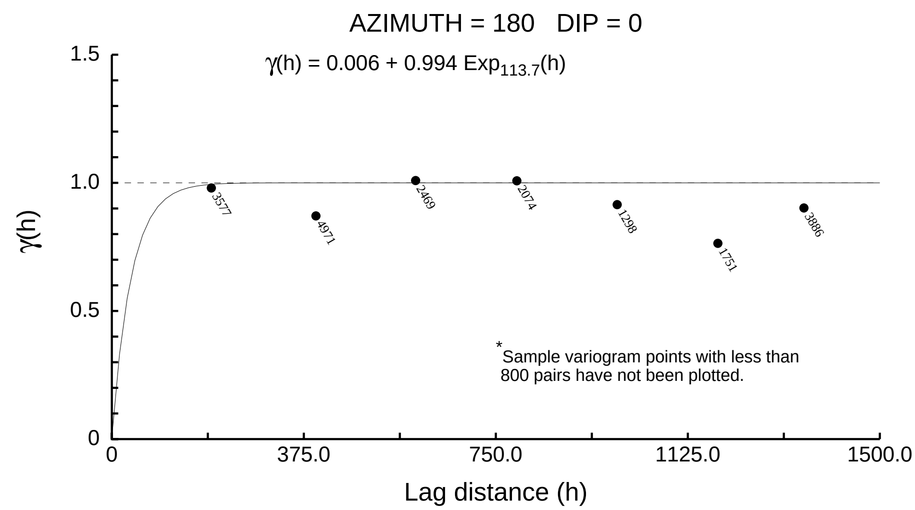
Directional 3000 - Cu

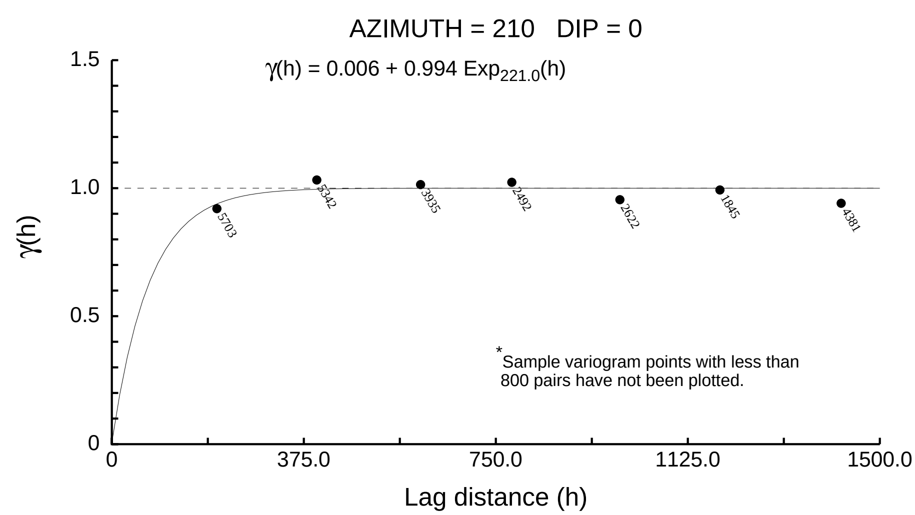


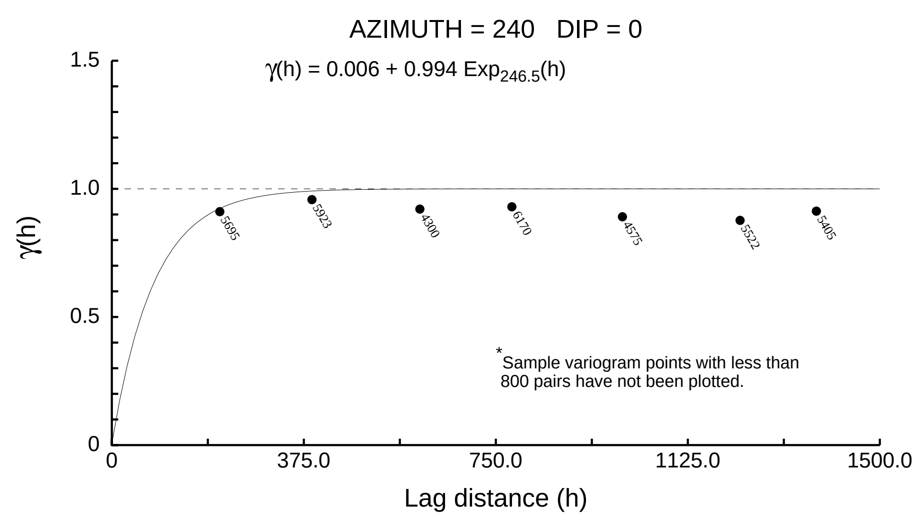




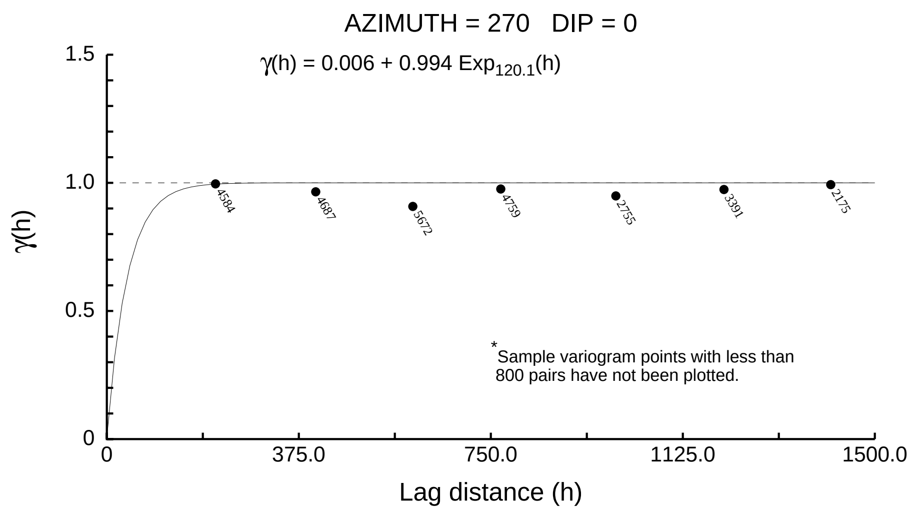
Directional 3000 - Cu

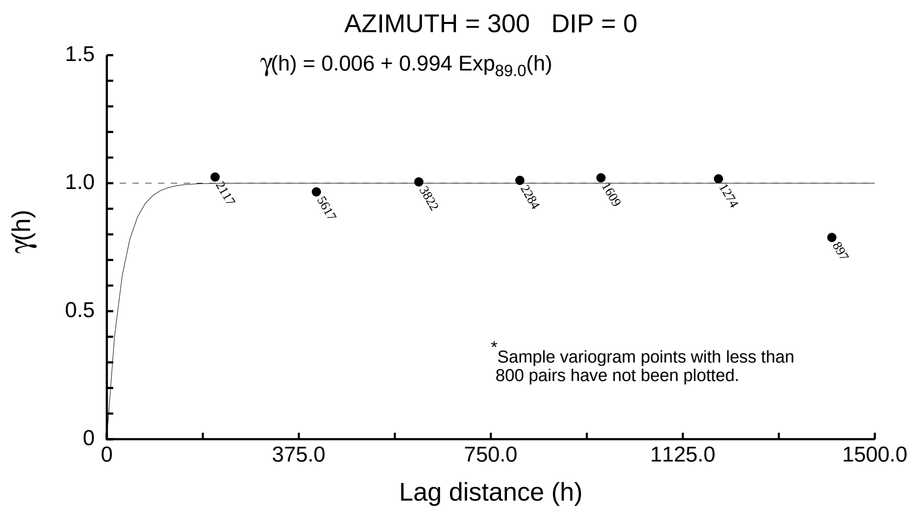


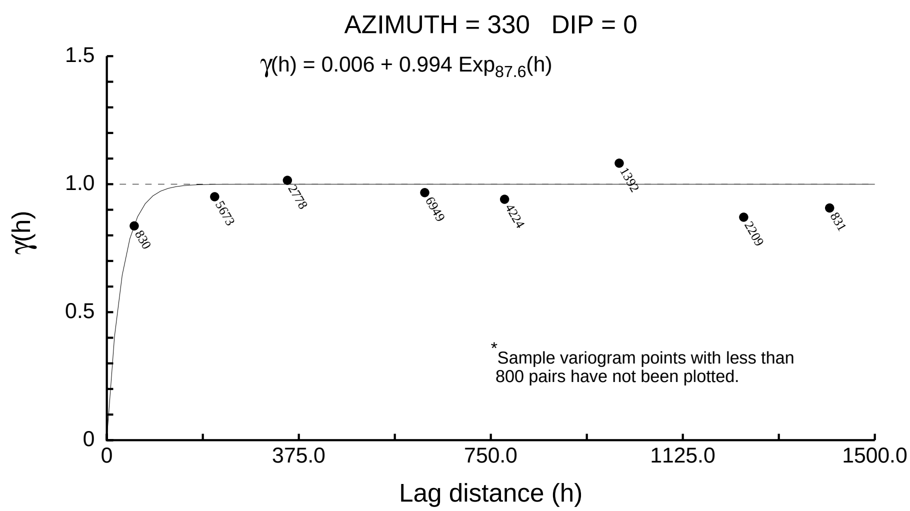




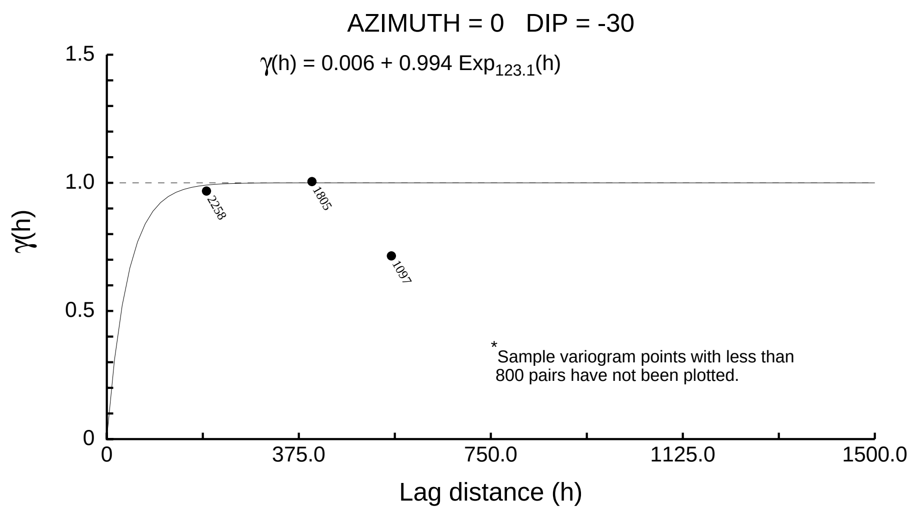
Directional 3000 - Cu

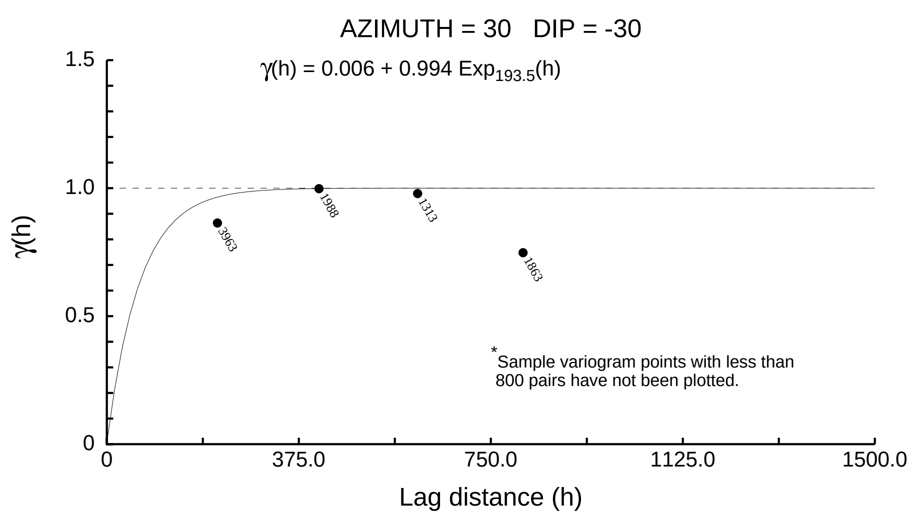


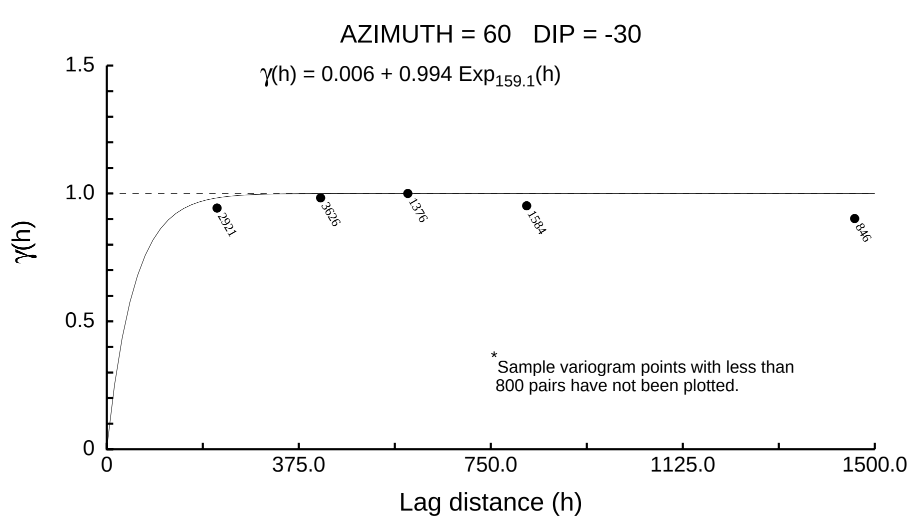




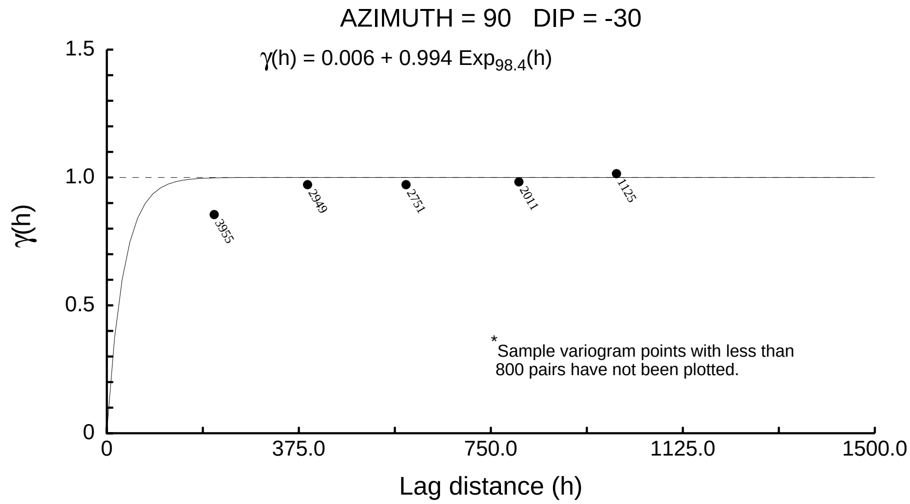
Directional 3000 - Cu

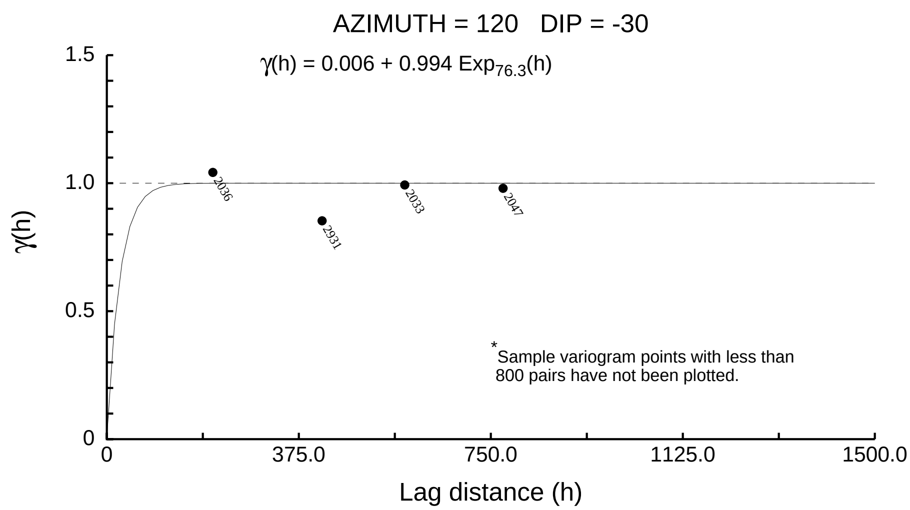


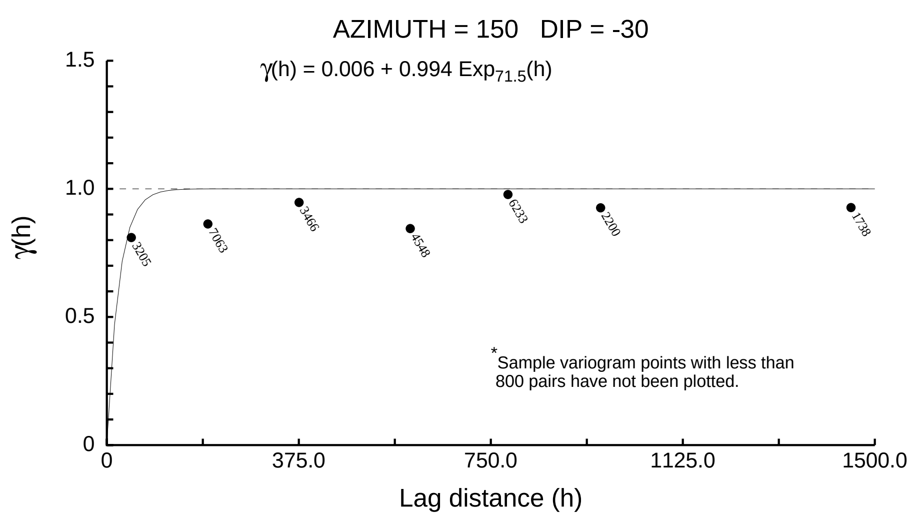




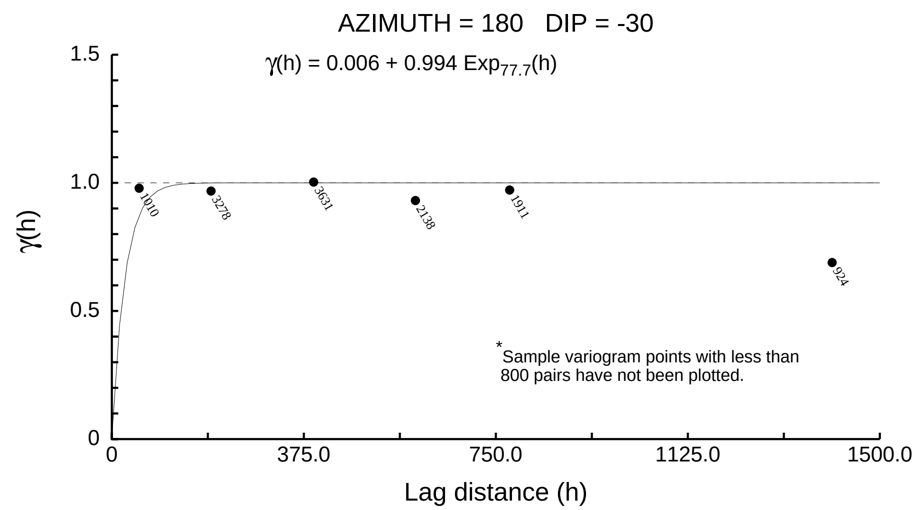
Directional 3000 - Cu

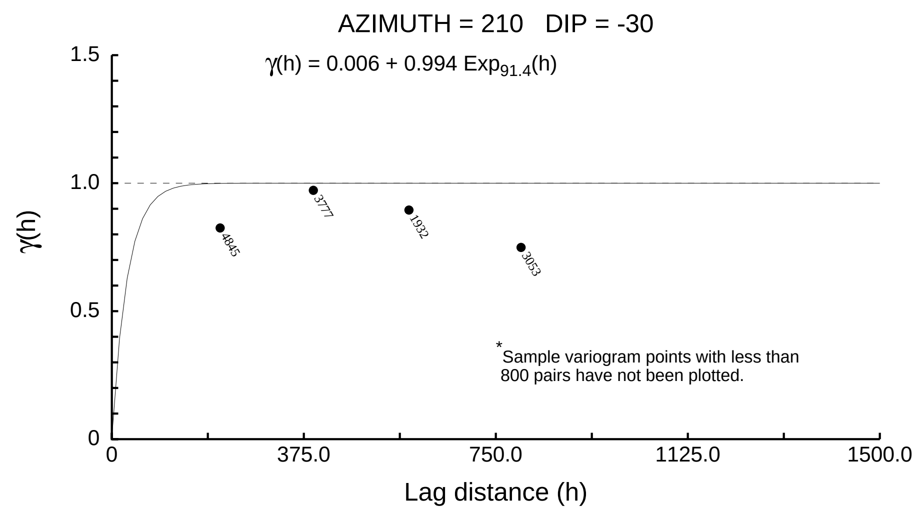


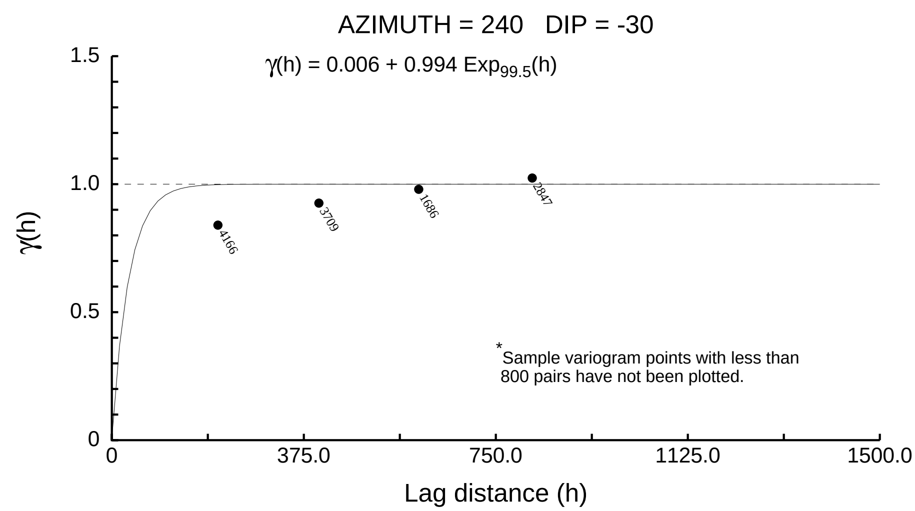




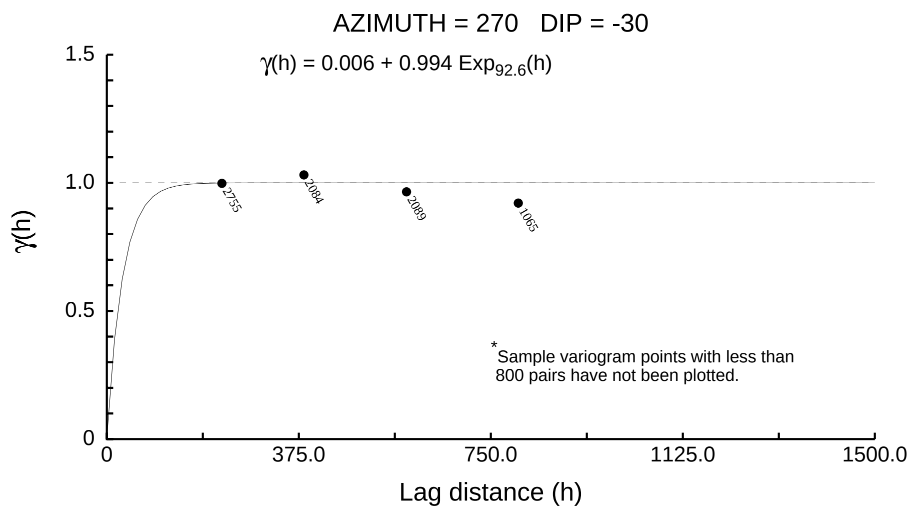
Directional 3000 - Cu

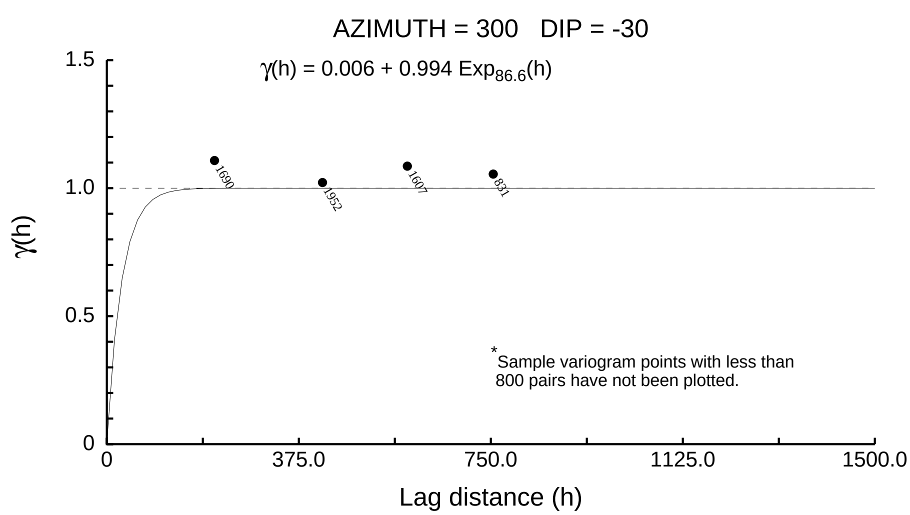


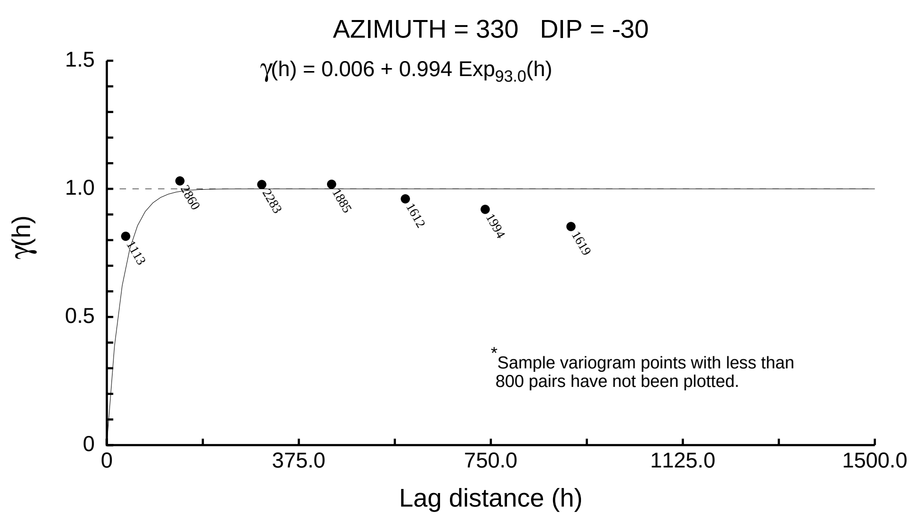




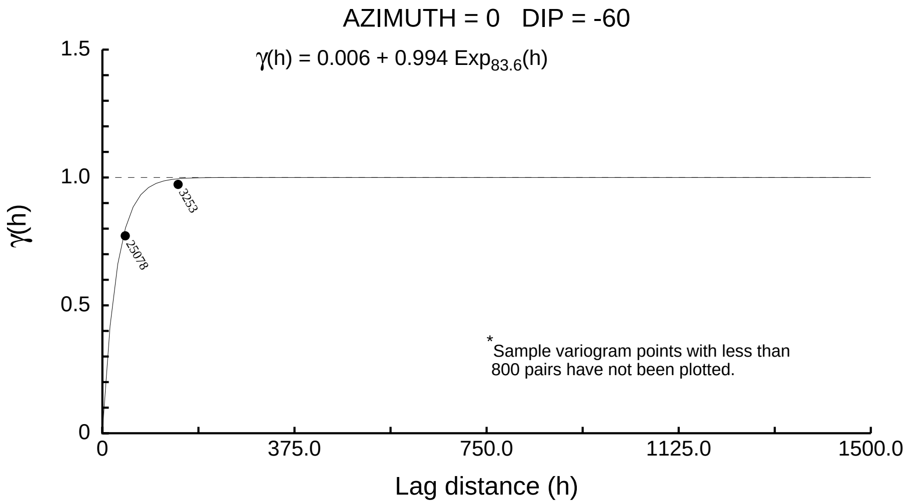
Directional 3000 - Cu

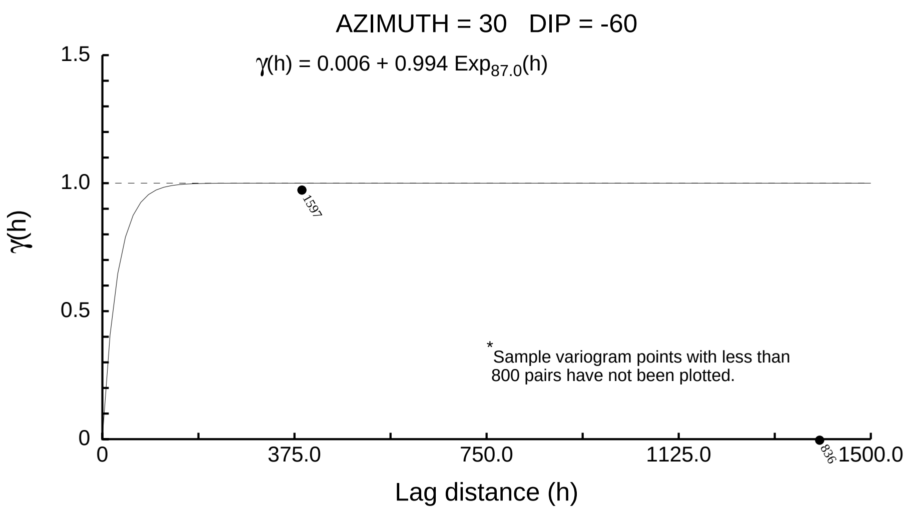


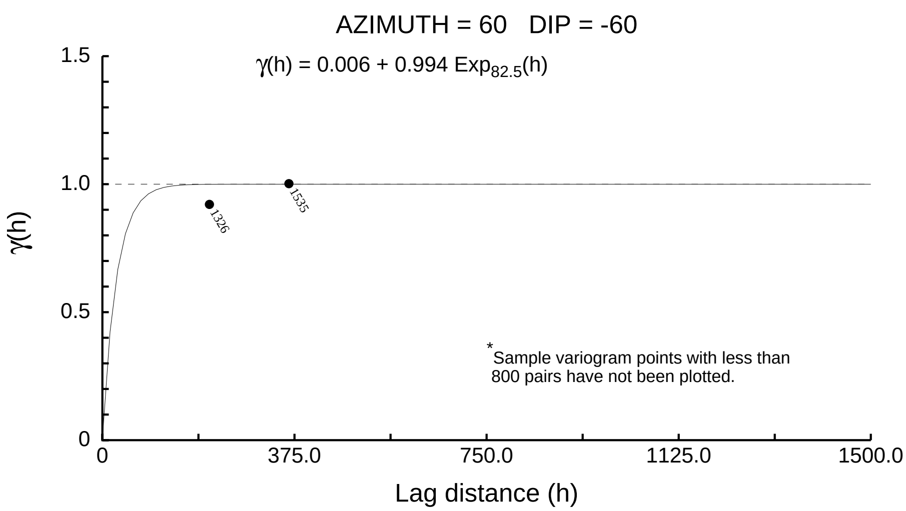




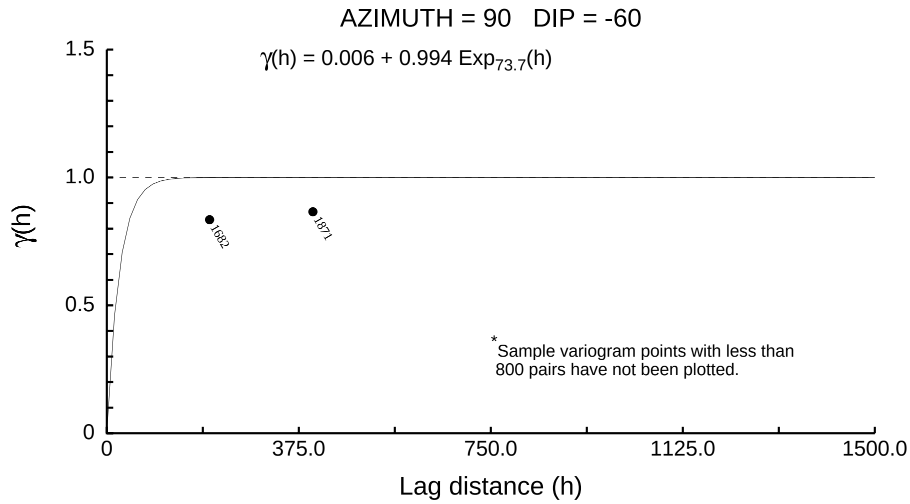
Directional 3000 - Cu

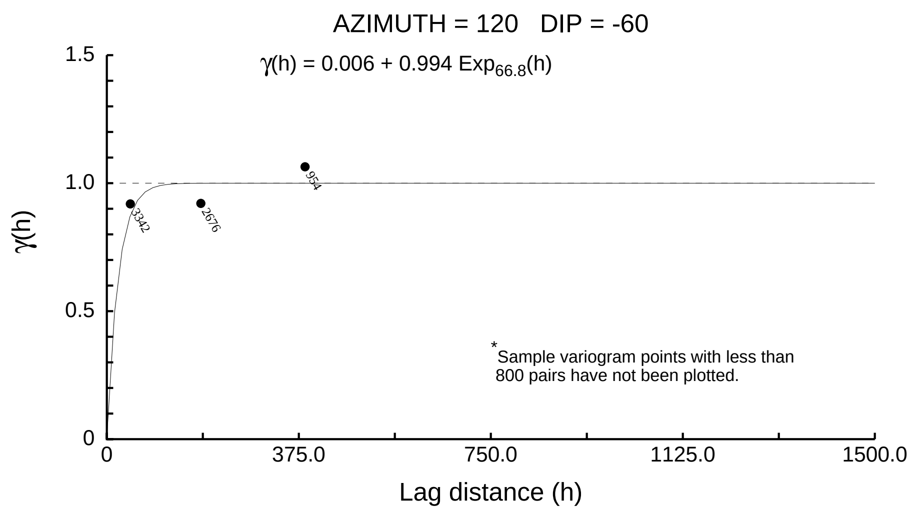


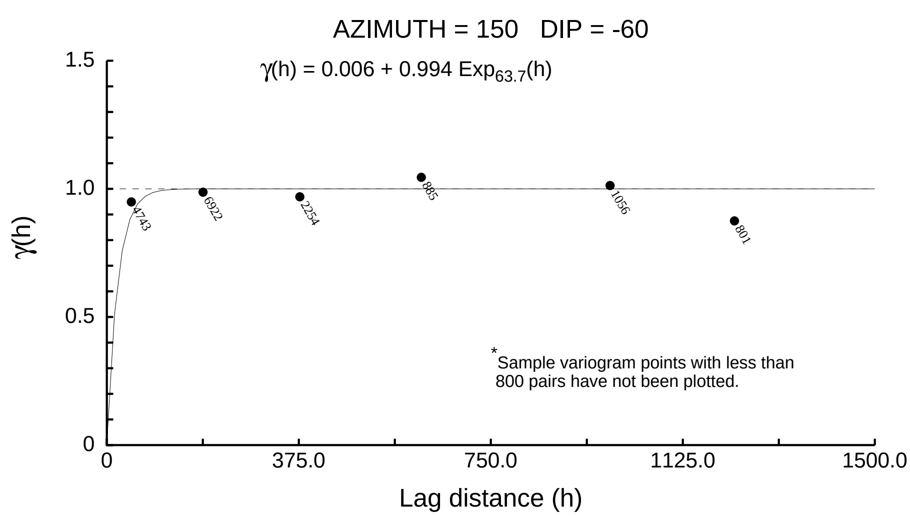




Directional 3000 - Cu

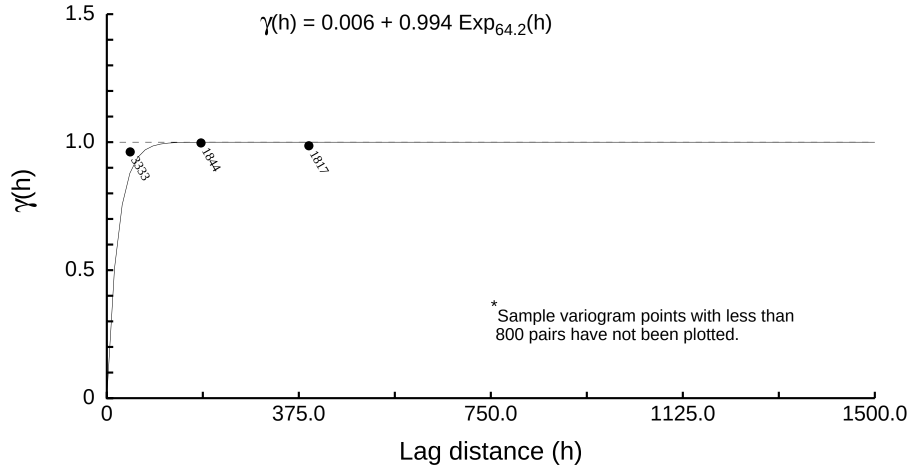




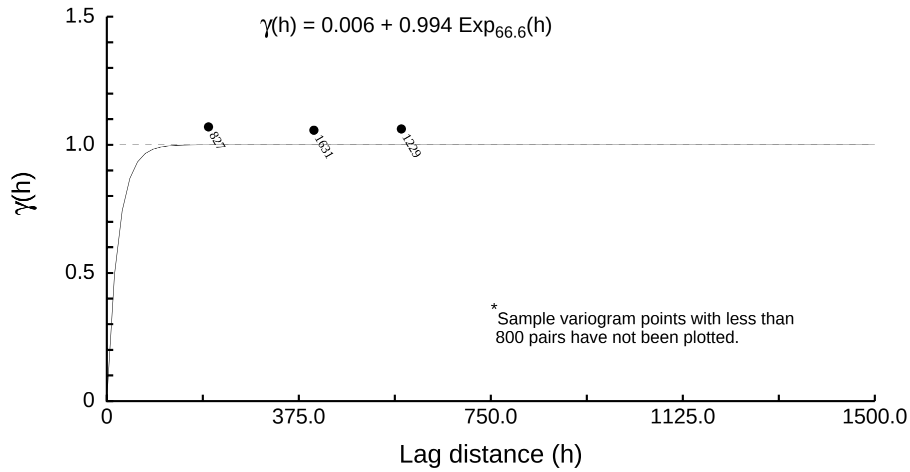


Directional 3000 - Cu

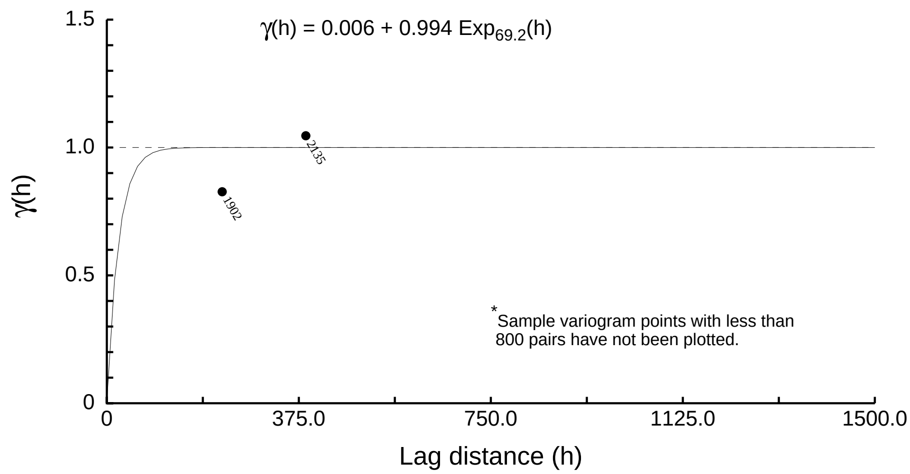
AZIMUTH = 180   DIP = -60



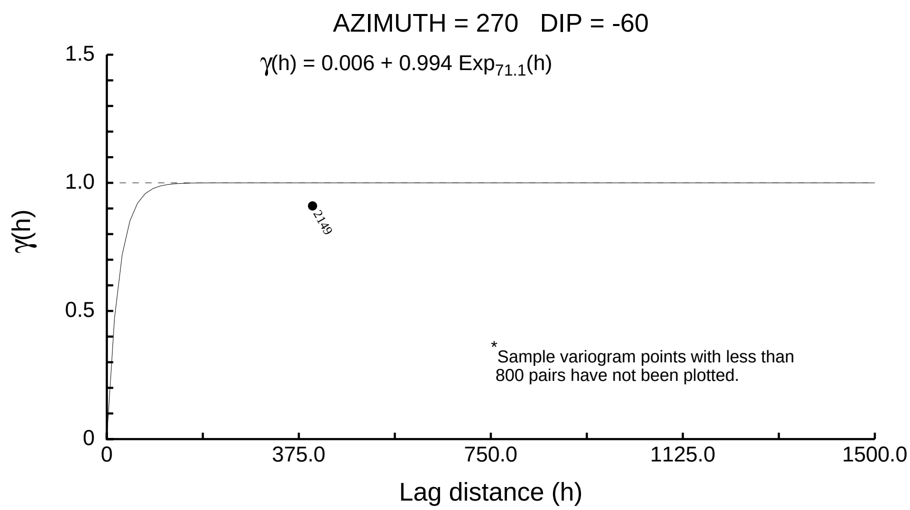
AZIMUTH = 210   DIP = -60

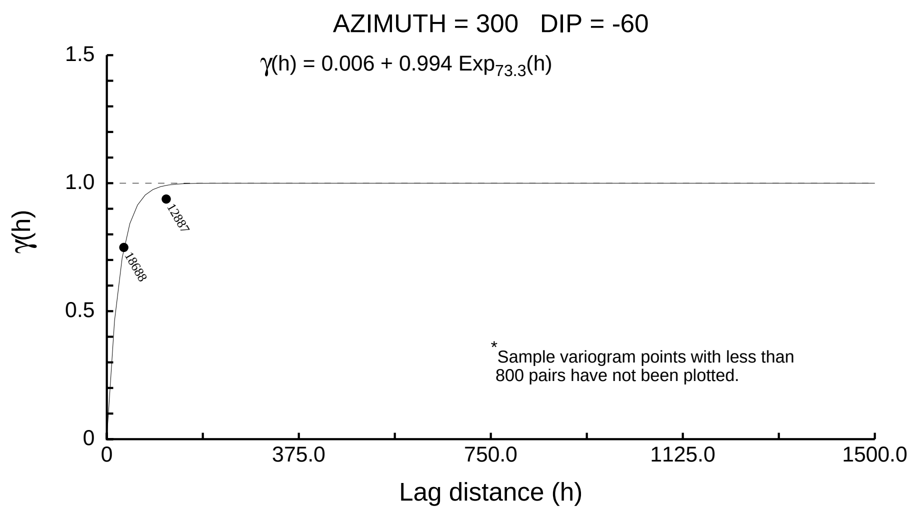


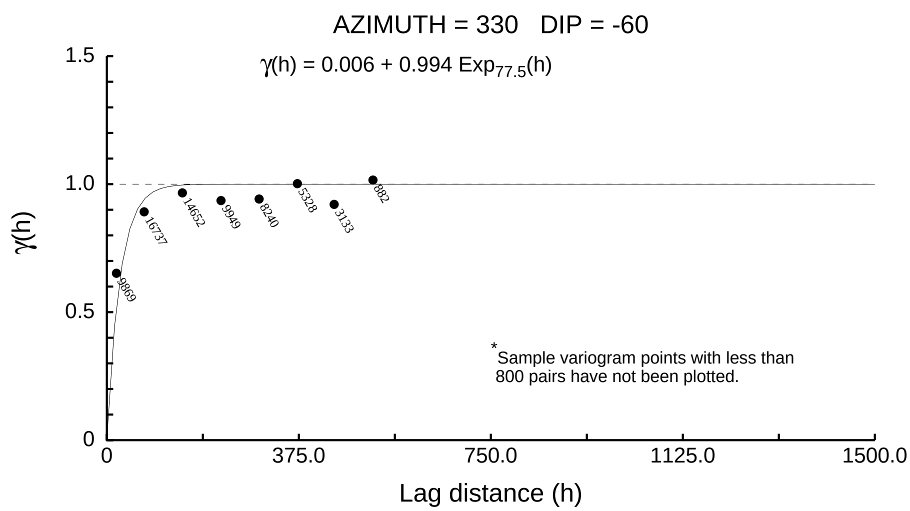
AZIMUTH = 240   DIP = -60



Directional 3000 - Cu







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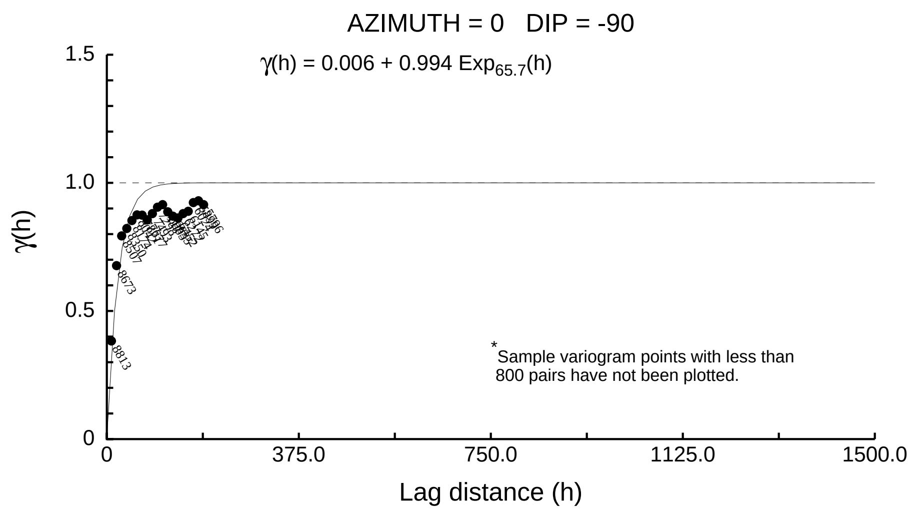
Directional 3000 - Cu



Directional 3000 - Ni

User Defined Rotation Conventions

Nugget ==> 0.142
C1 ==> 0.858

First Structure -- Exponential with Practical Range

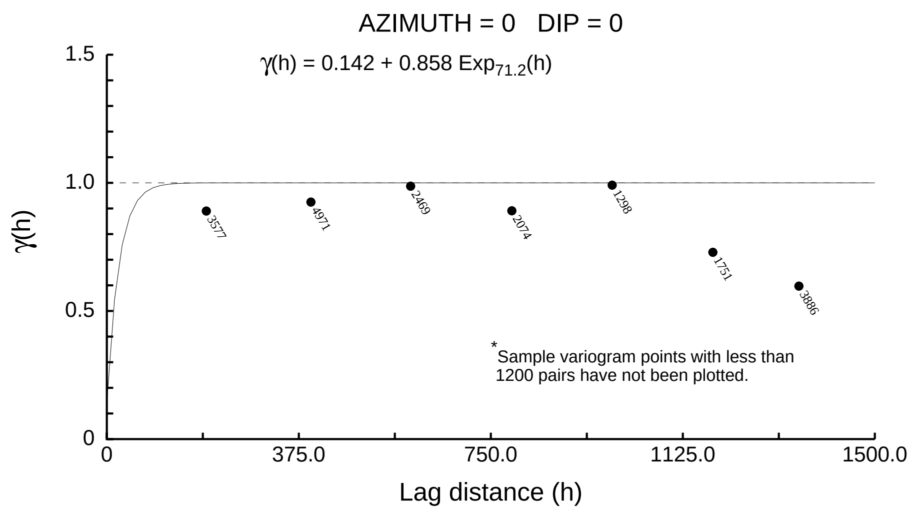
RH Rotation about the Z axis ==> 46
RH Rotation about the Y’ axis ==> -13
RH Rotation about the Z’ axis ==> -11

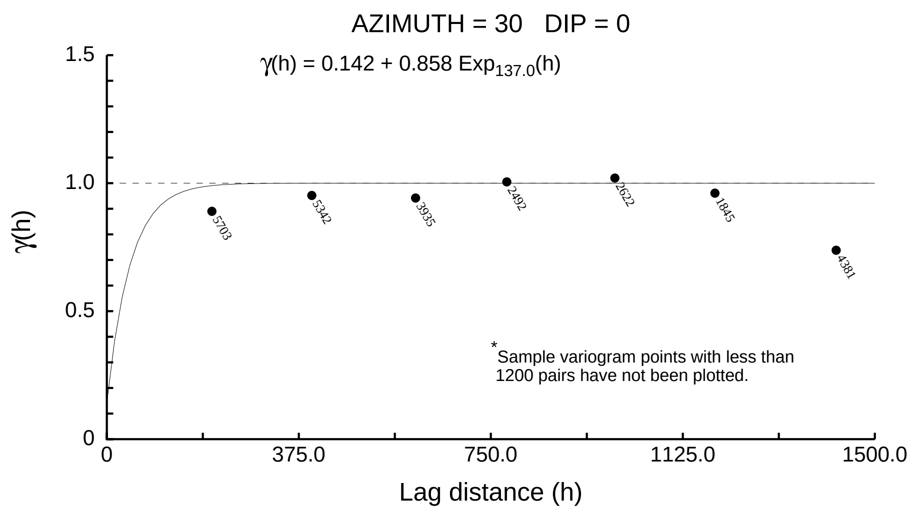
Range along the Z’ axis	==> 174.5	Azimuth ==> 224	Dip ==> 77
Range along the Y’ axis	==> 58.1	Azimuth ==> 325	Dip ==> 2
Range along the X’ axis	==> 956.8	Azimuth ==> 55	Dip ==> 12

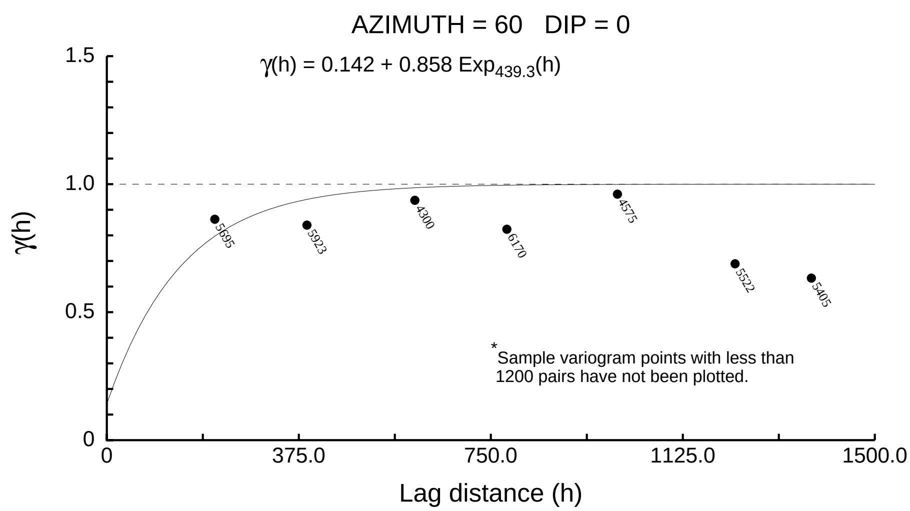
Modeling Criteria

Minimum number pairs req’d ==> 1200
Sample variogram points weighted by # pairs
Max allowable drift on head and tail means ==> 0.0

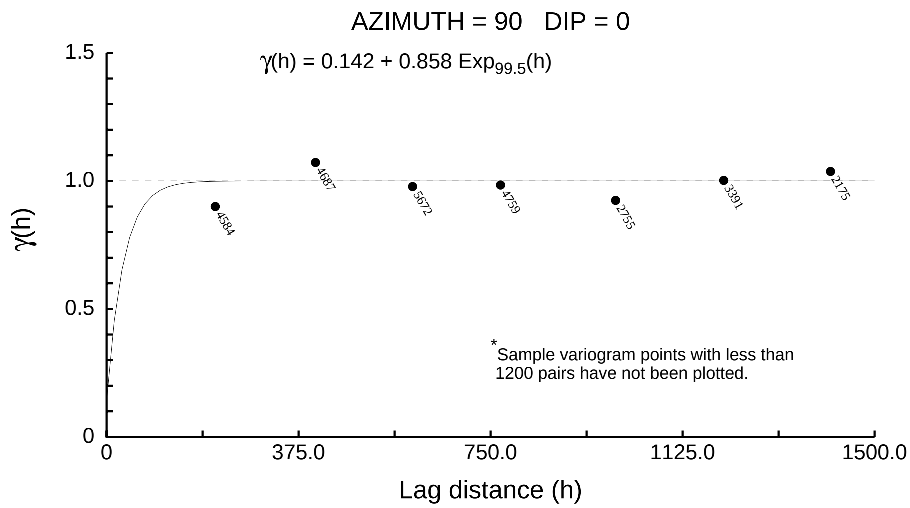
Directional 3000 - Ni

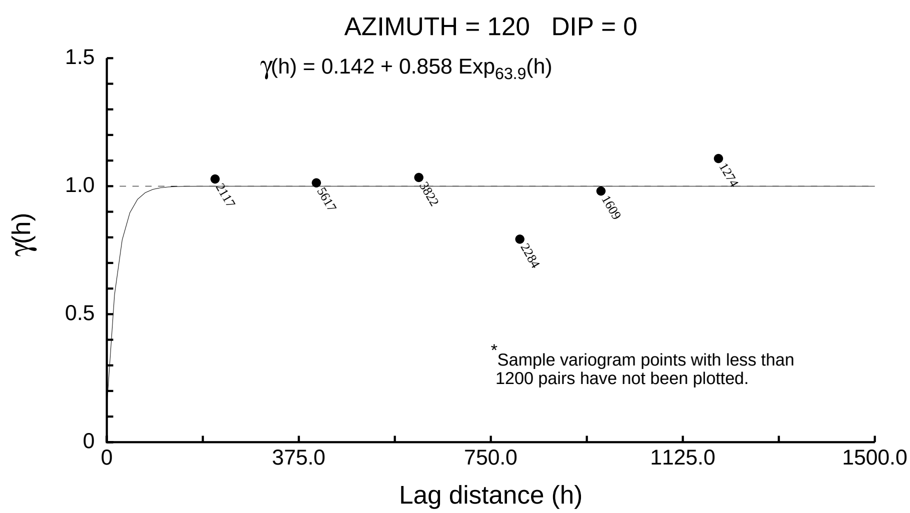


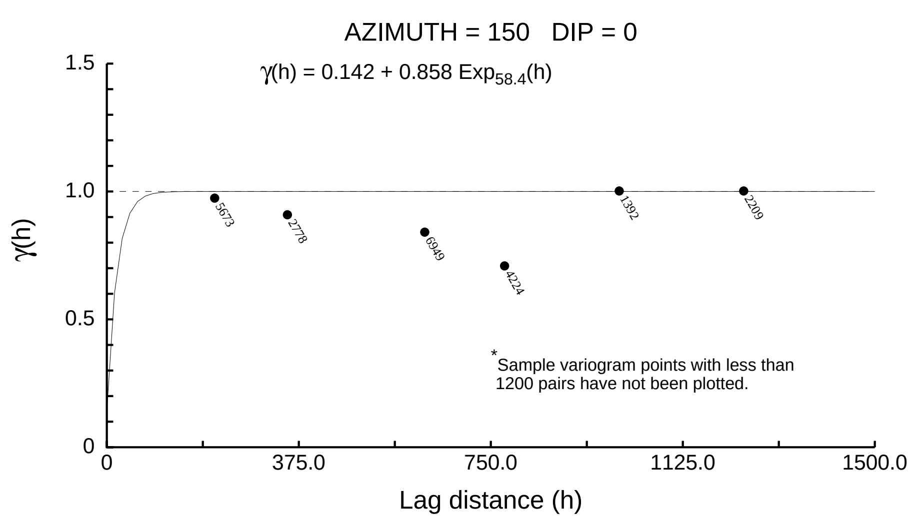




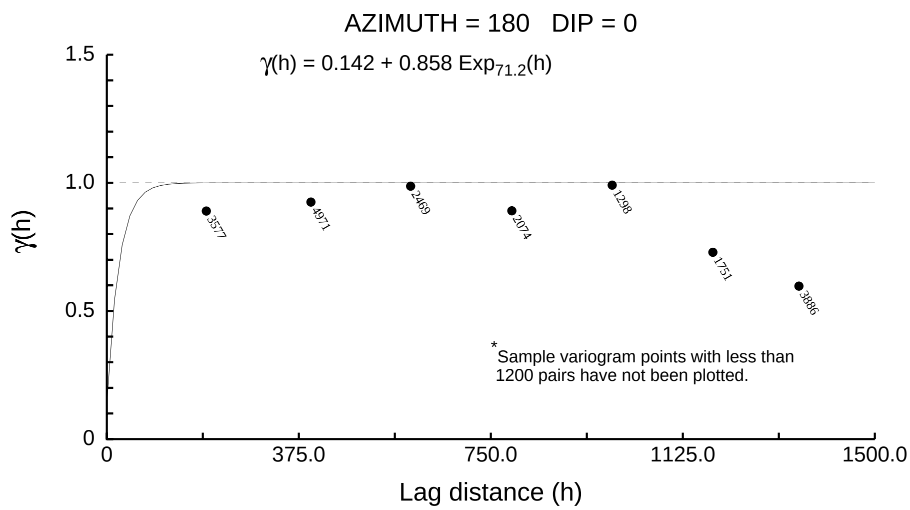
Directional 3000 - Ni

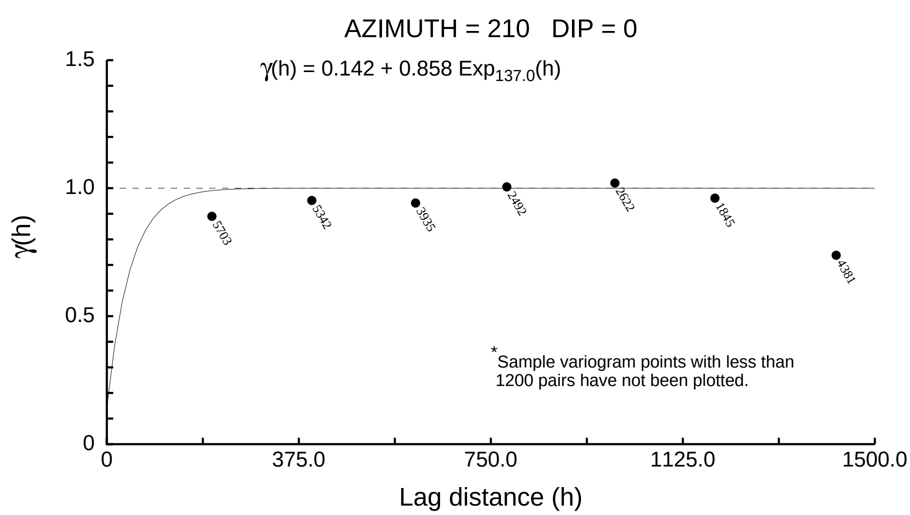


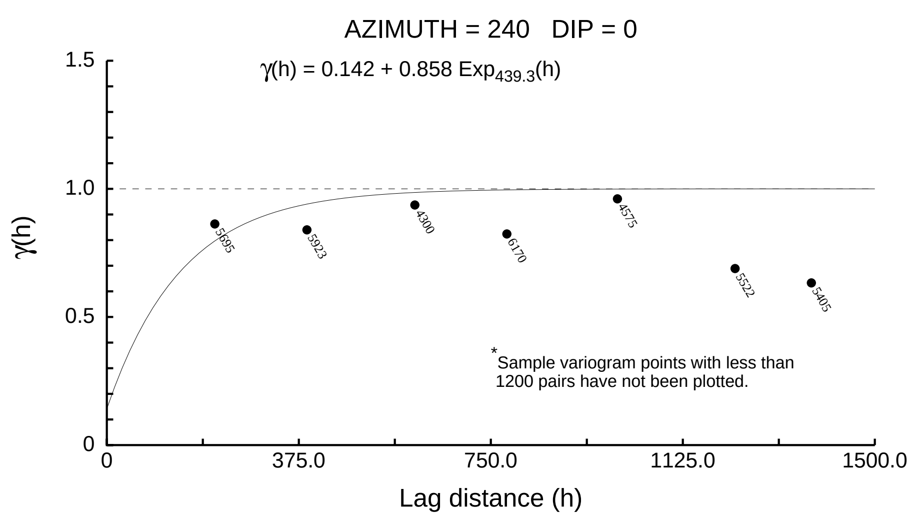




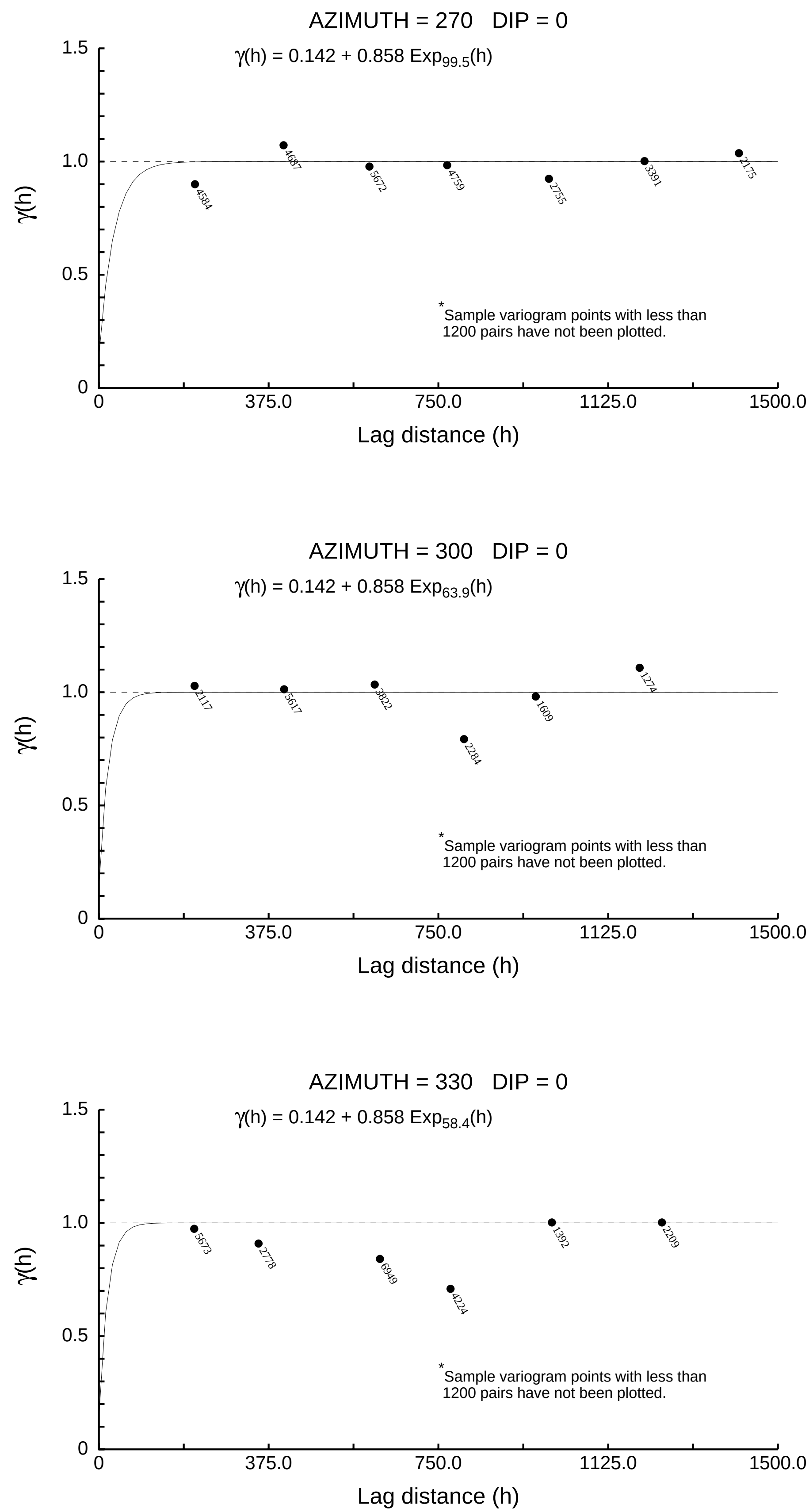
Directional 3000 - Ni







Directional 3000 - Ni



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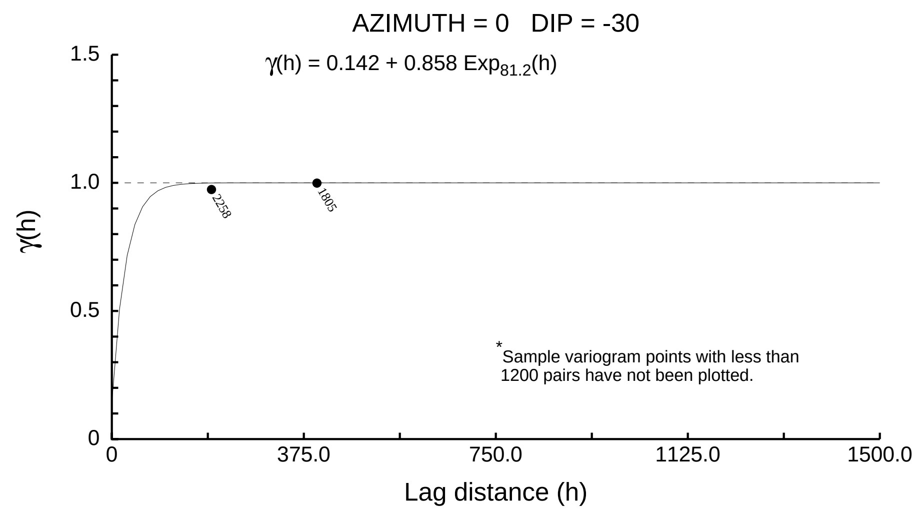
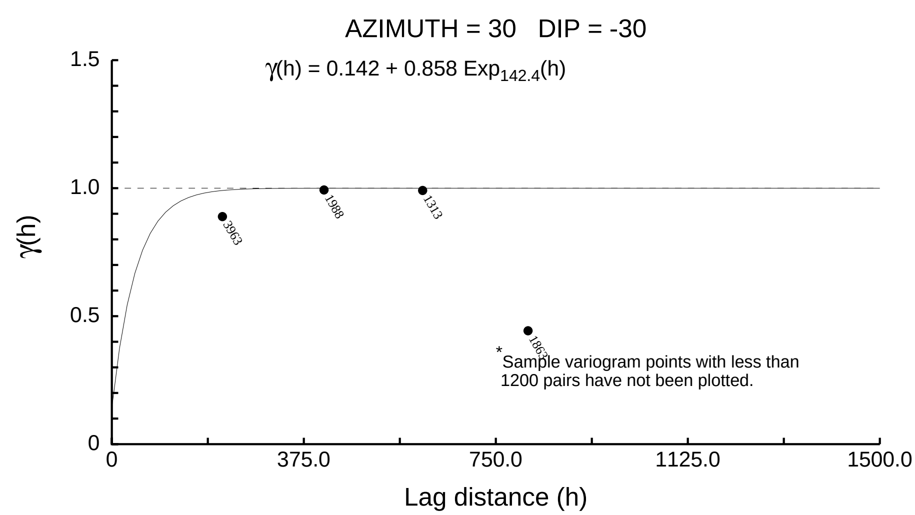
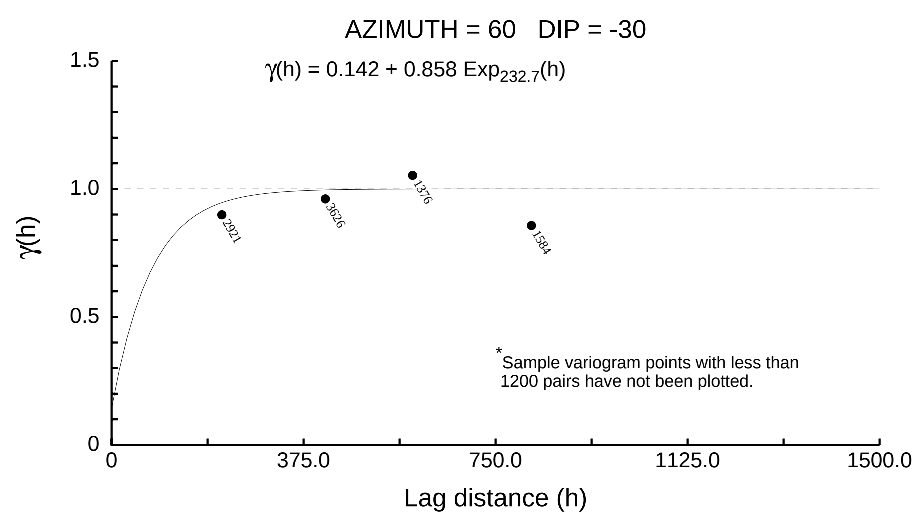
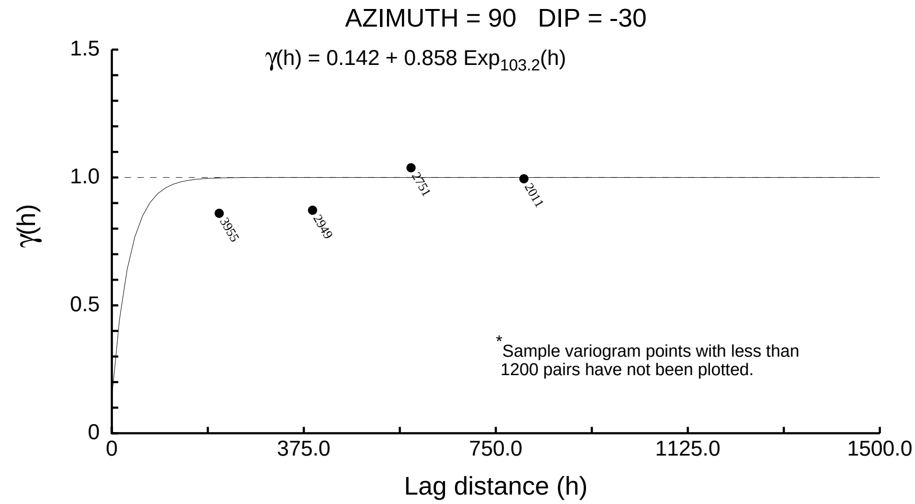
Directional 3000 - Ni

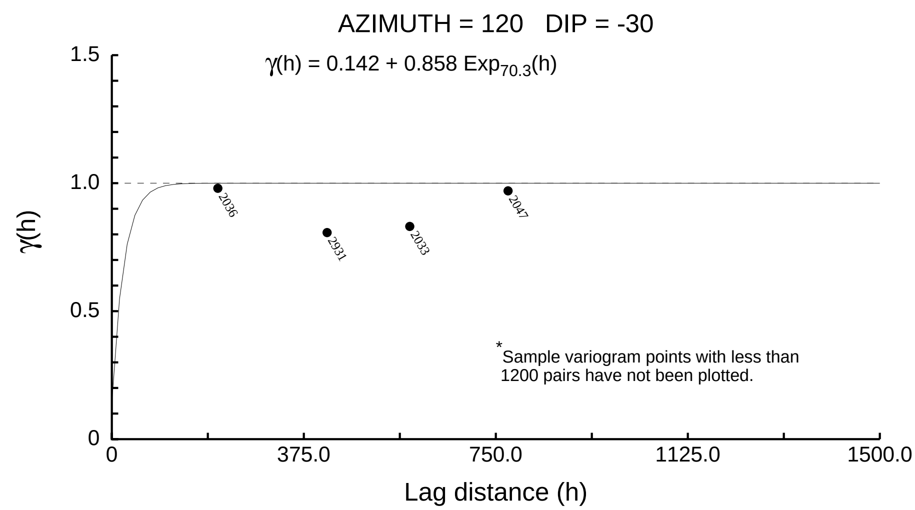


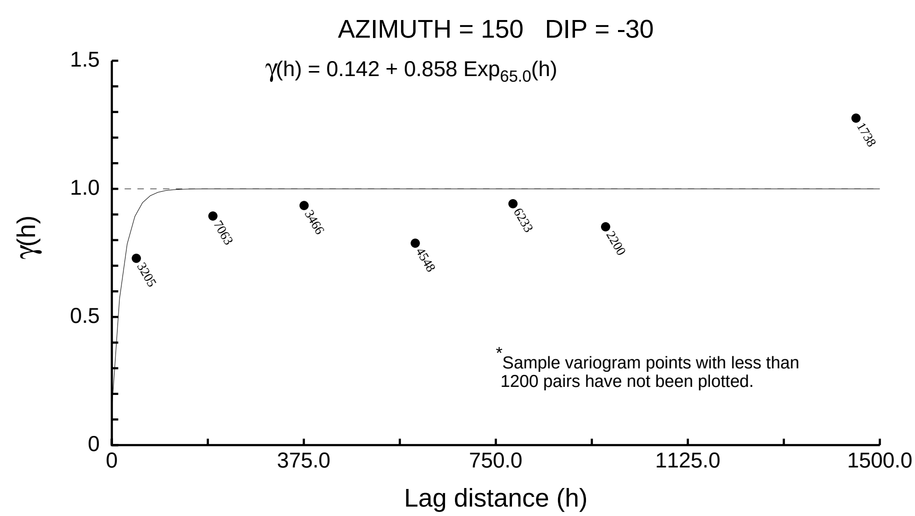




Directional 3000 - Ni

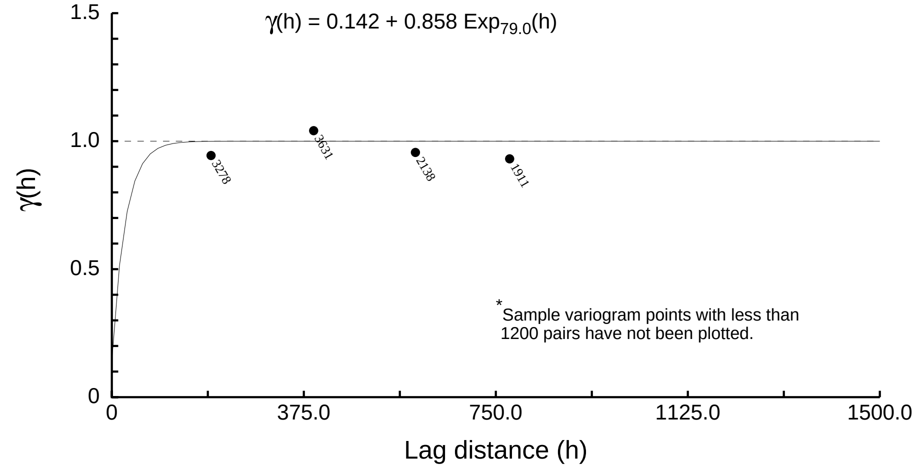




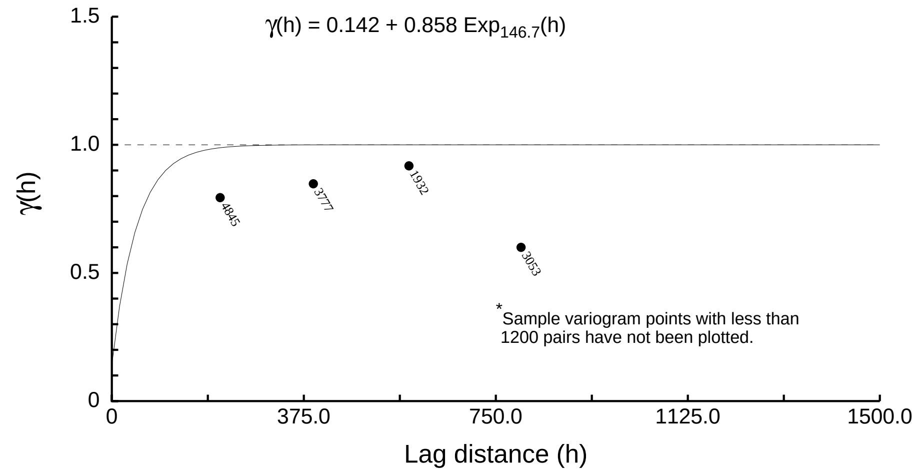


Directional 3000 - Ni

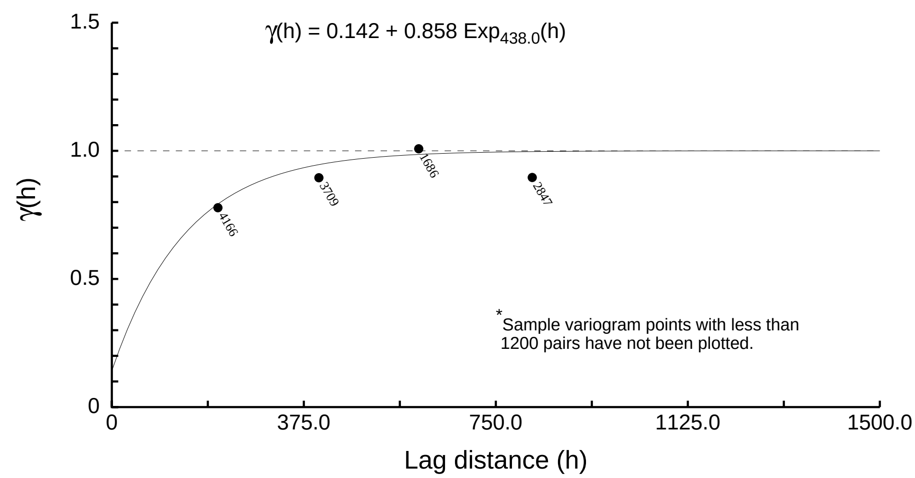
AZIMUTH = 180   DIP = -30



AZIMUTH = 210   DIP = -30

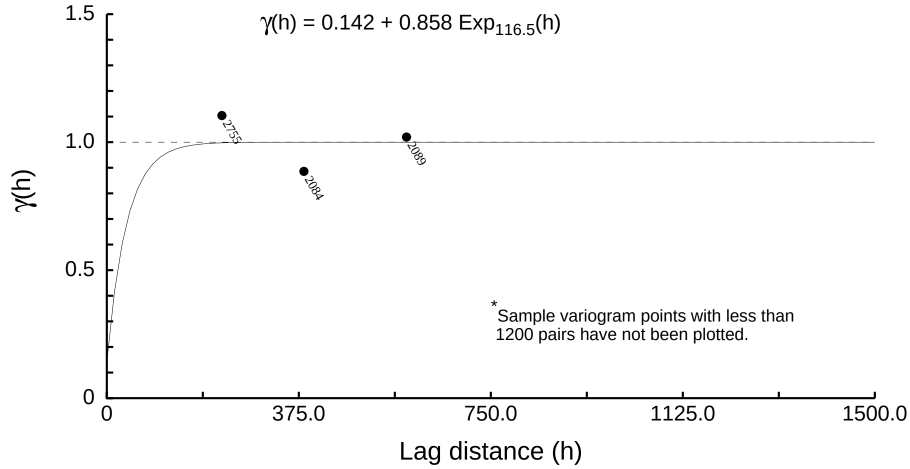


AZIMUTH = 240   DIP = -30

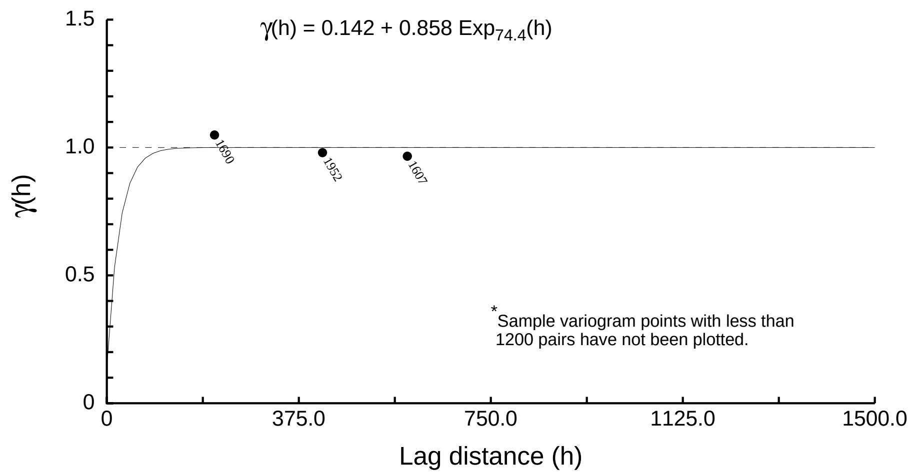


Directional 3000 - Ni

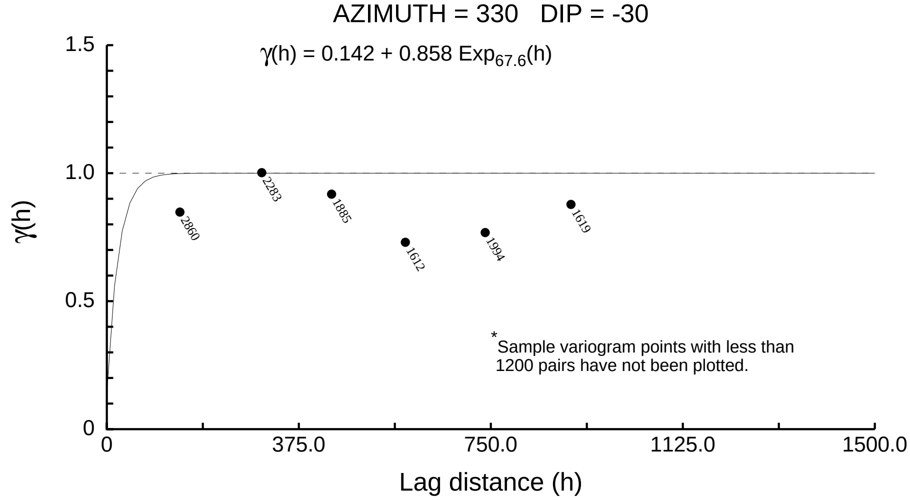
AZIMUTH = 270 DIP = -30



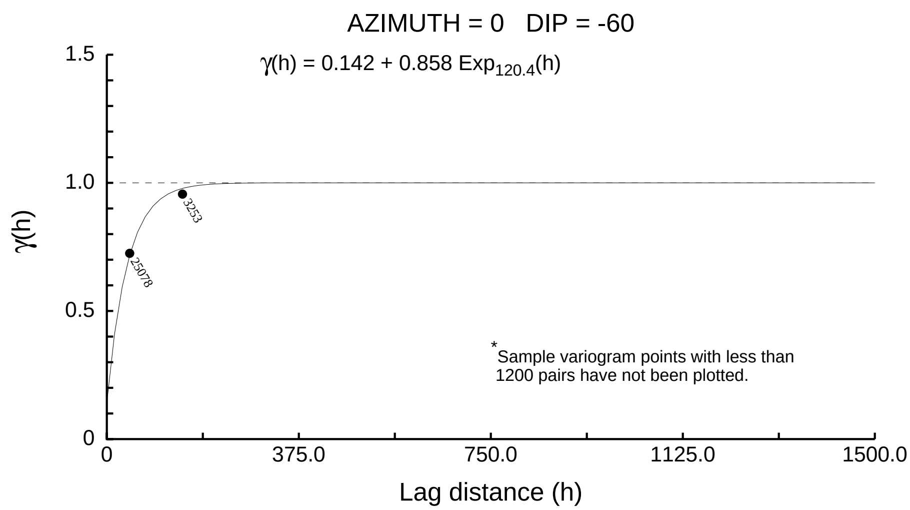
AZIMUTH = 300 DIP = -30

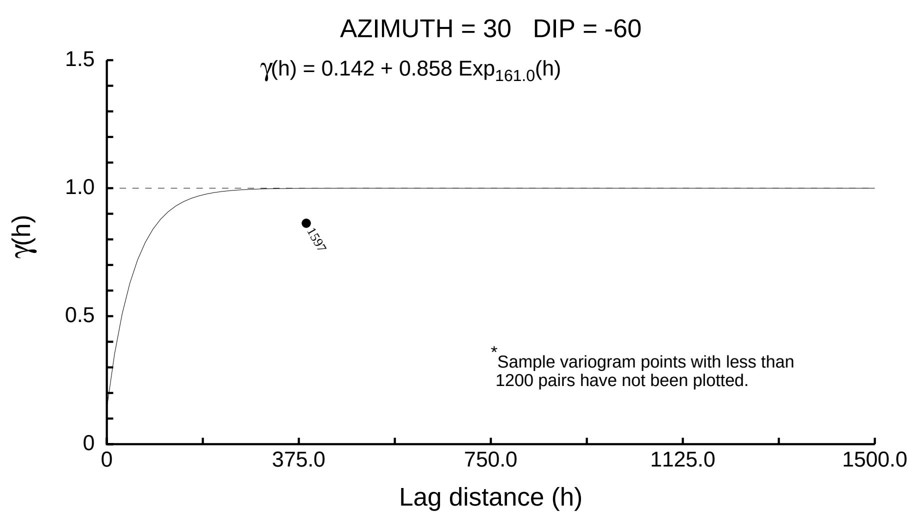


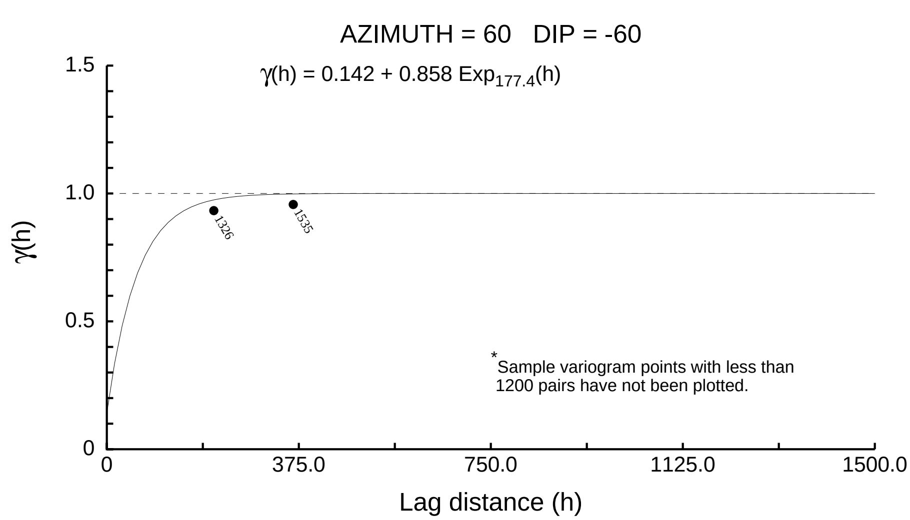
AZIMUTH = 330 DIP = -30



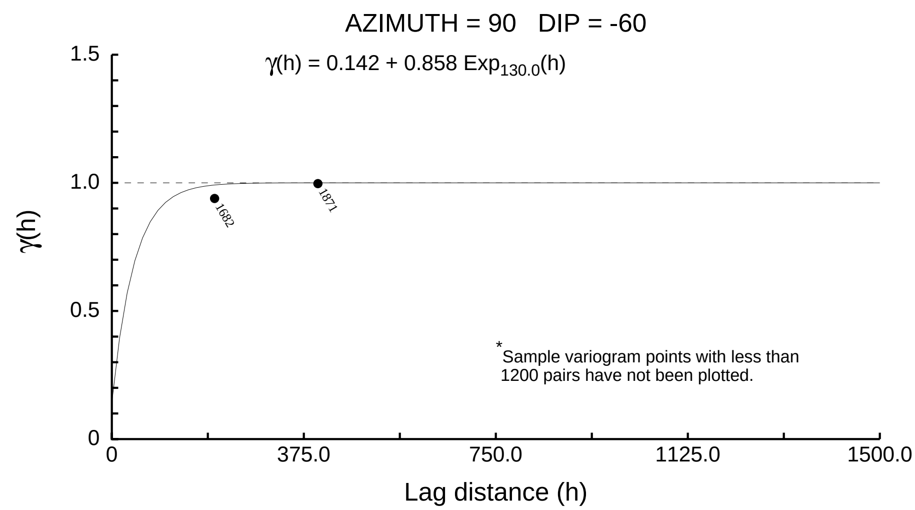
Directional 3000 - Ni

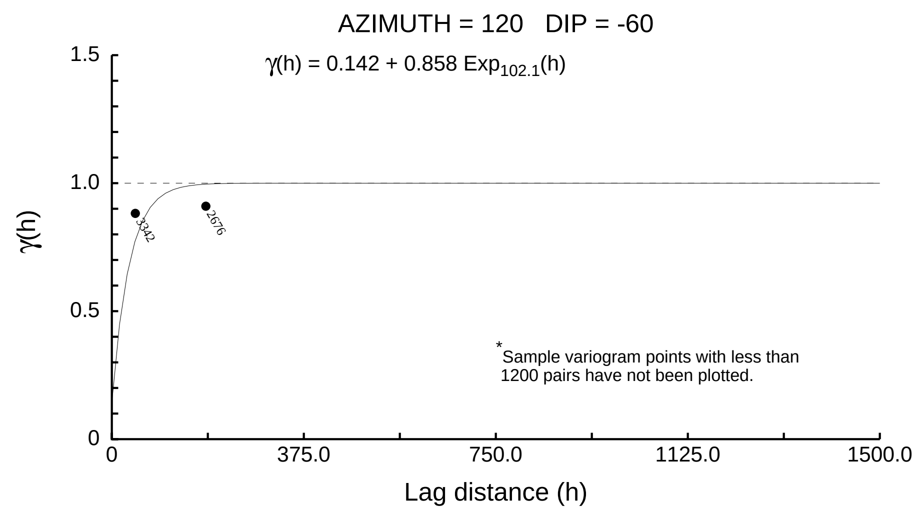


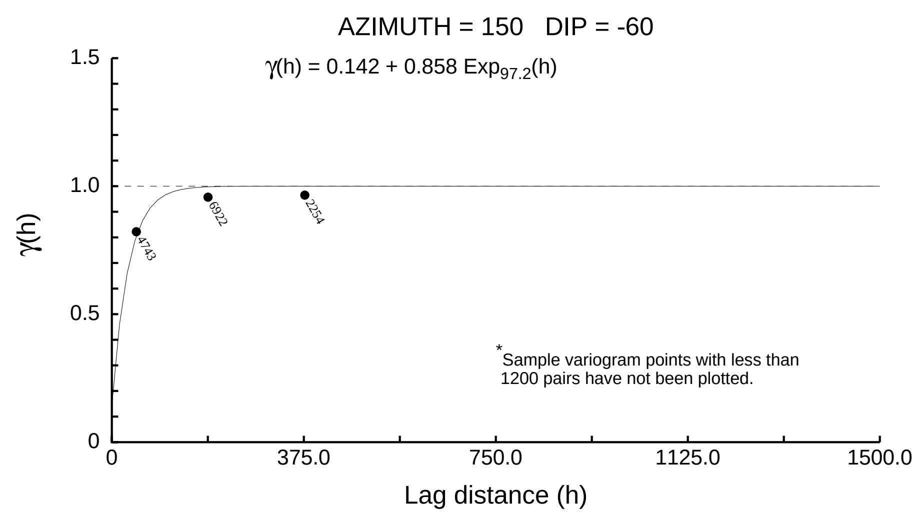




Directional 3000 - Ni







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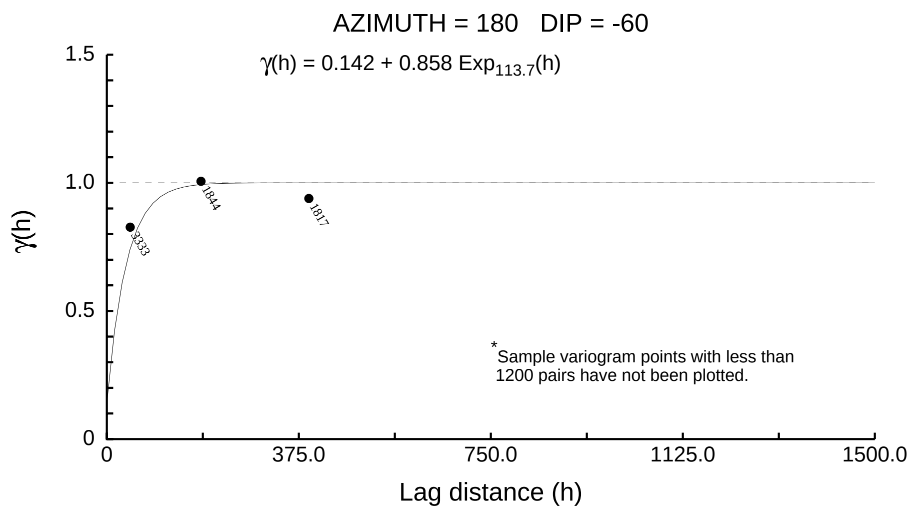
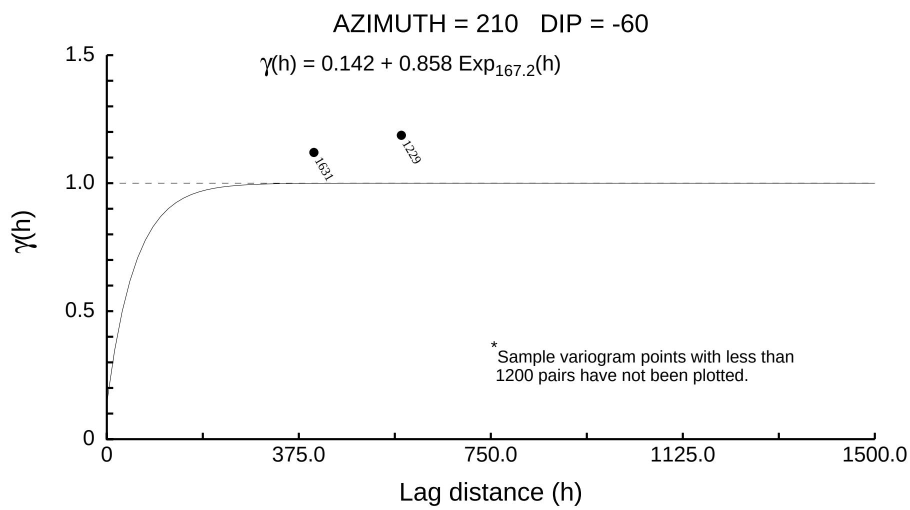
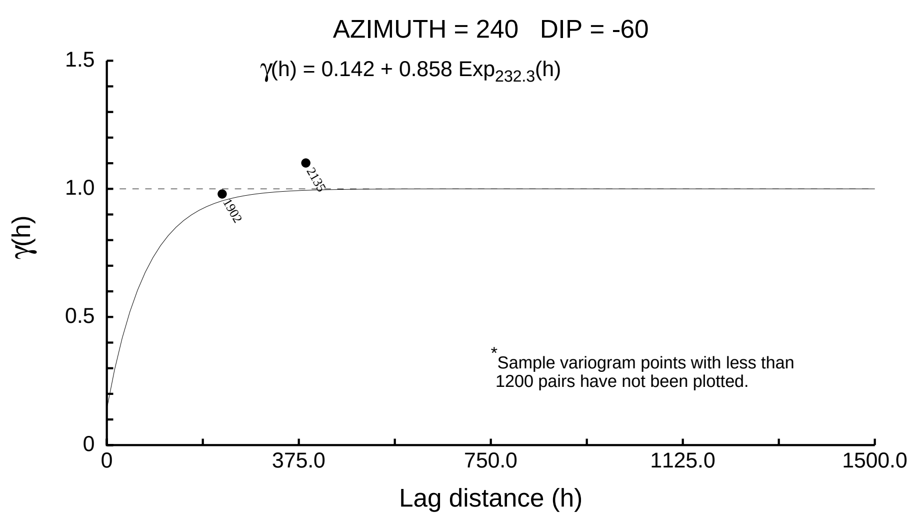
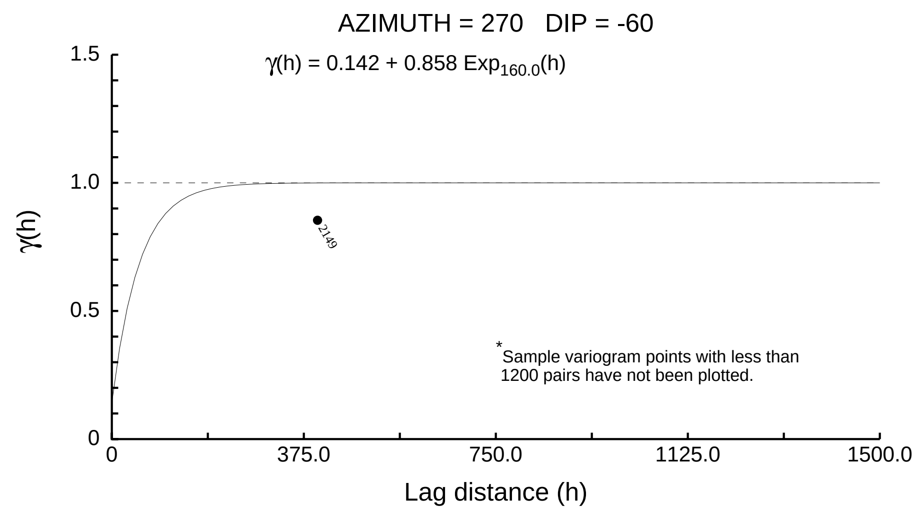
Directional 3000 - Ni

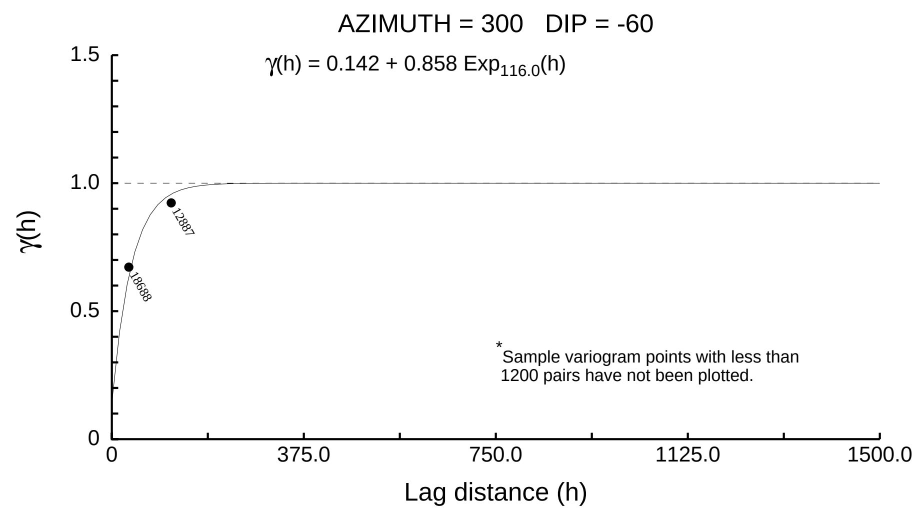


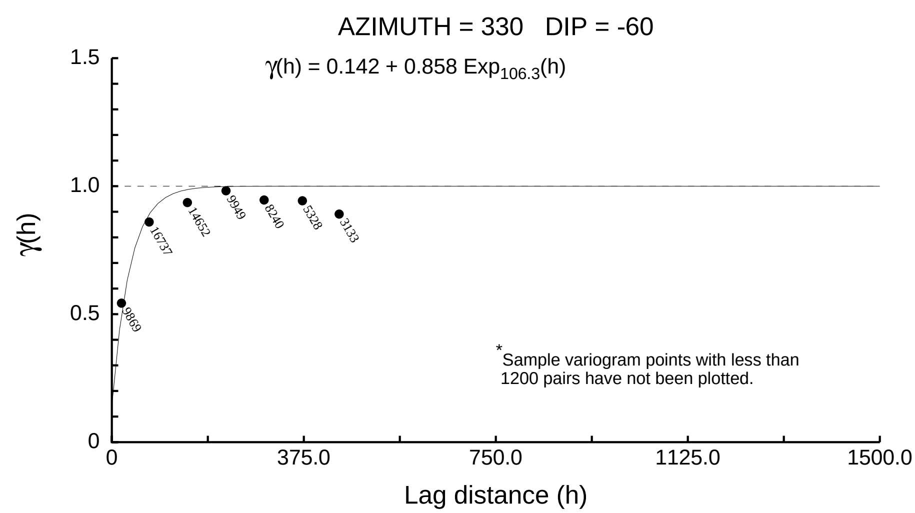




Directional 3000 - Ni







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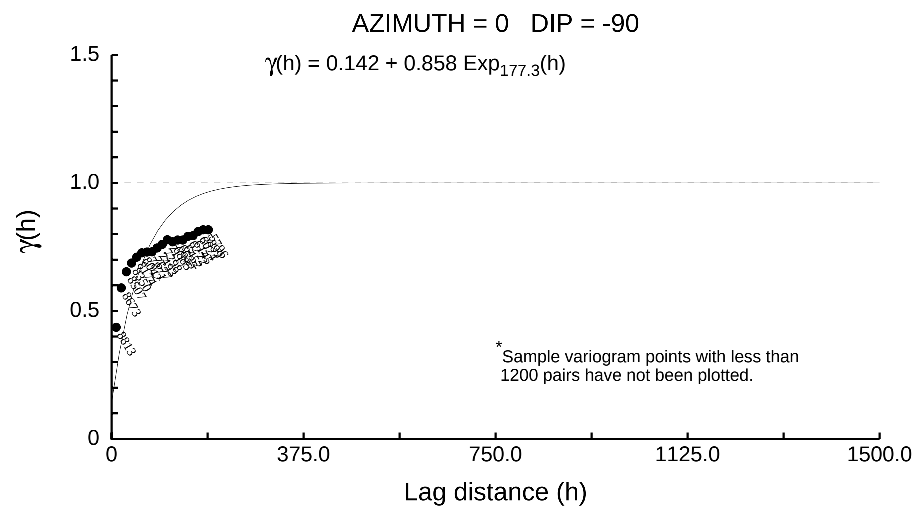
Directional 3000 - Ni



Directional 3000 - Pd

User Defined Rotation Conventions

Nugget ==> 0.400
C1 ==> 0.600

First Structure -- Exponential with Practical Range

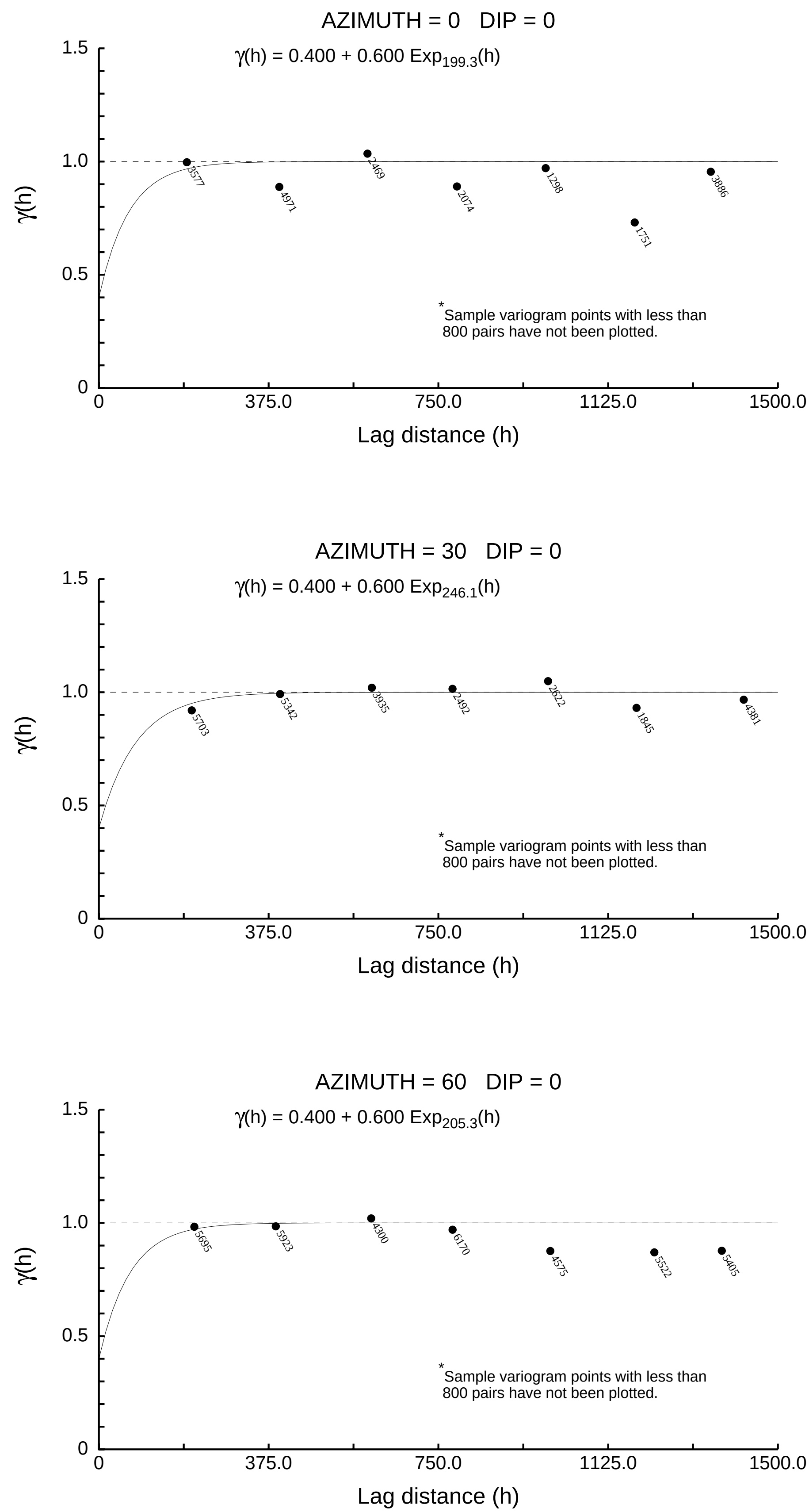
RH Rotation about the Z axis ==> -14
RH Rotation about the Y' axis ==> 25
RH Rotation about the Z' axis ==> 31

Range along the Z' axis ==> 68.2	Azimuth ==> 104	Dip ==> 65
Range along the Y' axis ==> 198.2	Azimuth ==> 346	Dip ==> 13
Range along the X' axis ==> 648.6	Azimuth ==> 71	Dip ==> -21

Modeling Criteria

Minimum number pairs req'd ==> 800
Sample variogram points weighted by # pairs

Directional 3000 - Pd



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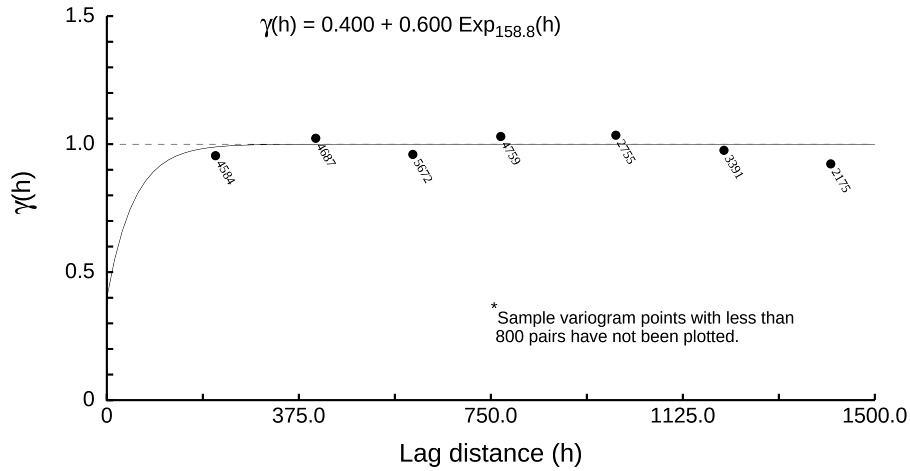
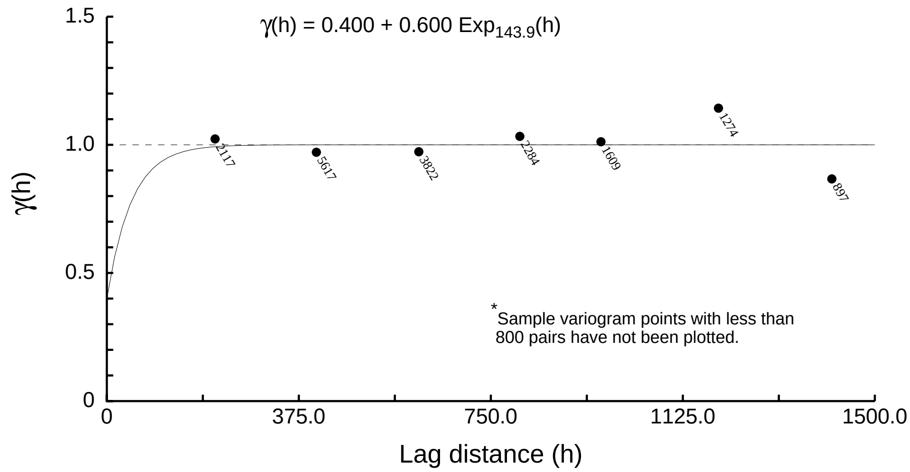
Directional 3000 - Pd

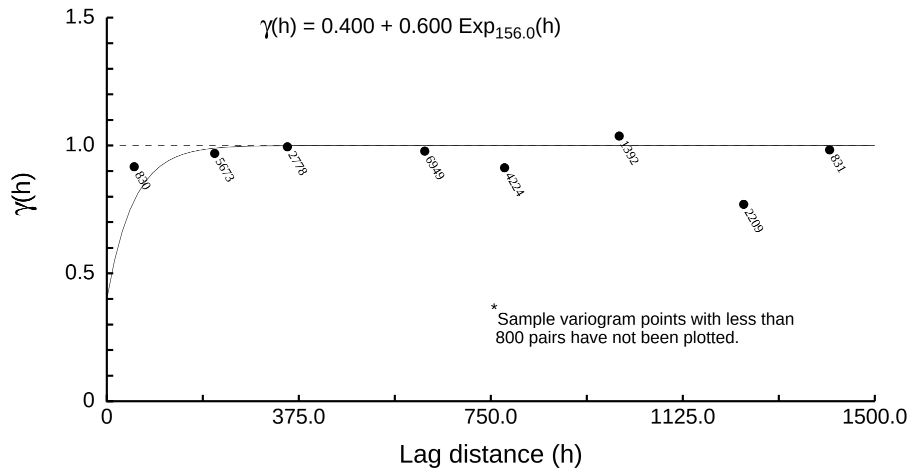
AZIMUTH = 90   DIP = 0



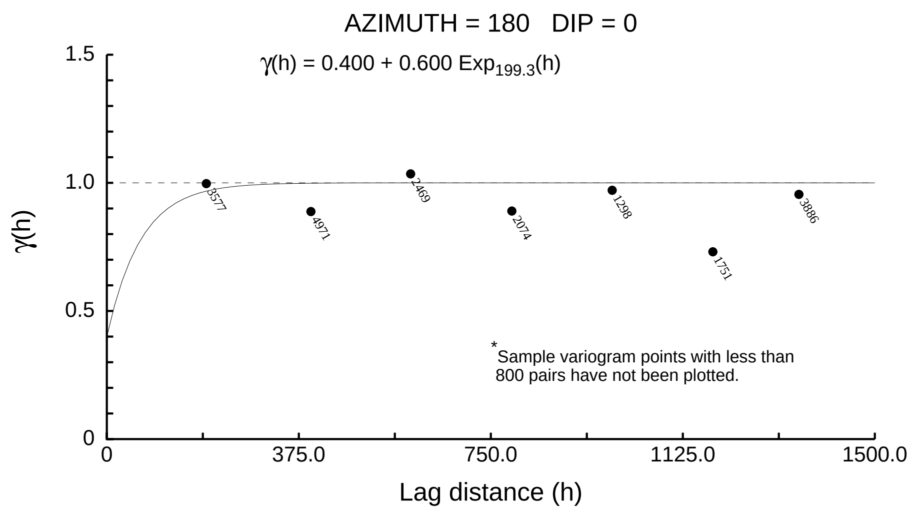
AZIMUTH = 120   DIP = 0

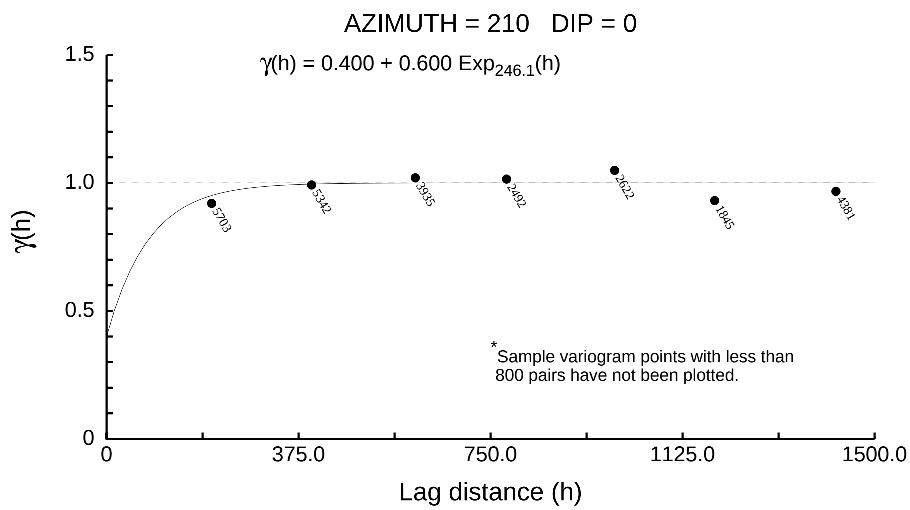


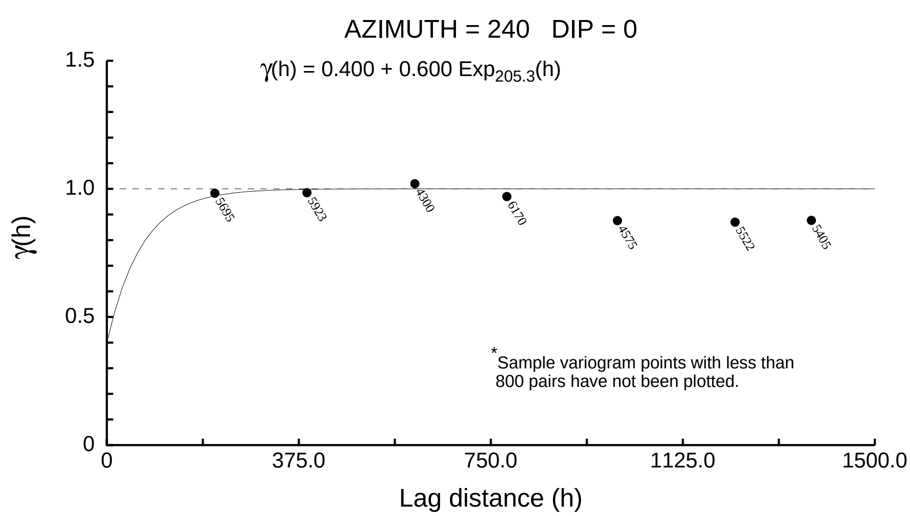
AZIMUTH = 150   DIP = 0



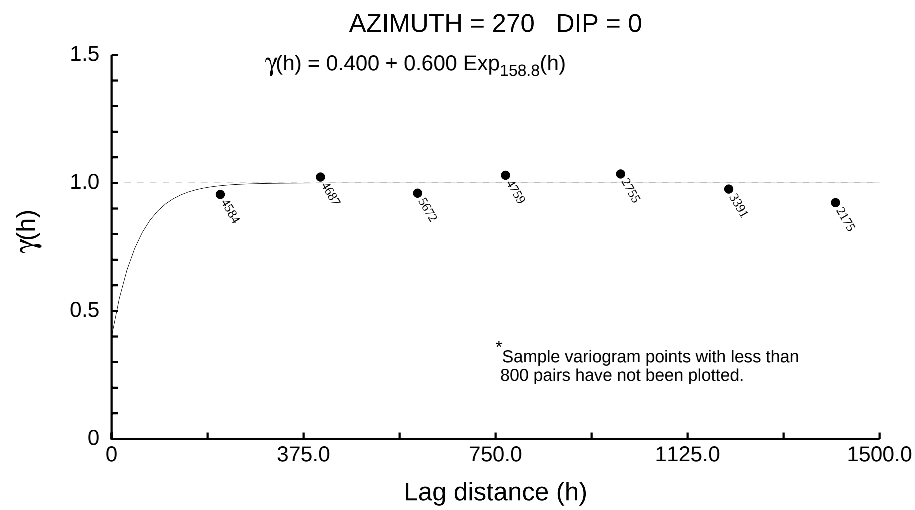
Directional 3000 - Pd

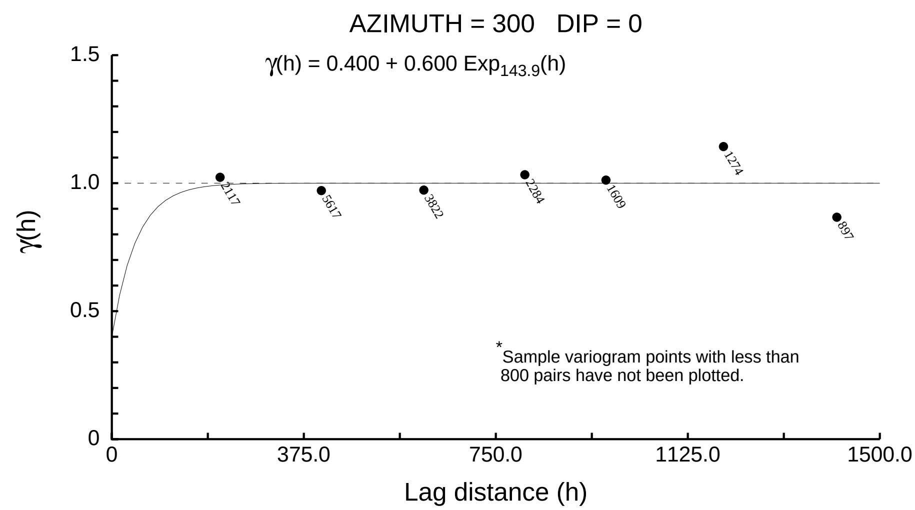


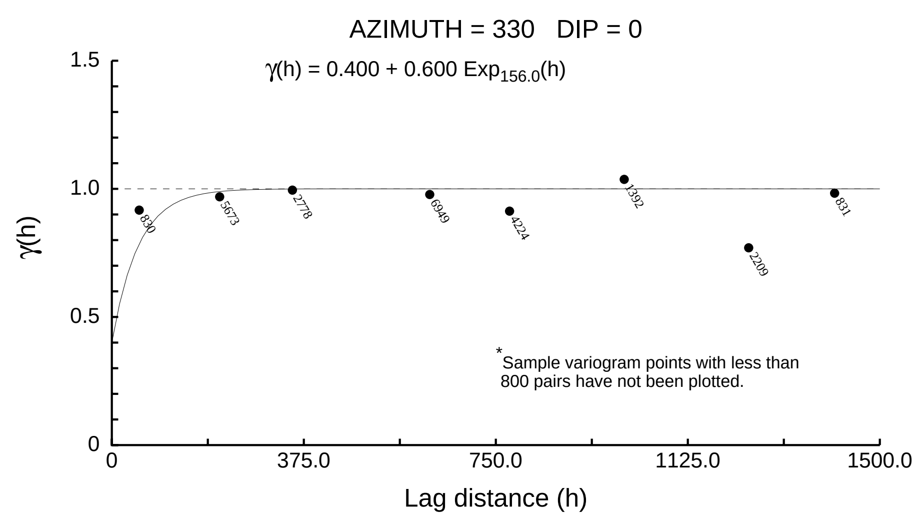




Directional 3000 - Pd

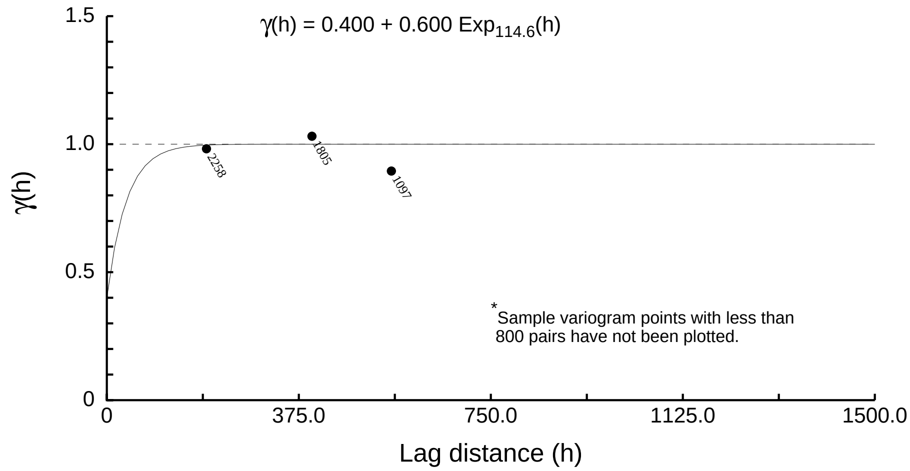




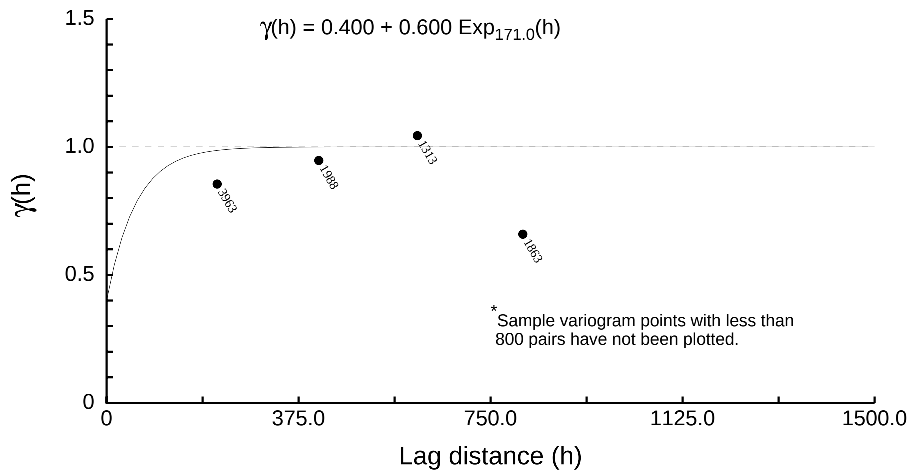


Directional 3000 - Pd

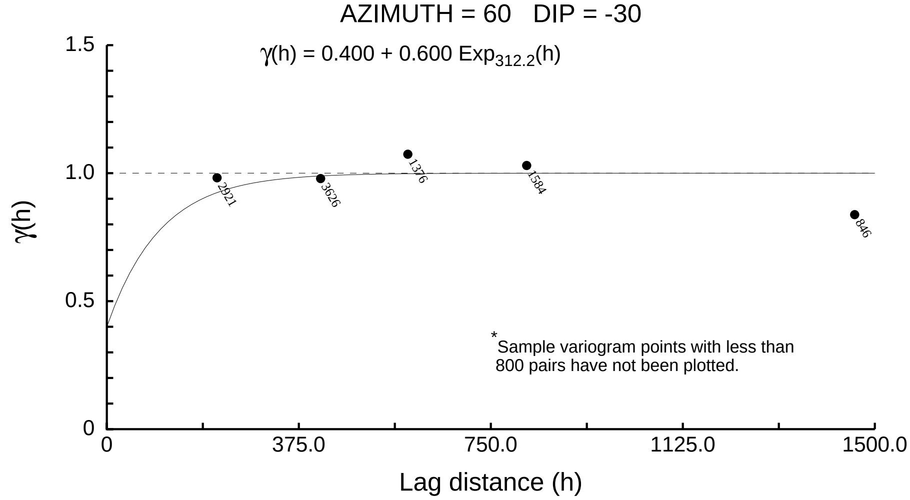
AZIMUTH = 0   DIP = -30



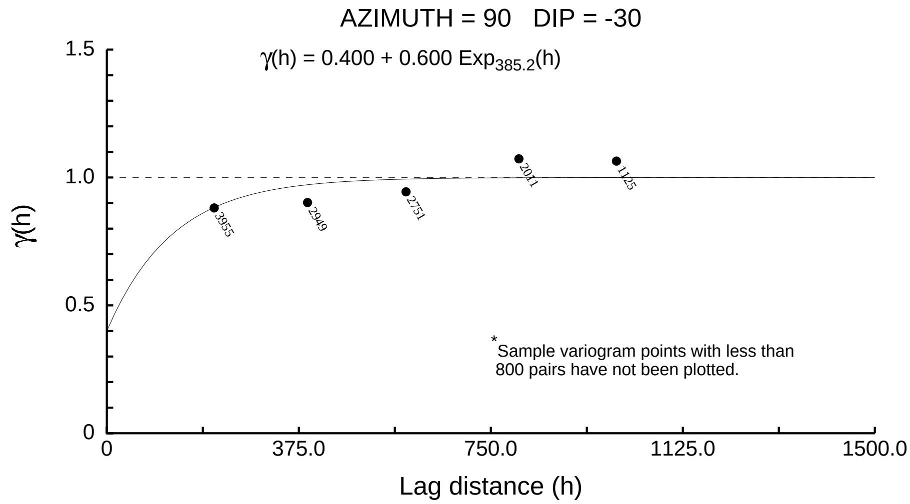
AZIMUTH = 30   DIP = -30

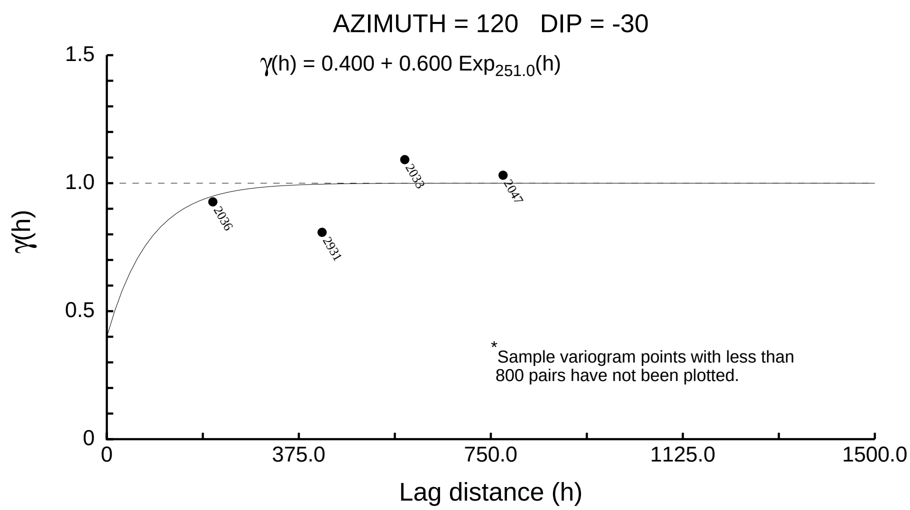


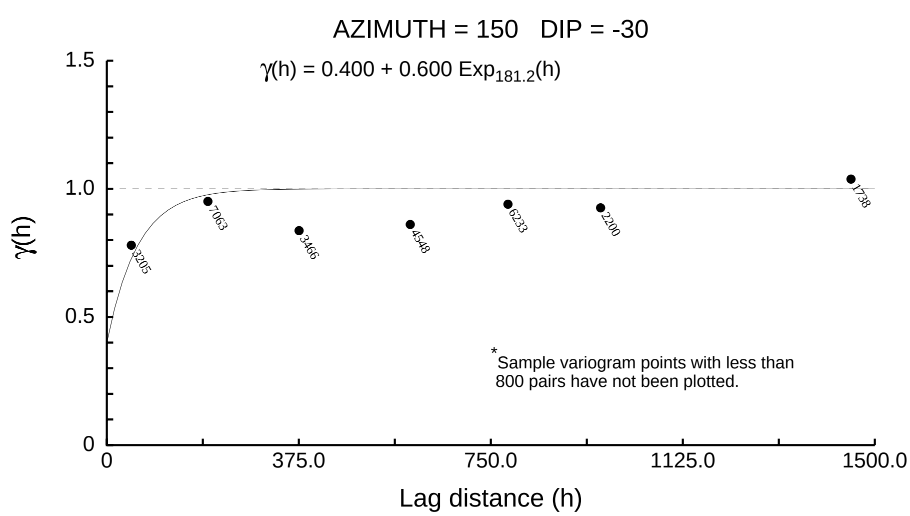
AZIMUTH = 60   DIP = -30



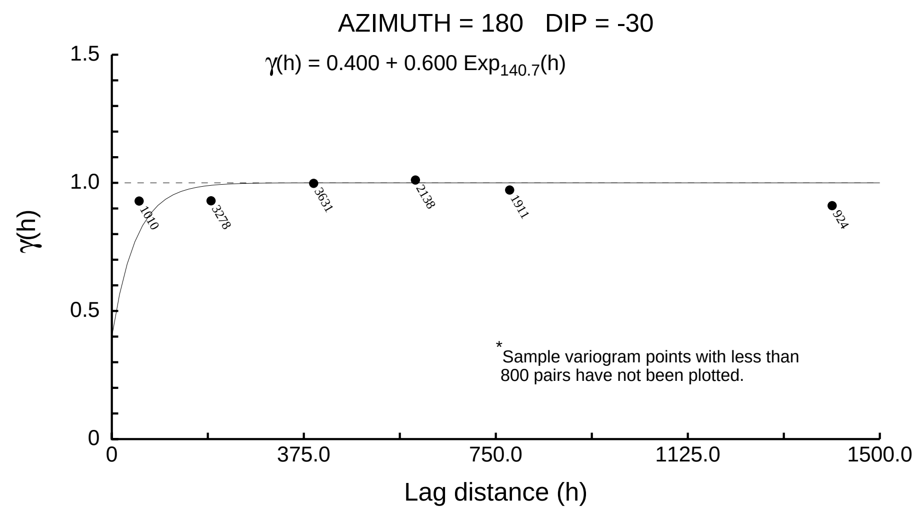
Directional 3000 - Pd

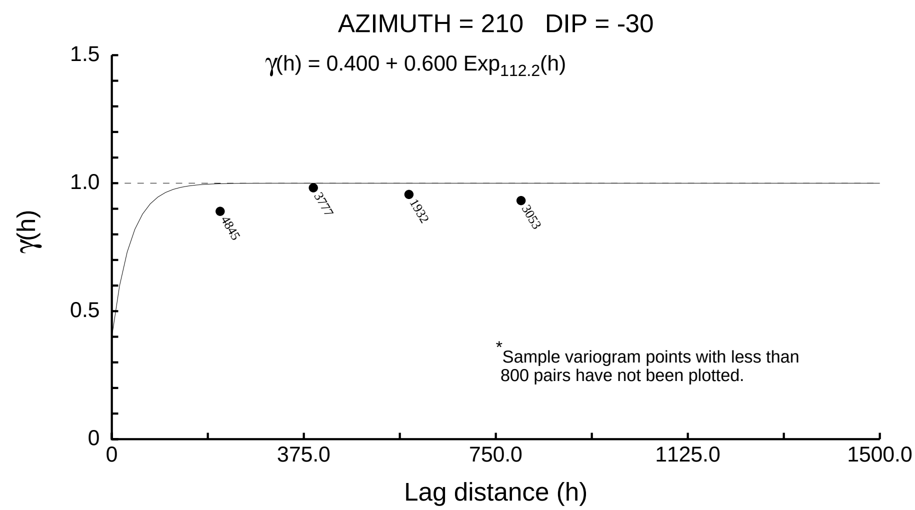


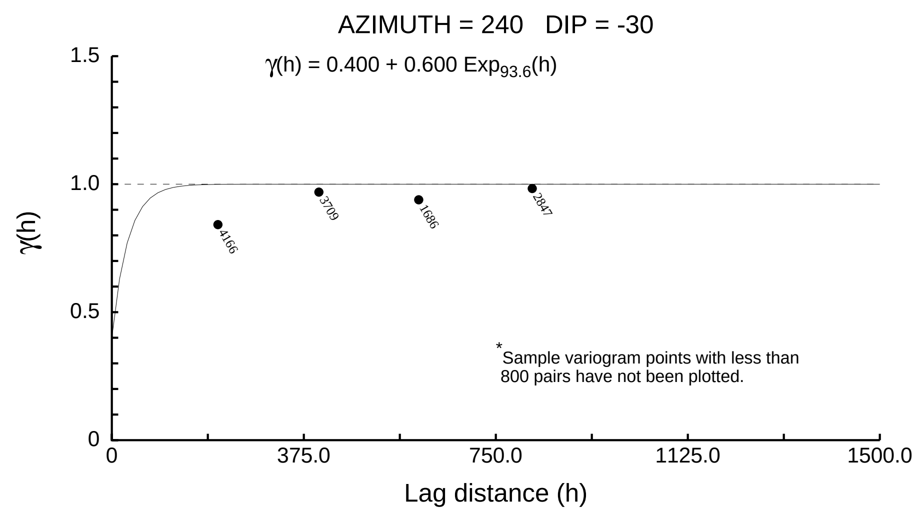




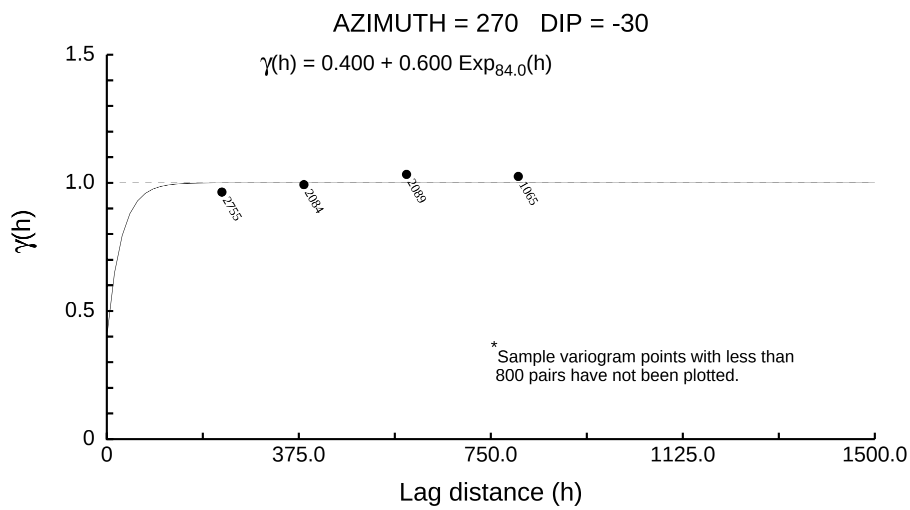
Directional 3000 - Pd

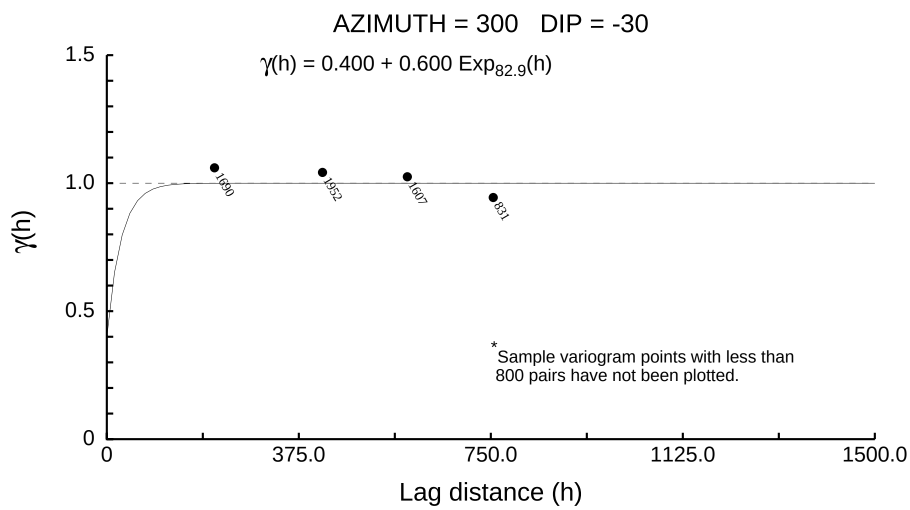


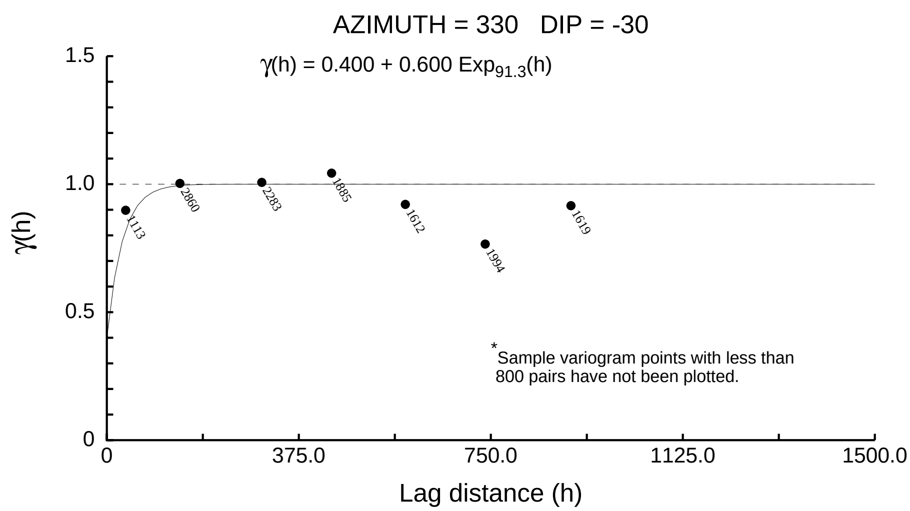




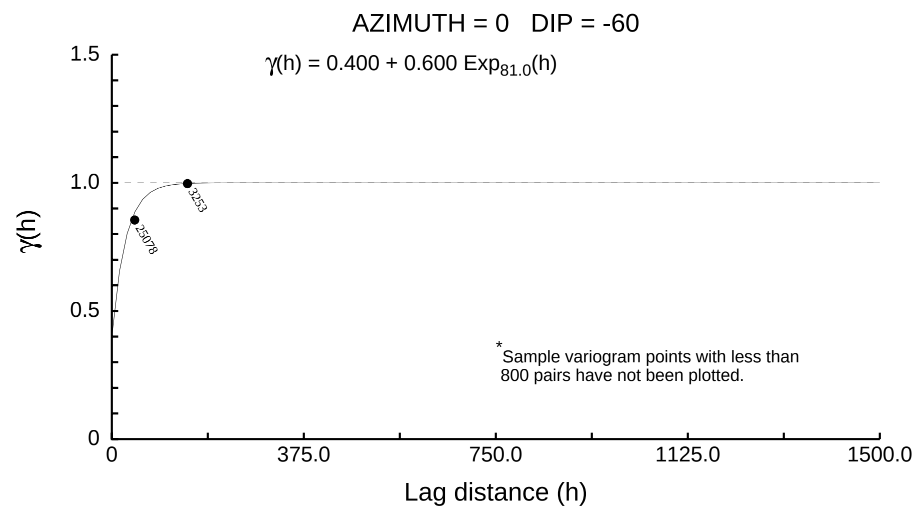
Directional 3000 - Pd

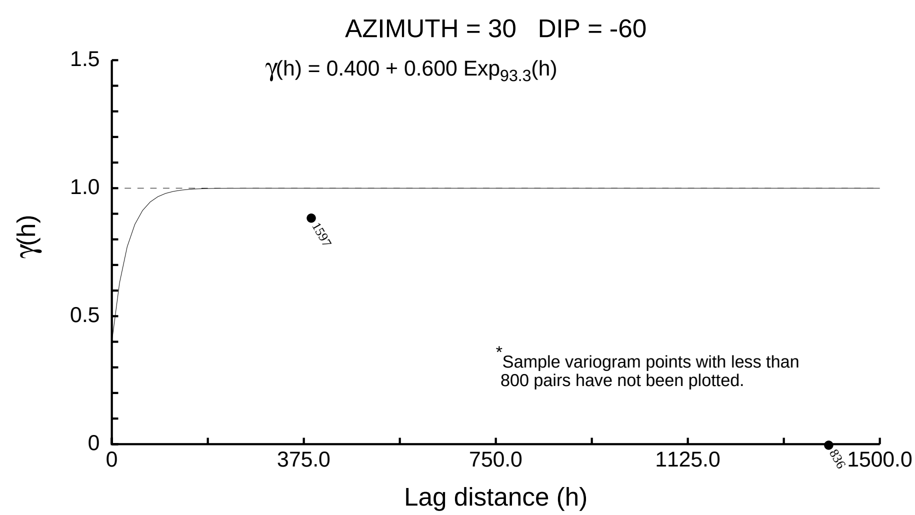


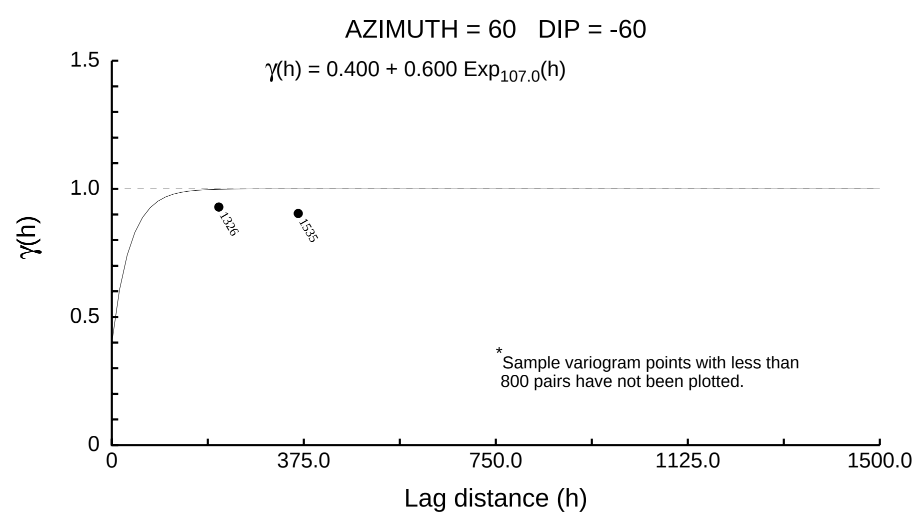




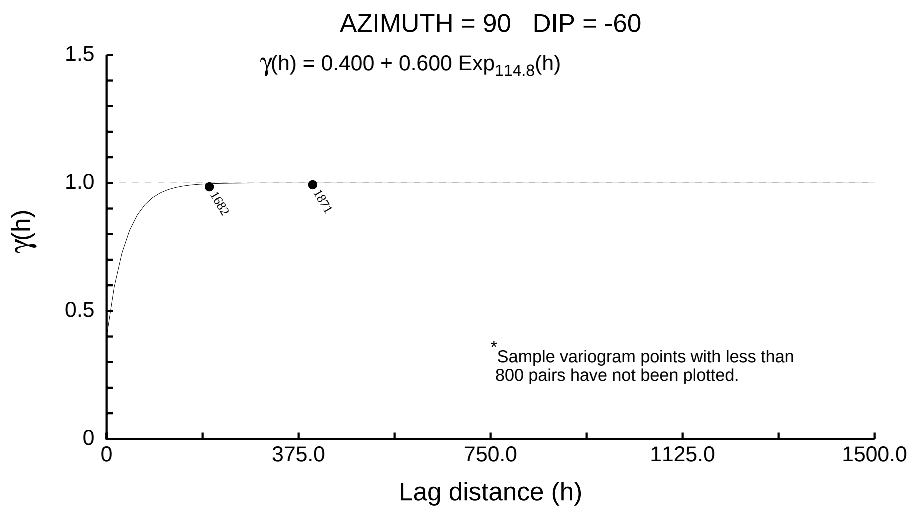
Directional 3000 - Pd

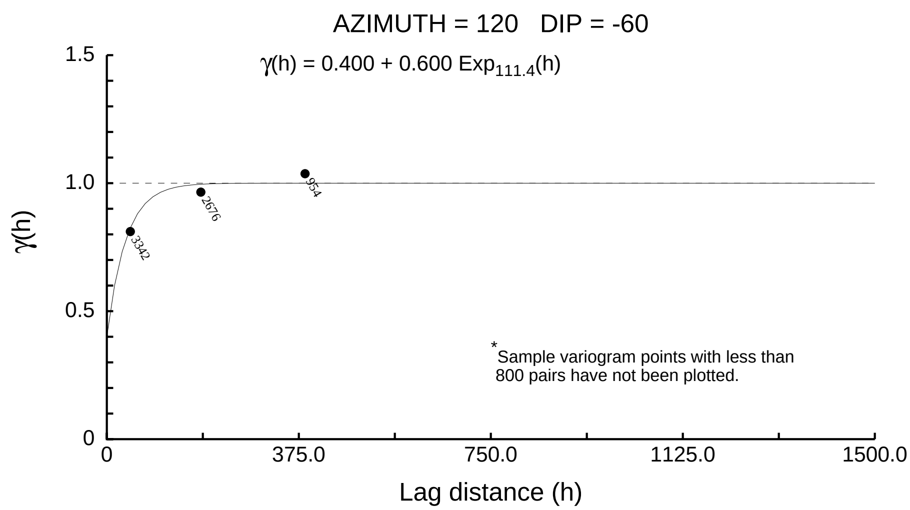


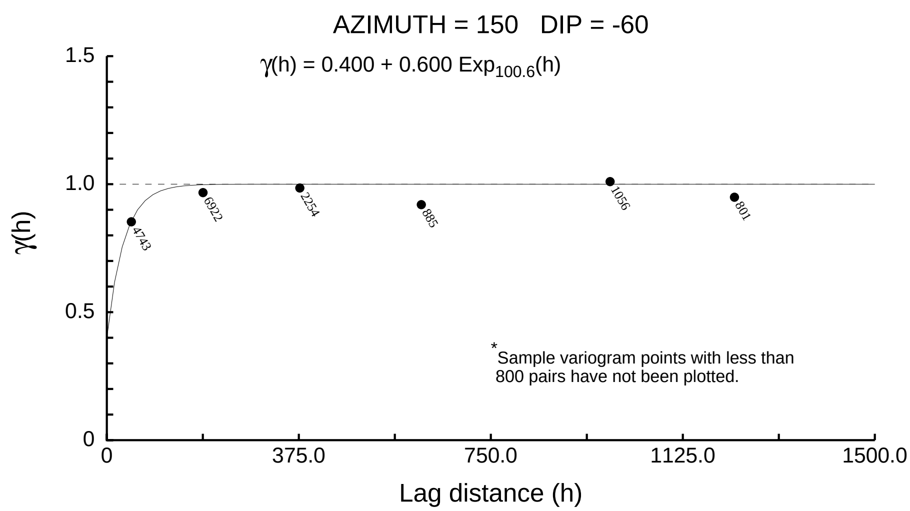




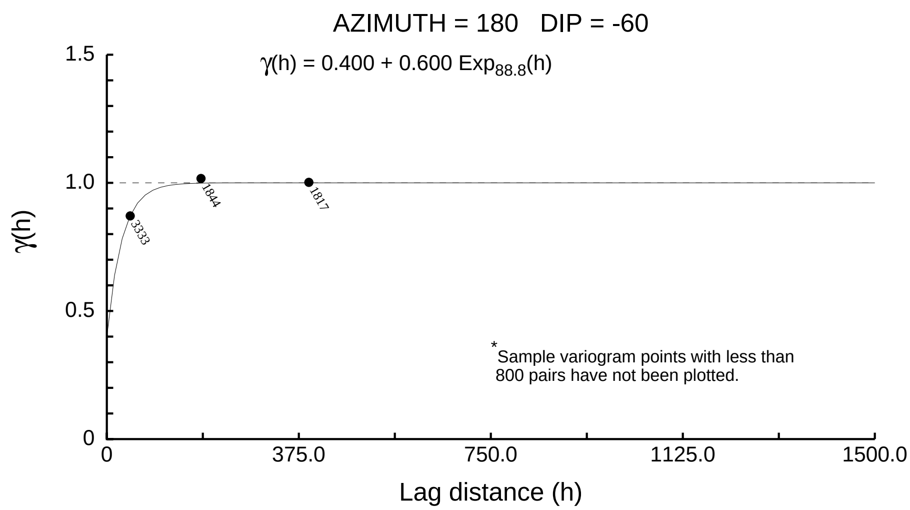
Directional 3000 - Pd

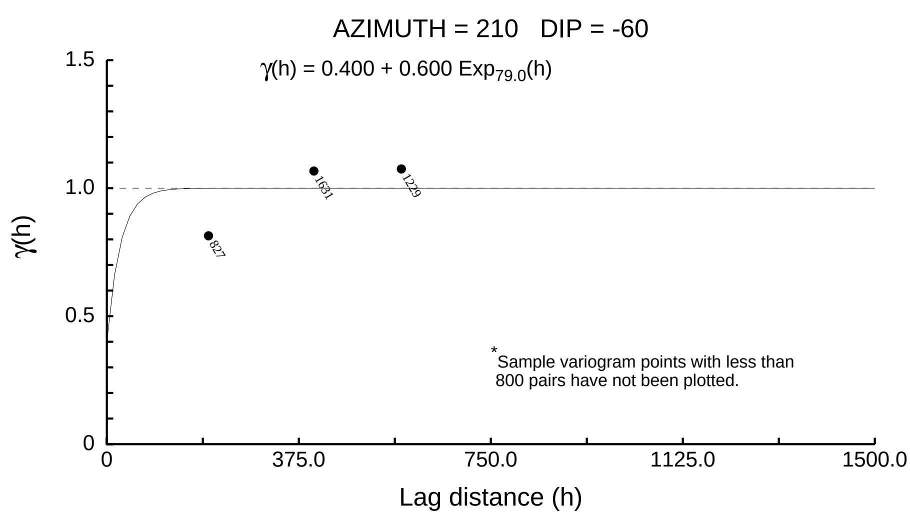


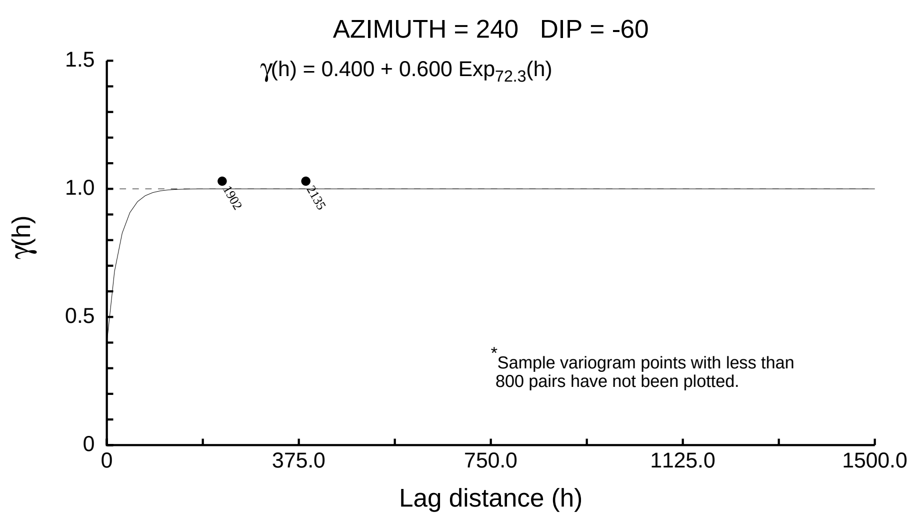




Directional 3000 - Pd







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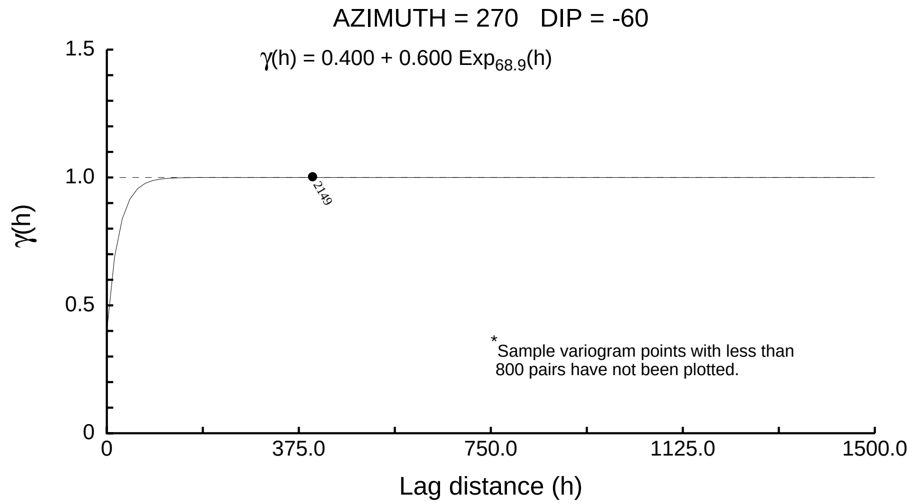
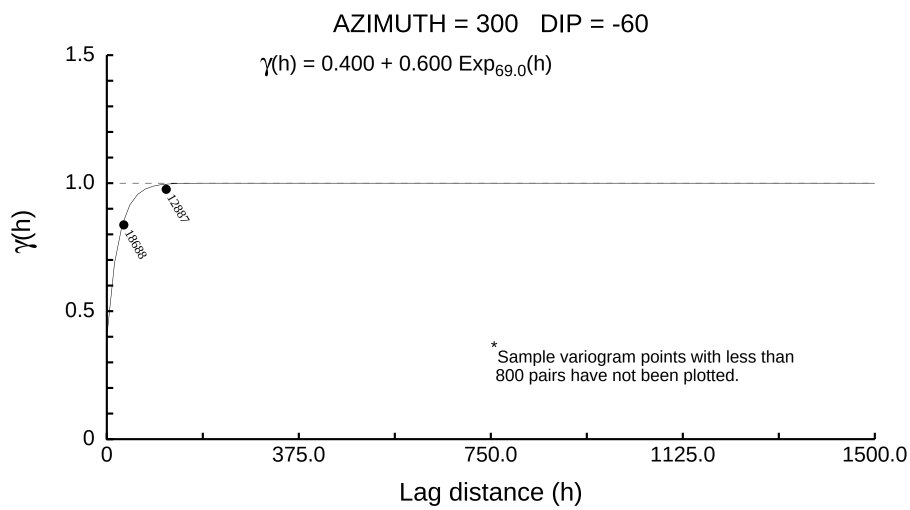
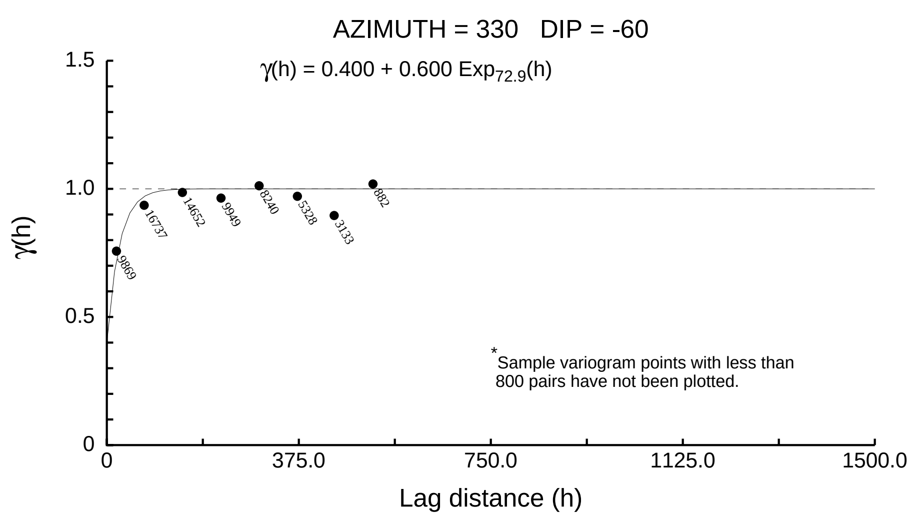
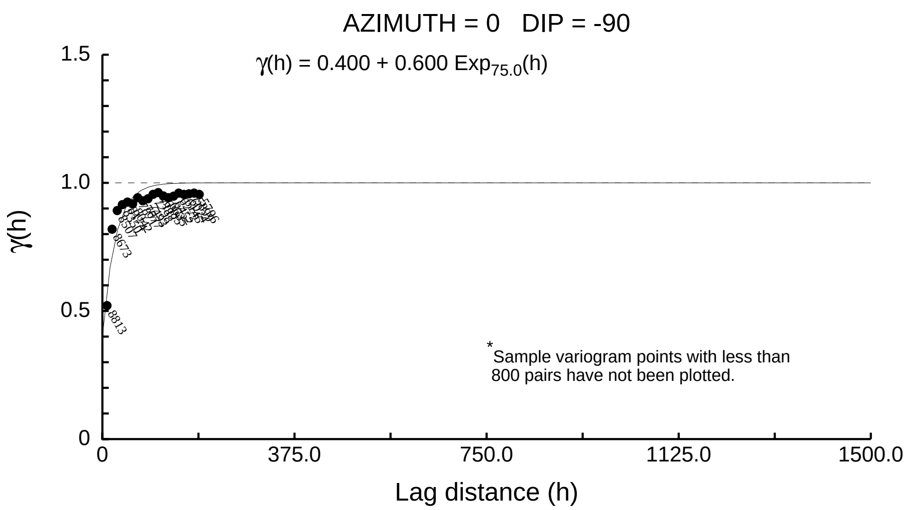
Directional 3000 - Pd







Directional 3000 - Pd



Directional 3000 - Pt

User Defined Rotation Conventions

Nugget ==> 0.133
C1 ==> 0.867

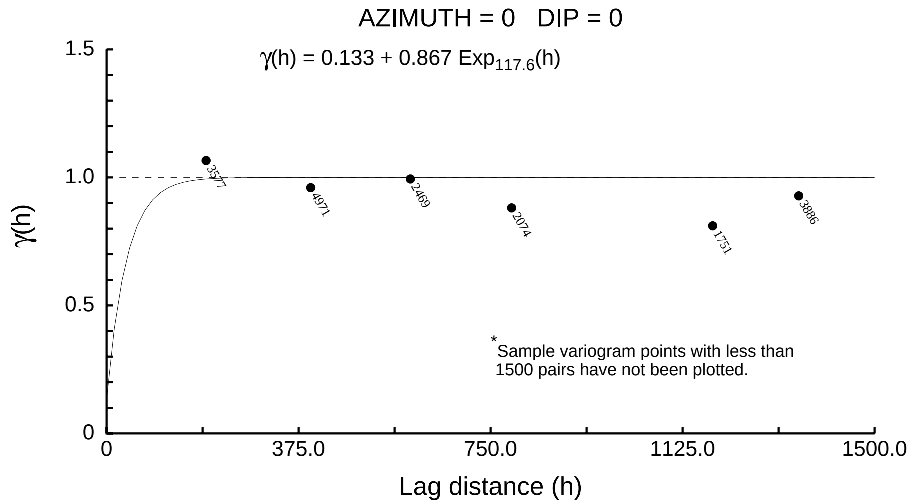
First Structure -- Exponential with Practical Range

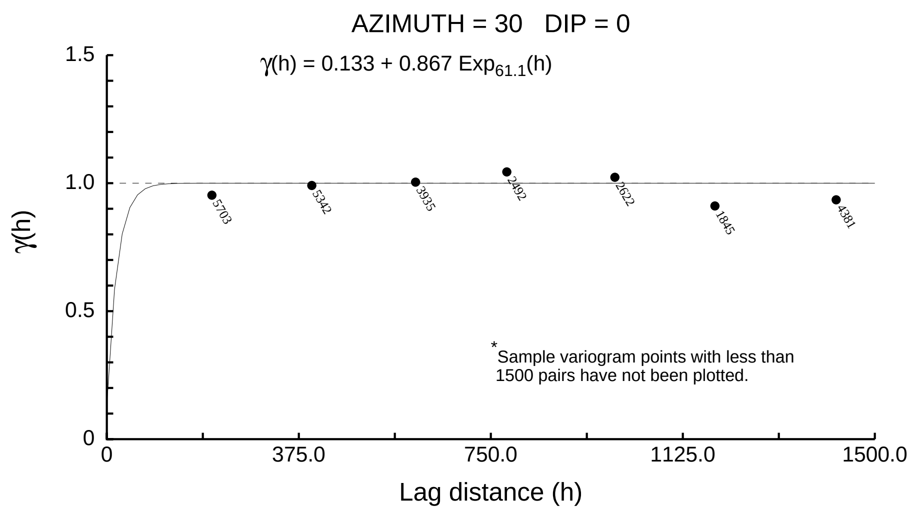
RH Rotation about the Z axis ==> 22
RH Rotation about the Y’ axis ==> 37
RH Rotation about the Z’ axis ==> -14
Range along the Z’ axis ==> 29.3 Azimuth ==> 68 Dip ==> 53
Range along the Y’ axis ==> 263.4 Azimuth ==> 349 Dip ==> -8
Range along the X’ axis ==> 400.1 Azimuth ==> 85 Dip ==> -35

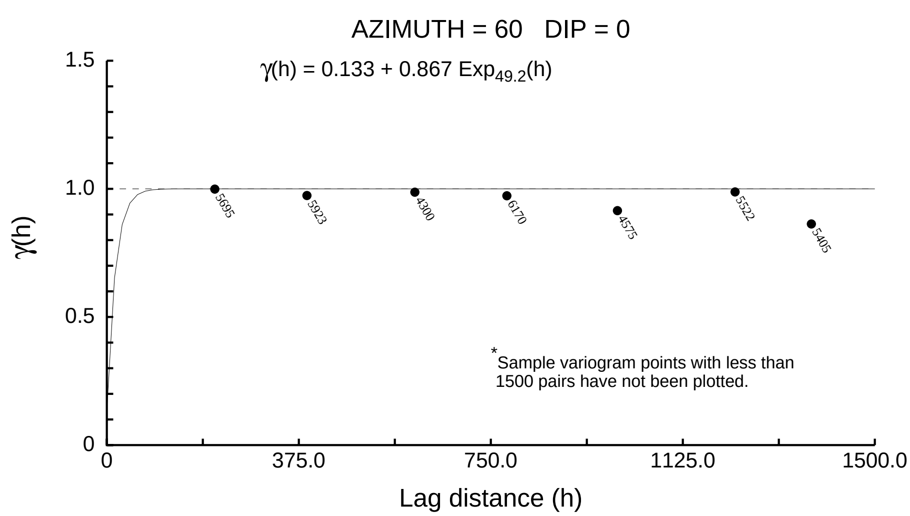
Modeling Criteria

Minimum number pairs req’d ==> 1500
Sample variogram points weighted by # pairs

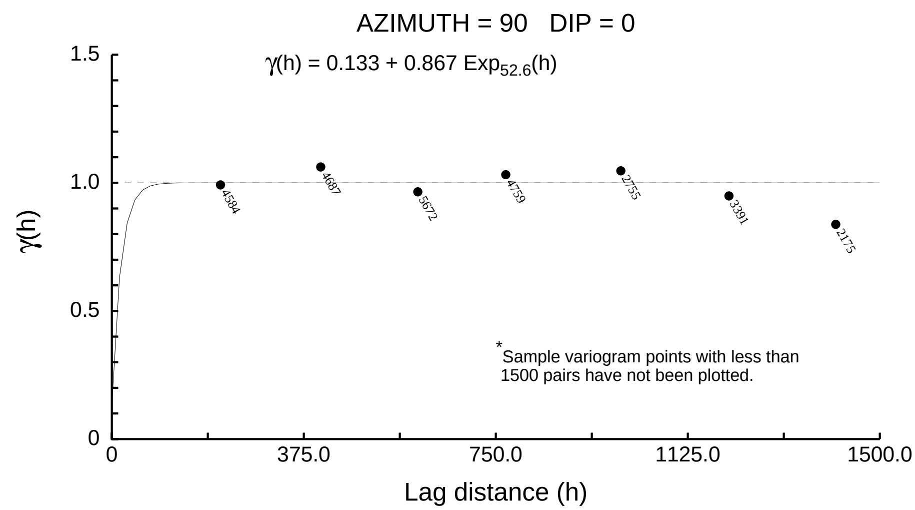
Directional 3000 - Pt

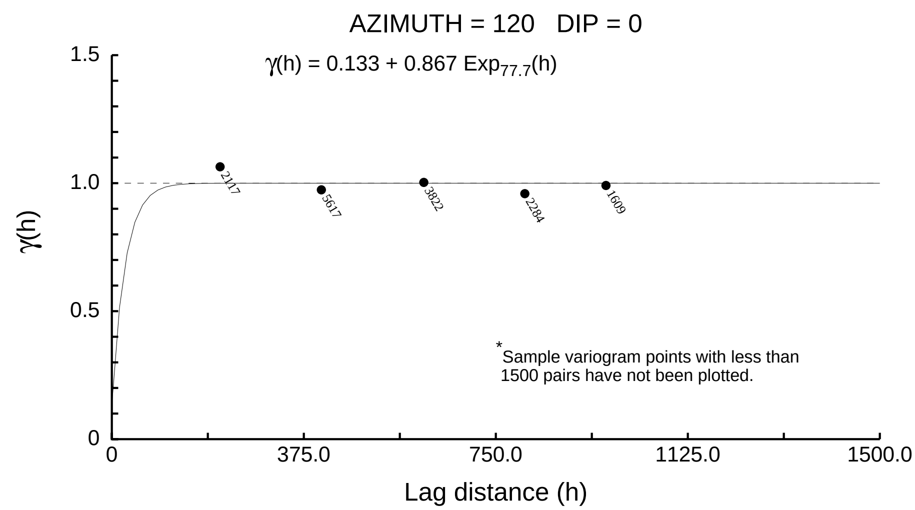


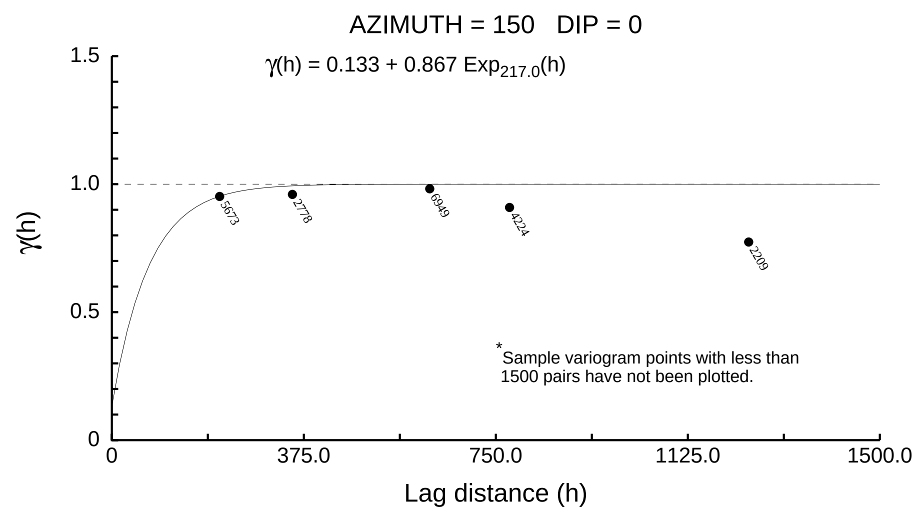




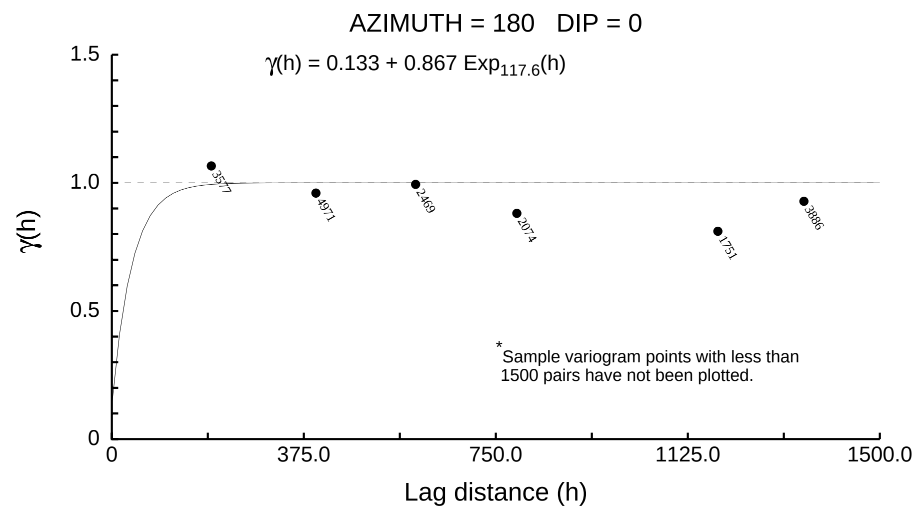
Directional 3000 - Pt

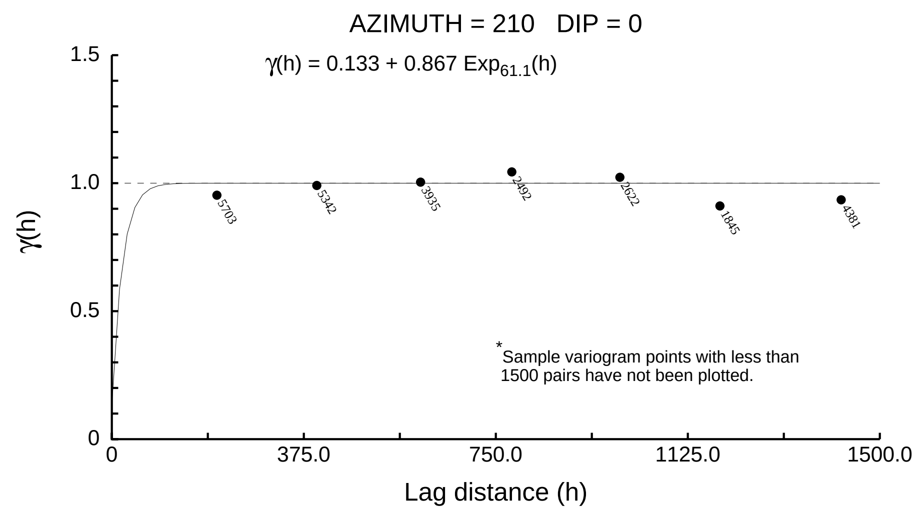


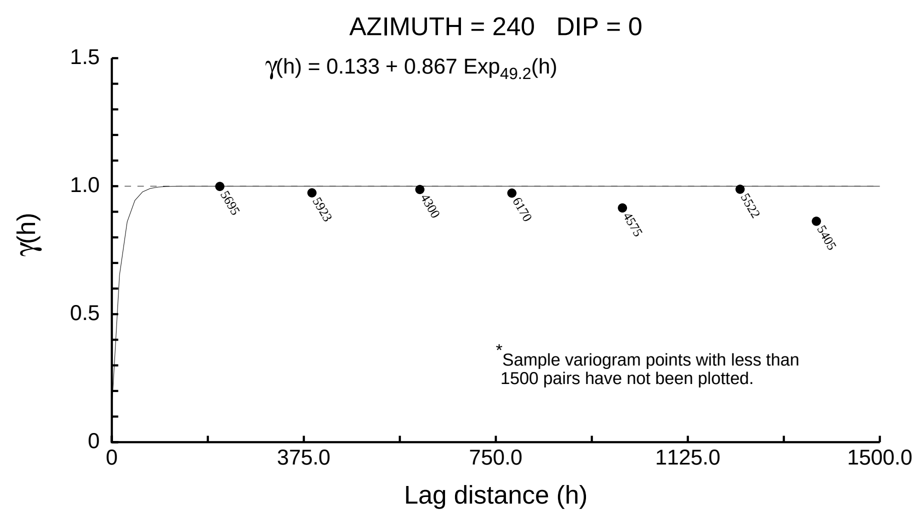




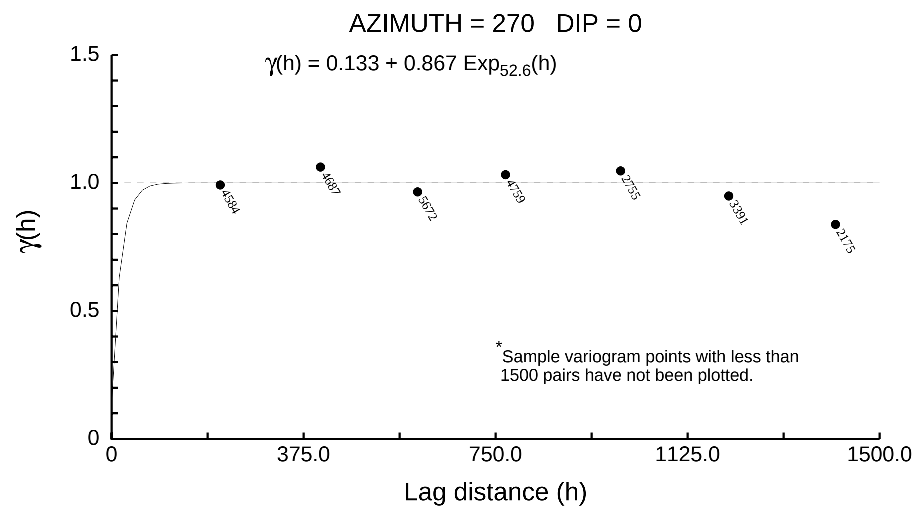
Directional 3000 - Pt

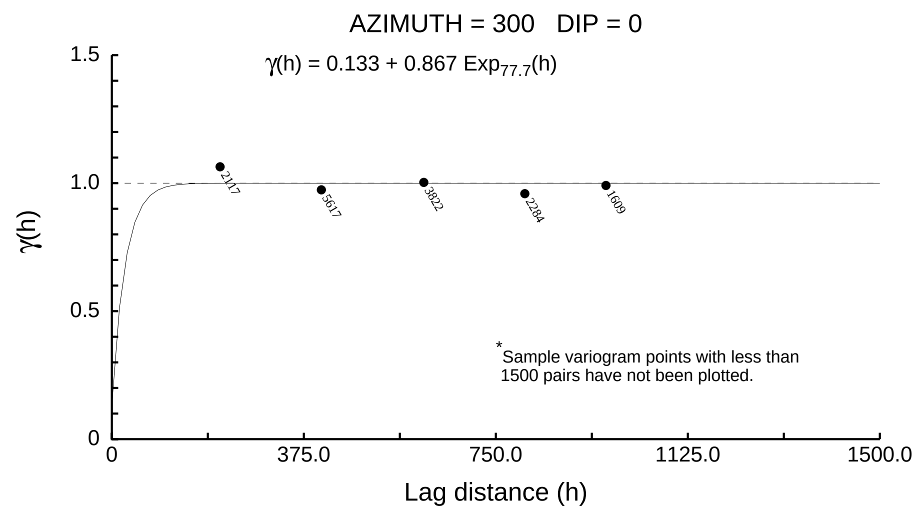


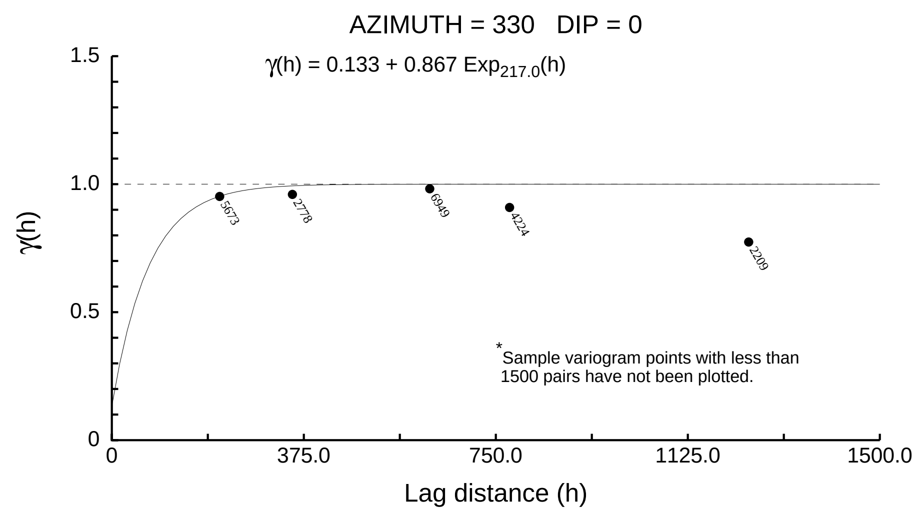




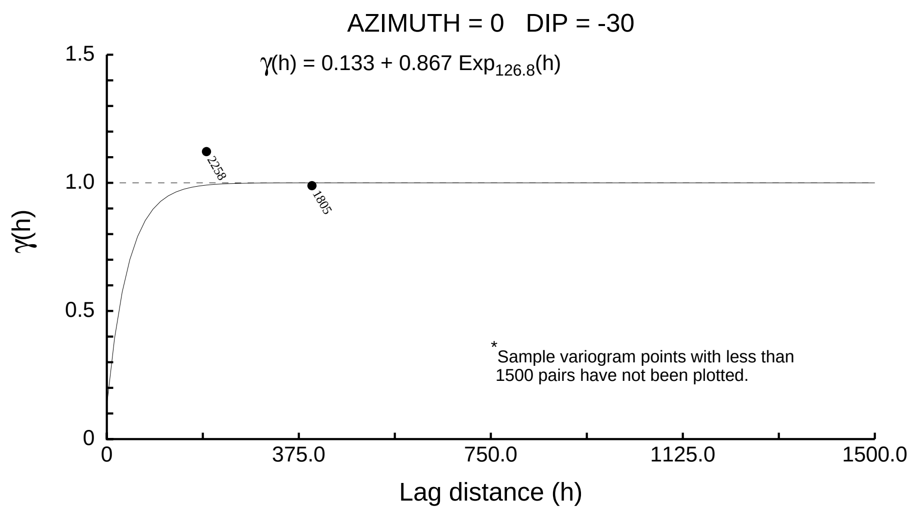
Directional 3000 - Pt

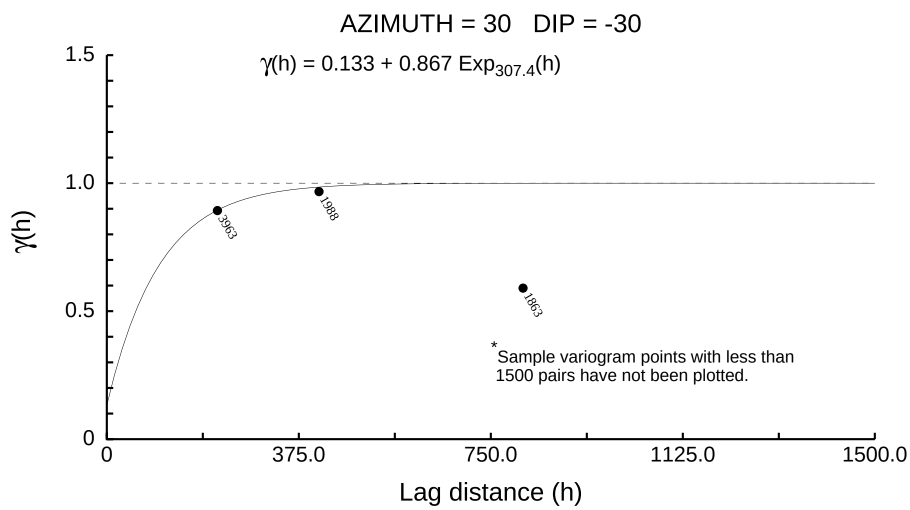


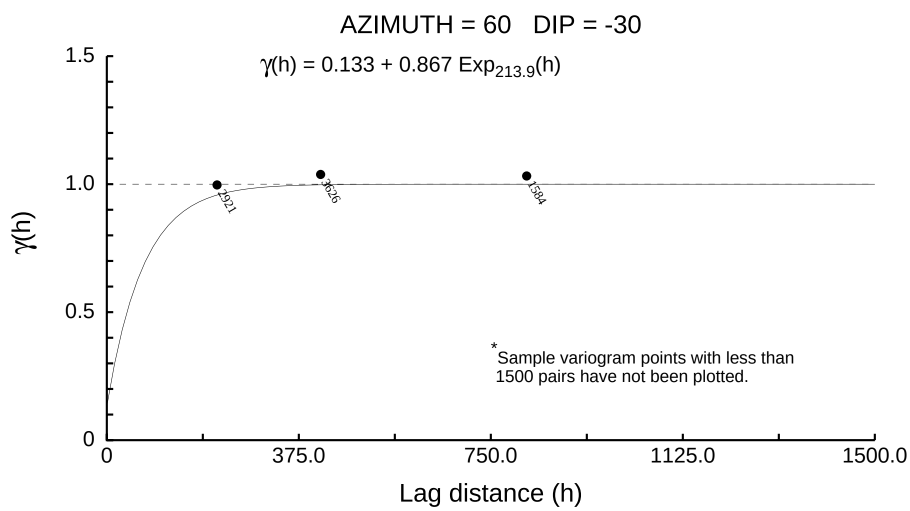




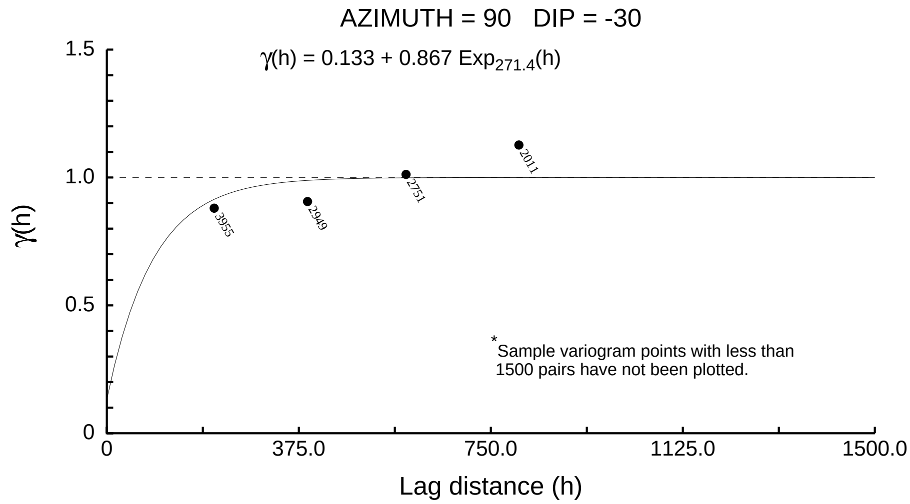
Directional 3000 - Pt

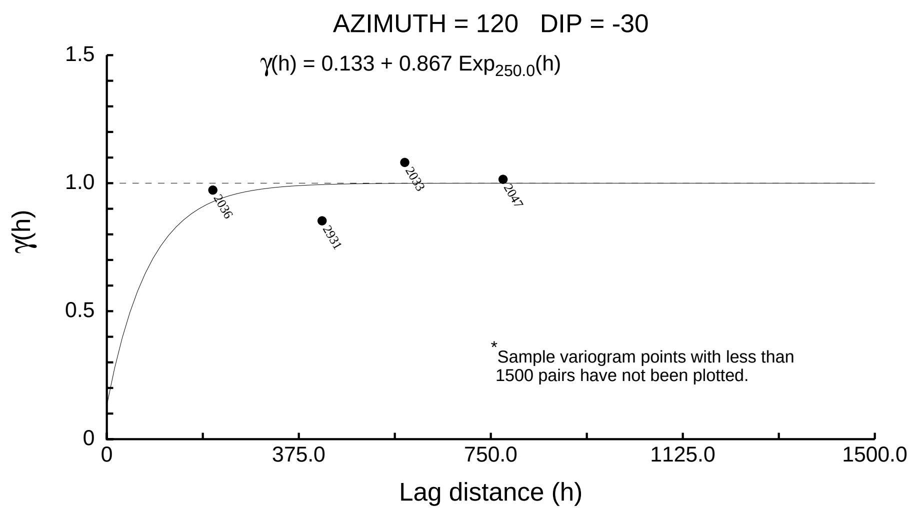


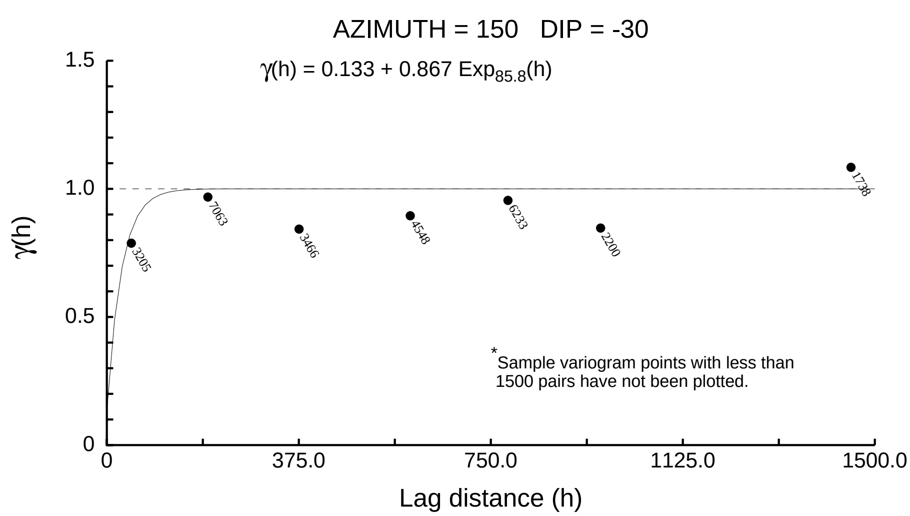




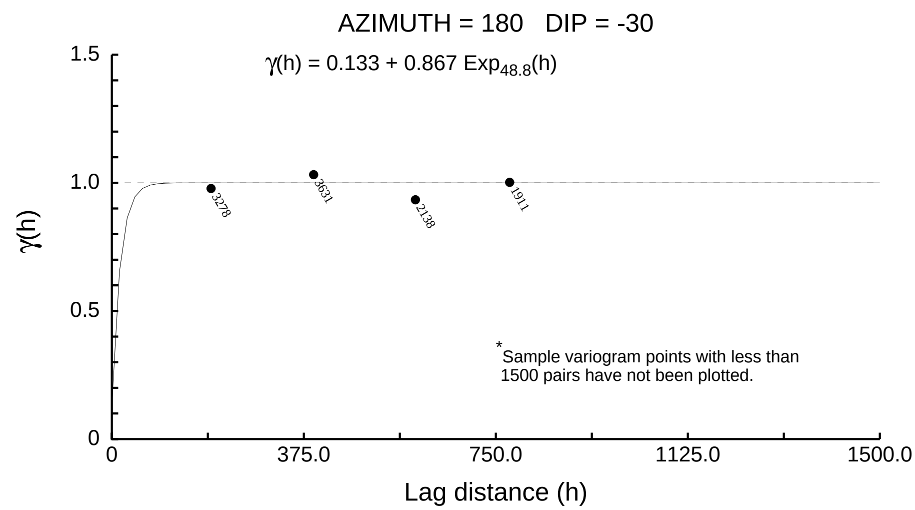
Directional 3000 - Pt

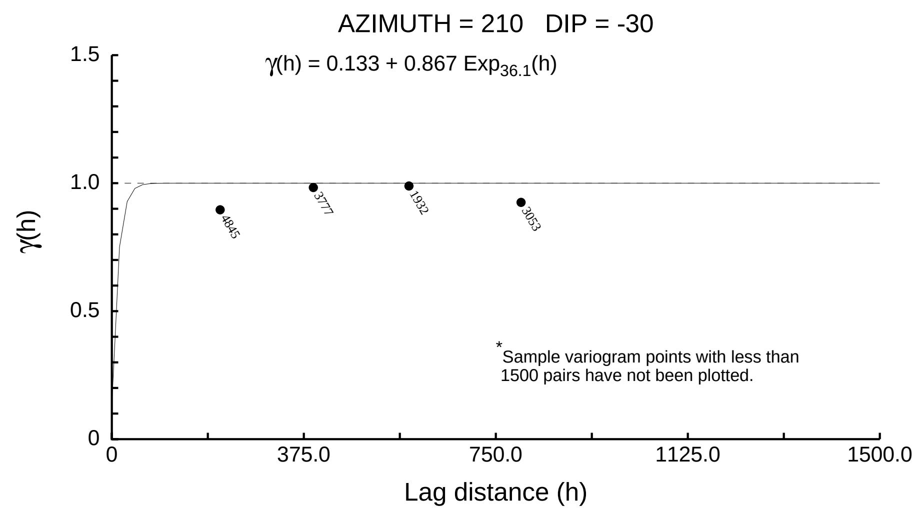


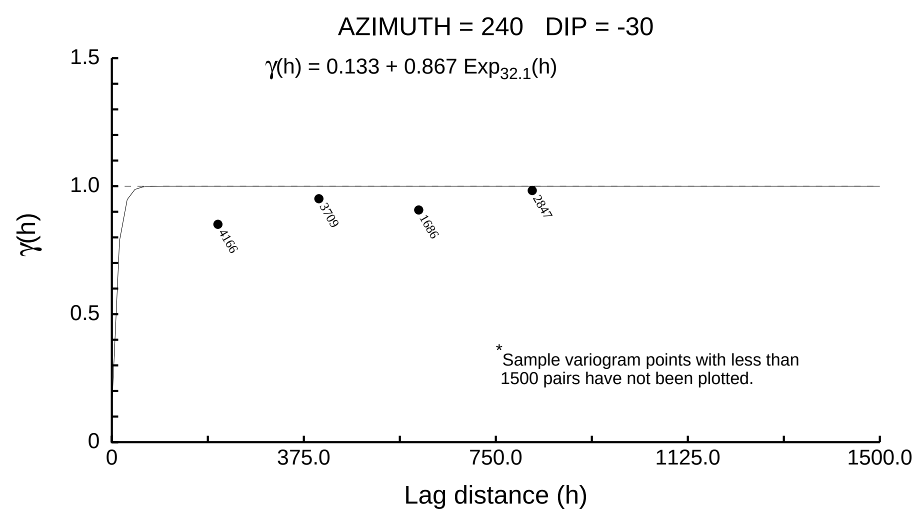




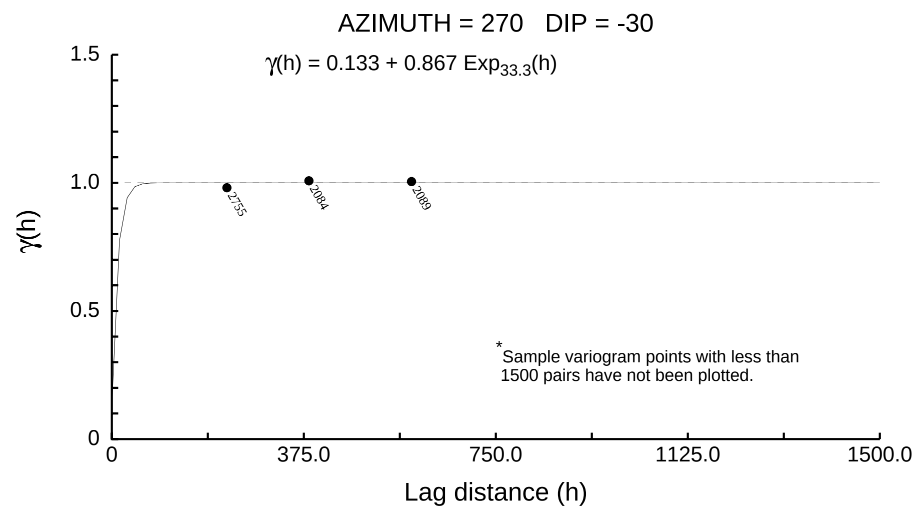
Directional 3000 - Pt

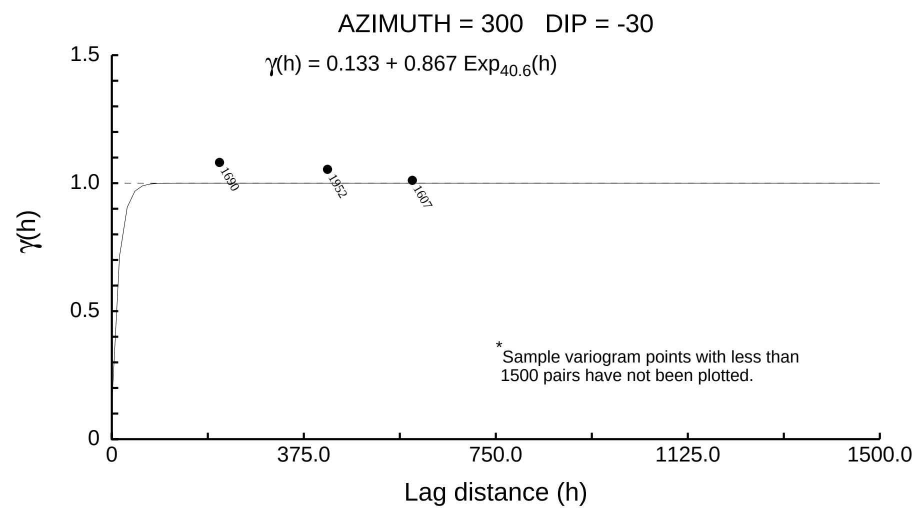


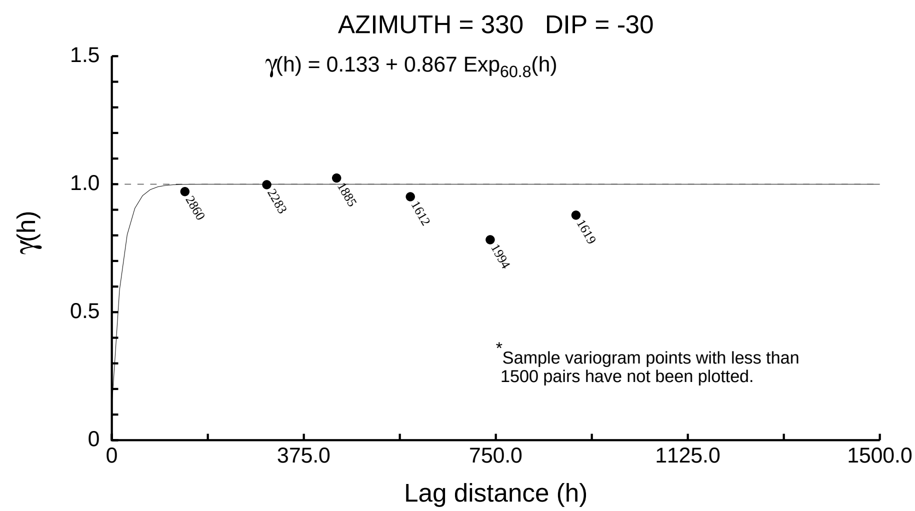




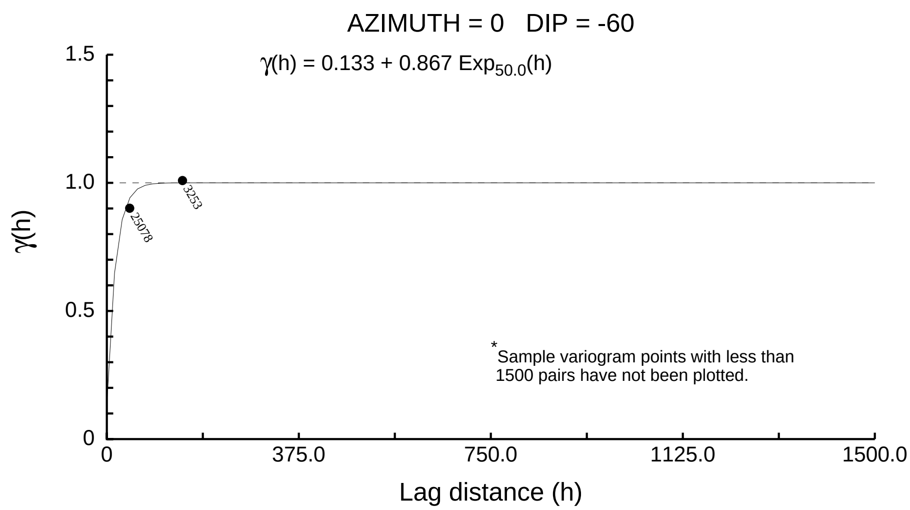
Directional 3000 - Pt

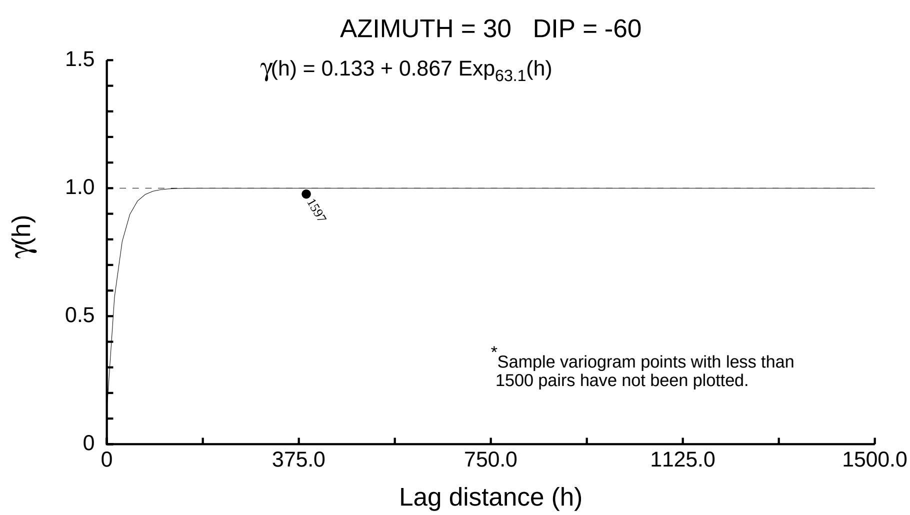


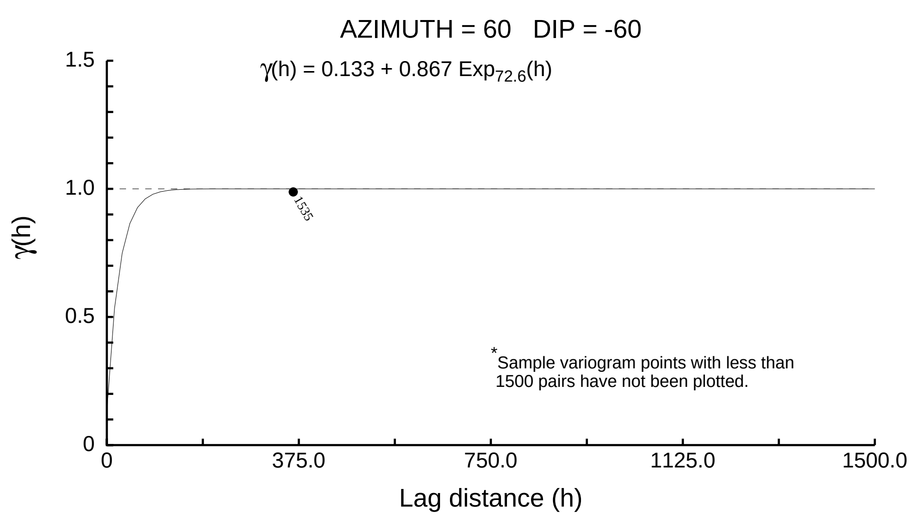




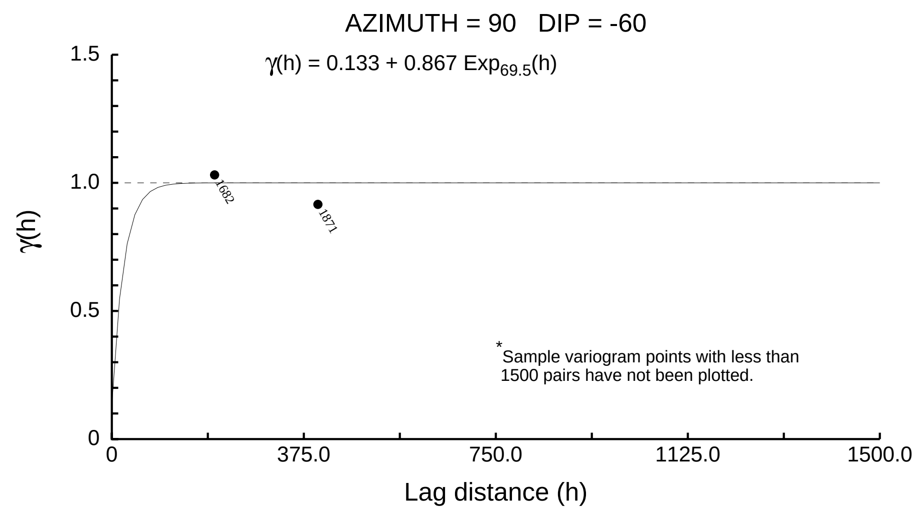
Directional 3000 - Pt

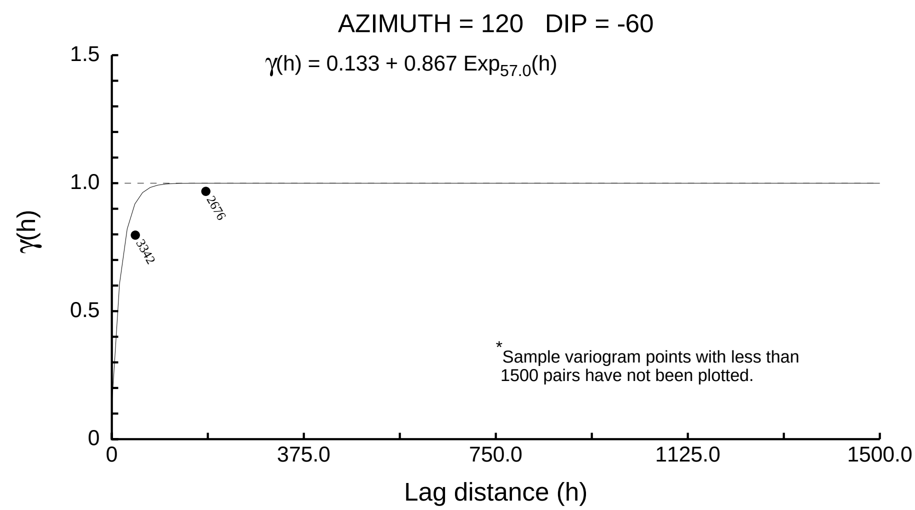


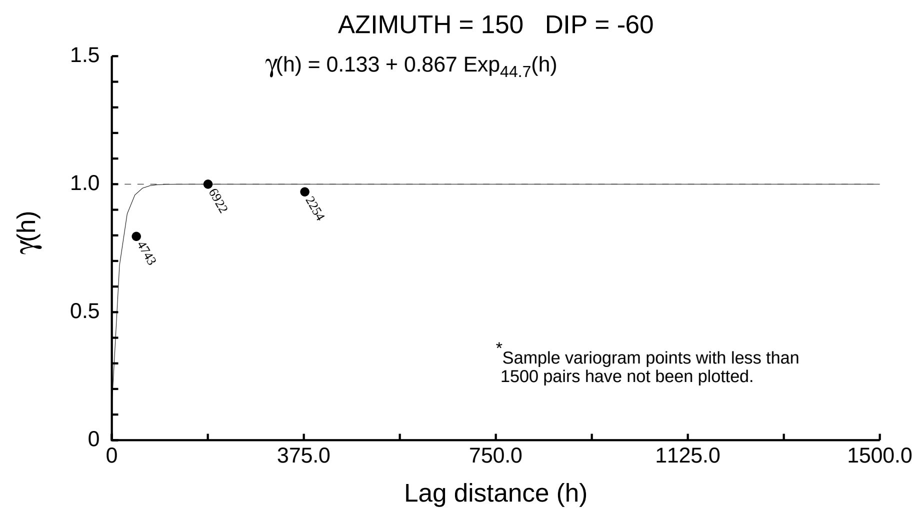




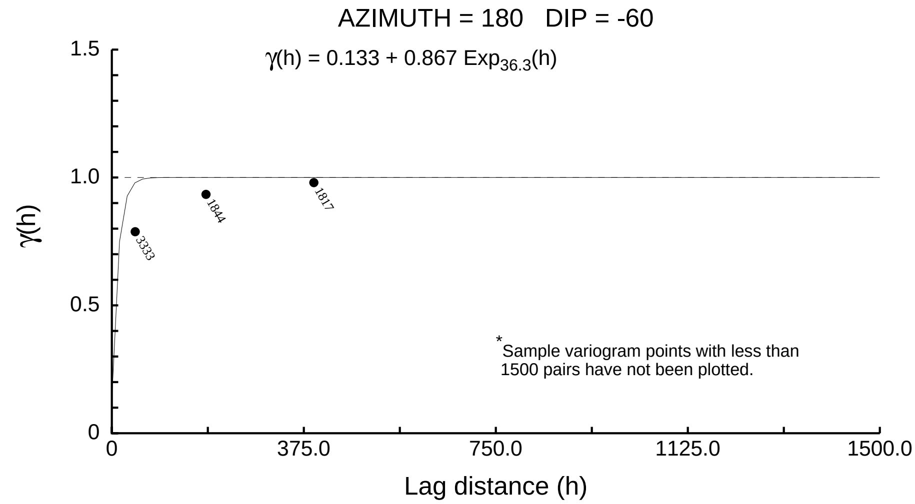
Directional 3000 - Pt

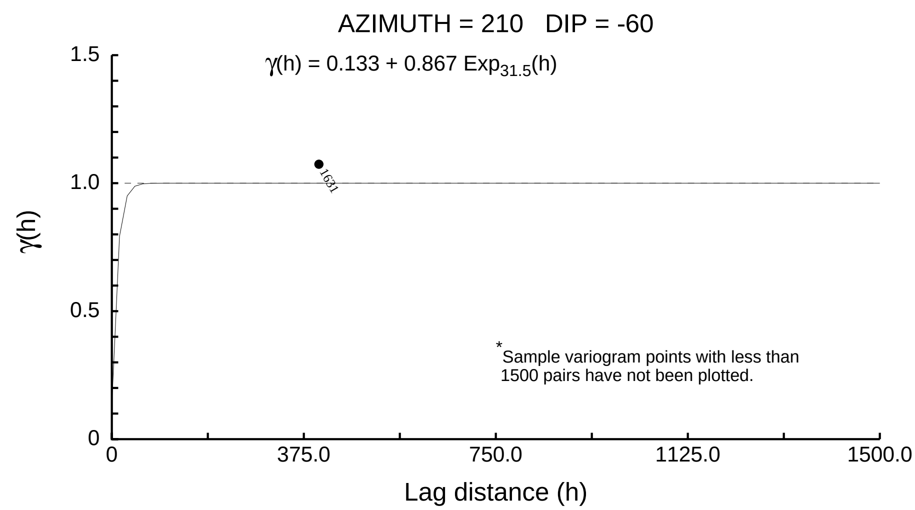


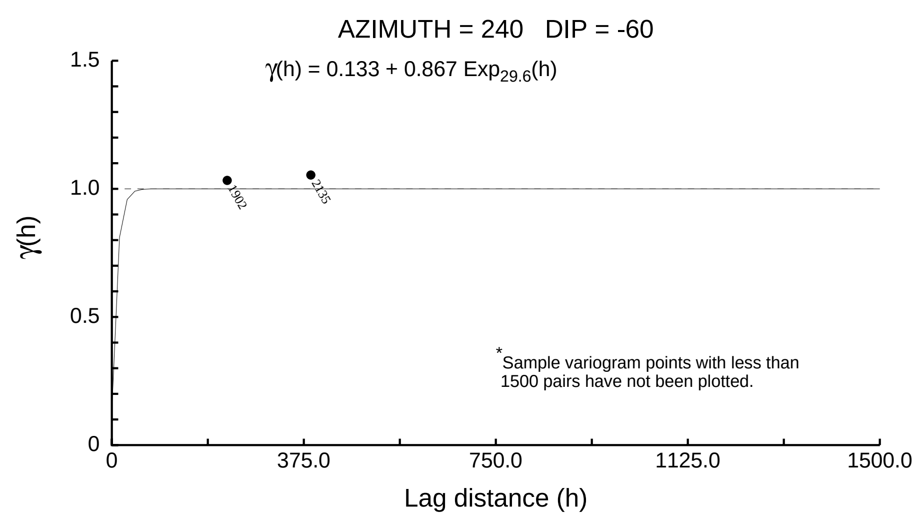




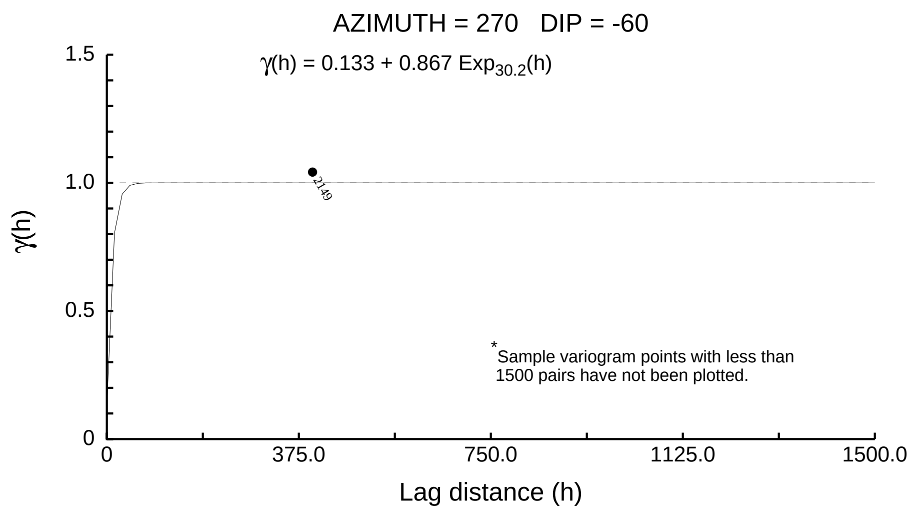
Directional 3000 - Pt

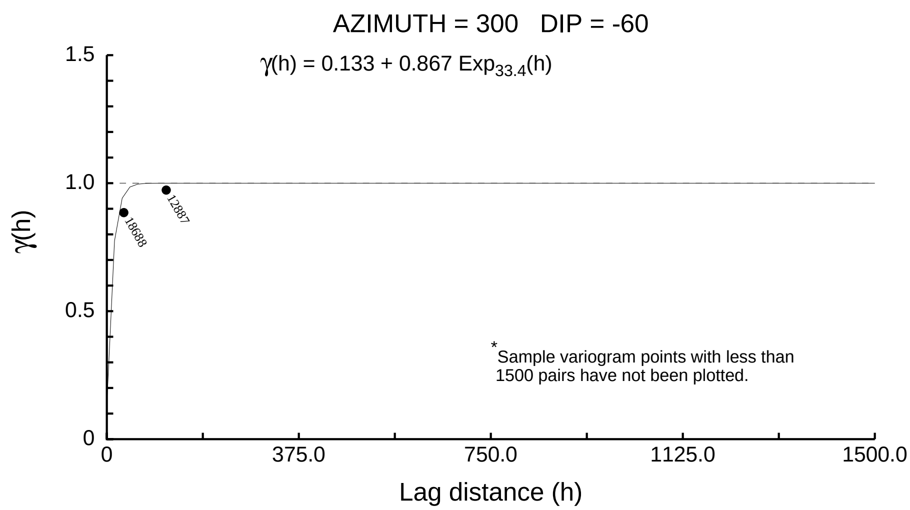


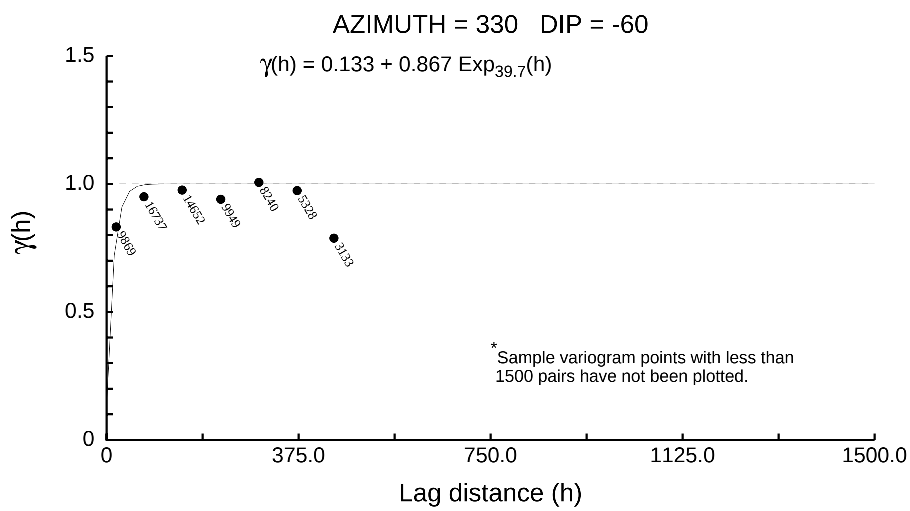




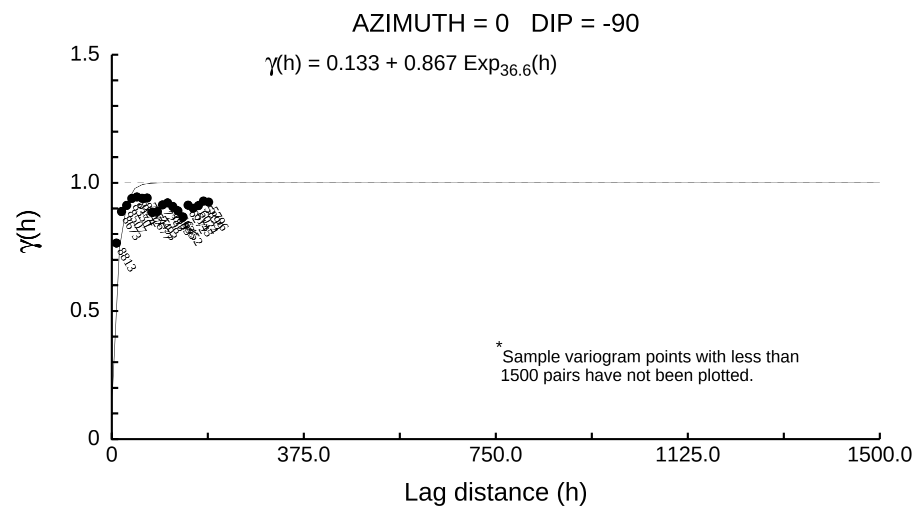
Directional 3000 - Pt







Directional 3000 - Pt



Directional 3000 - S

User Defined Rotation Conventions

Nugget ==> 0.011
C1 ==> 0.989

First Structure -- Exponential with Practical Range

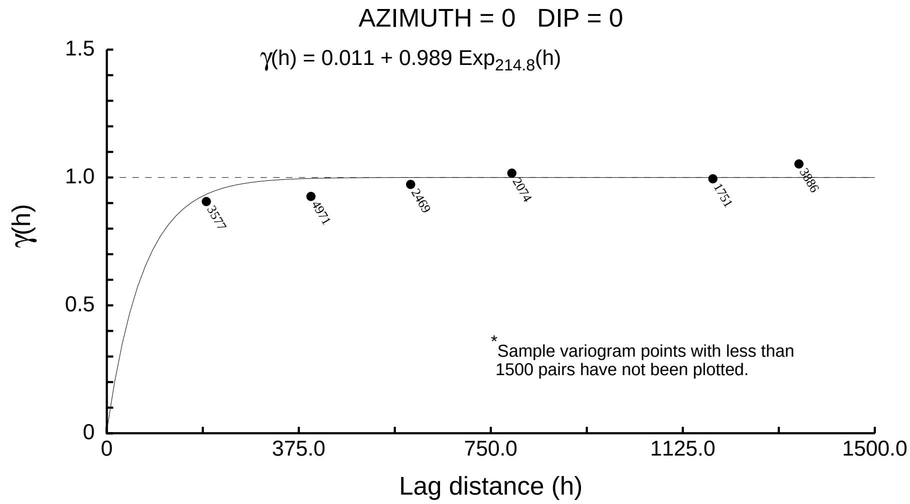
RH Rotation about the Z axis ==> 113
RH Rotation about the Y' axis ==> 18
RH Rotation about the Z' axis ==> -55

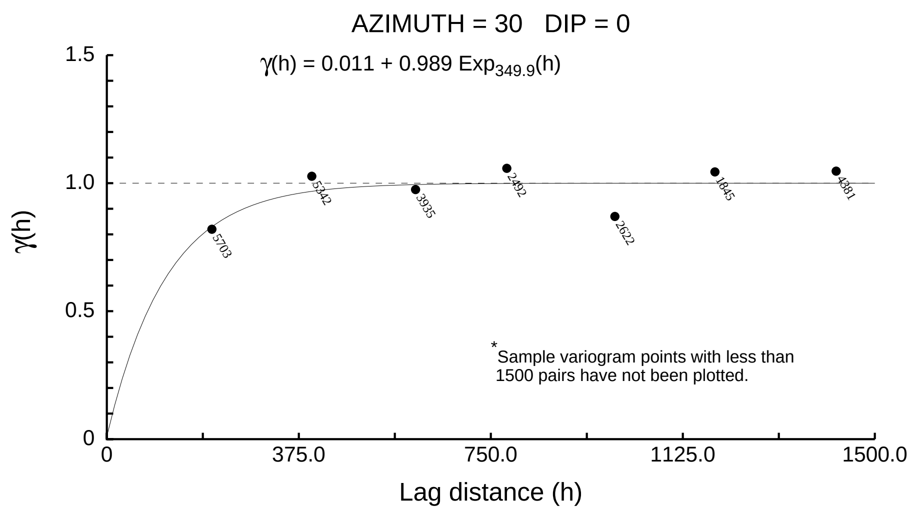
Range along the Z' axis ==> 84.7	Azimuth ==> 337	Dip ==> 72
Range along the Y' axis ==> 170.7	Azimuth ==> 300	Dip ==> -14
Range along the X' axis ==> 529.3	Azimuth ==> 33	Dip ==> -10

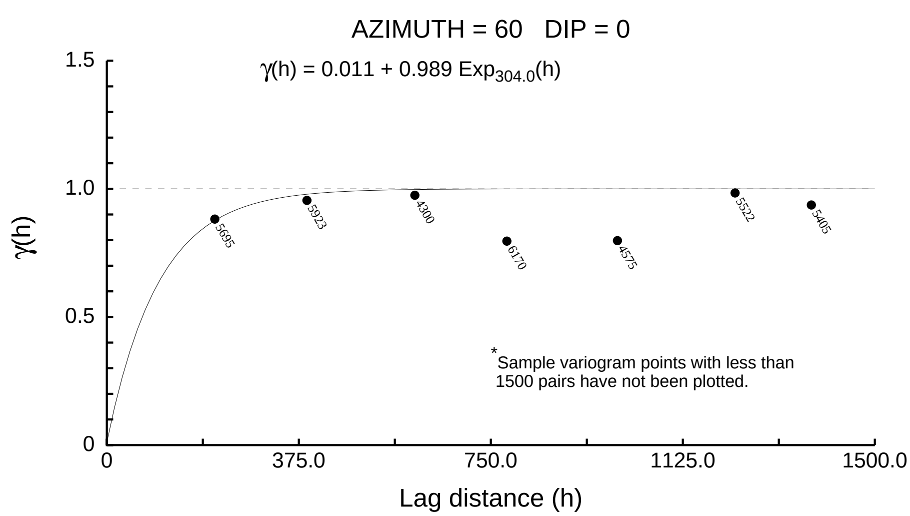
Modeling Criteria

Minimum number pairs req'd ==> 1500
Sample variogram points weighted by # pairs
Max allowable drift on head and tail means ==> 1.8

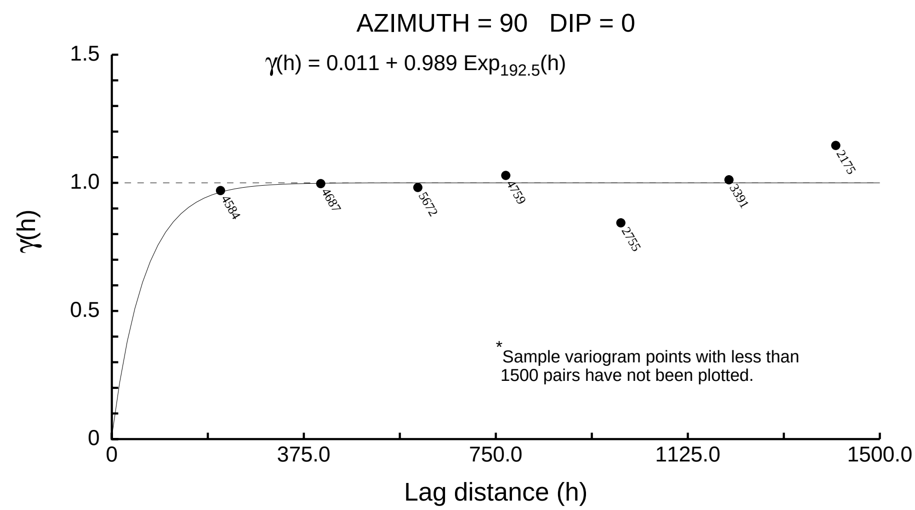
Directional 3000 - S

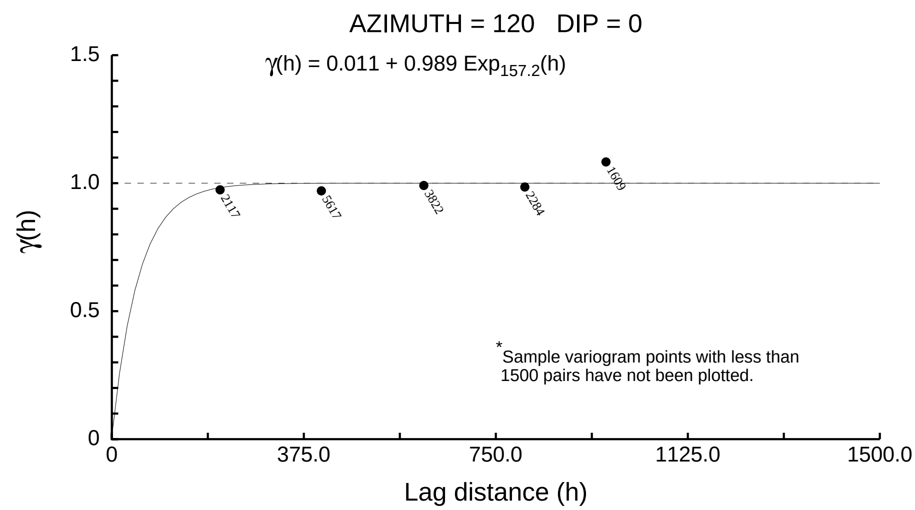


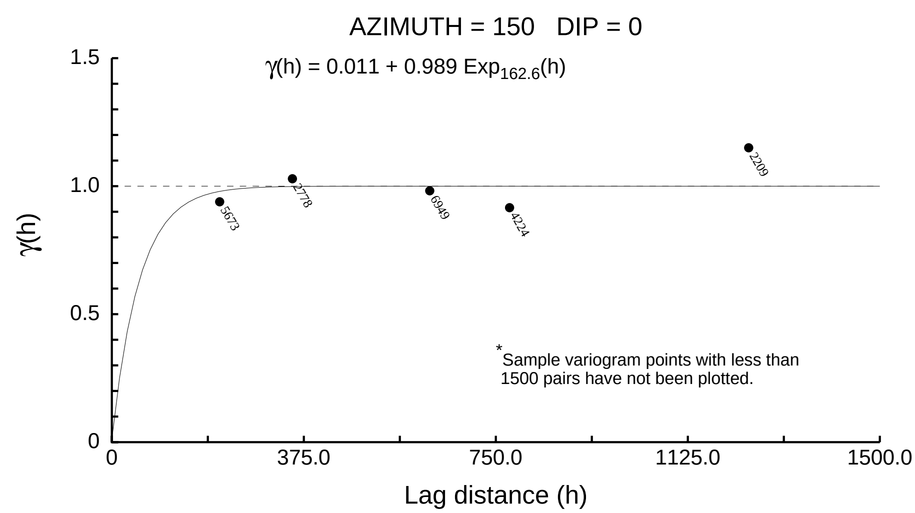




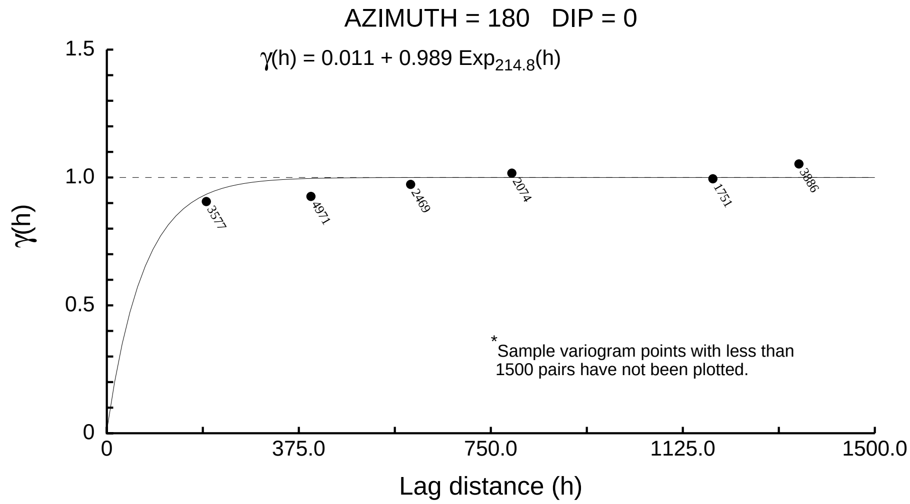
Directional 3000 - S

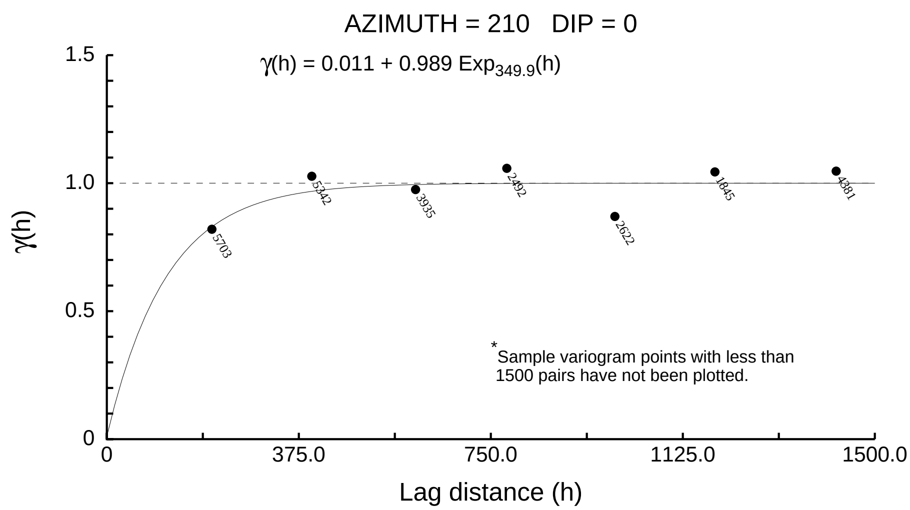


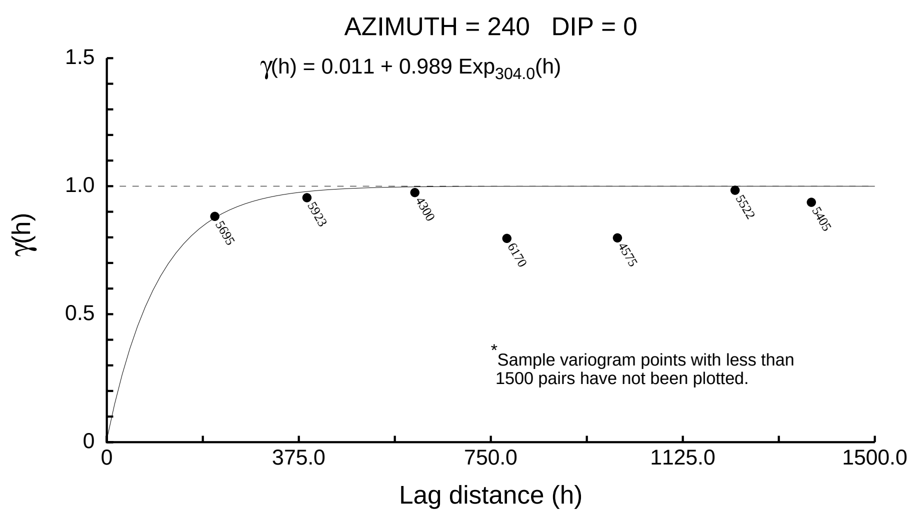




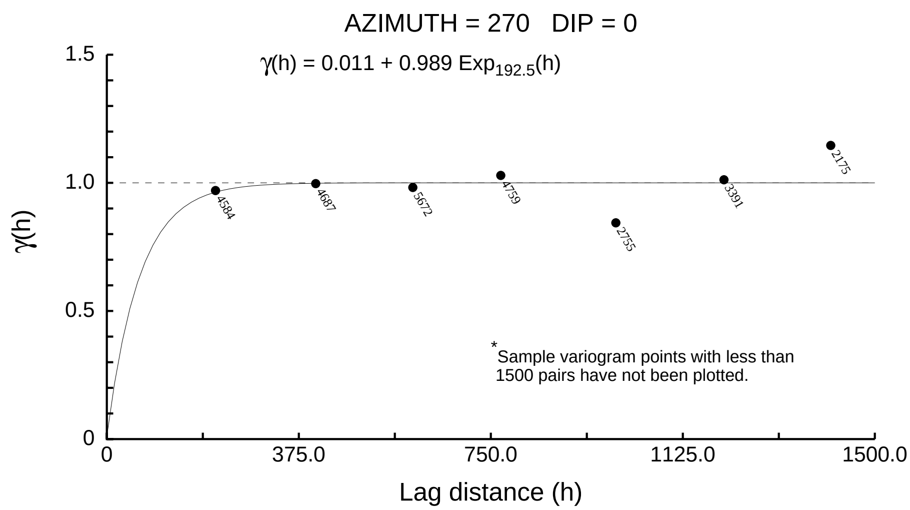
Directional 3000 - S

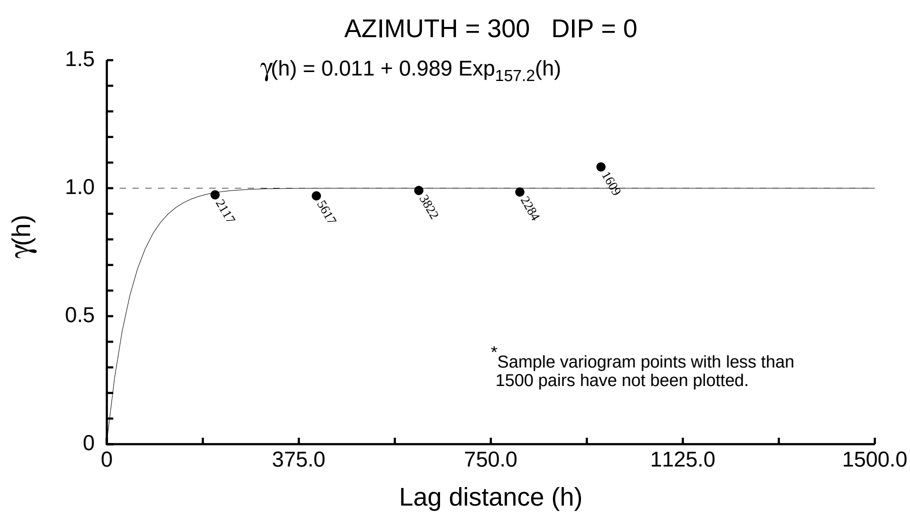


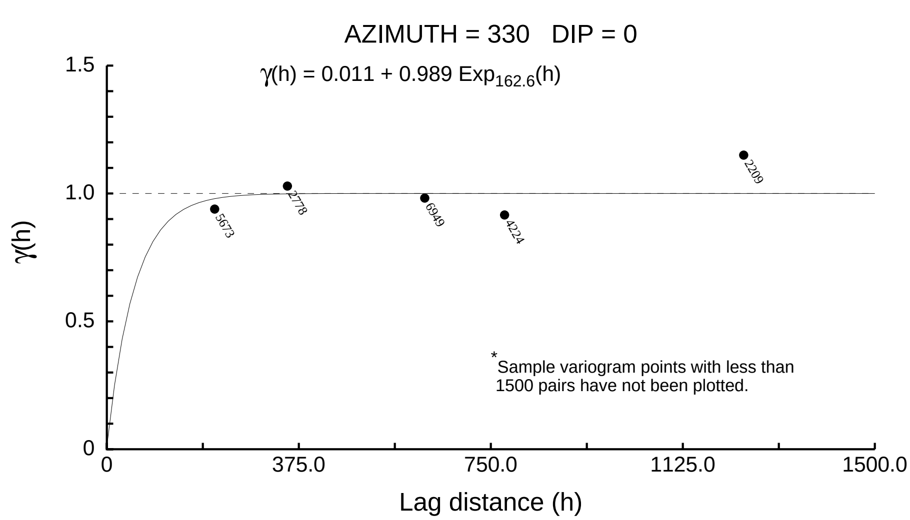




Directional 3000 - S







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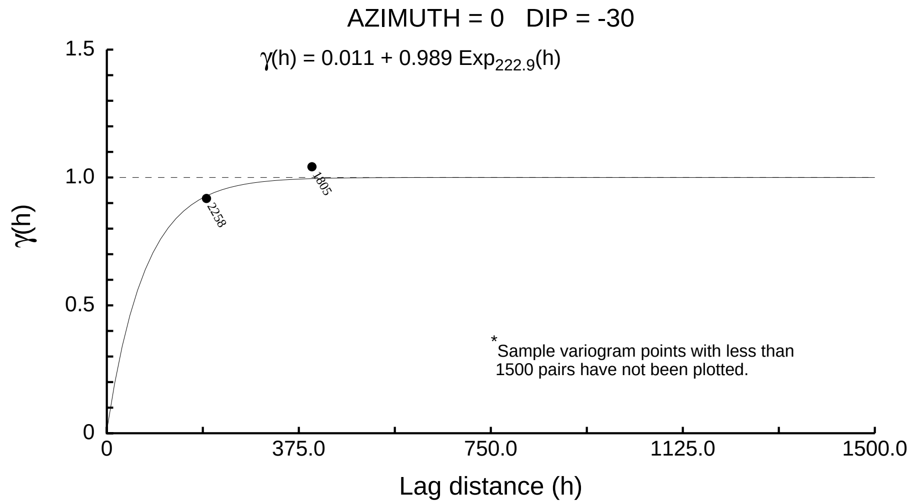

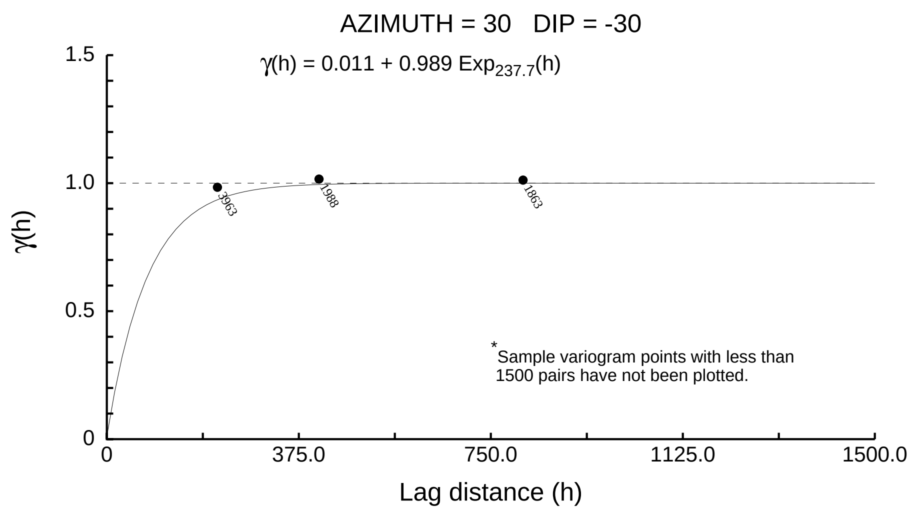

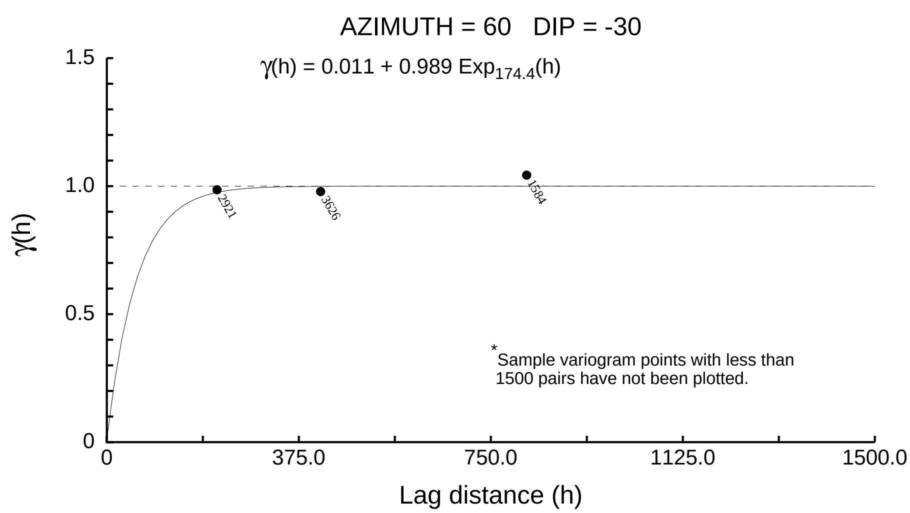

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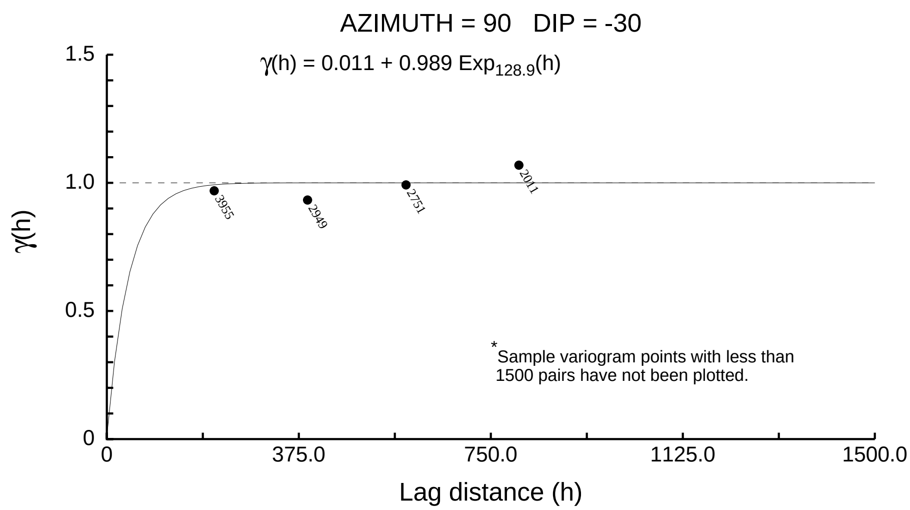
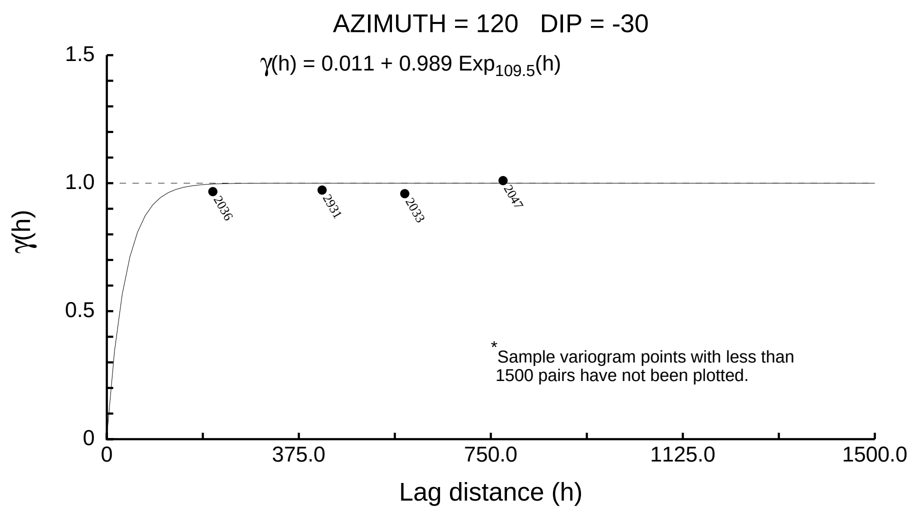
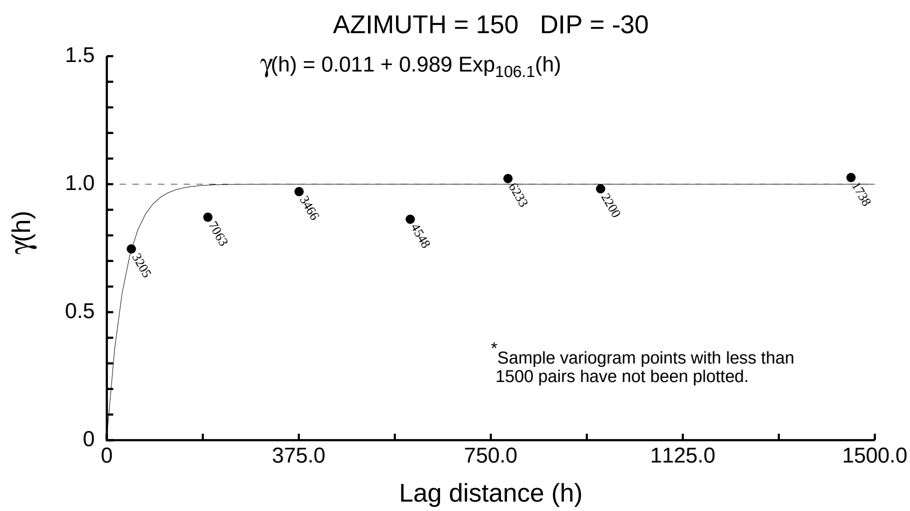
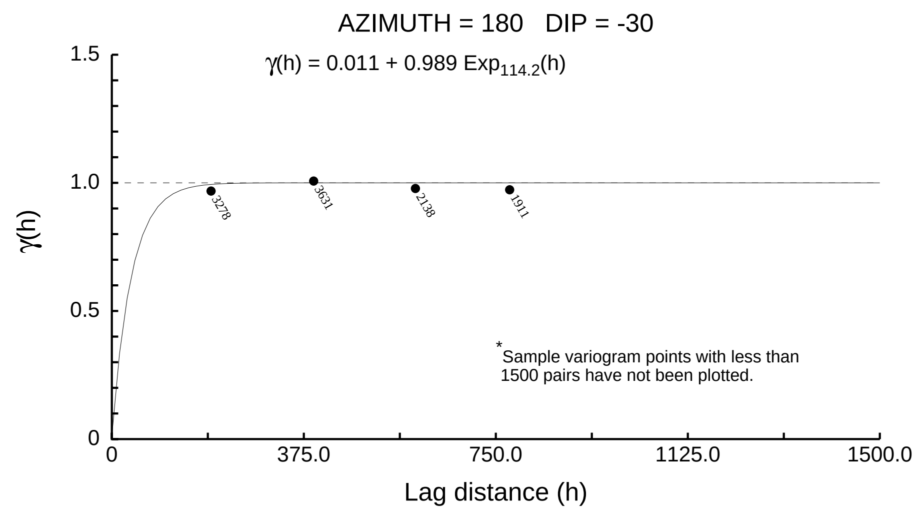
Directional 3000 - S

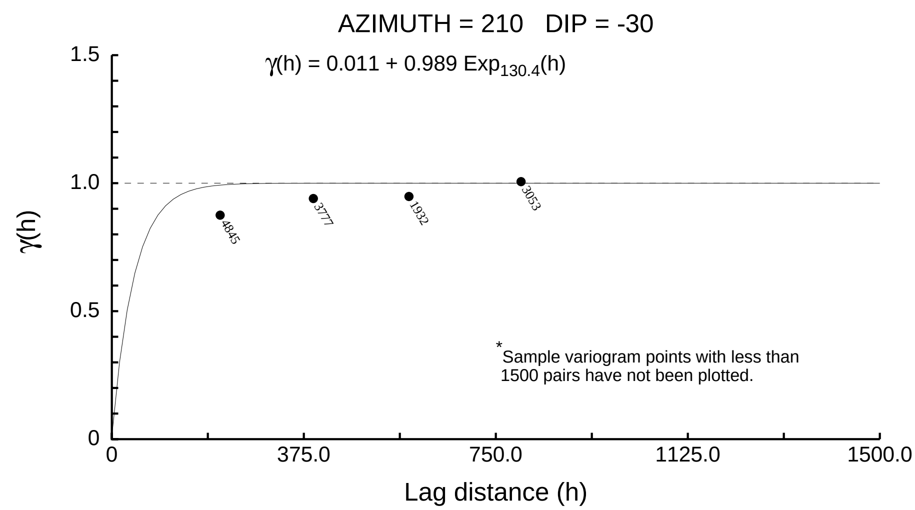


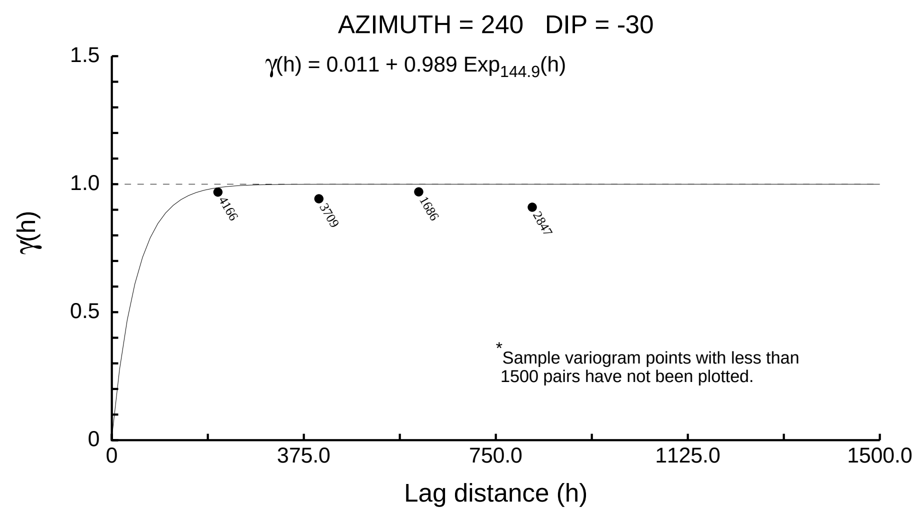




Directional 3000 - S







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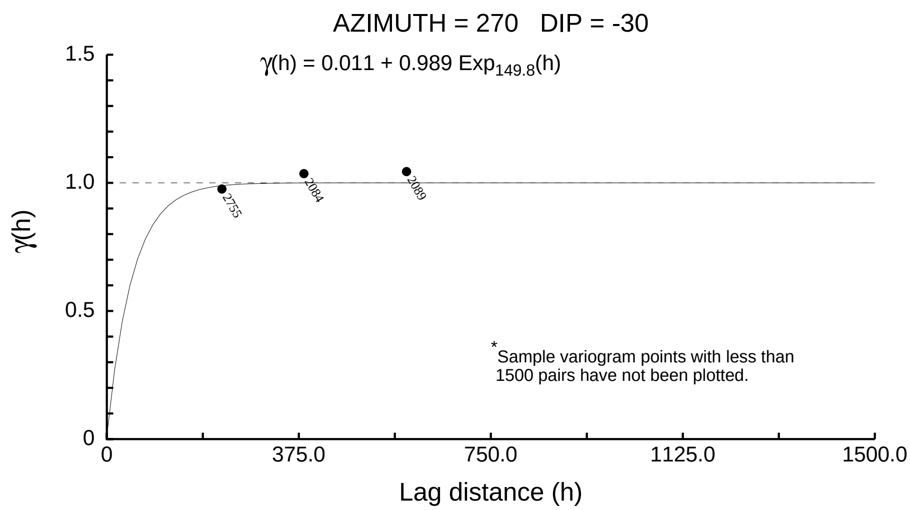

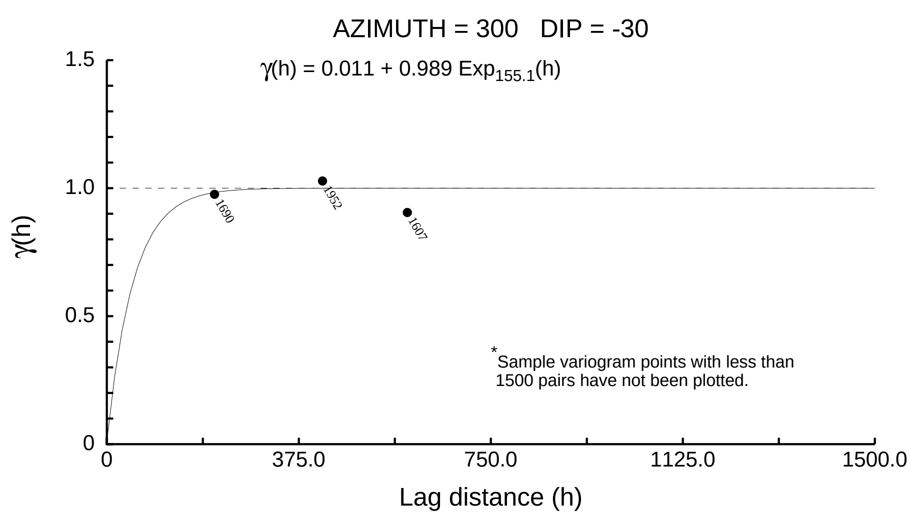

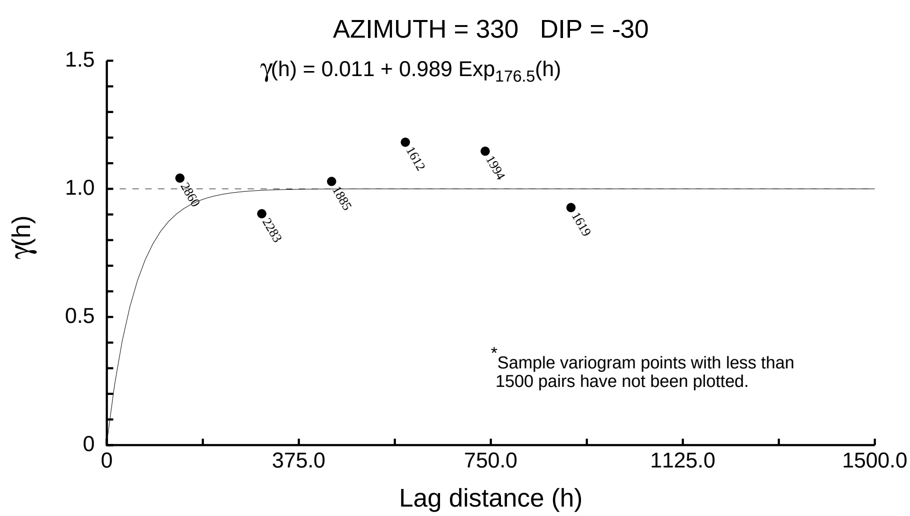

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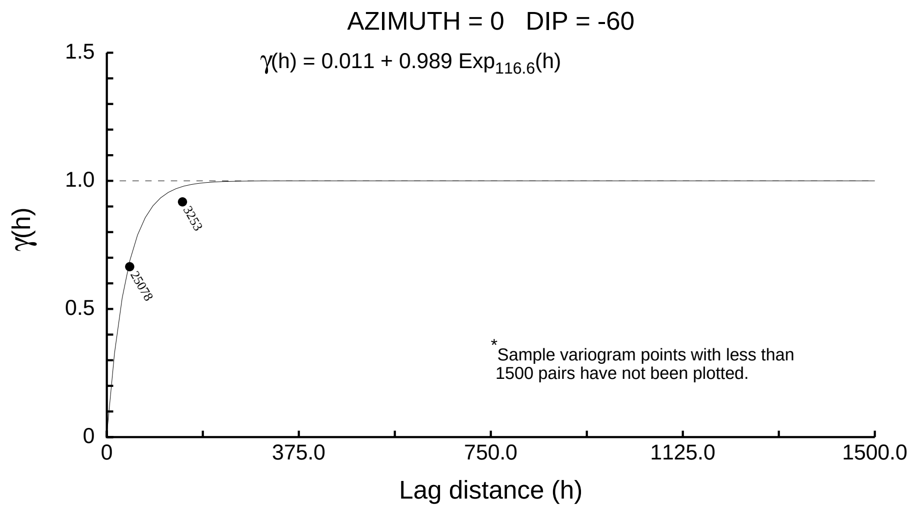
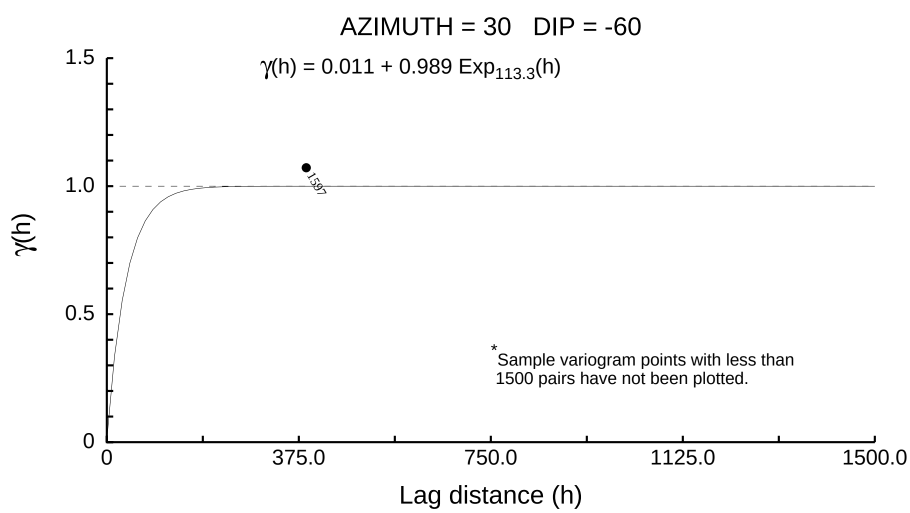
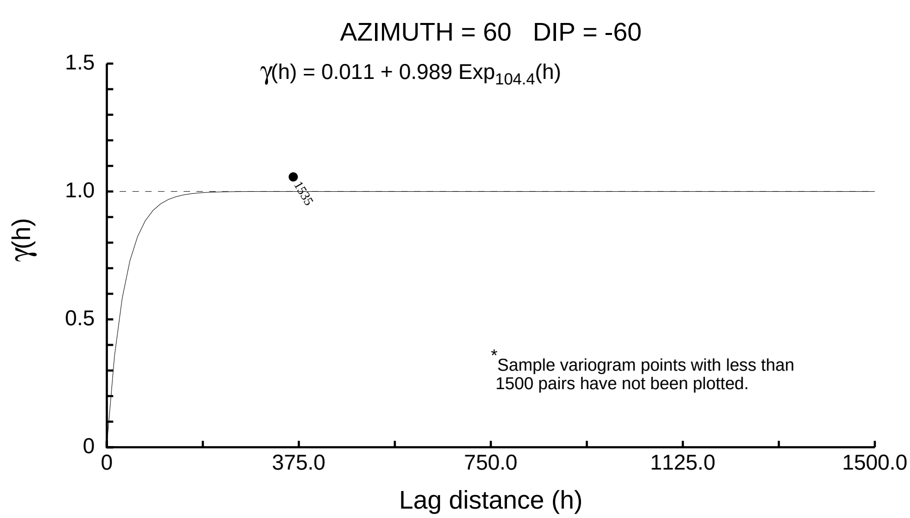
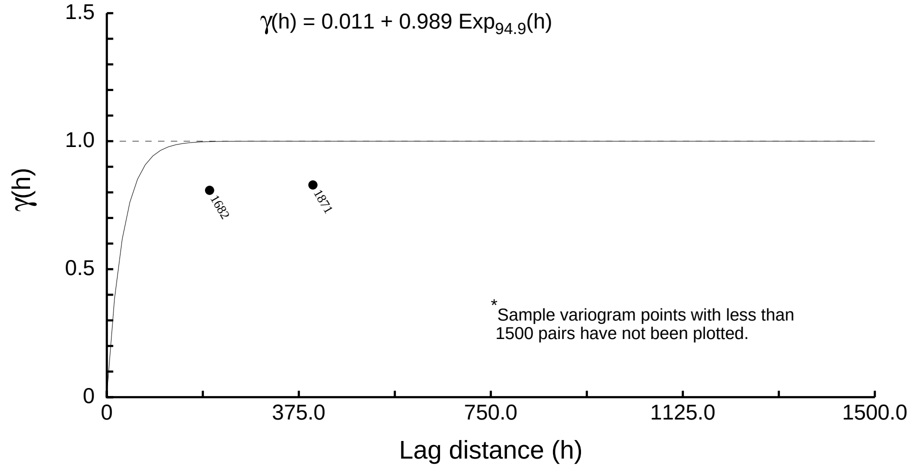






Directional 3000 - S

AZIMUTH = 90   DIP = -60



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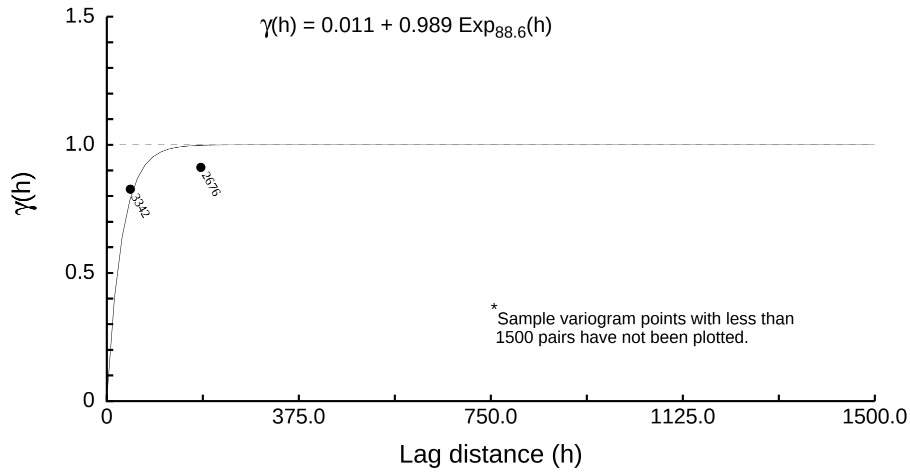
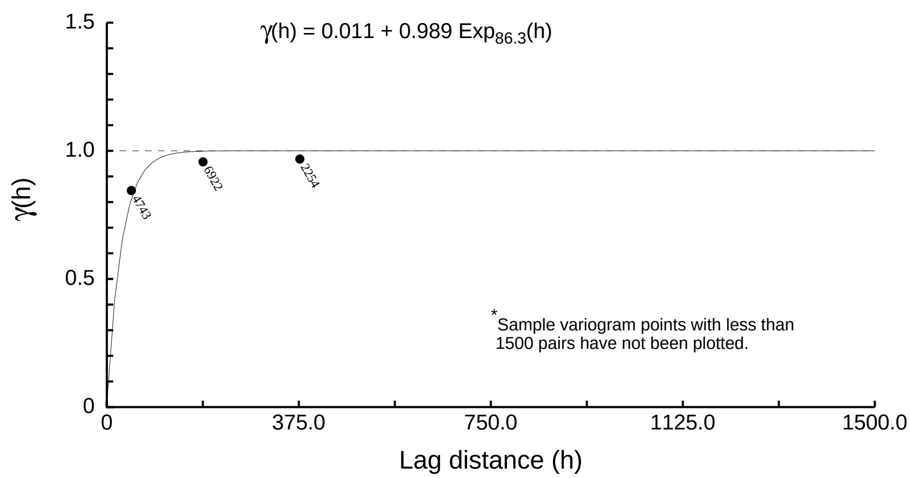
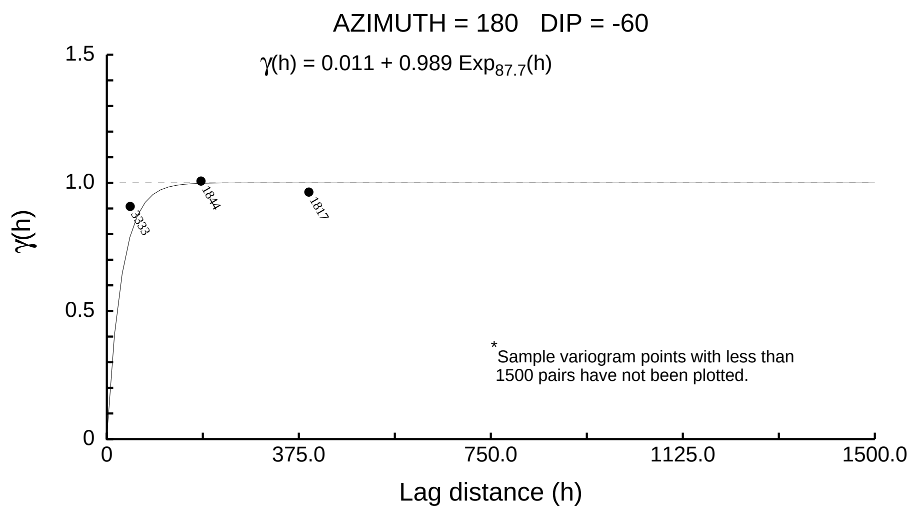
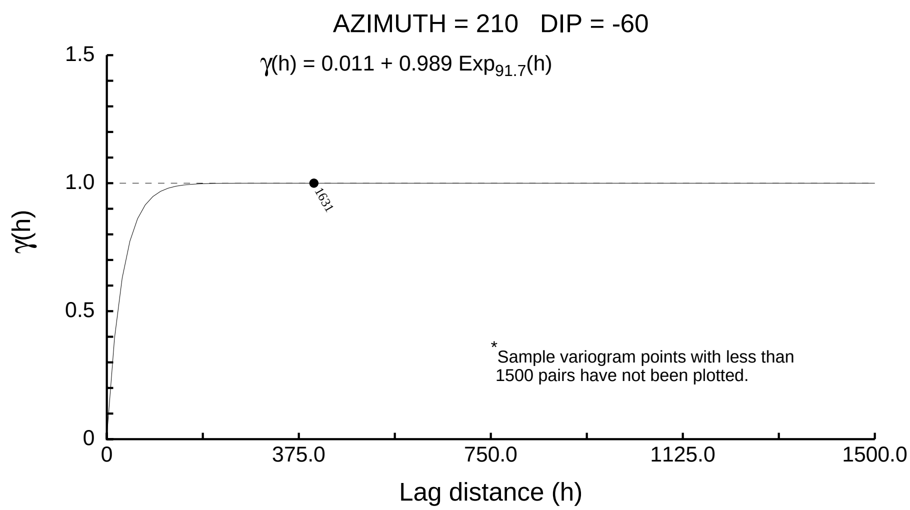


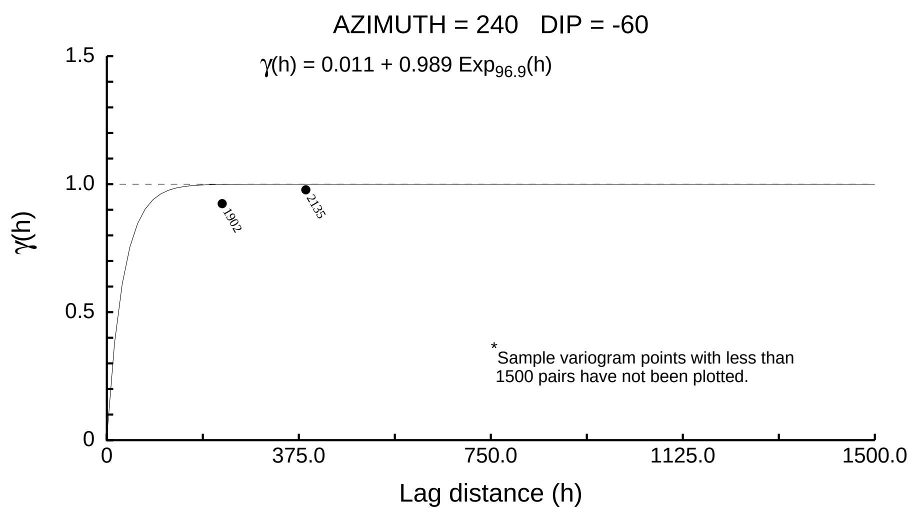
AZIMUTH = 150   DIP = -60



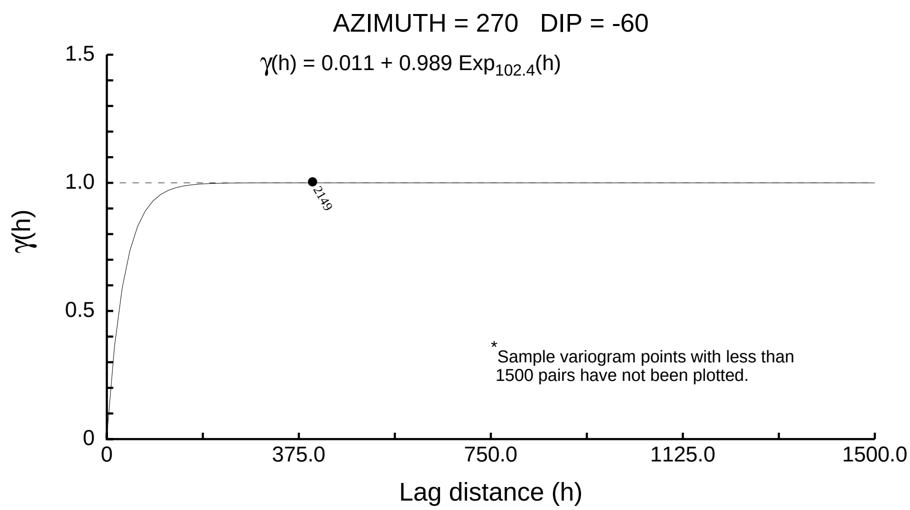
Directional 3000 - S

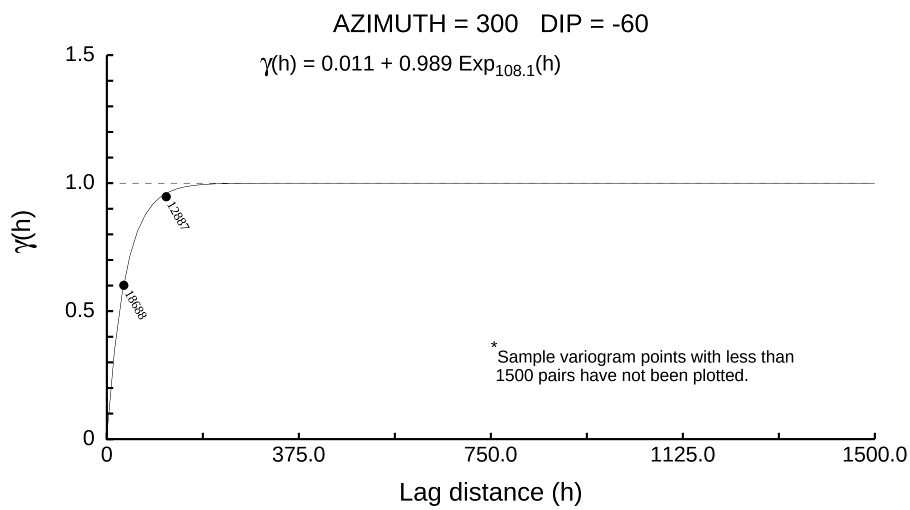


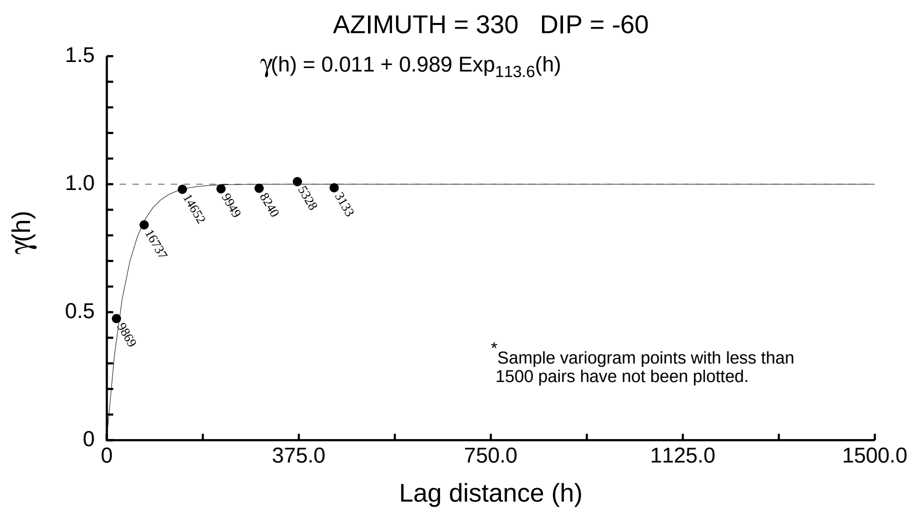




Directional 3000 - S







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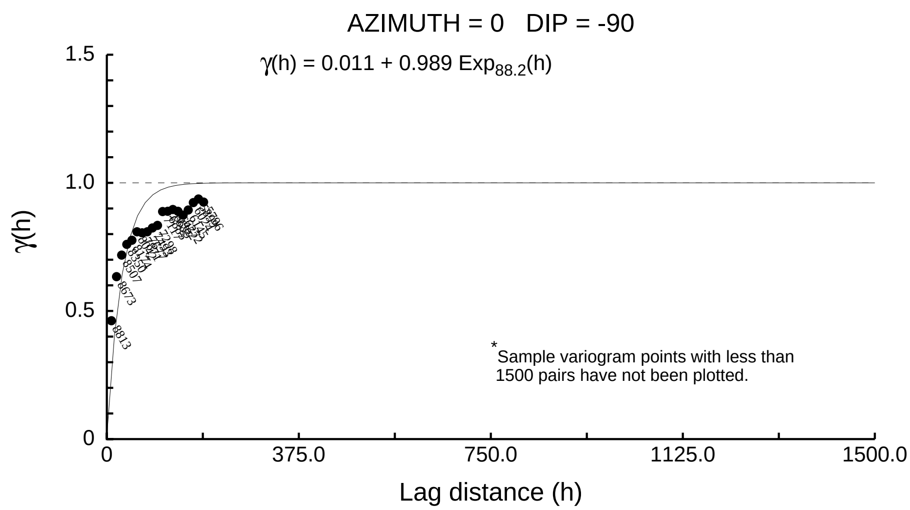
Directional 3000 - S



NorthMet U_1_Au_MDIR

User Defined Rotation Conventions

Nugget ==> 0.784
C1 ==> 0.137
C2 ==> 0.079

First Structure -- Spherical

RH Rotation about the Z axis ==> -24
RH Rotation about the Y' axis ==> 80
RH Rotation about the Z' axis ==> -36

Range along the Z' axis	==> 3.0	Azimuth ==> 114	Dip ==> 10
Range along the Y' axis	==> 102.9	Azimuth ==> 31	Dip ==> -36
Range along the X' axis	==> 143.4	Azimuth ==> 190	Dip ==> -52

Second Structure -- Spherical

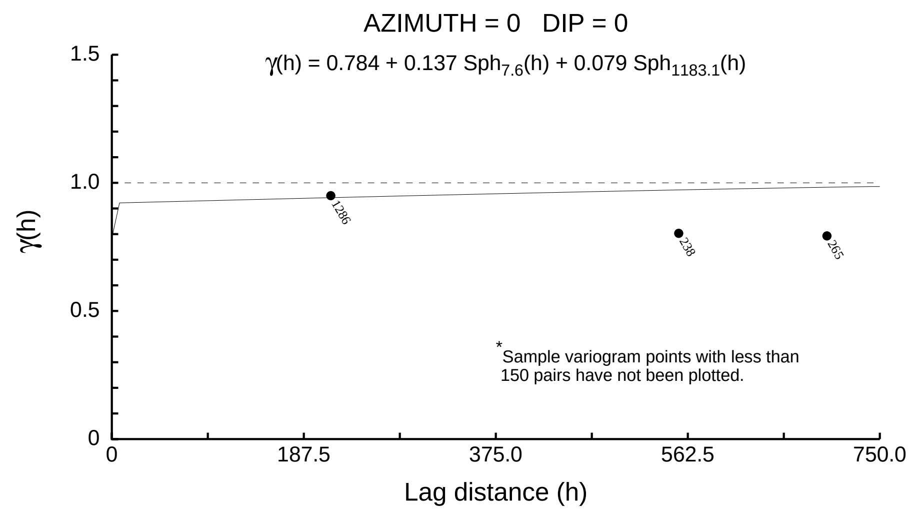
RH Rotation about the Z axis ==> -118
RH Rotation about the Y' axis ==> -3
RH Rotation about the Z' axis ==> 91

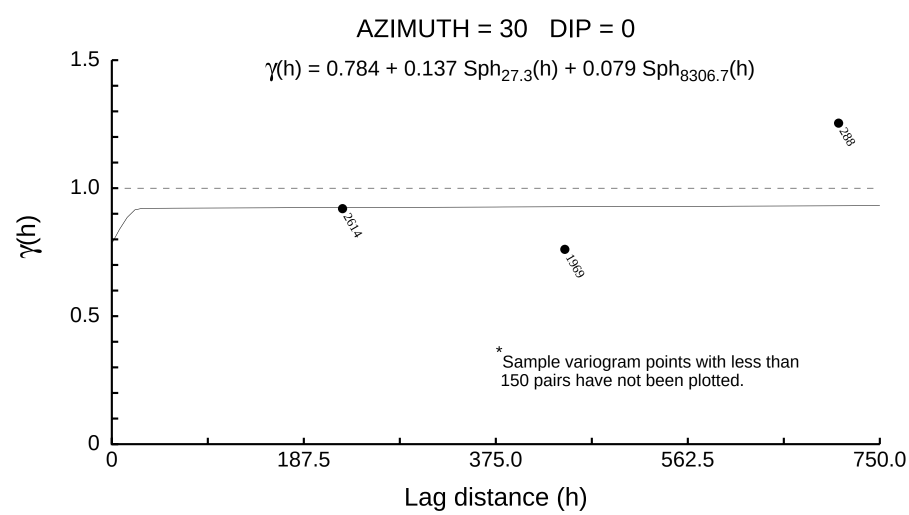
Range along the Z' axis	==> 16953.8	Azimuth ==> 28	Dip ==> 87
Range along the Y' axis	==> 12687.8	Azimuth ==> 27	Dip ==> -3
Range along the X' axis	==> 542.1	Azimuth ==> 117	Dip ==> -0

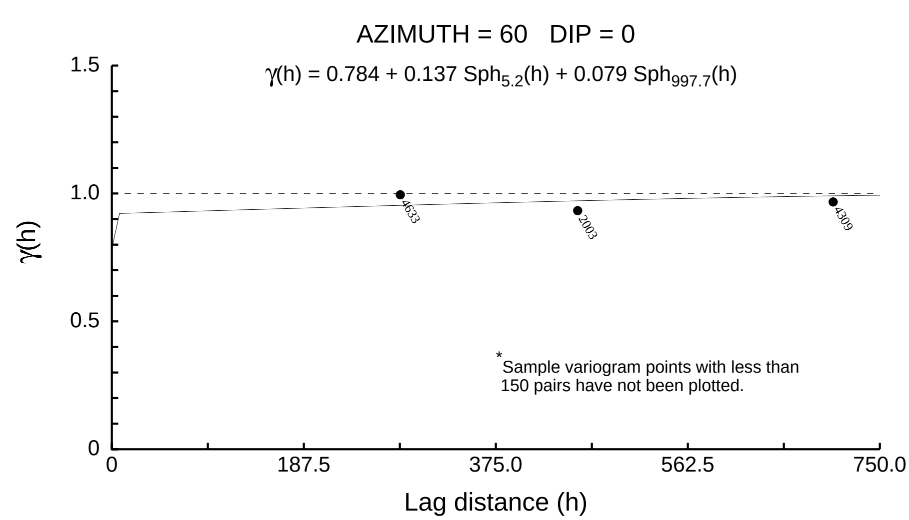
Modeling Criteria

Minimum number pairs req'd ==> 150
Sample variogram points weighted by # pairs

NorthMet U_1_Au_MDIR







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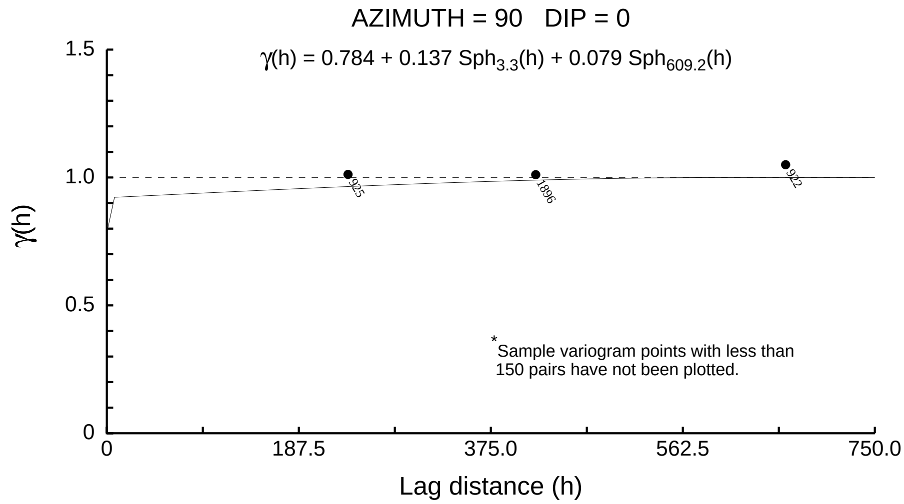
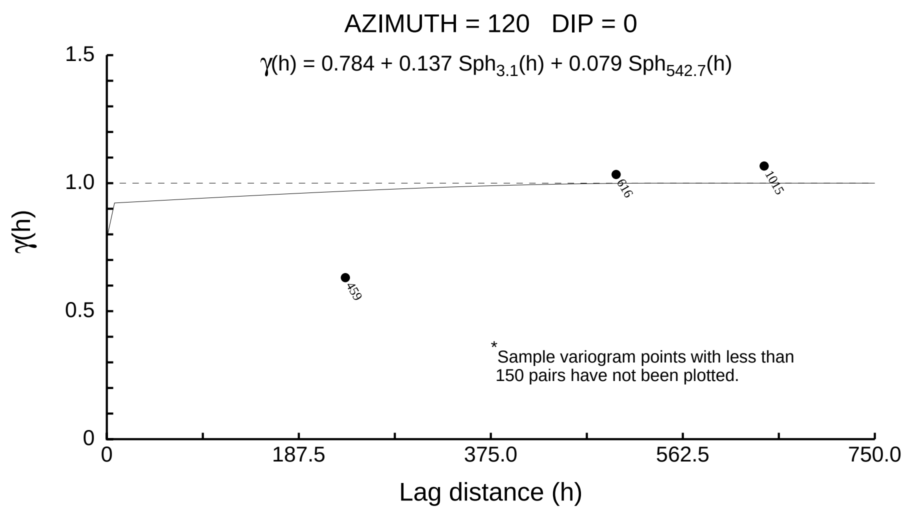
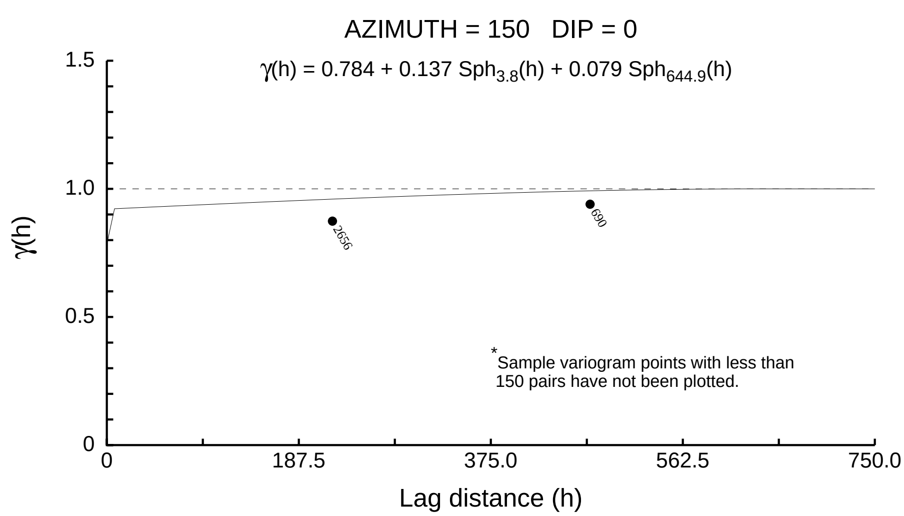
NorthMet U_1_Au_MDIR







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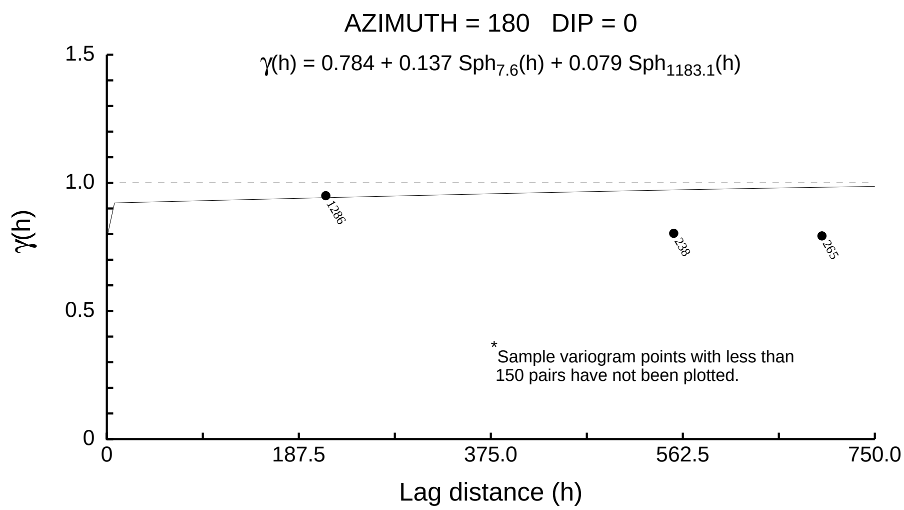
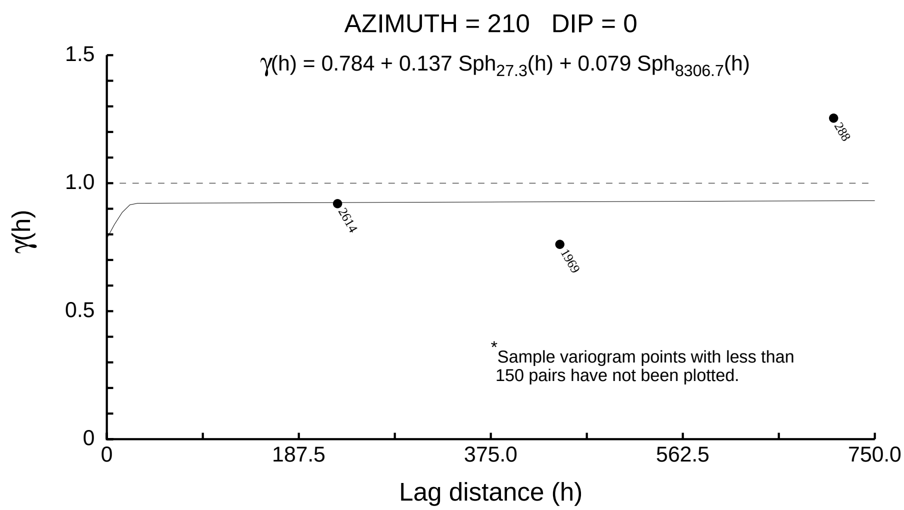
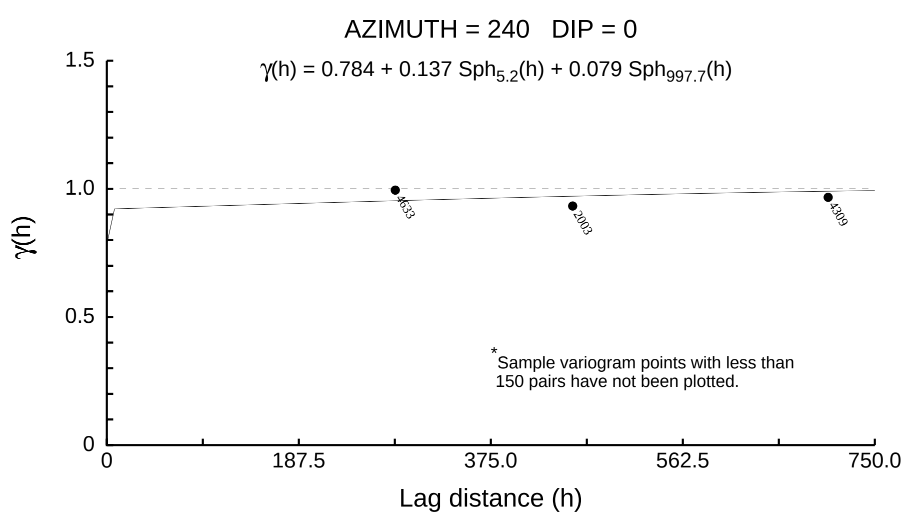
NorthMet U_1_Au_MDIR







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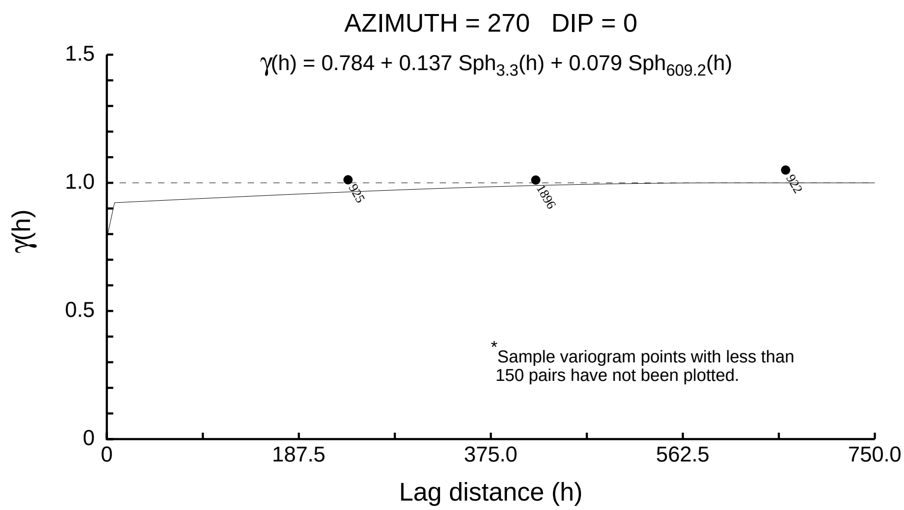
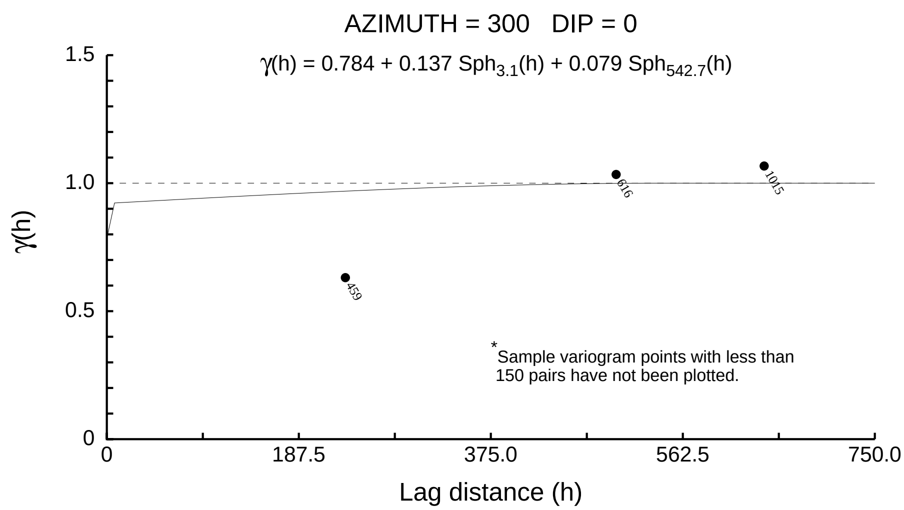
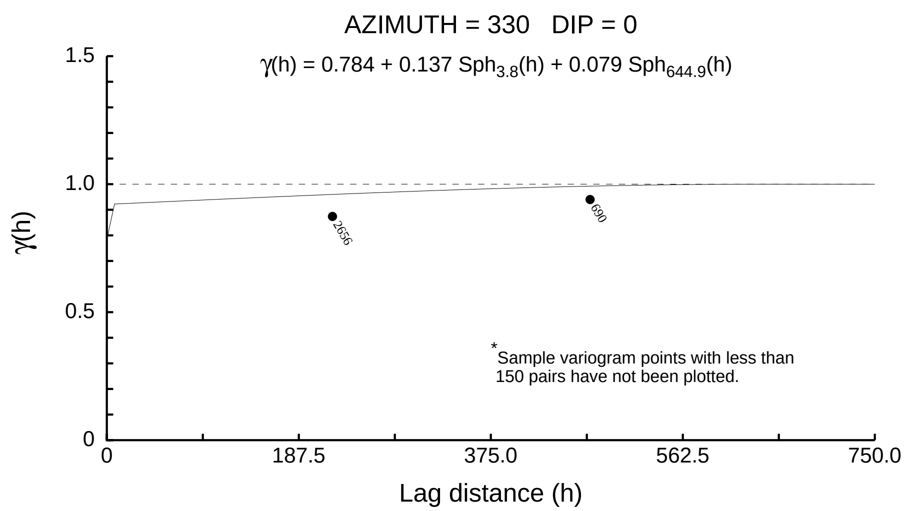
NorthMet U_1_Au_MDIR







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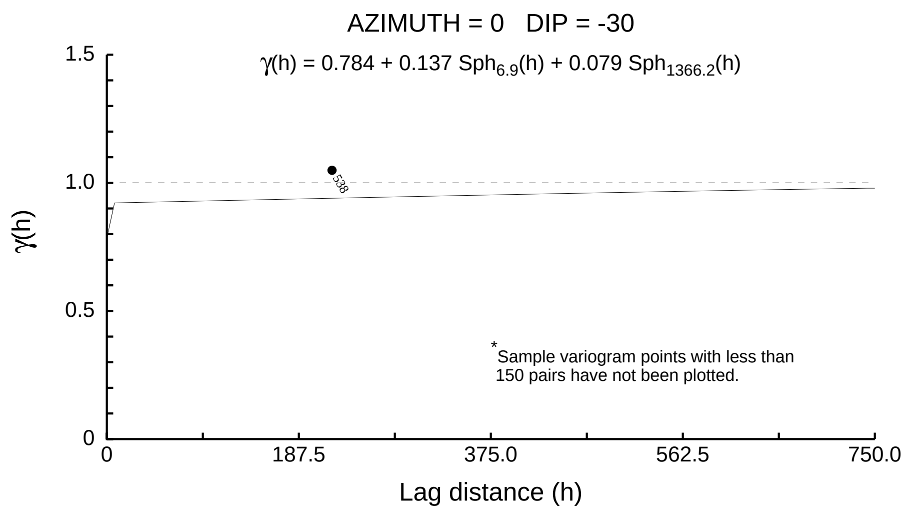
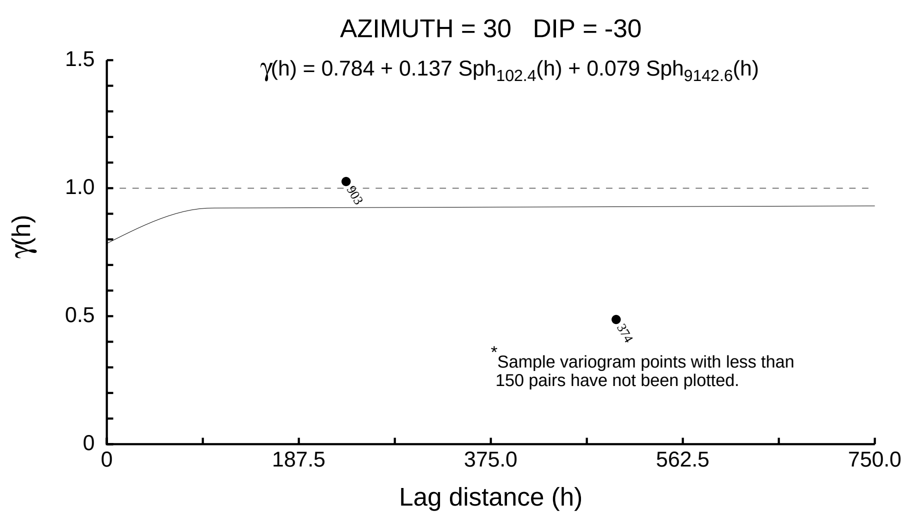
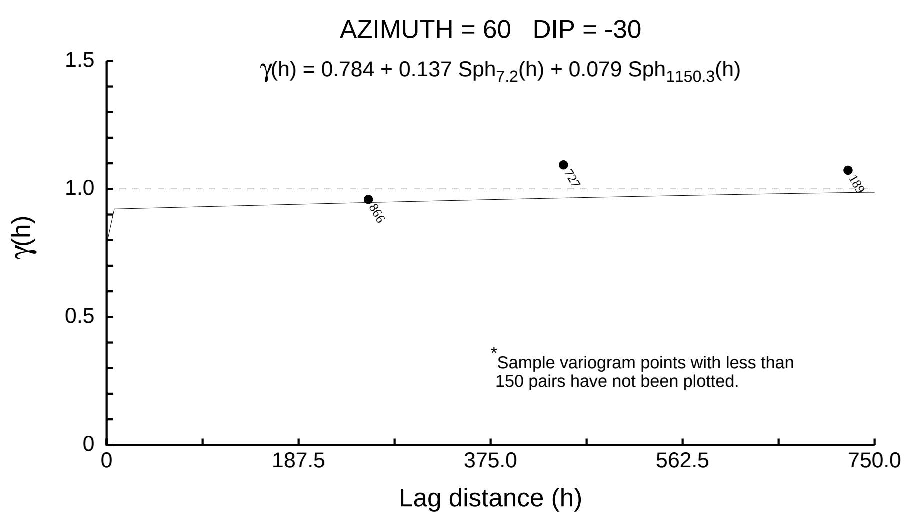
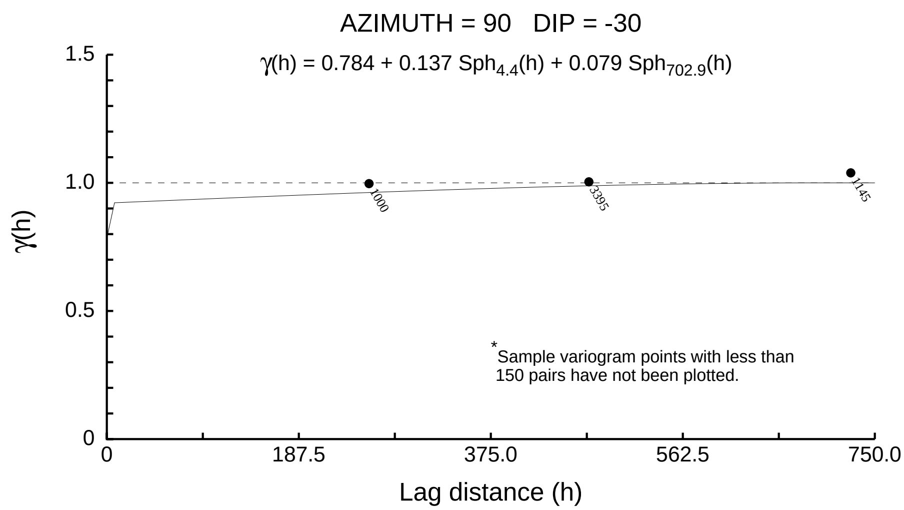
NorthMet U_1_Au_MDIR

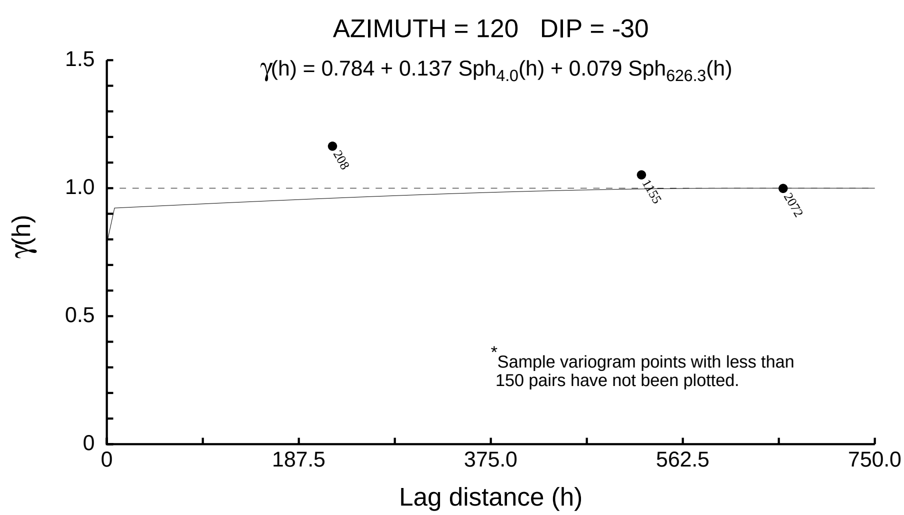


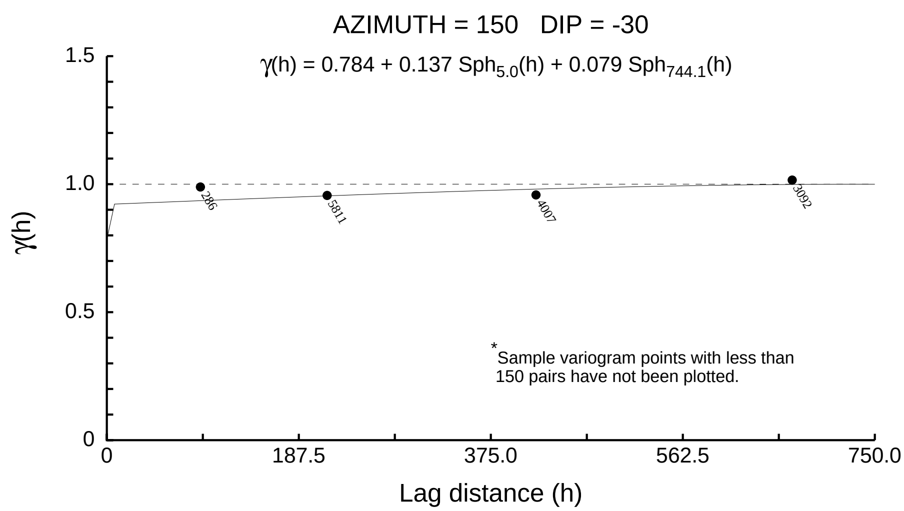




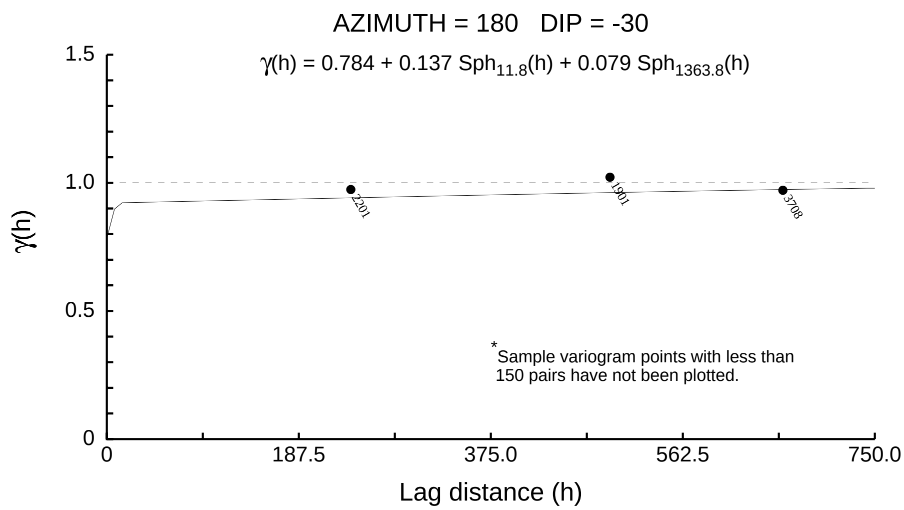
NorthMet U_1_Au_MDIR

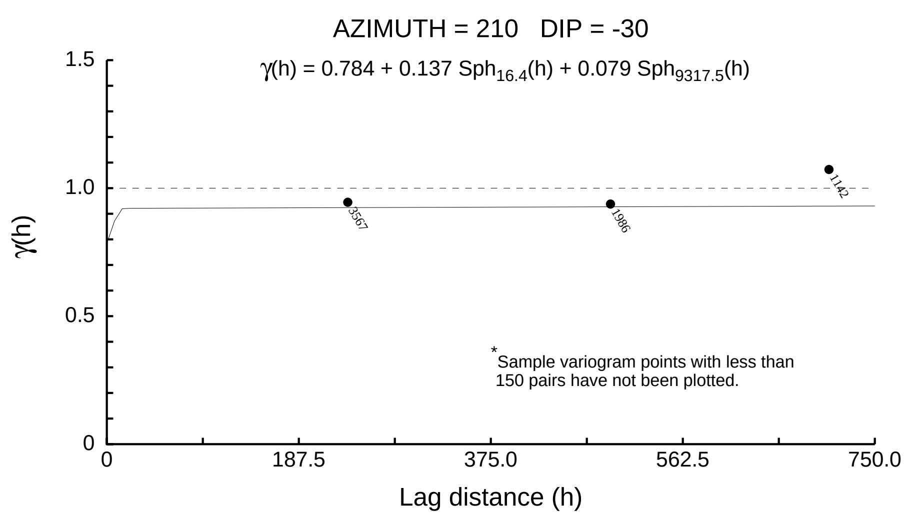


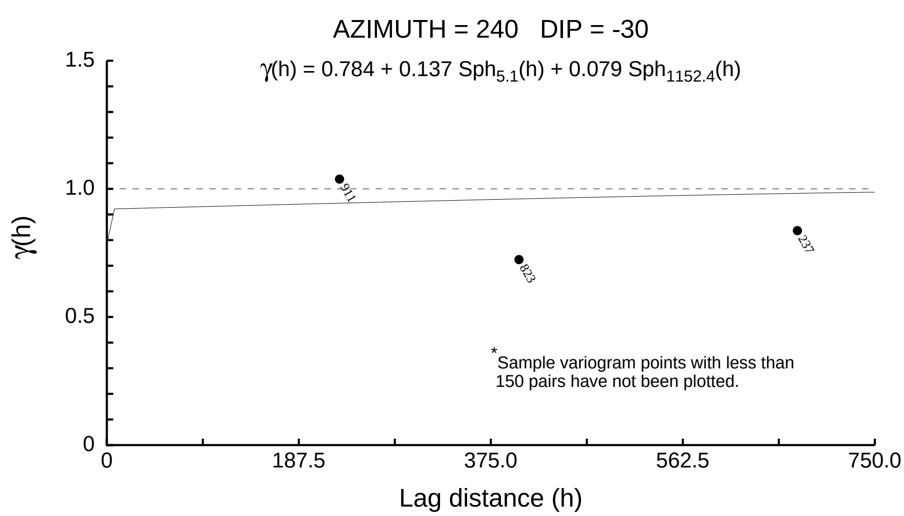




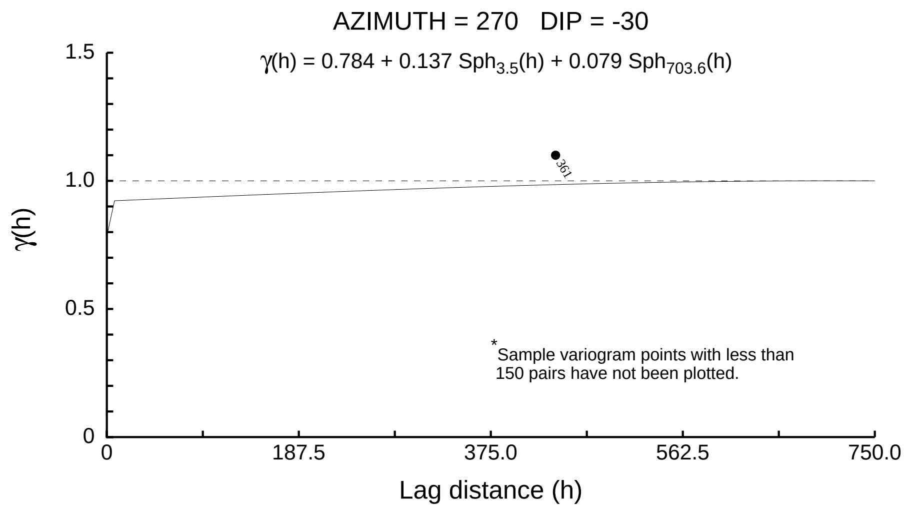
NorthMet U_1_Au_MDIR

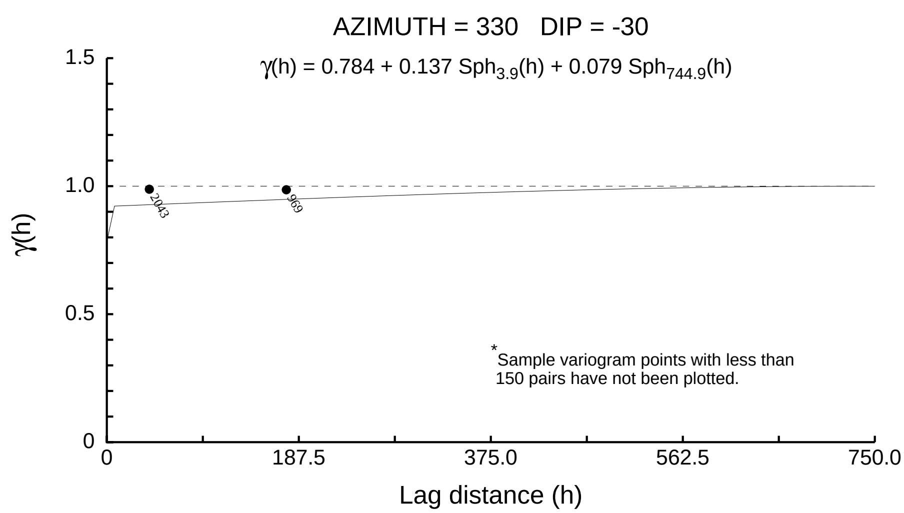


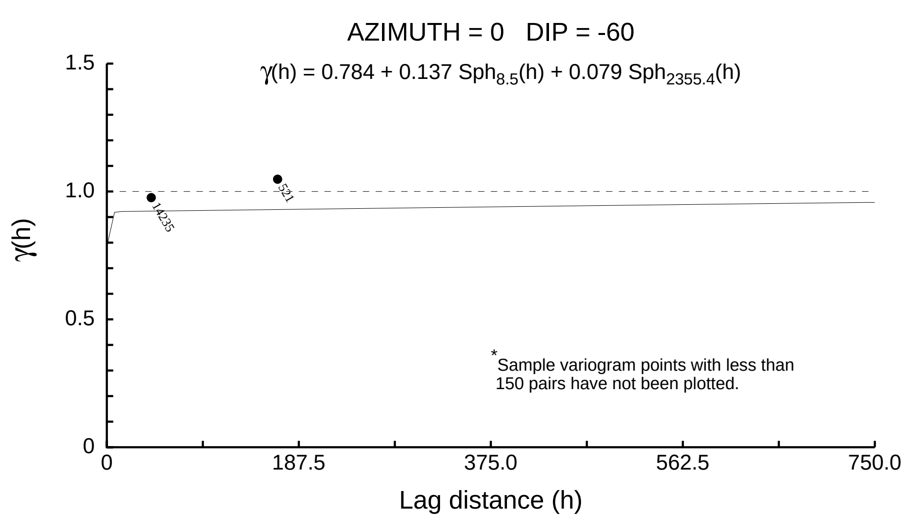




NorthMet U_1_Au_MDIR







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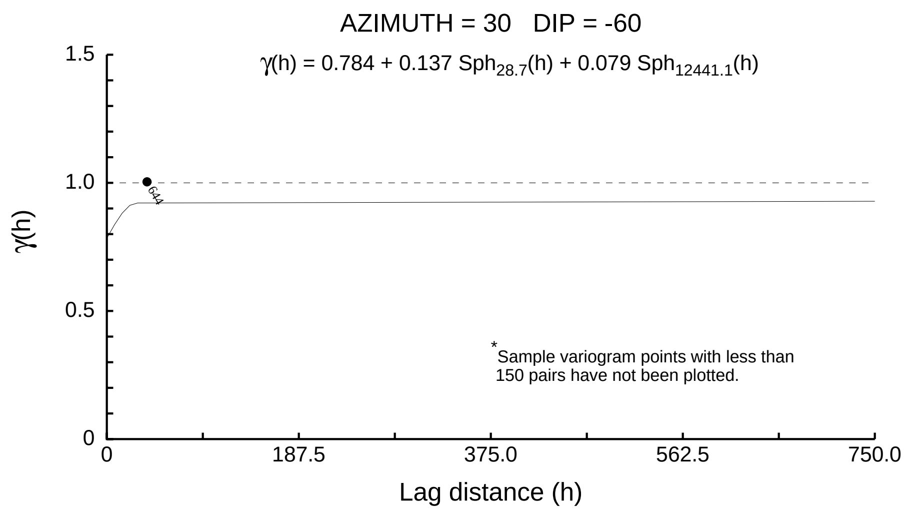

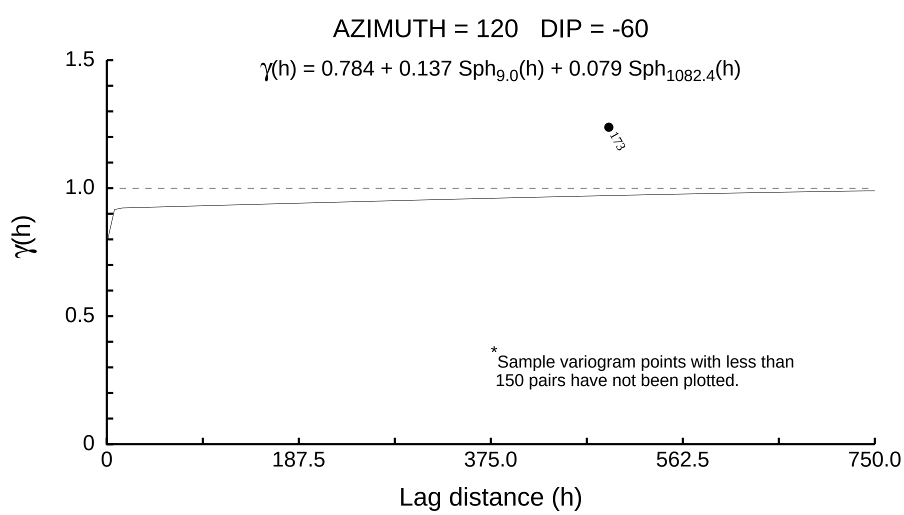

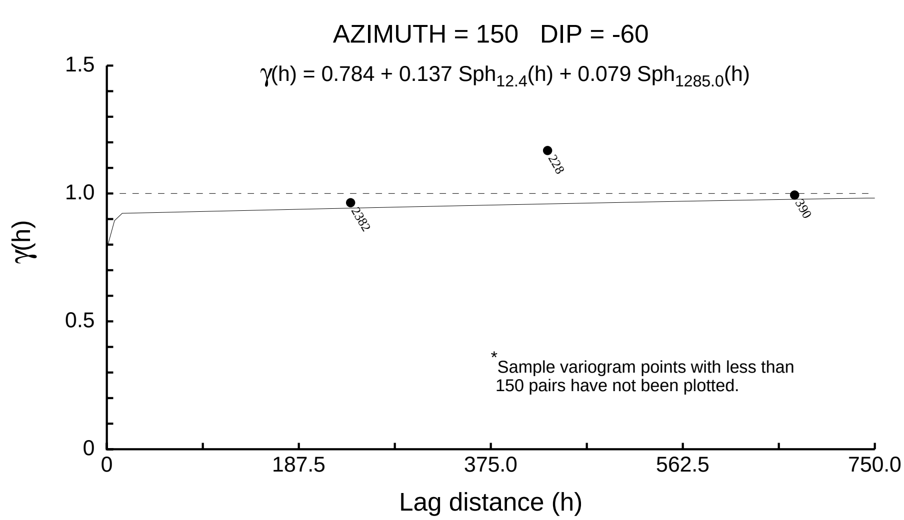

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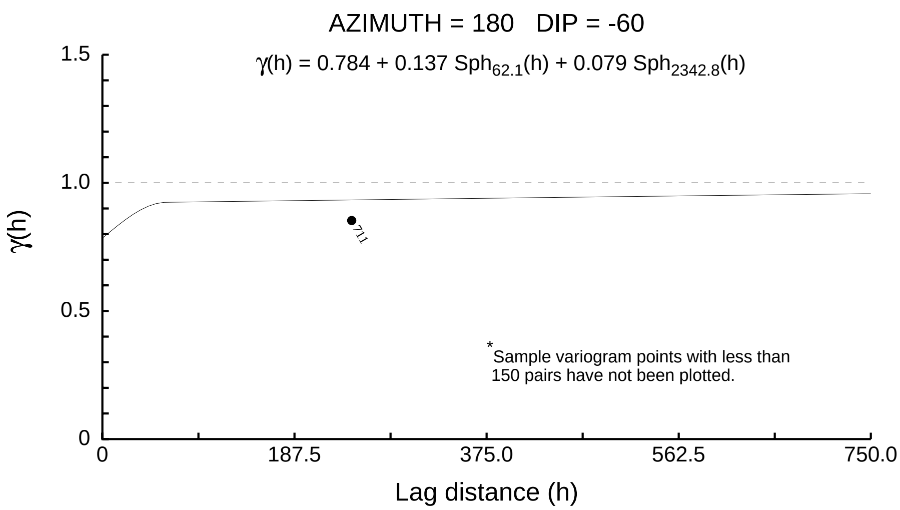
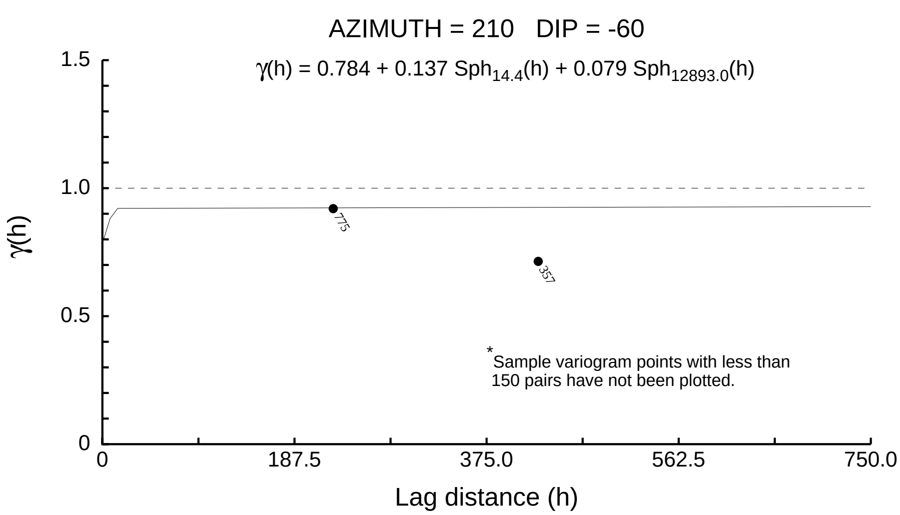
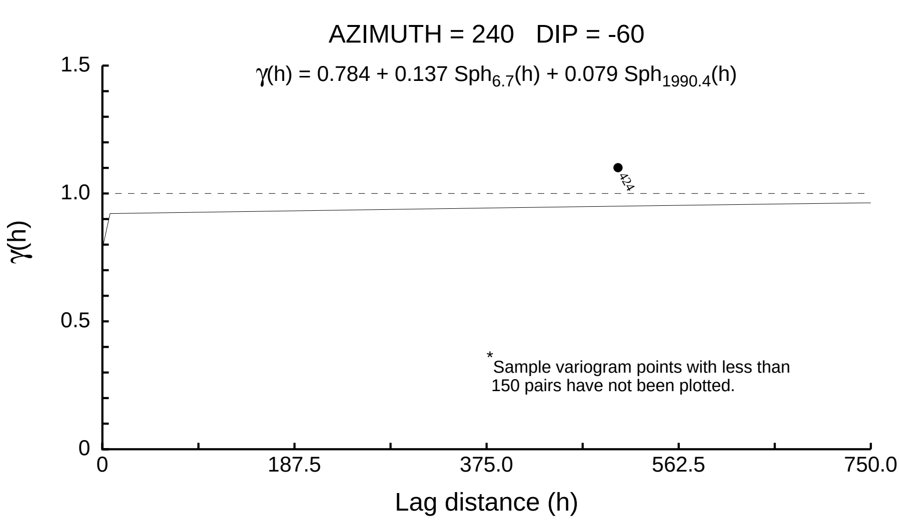
NorthMet U_1_Au_MDIR







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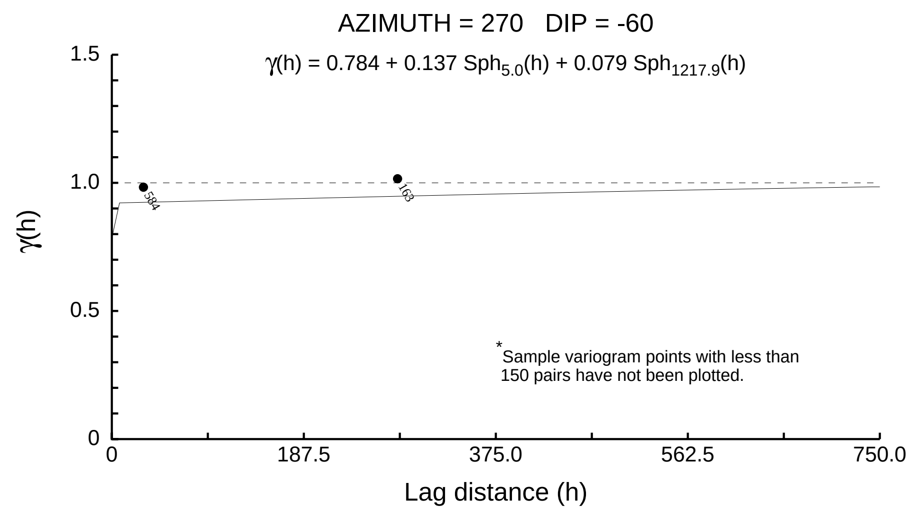
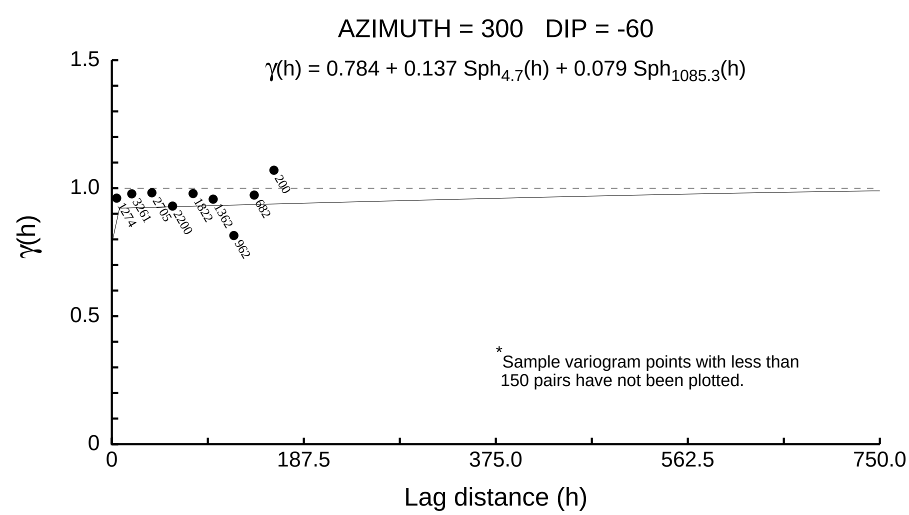
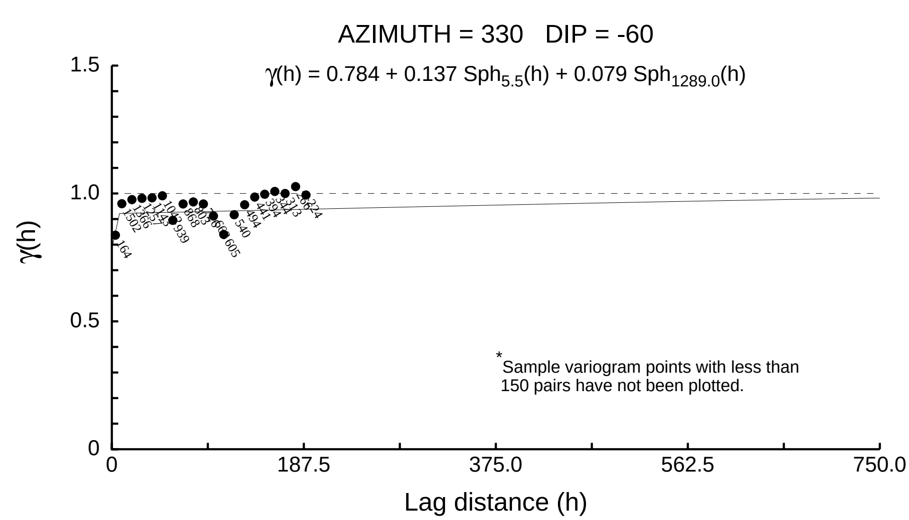
NorthMet U_1_Au_MDIR







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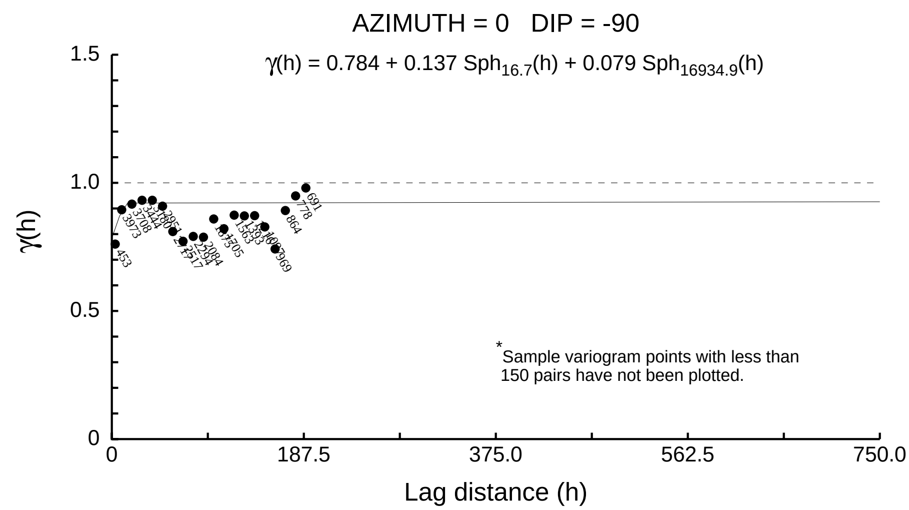
NorthMet U_1_Au_MDIR



NorthMet U_1_Co_MDIR

User Defined Rotation Conventions

Nugget ==> 0.495
C1 ==> 0.186
C2 ==> 0.319

First Structure -- Spherical

RH Rotation about the Z axis ==> -82
RH Rotation about the Y' axis ==> 64
RH Rotation about the Z' axis ==> -50

Range along the Z' axis	==> 26.7	Azimuth ==> 172	Dip ==> 26
Range along the Y' axis	==> 80.9	Azimuth ==> 109	Dip ==> -43
Range along the X' axis	==> 213.8	Azimuth ==> 242	Dip ==> -36

Second Structure -- Spherical

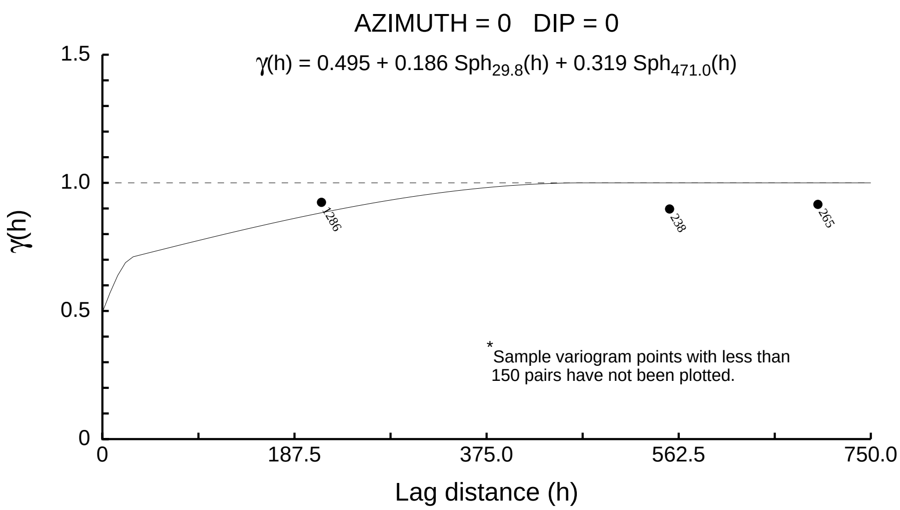
RH Rotation about the Z axis ==> -56
RH Rotation about the Y' axis ==> -48
RH Rotation about the Z' axis ==> 97

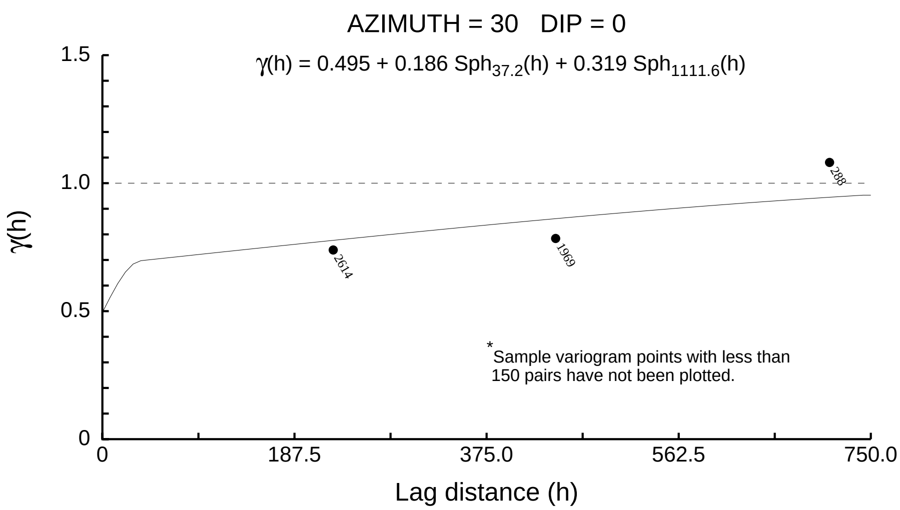
Range along the Z' axis	==> 789.9	Azimuth ==> 326	Dip ==> 42
Range along the Y' axis	==> 244.7	Azimuth ==> 316	Dip ==> -48
Range along the X' axis	==> 3002.4	Azimuth ==> 51	Dip ==> -5

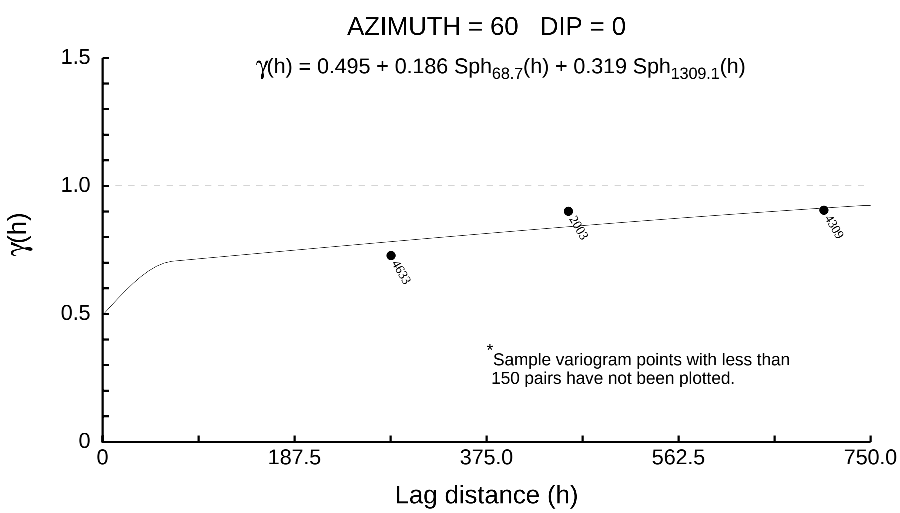
Modeling Criteria

Minimum number pairs req'd ==> 150
Sample variogram points weighted by # pairs

NorthMet U_1_Co_MDIR







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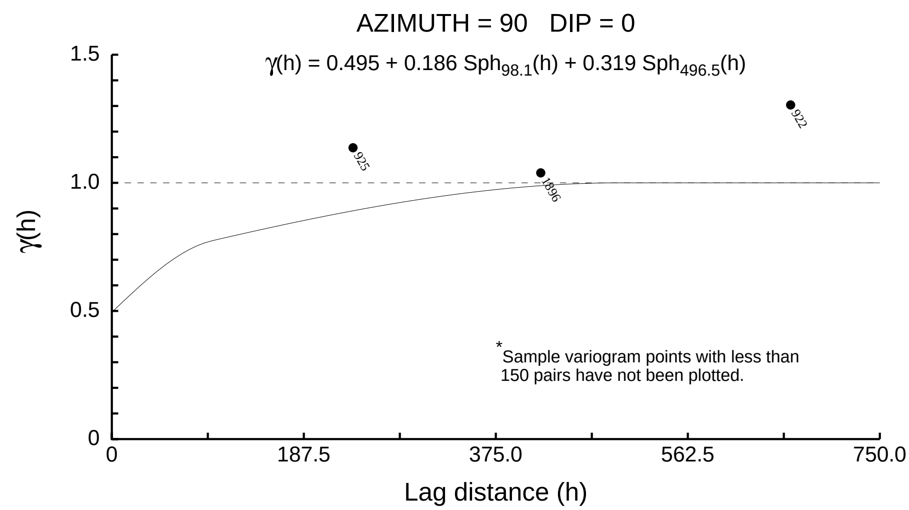
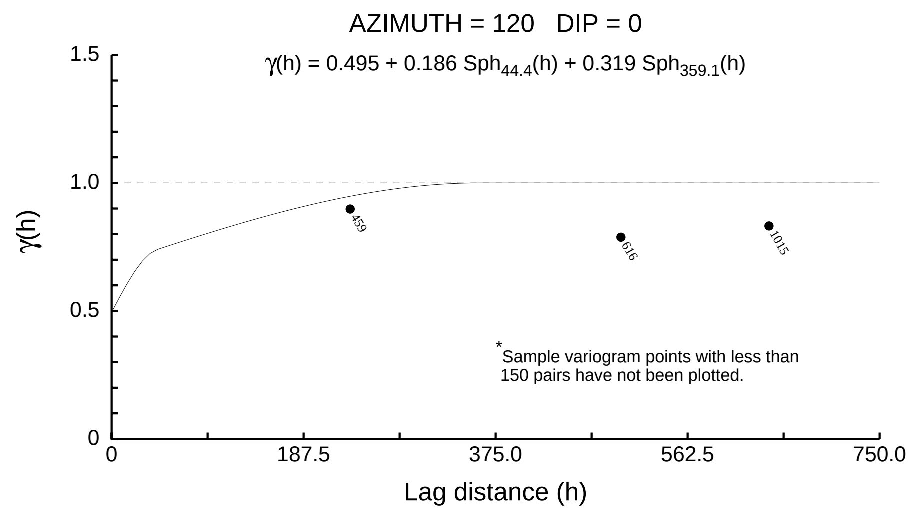
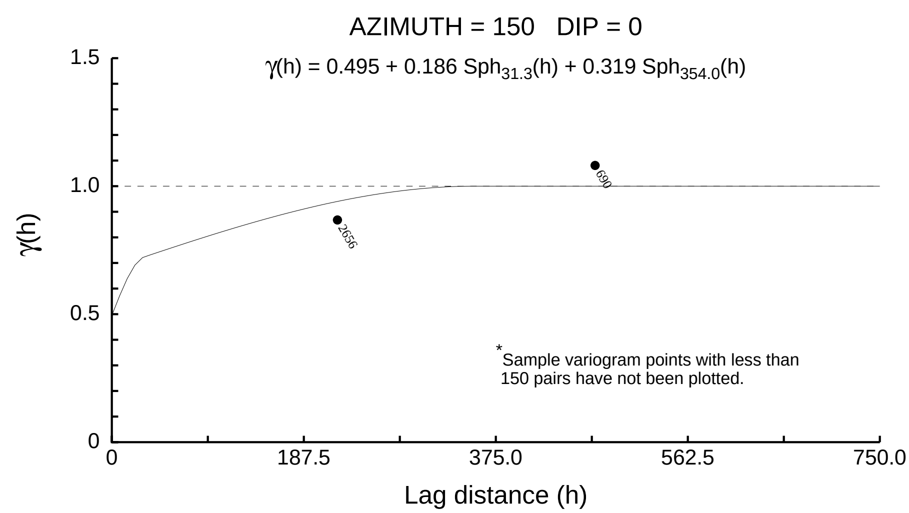
NorthMet U_1_Co_MDIR

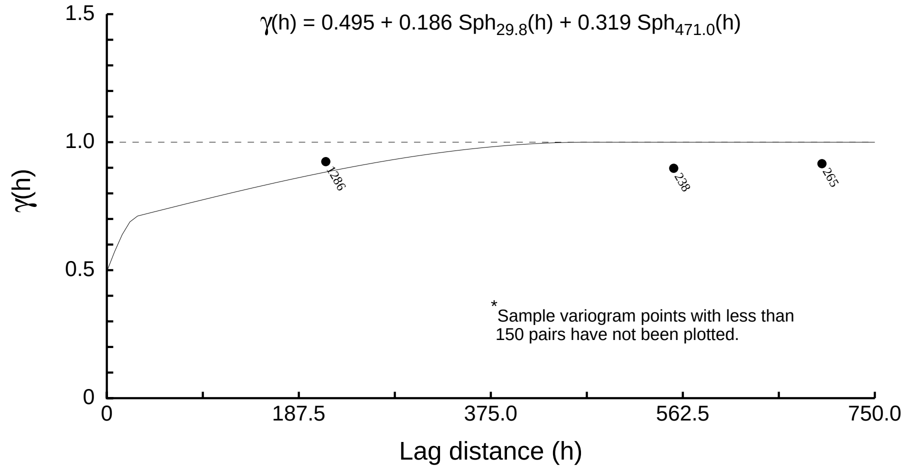




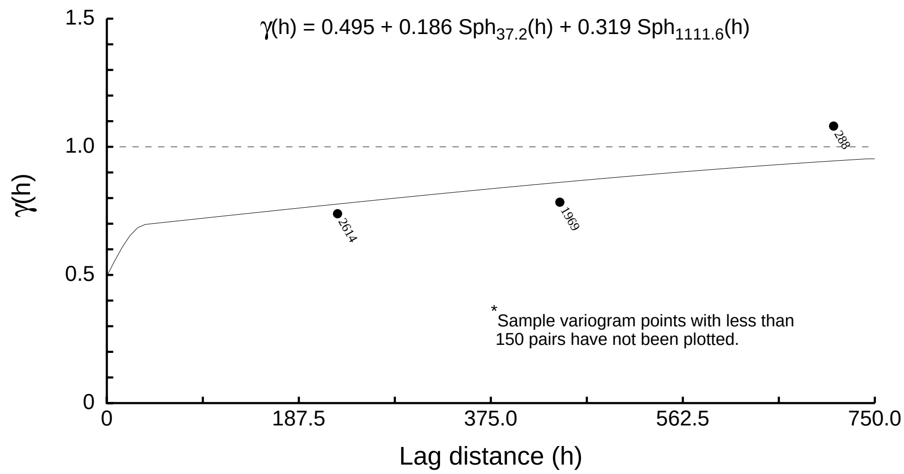


NorthMet U_1_Co_MDIR

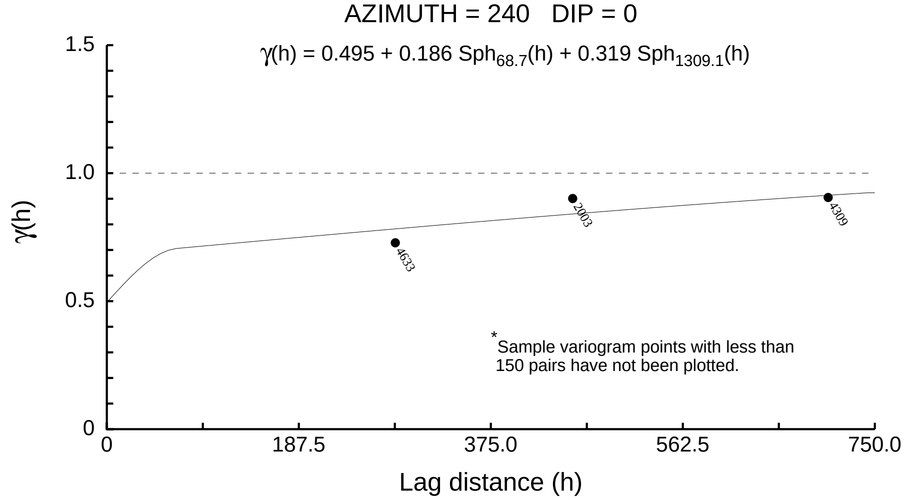
AZIMUTH = 180   DIP = 0



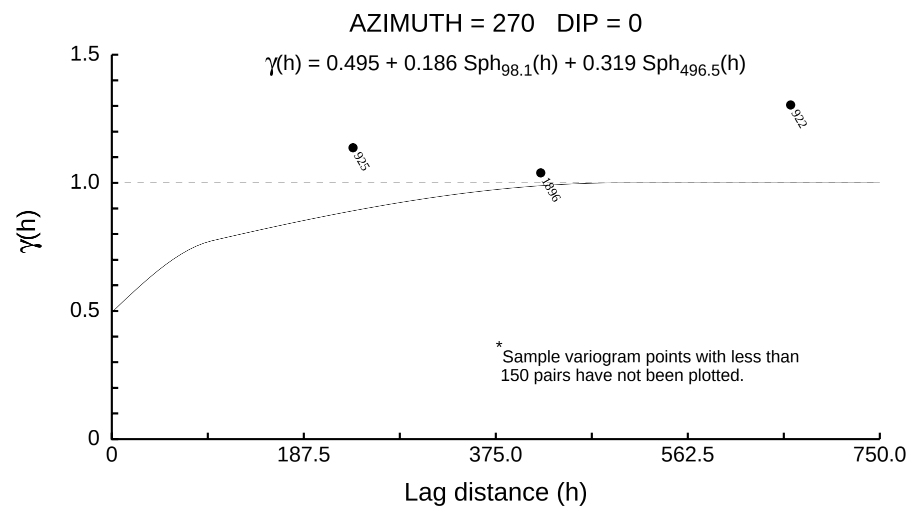
AZIMUTH = 210   DIP = 0

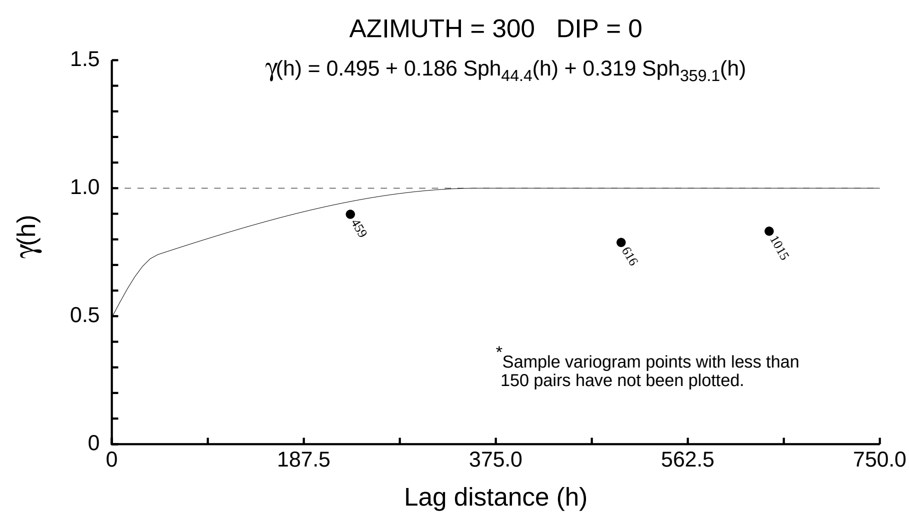


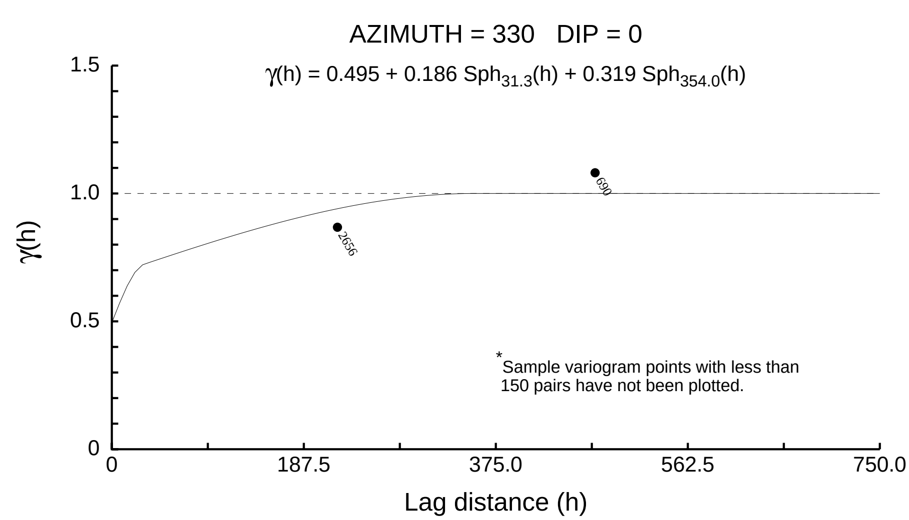
AZIMUTH = 240   DIP = 0



NorthMet U_1_Co_MDIR







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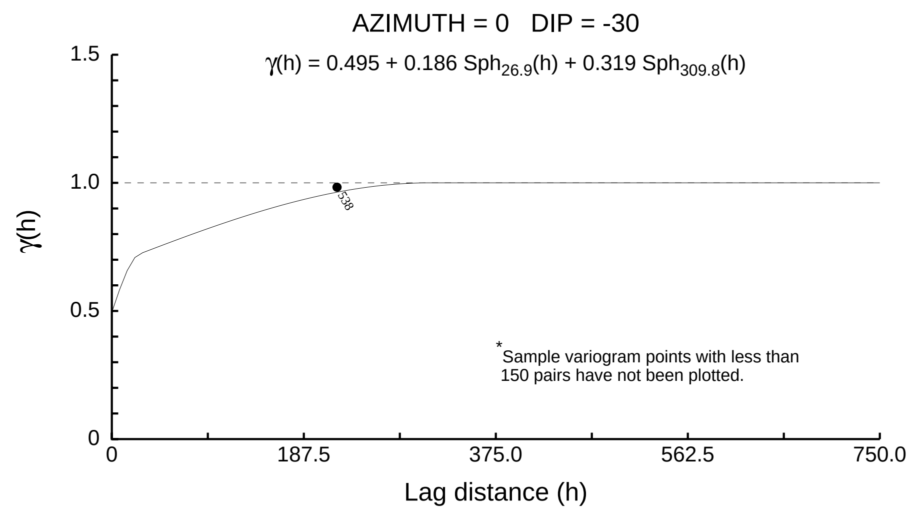
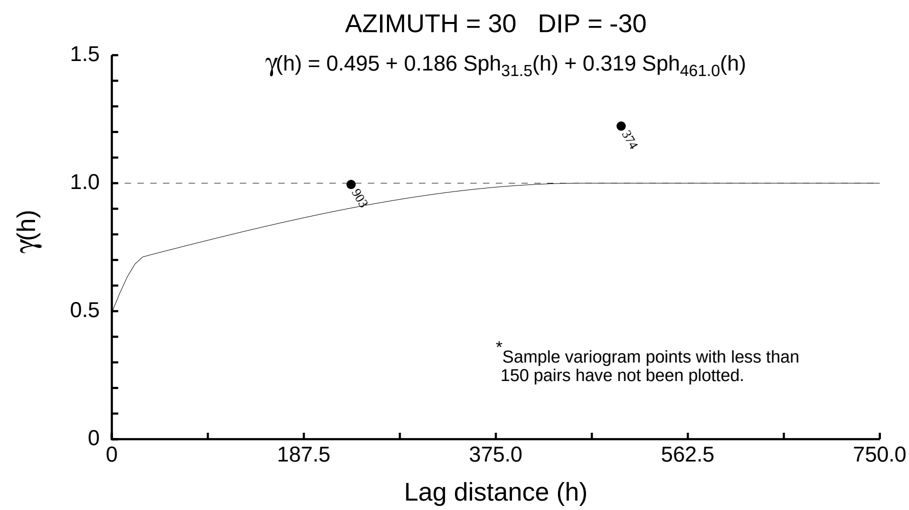
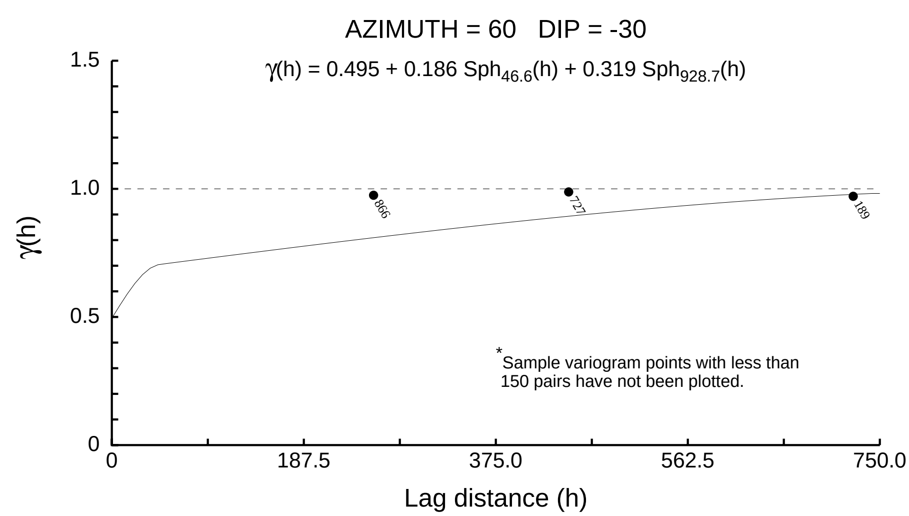
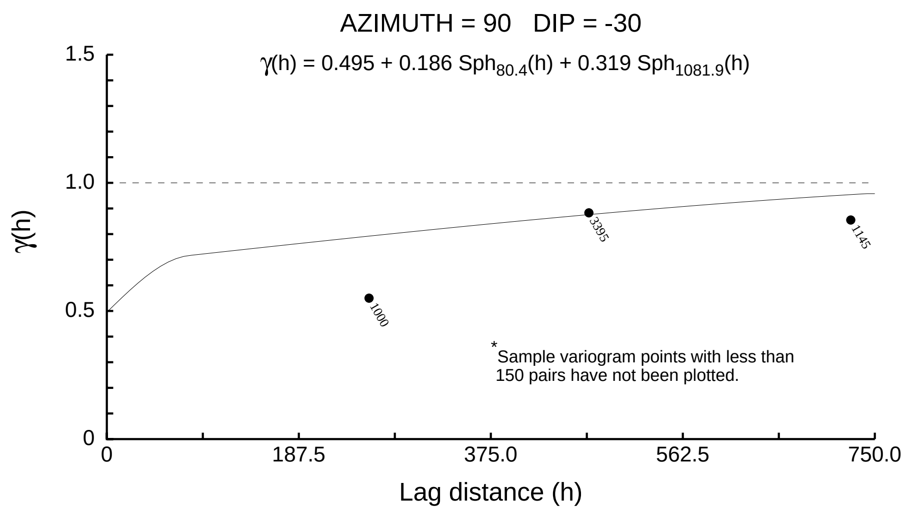
NorthMet U_1_Co_MDIR

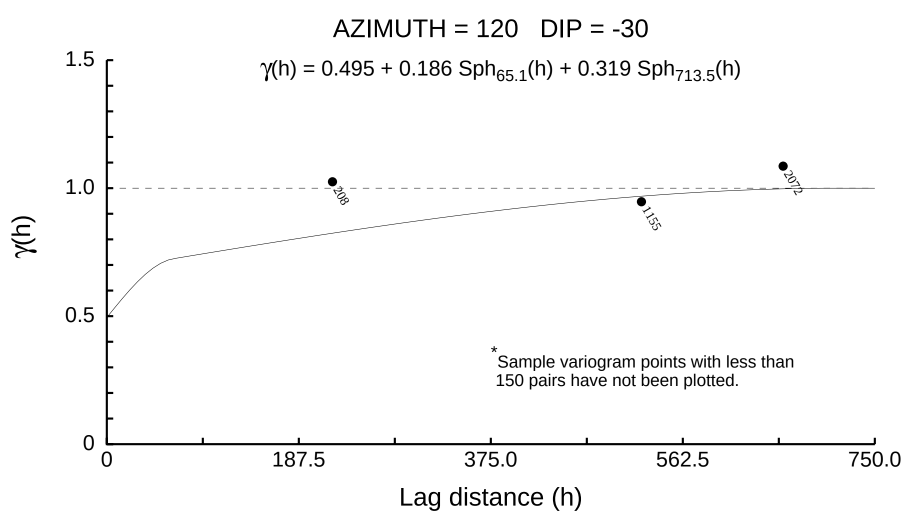


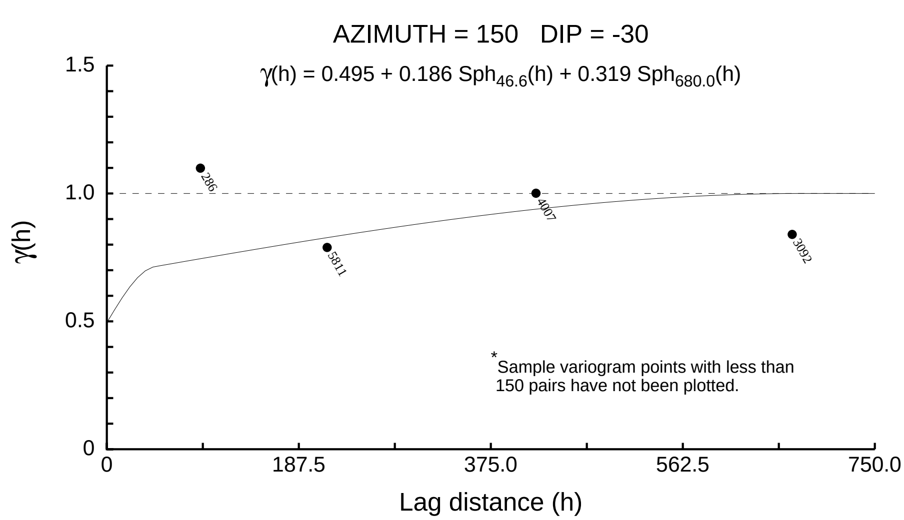




NorthMet U_1_Co_MDIR







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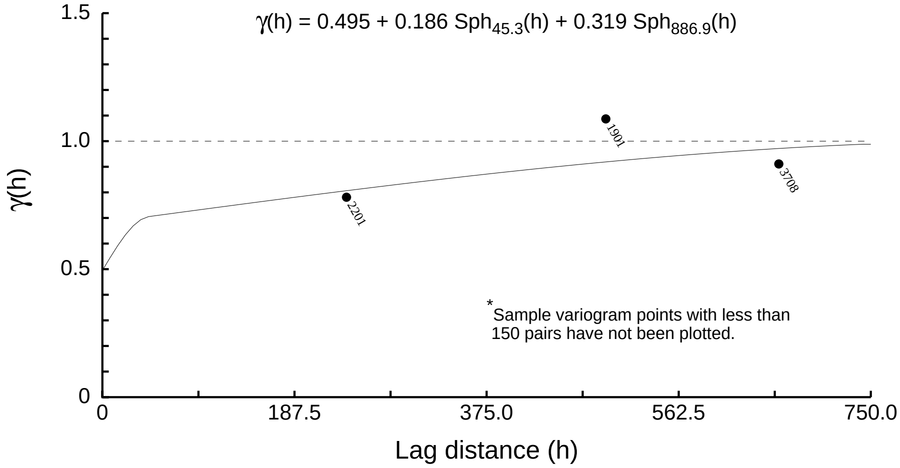
NorthMet U_1_Co_MDIR

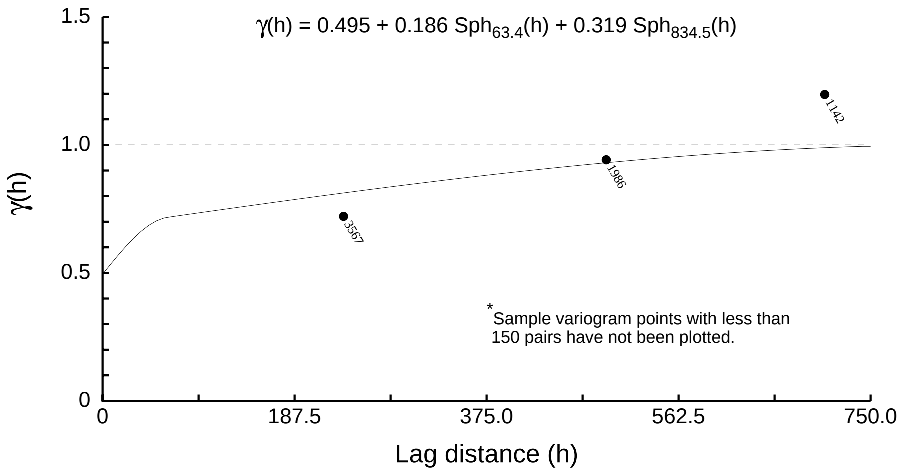
AZIMUTH = 180 DIP = -30

$\gamma(h) = 0.495 + 0.186\ Sph_{45.3}(h) + 0.319\ Sph_{886.9}(h)$



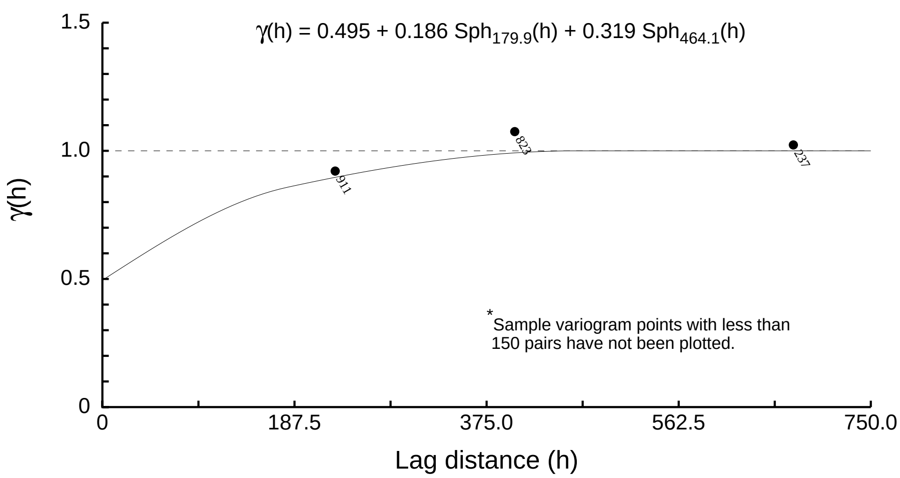
AZIMUTH = 210 DIP = -30

$\gamma(h) = 0.495 + 0.186\ Sph_{63.4}(h) + 0.319\ Sph_{834.5}(h)$

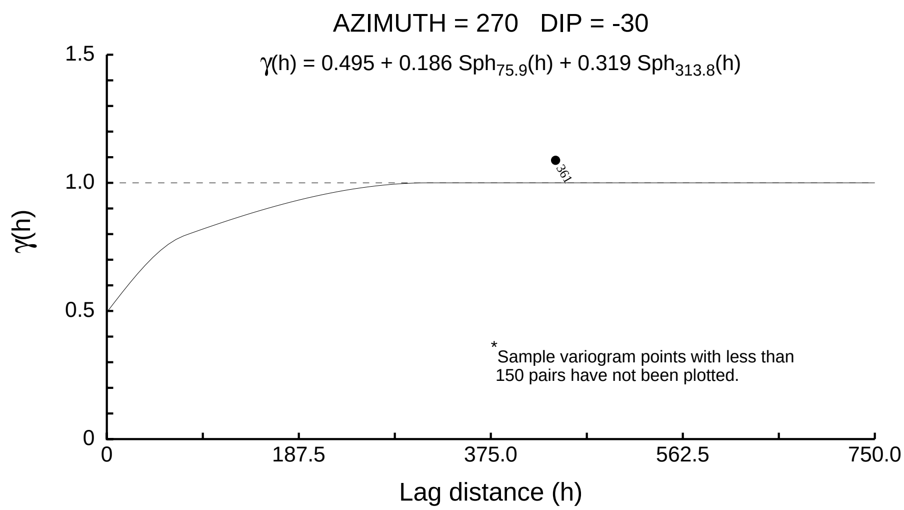


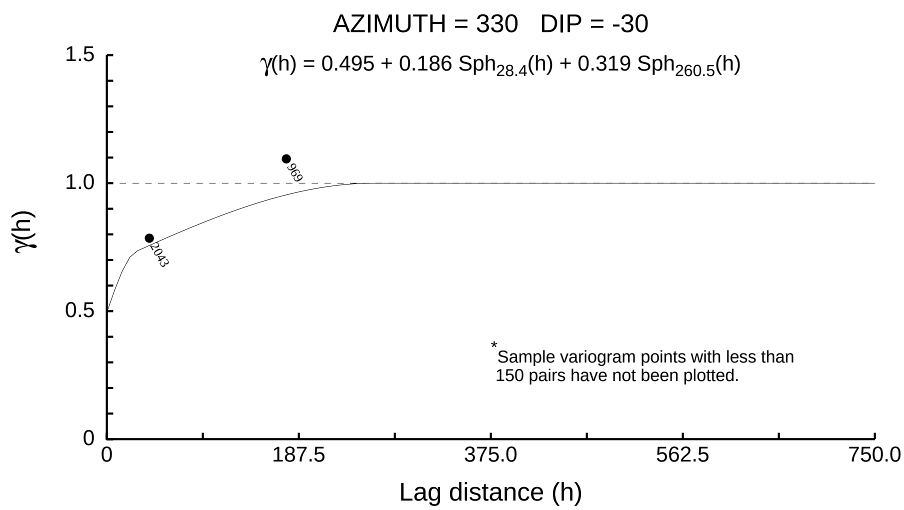
AZIMUTH = 240 DIP = -30

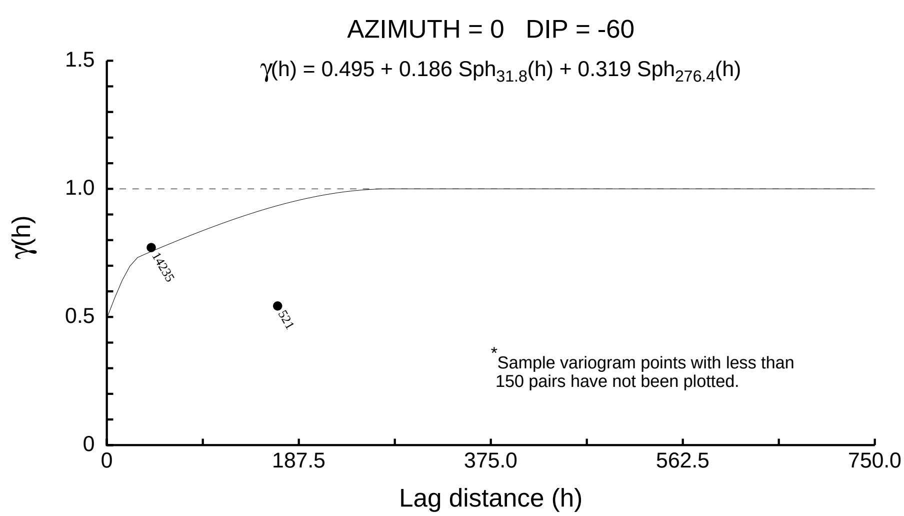
$\gamma(h) = 0.495 + 0.186\ Sph_{179.9}(h) + 0.319\ Sph_{464.1}(h)$



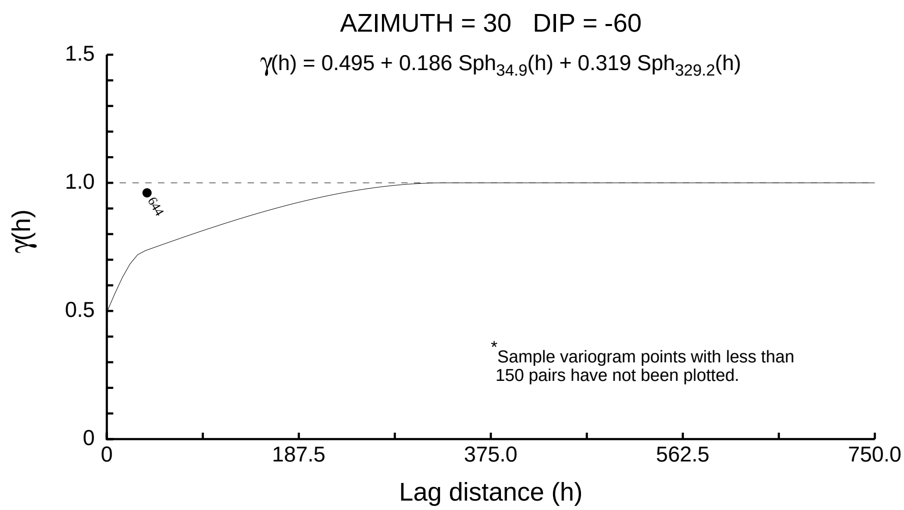
NorthMet U_1_Co_MDIR

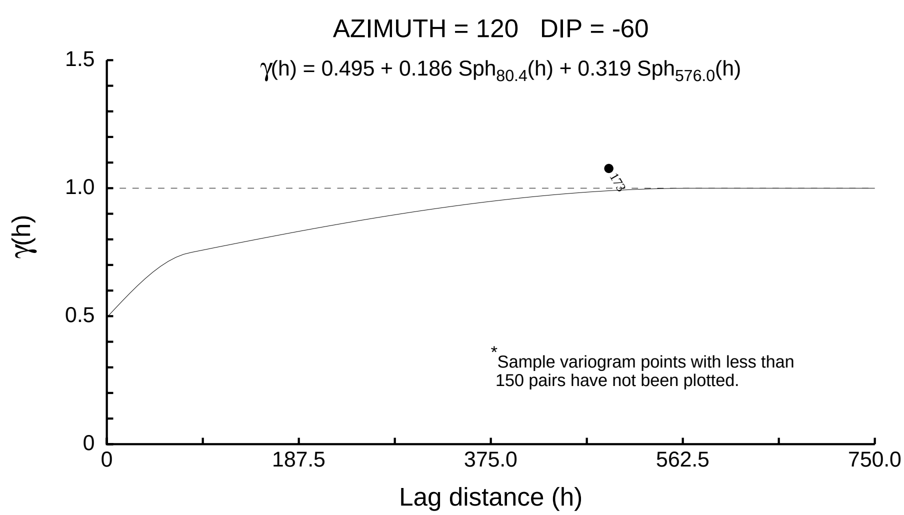


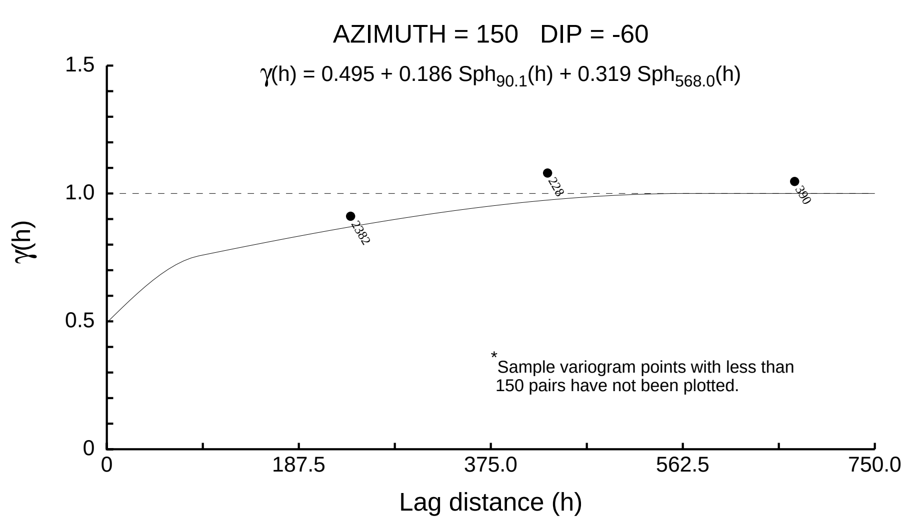




NorthMet U_1_Co_MDIR







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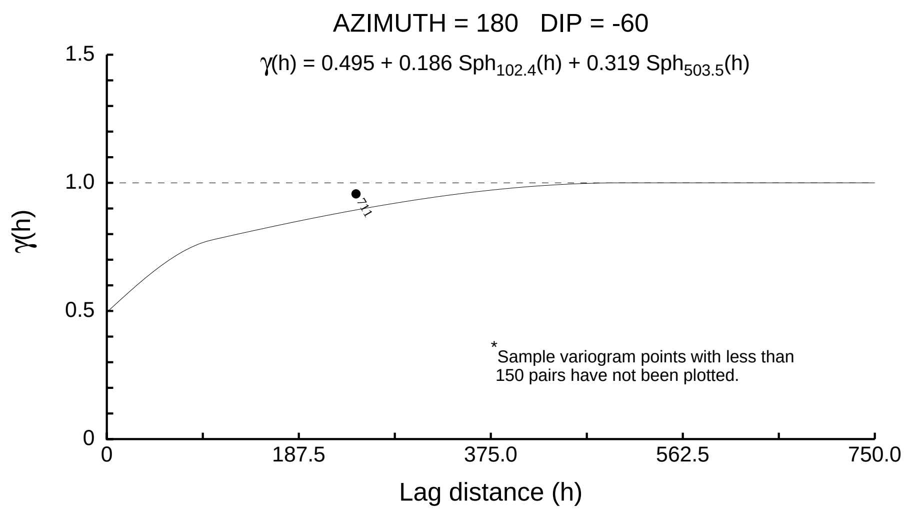

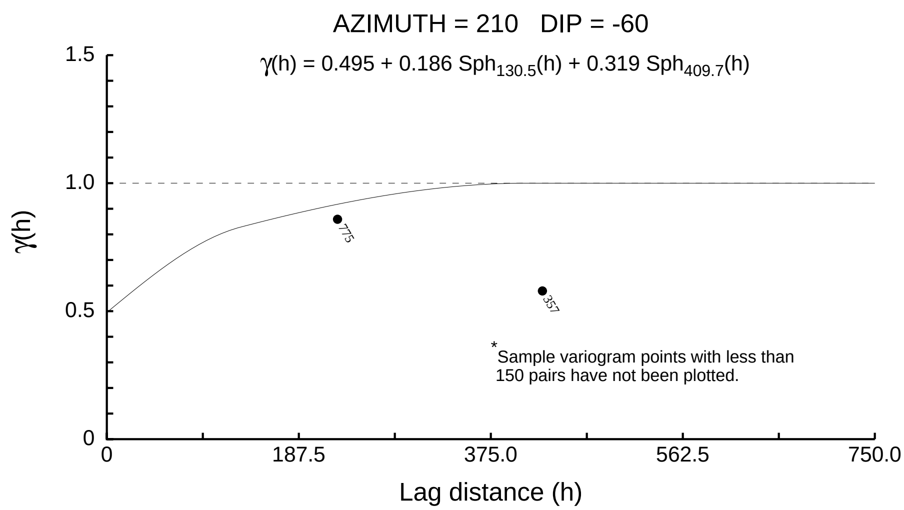

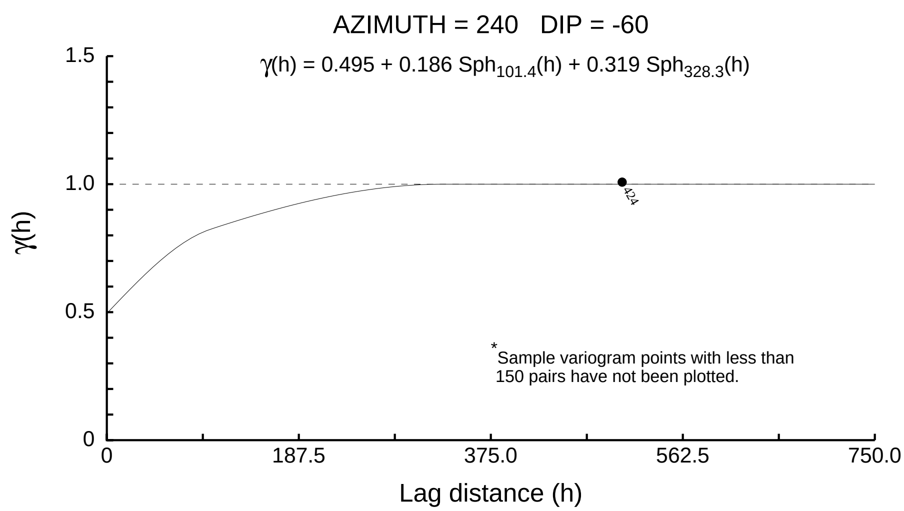

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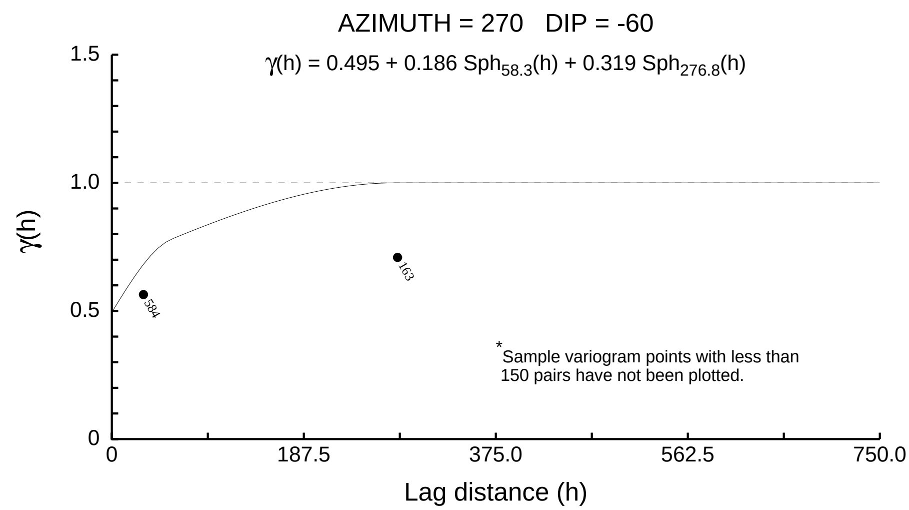
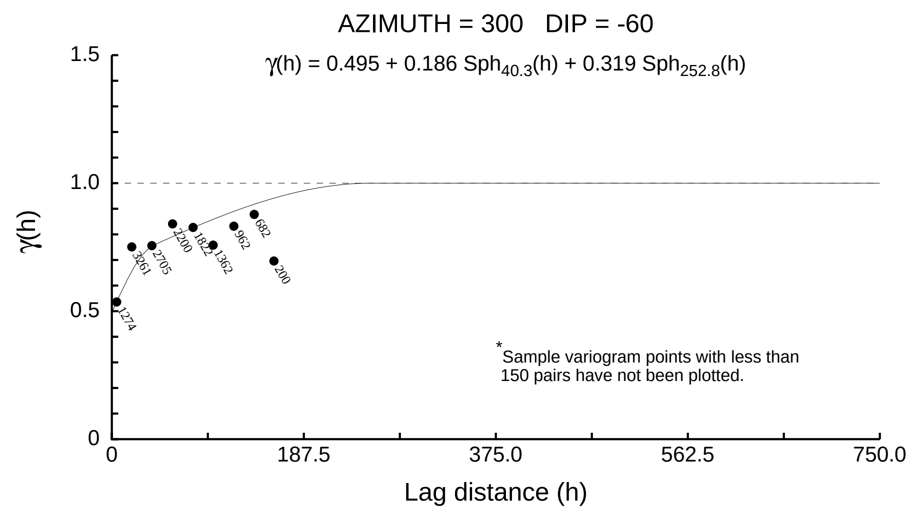
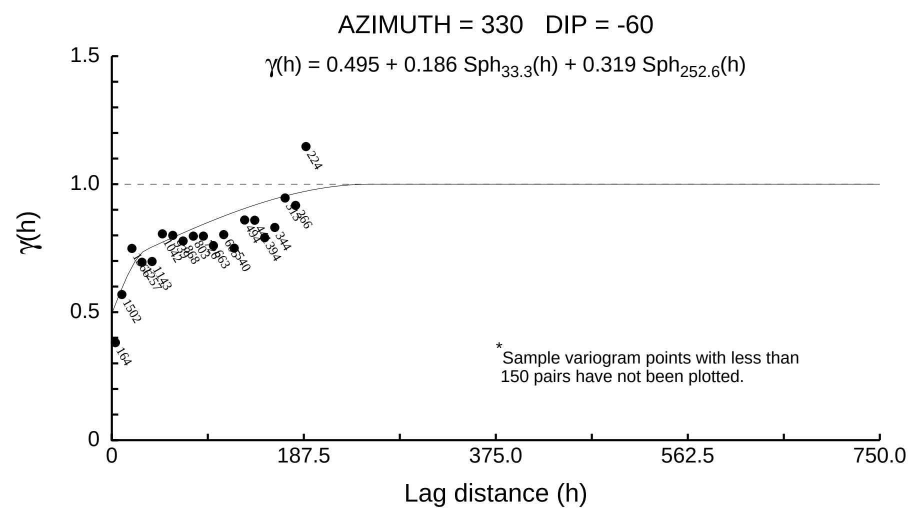
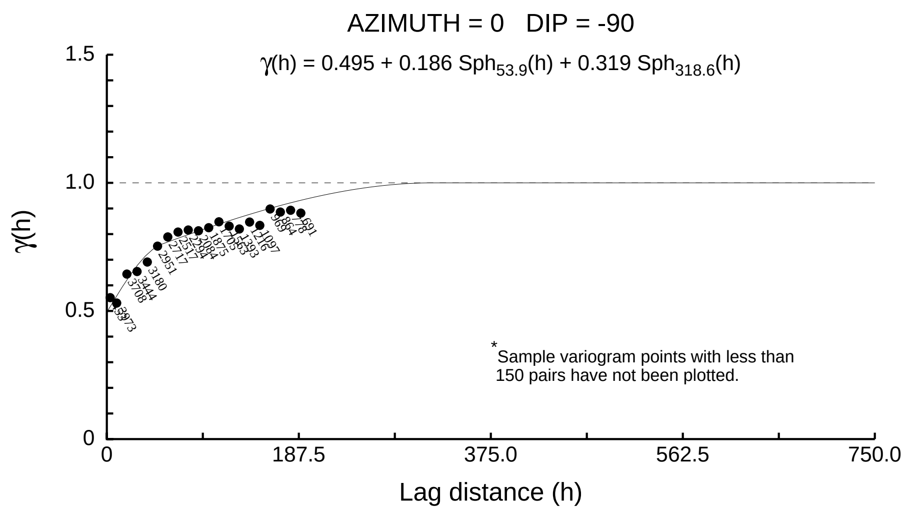






NorthMet U_1_Co_MDIR



NorthMet U_1_Cu_MDIR

User Defined Rotation Conventions

Nugget ==> 0.480
C1 ==> 0.265
C2 ==> 0.255

First Structure -- Spherical

RH Rotation about the Z axis ==> -67
RH Rotation about the Y' axis ==> -11
RH Rotation about the Z' axis ==> -30

Range along the Z' axis ==> 118.3	Azimuth ==> 337	Dip ==> 79
Range along the Y' axis ==> 95.6	Azimuth ==> 97	Dip ==> 5
Range along the X' axis ==> 15.6	Azimuth ==> 188	Dip ==> 10

Second Structure -- Spherical

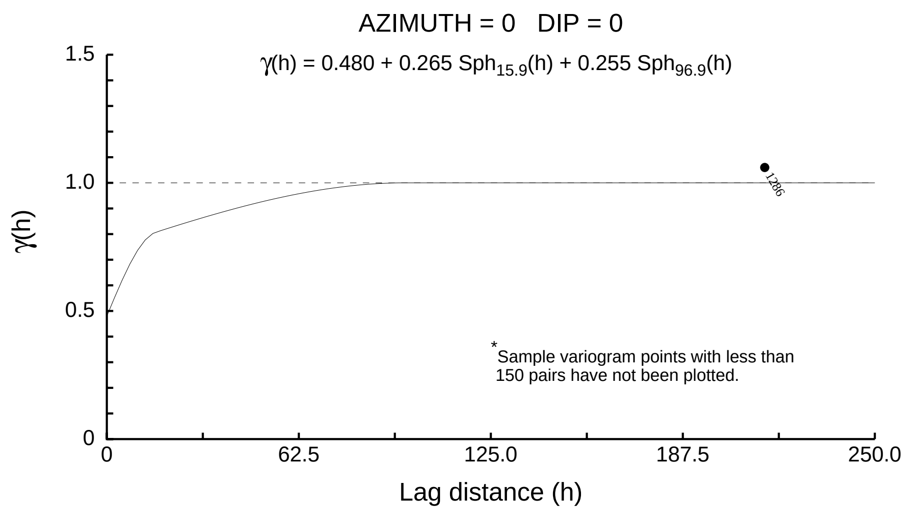
RH Rotation about the Z axis ==> -29
RH Rotation about the Y' axis ==> 4
RH Rotation about the Z' axis ==> 16

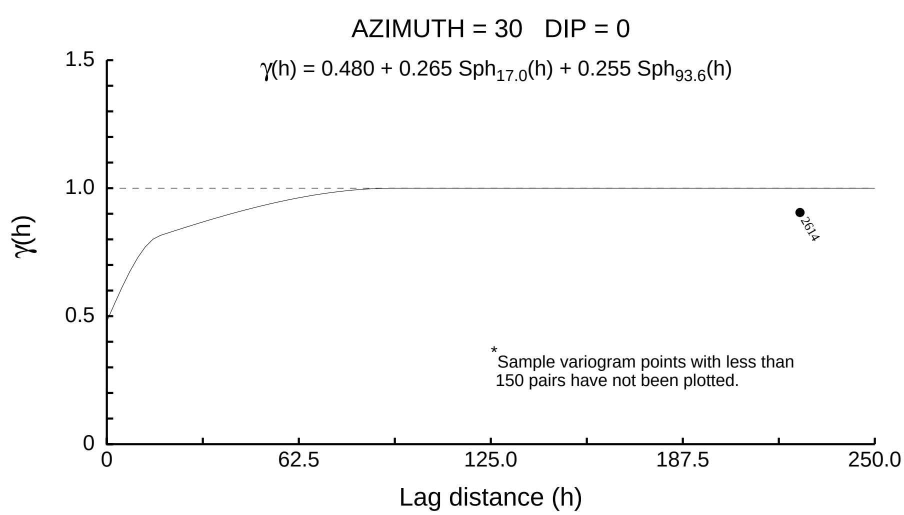
Range along the Z' axis ==> 960.3	Azimuth ==> 119	Dip ==> 86
Range along the Y' axis ==> 104.2	Azimuth ==> 13	Dip ==> 1
Range along the X' axis ==> 52.4	Azimuth ==> 103	Dip ==> -4

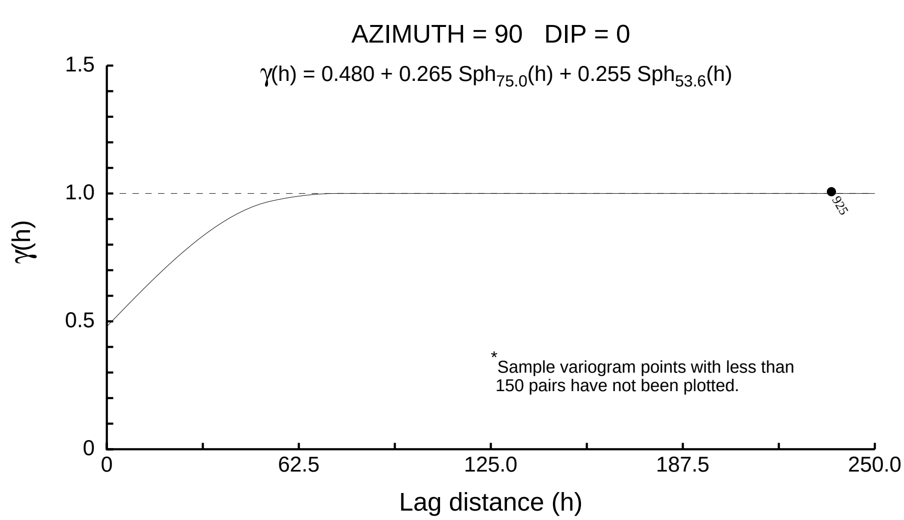
Modeling Criteria

Minimum number pairs req'd ==> 150
Sample variogram points weighted by # pairs

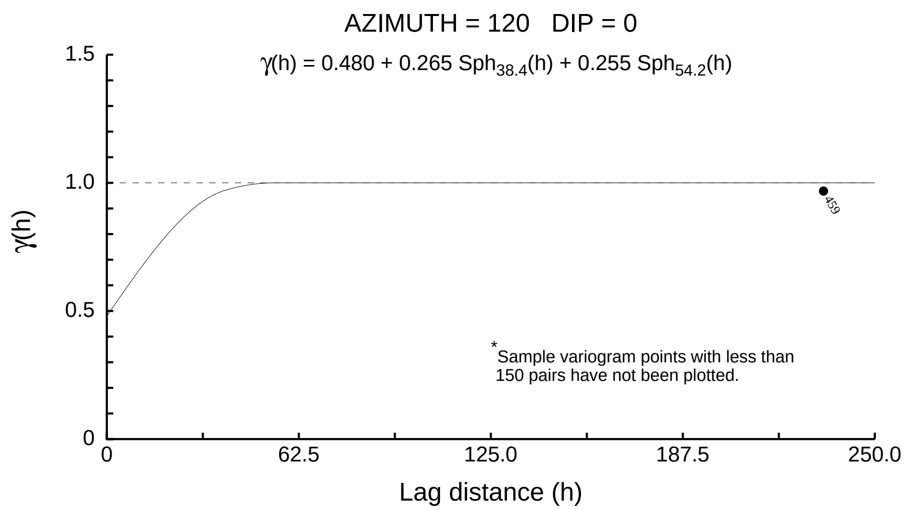
NorthMet U_1_Cu_MDIR

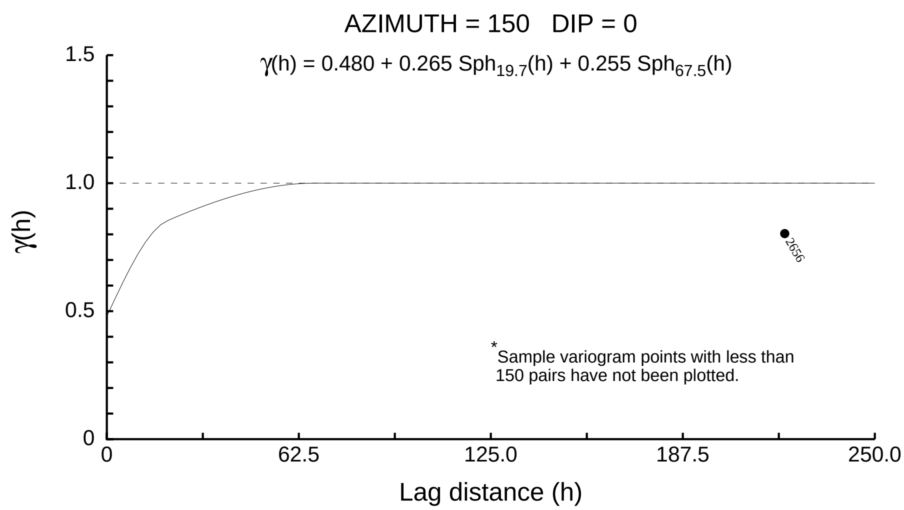


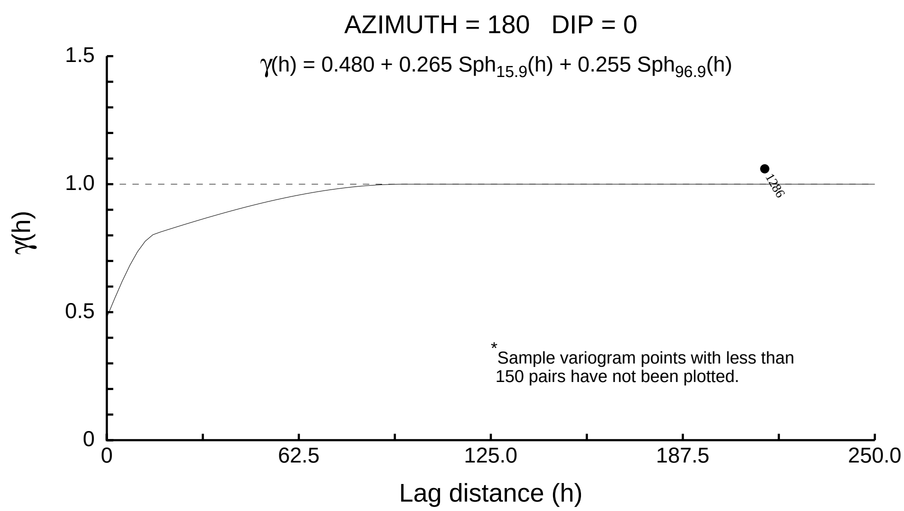




NorthMet U_1_Cu_MDIR







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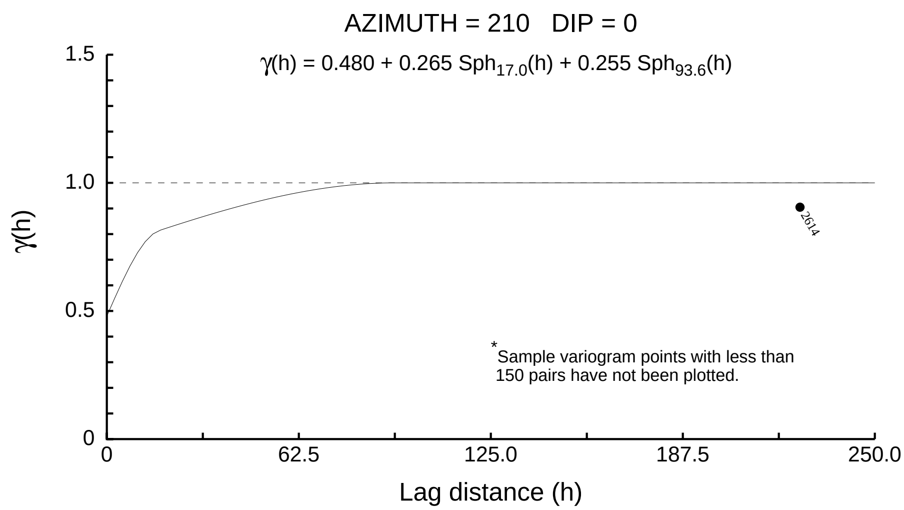
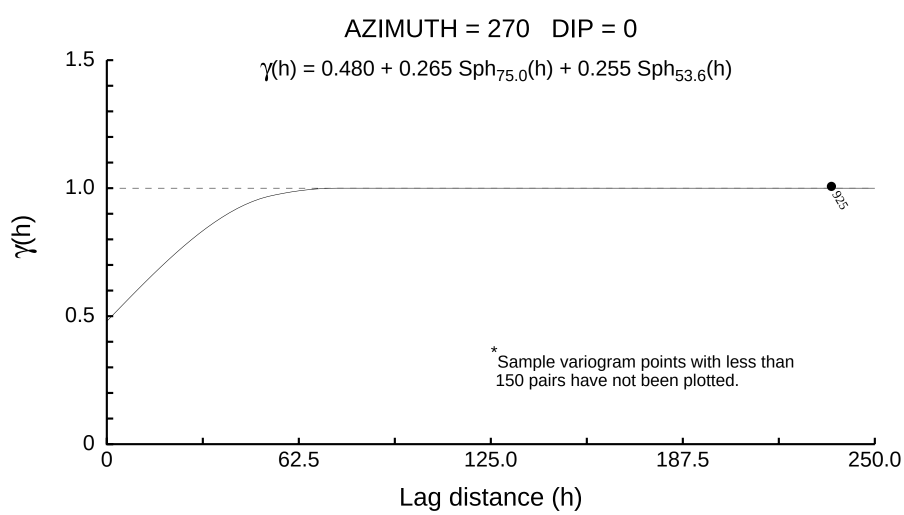
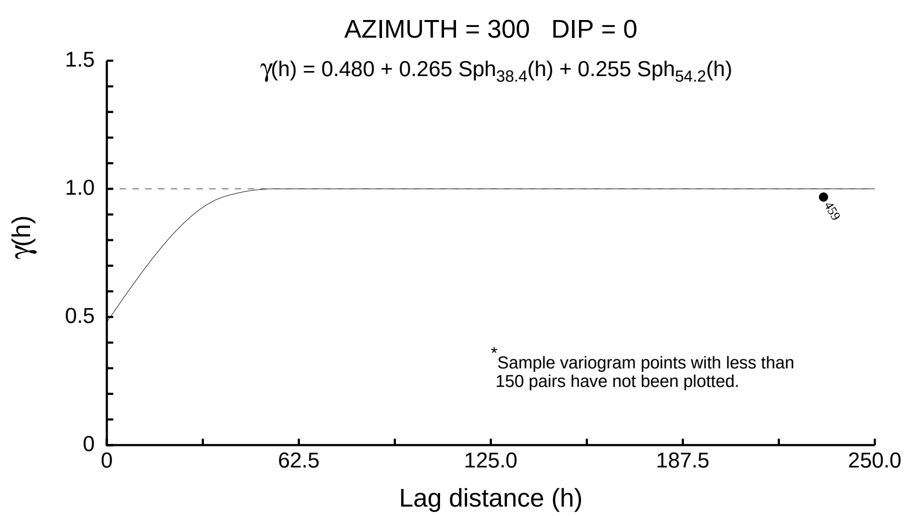
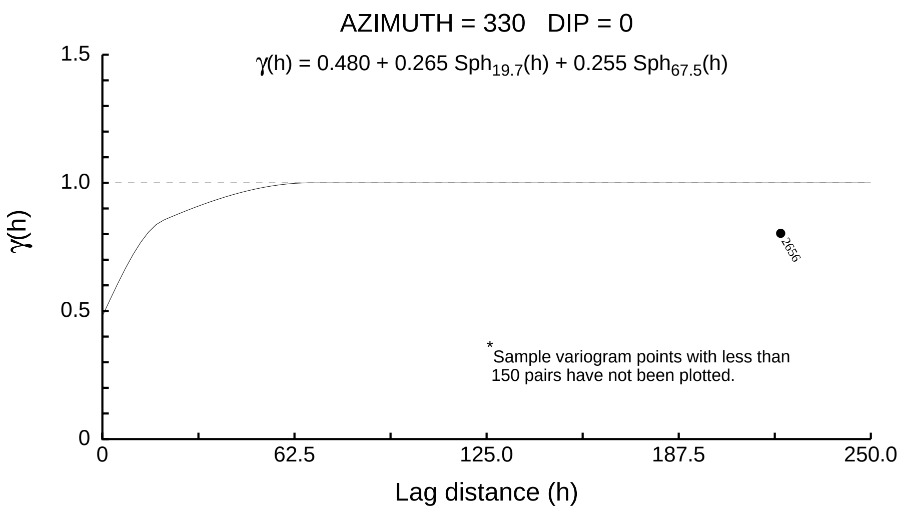
NorthMet U_1_Cu_MDIR

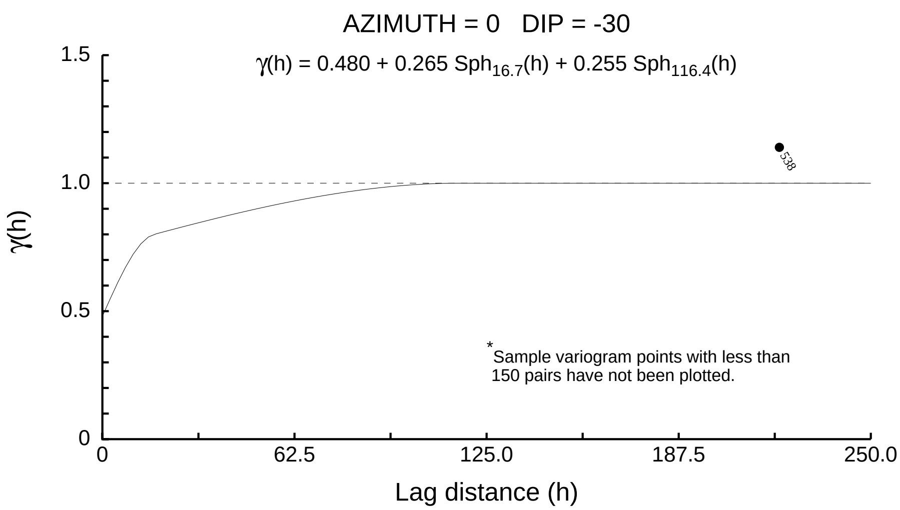


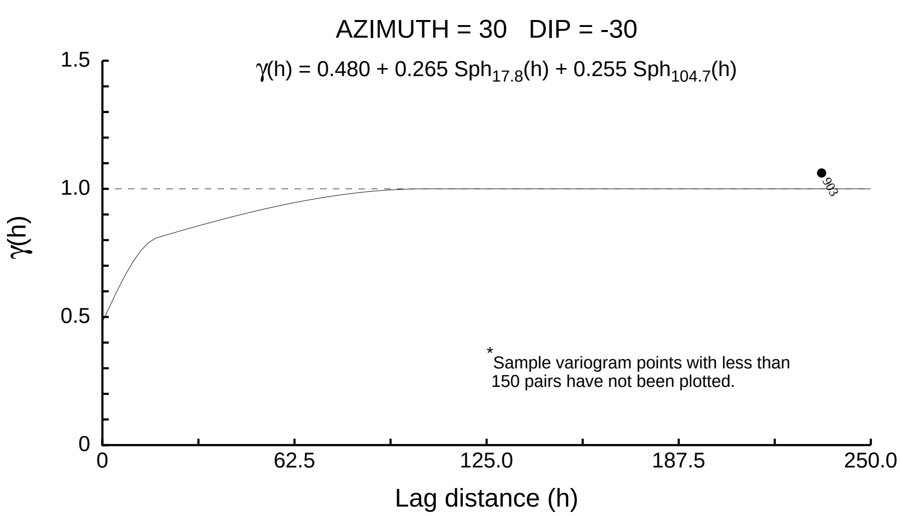




NorthMet U_1_Cu_MDIR







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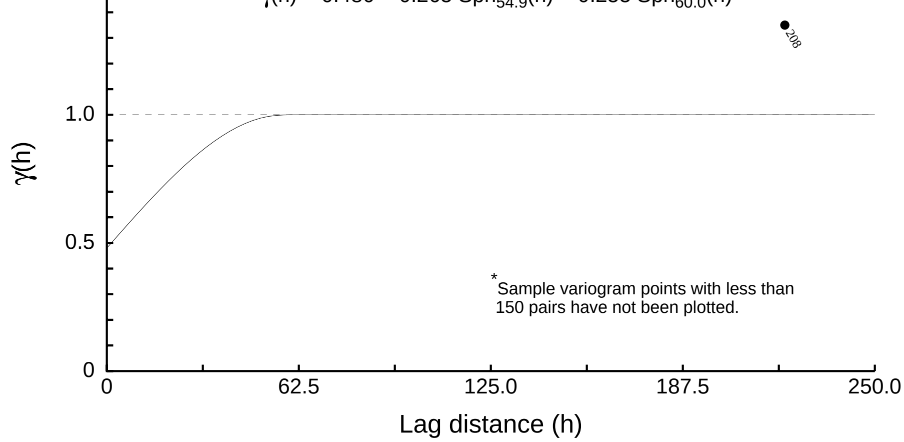
NorthMet U_1_Cu_MDIR

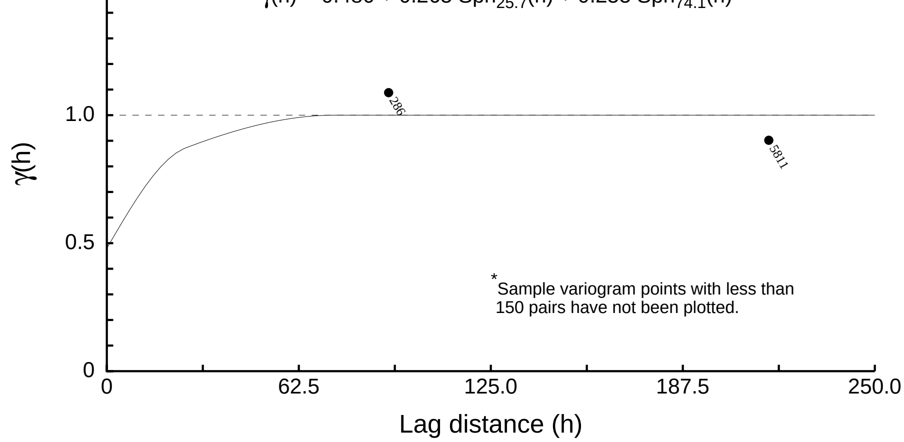
AZIMUTH = 120   DIP = -30

$\gamma(h) = 0.480 + 0.265\ Sph_{54.9}(h) + 0.255\ Sph_{60.0}(h)$



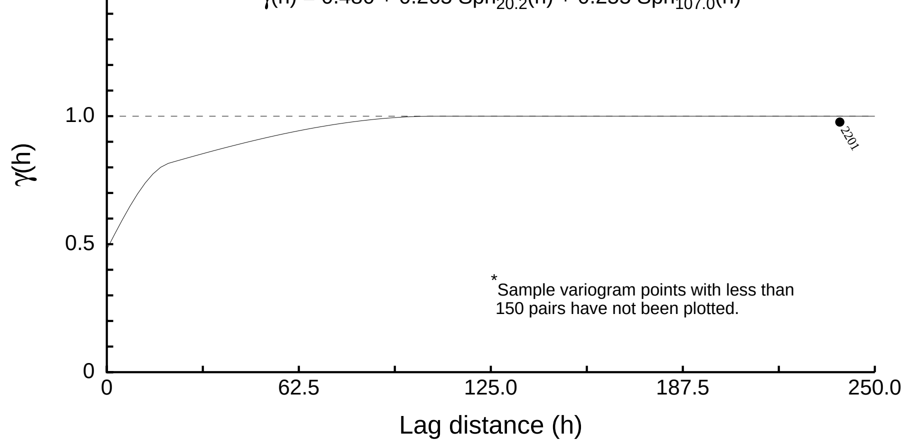
AZIMUTH = 150   DIP = -30

$\gamma(h) = 0.480 + 0.265\ Sph_{25.7}(h) + 0.255\ Sph_{74.1}(h)$

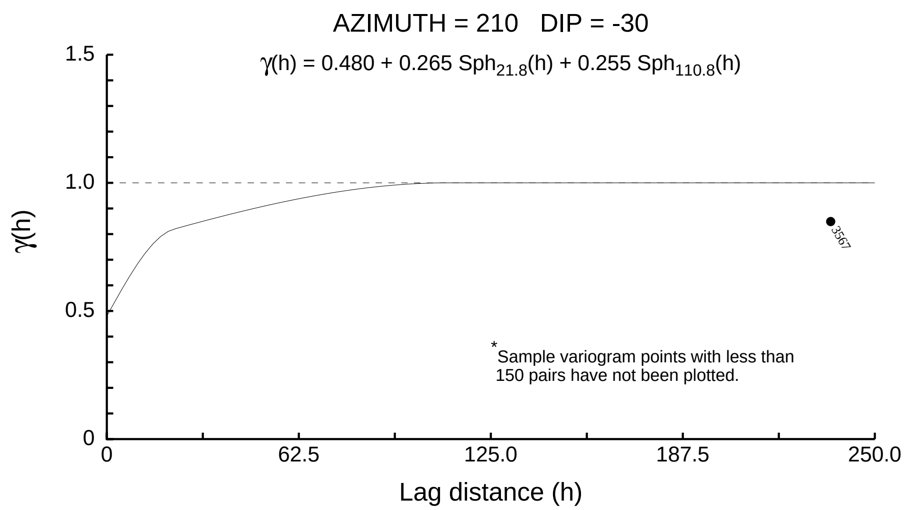


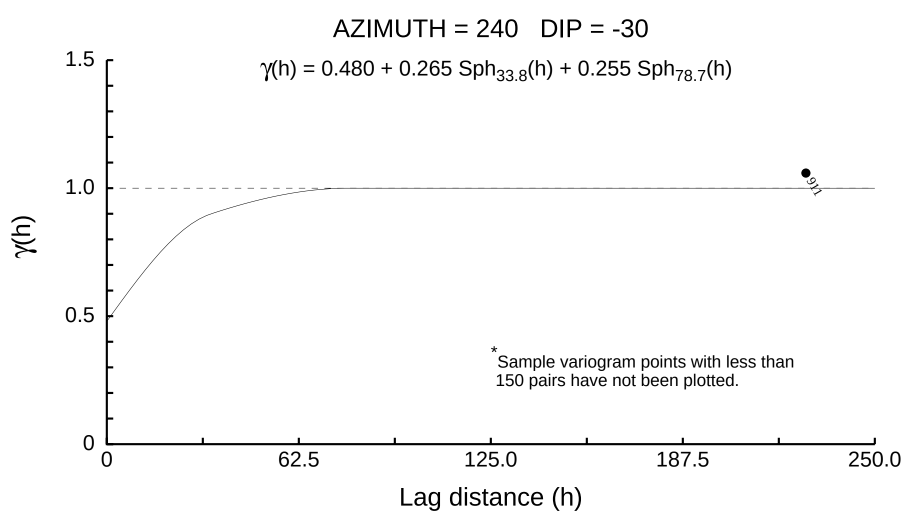
AZIMUTH = 180   DIP = -30

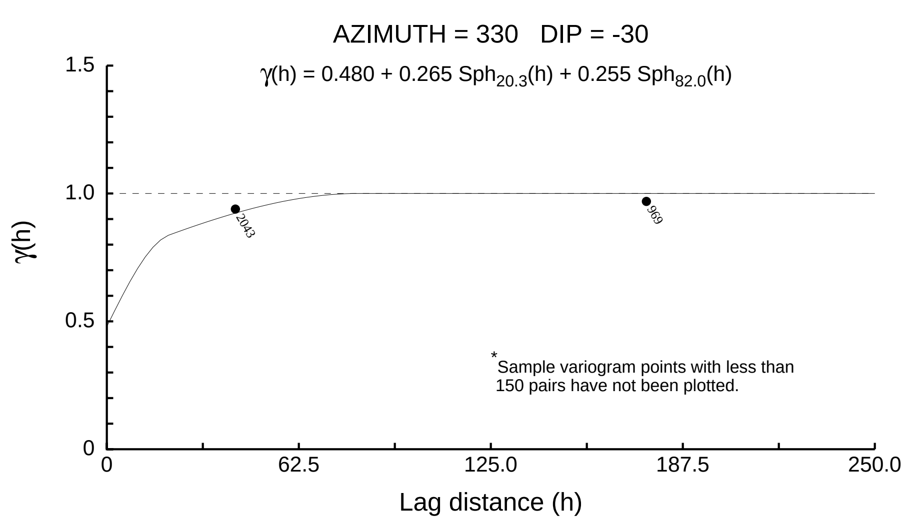
$\gamma(h) = 0.480 + 0.265\ Sph_{20.2}(h) + 0.255\ Sph_{107.0}(h)$



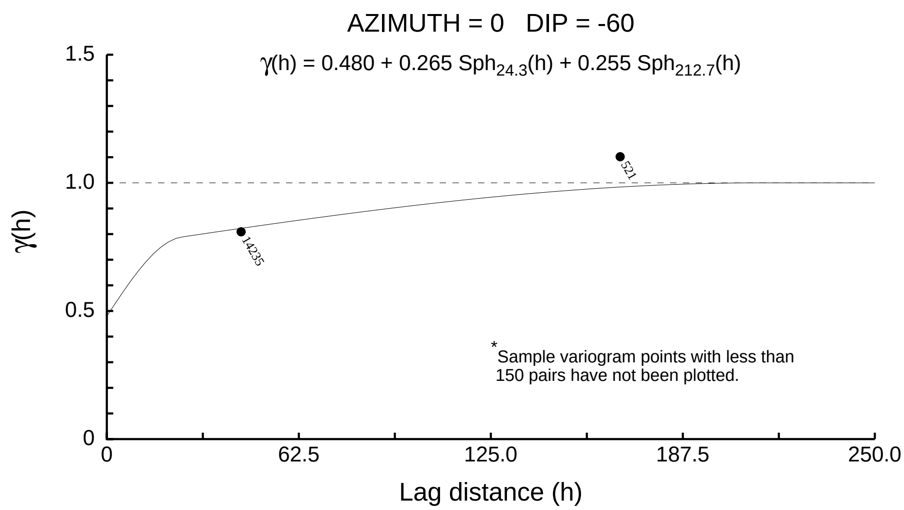
NorthMet U_1_Cu_MDIR

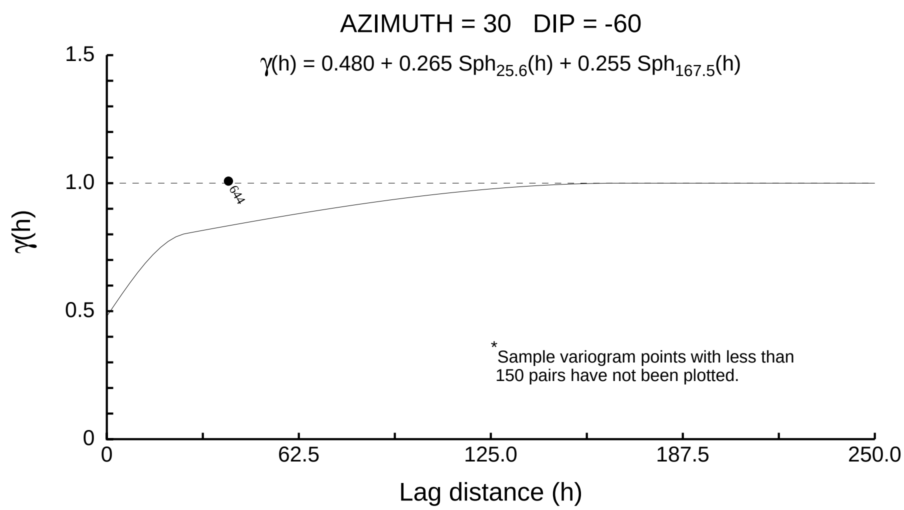


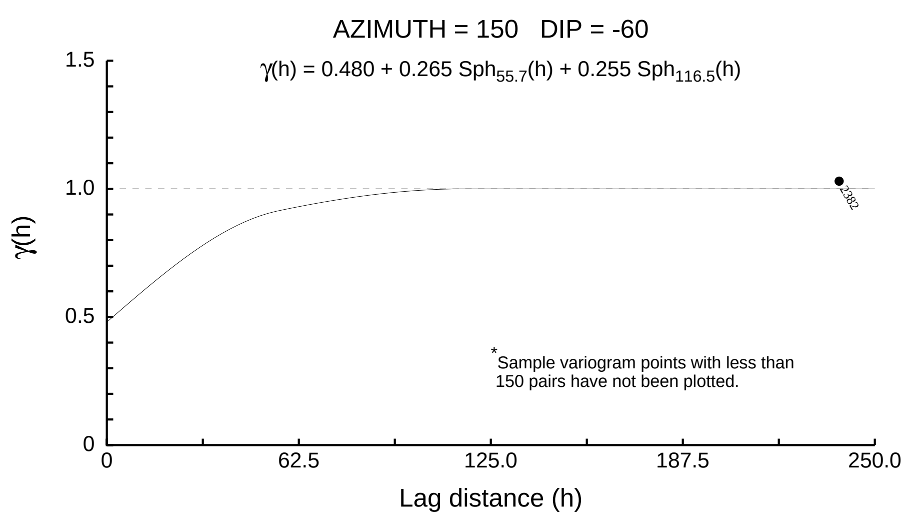




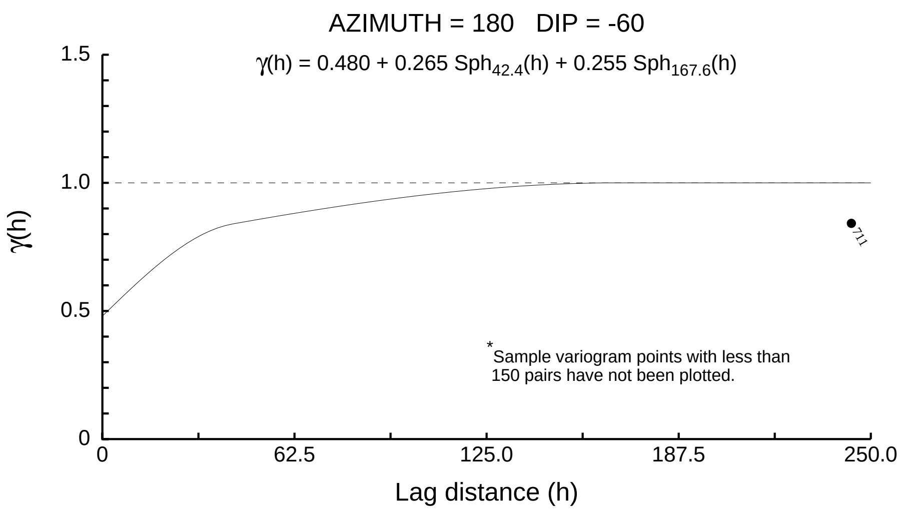
NorthMet U_1_Cu_MDIR

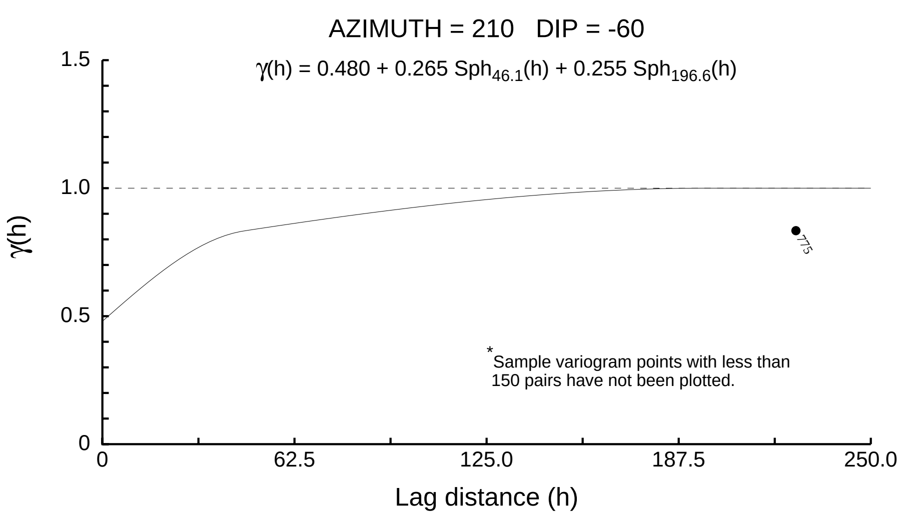


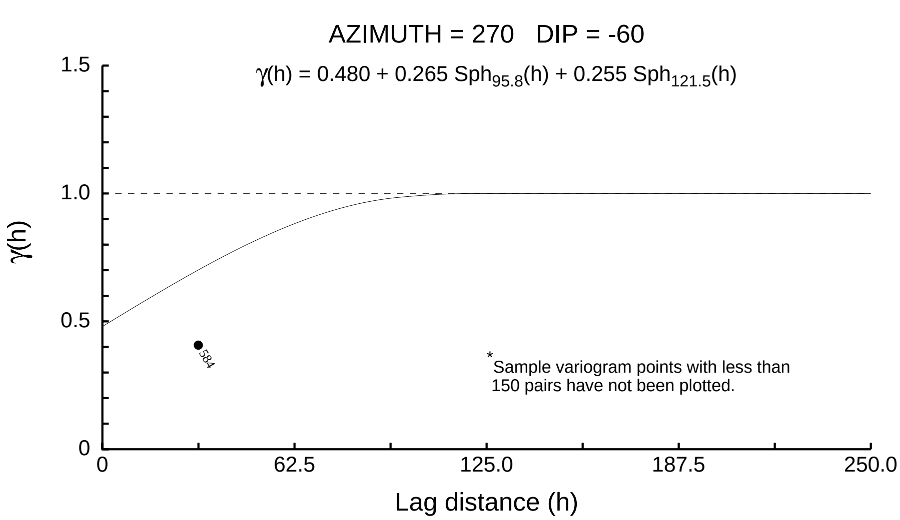




NorthMet U_1_Cu_MDIR







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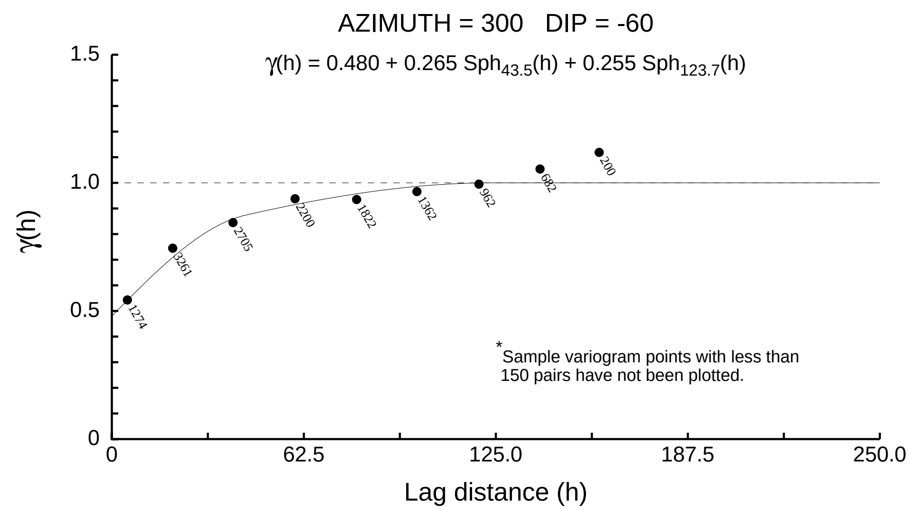
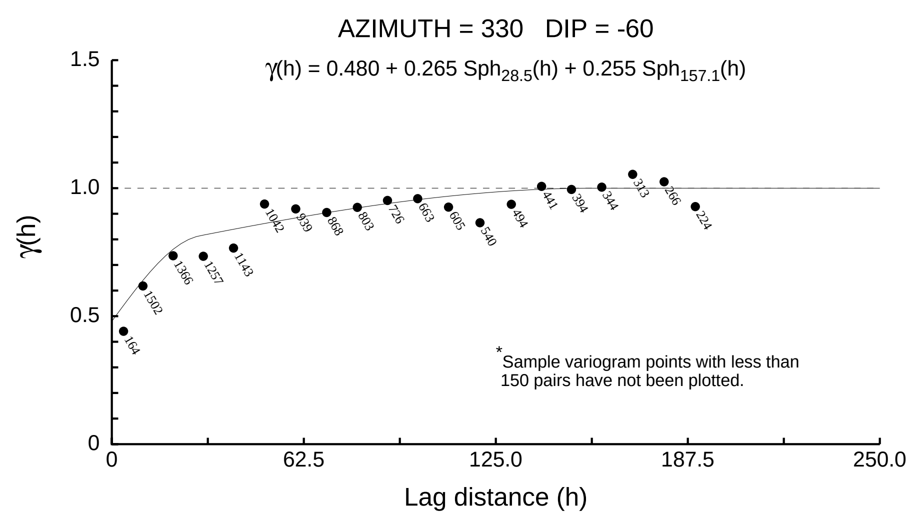
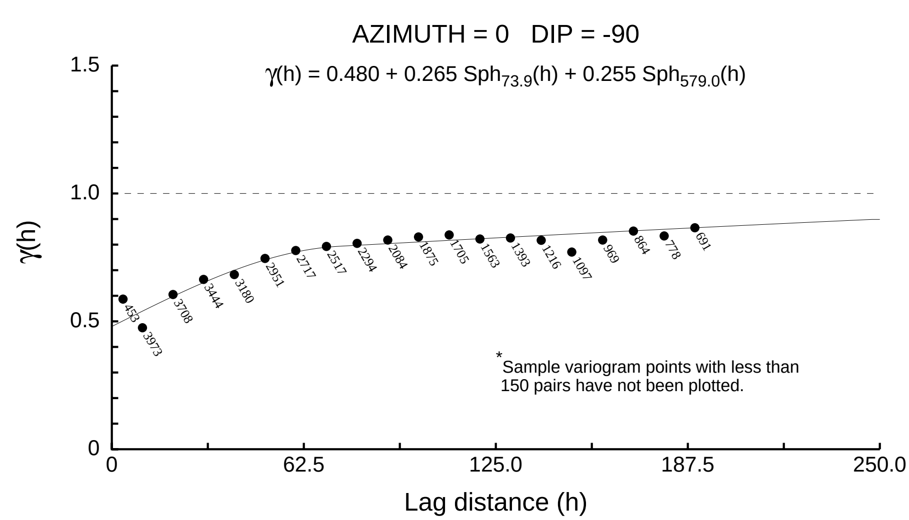
NorthMet U_1_Cu_MDIR







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NorthMet U_1_Ni_MDIR

User Defined Rotation Conventions

Nugget ==> 0.647
C1 ==> 0.205
C2 ==> 0.148

First Structure -- Spherical

RH Rotation about the Z axis ==> -95
RH Rotation about the Y' axis ==> 85
RH Rotation about the Z' axis ==> 48

Range along the Z' axis	==> 10.1	Azimuth ==> 185	Dip ==> 5
Range along the Y' axis	==> 181.5	Azimuth ==> 89	Dip ==> 48
Range along the X' axis	==> 155.9	Azimuth ==> 100	Dip ==> -42

Second Structure -- Spherical

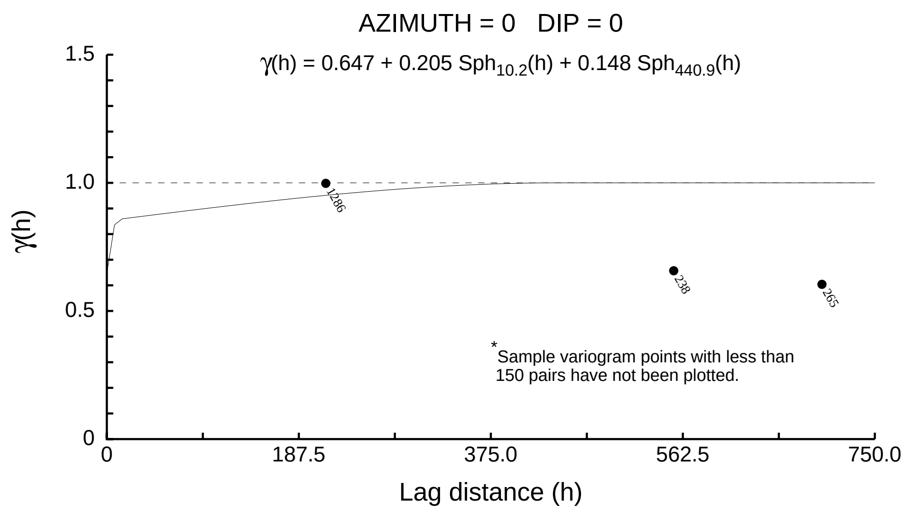
RH Rotation about the Z axis ==> -85
RH Rotation about the Y' axis ==> 3
RH Rotation about the Z' axis ==> 46

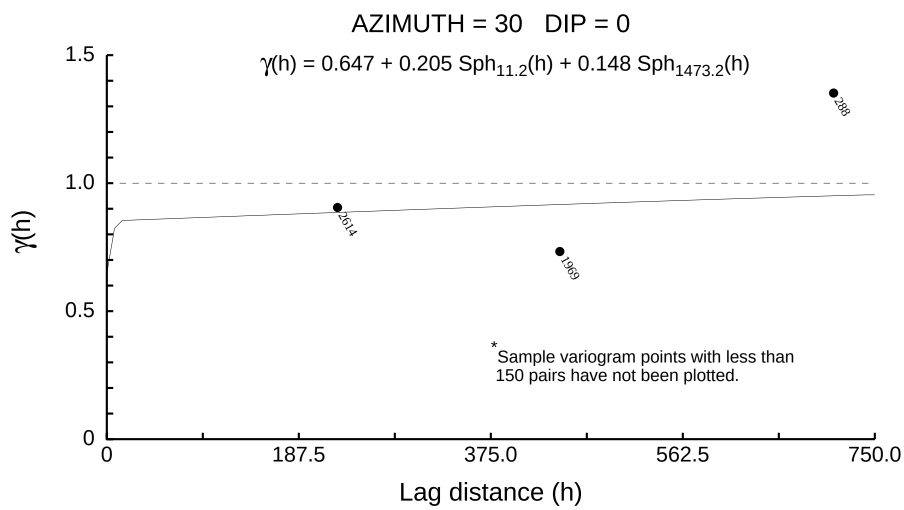
Range along the Z' axis	==> 1094.7	Azimuth ==> 175	Dip ==> 87
Range along the Y' axis	==> 3019.2	Azimuth ==> 40	Dip ==> 2
Range along the X' axis	==> 283.3	Azimuth ==> 130	Dip ==> -2

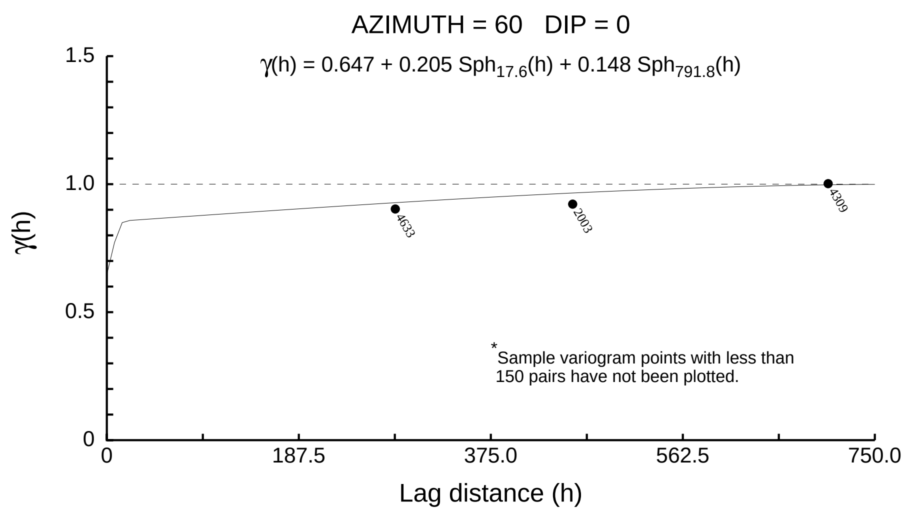
Modeling Criteria

Minimum number pairs req'd ==> 150
Sample variogram points weighted by # pairs

NorthMet U_1_Ni_MDIR







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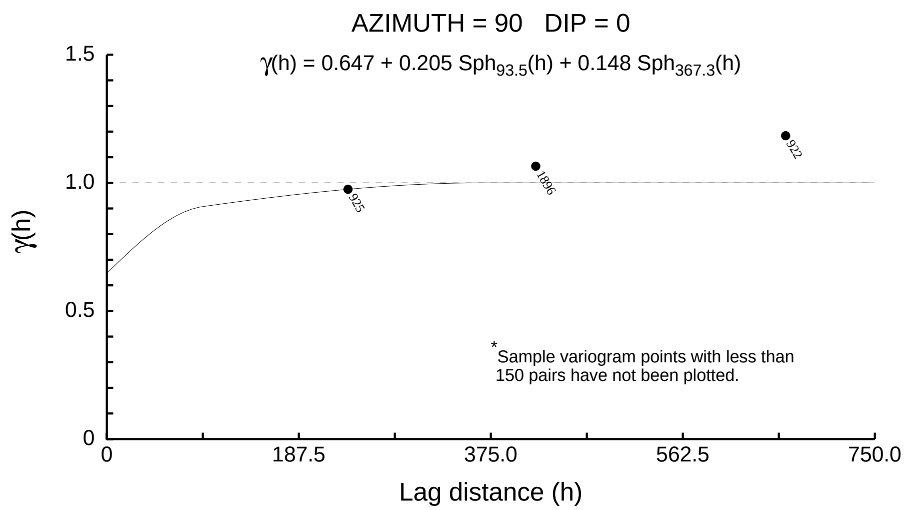
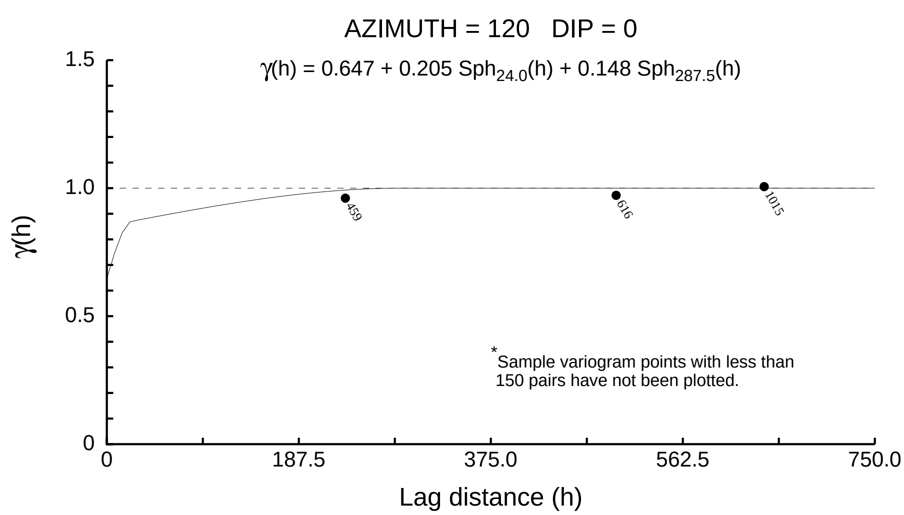
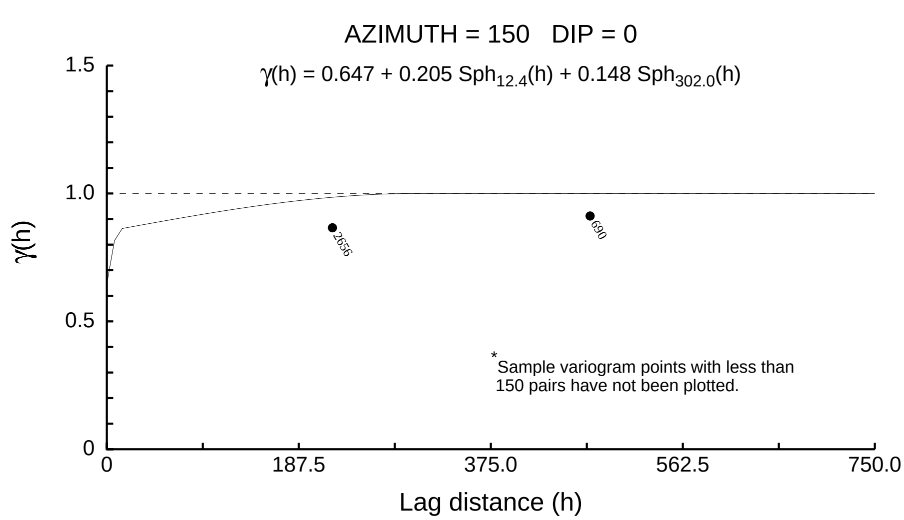
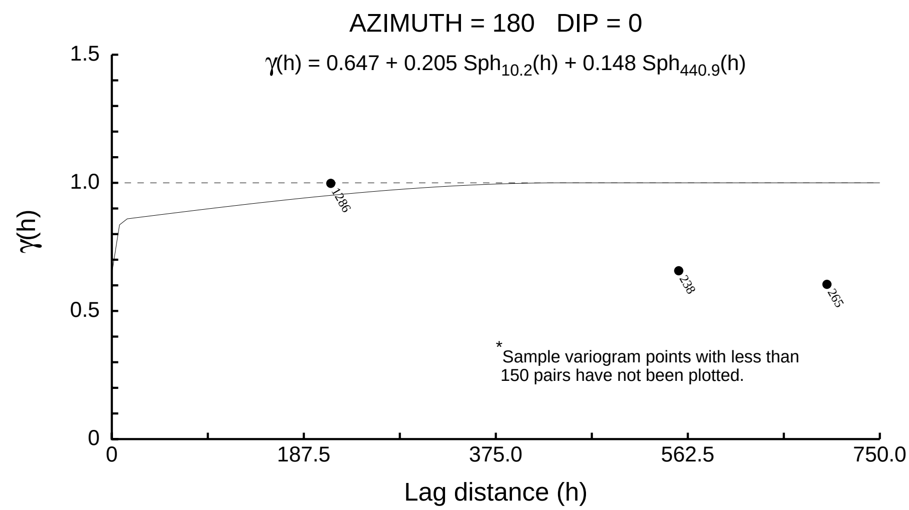
NorthMet U_1_Ni_MDIR

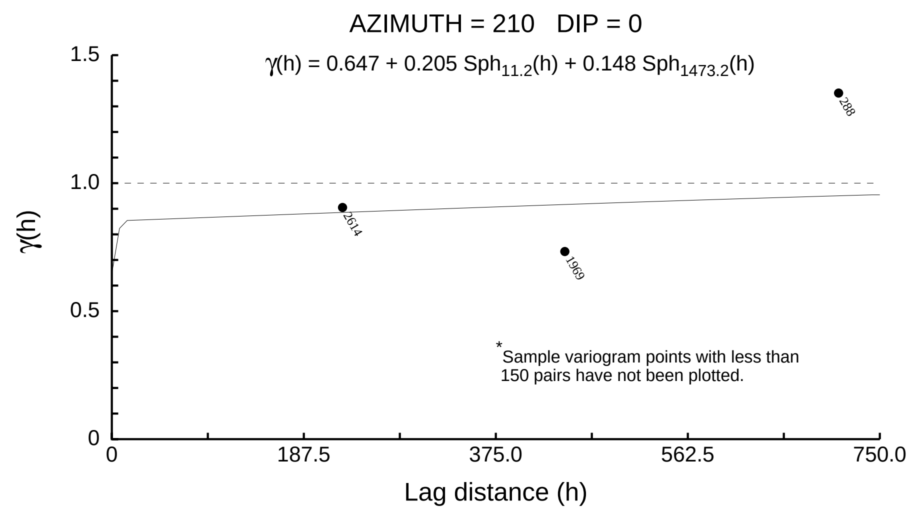


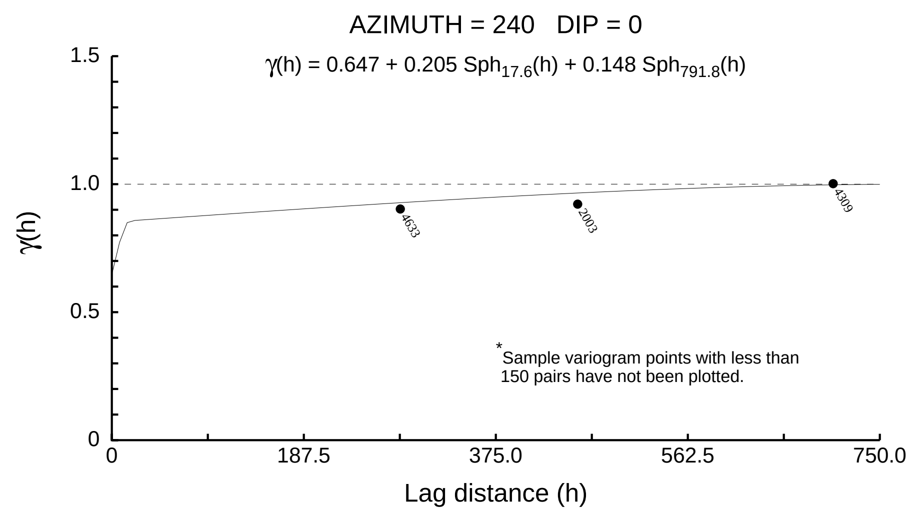




NorthMet U_1_Ni_MDIR







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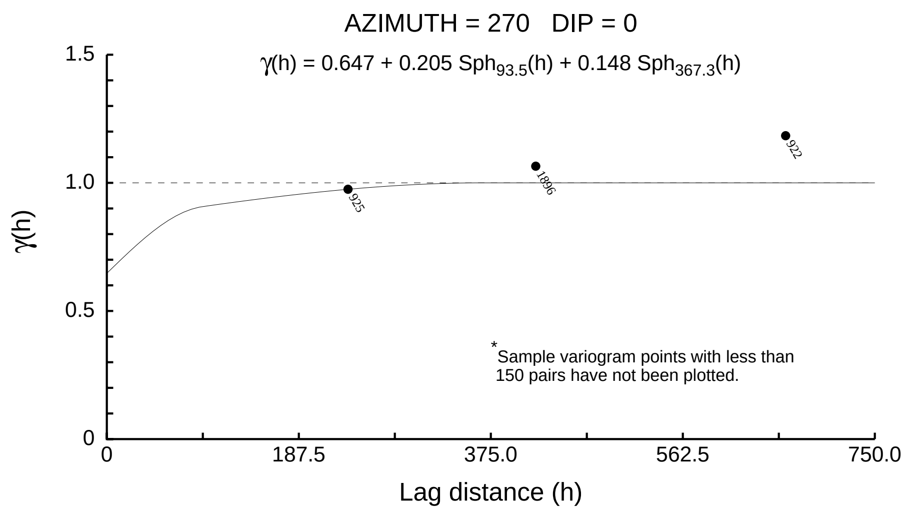

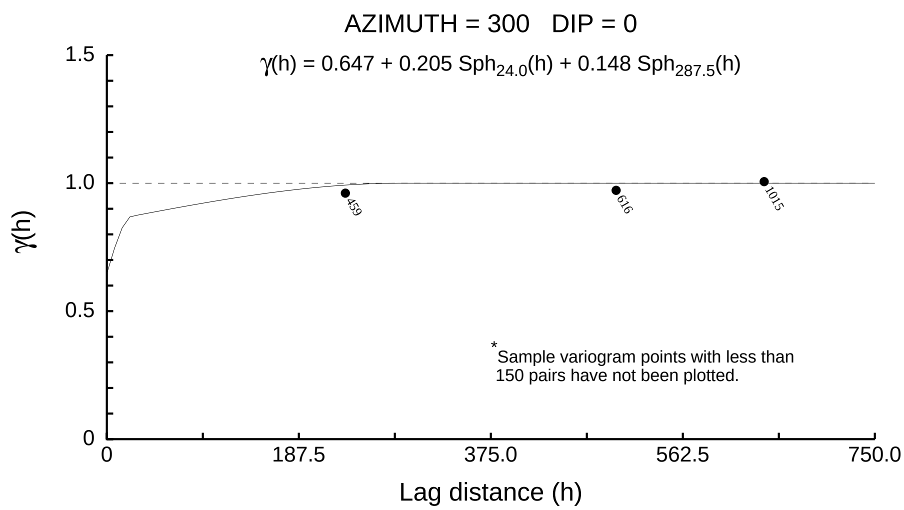

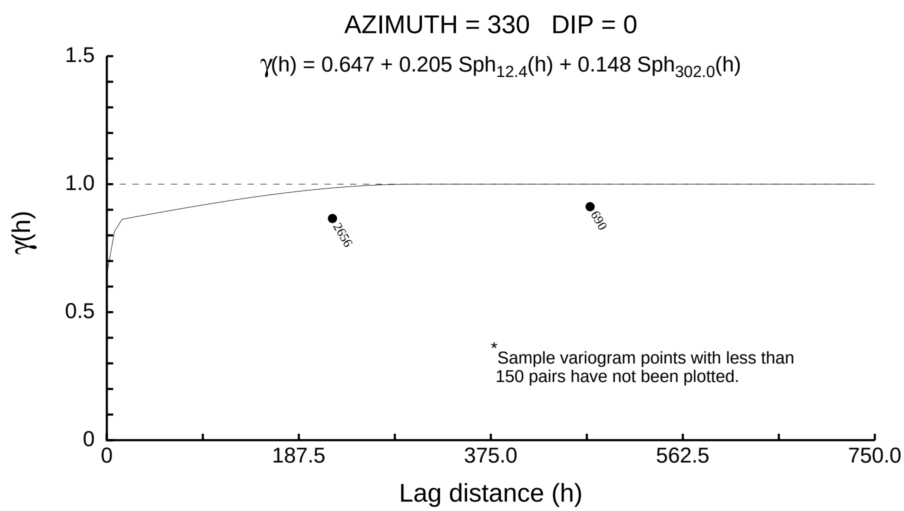

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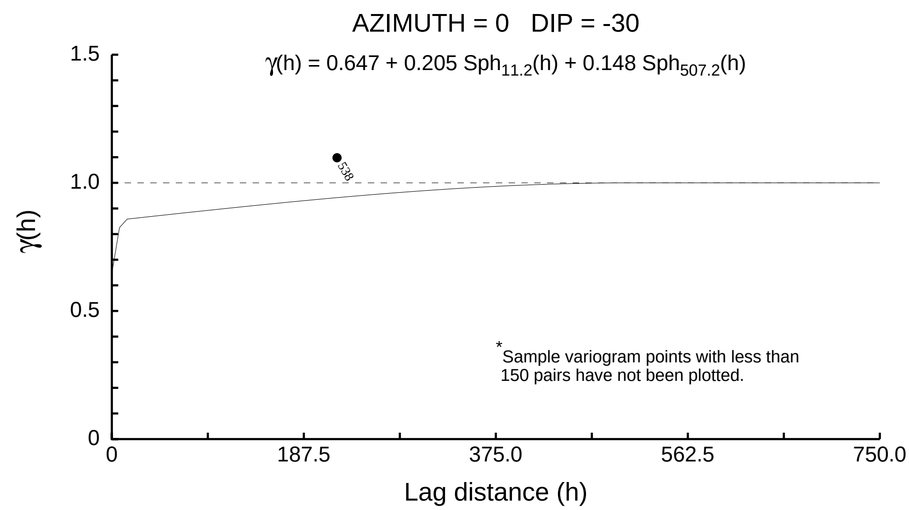
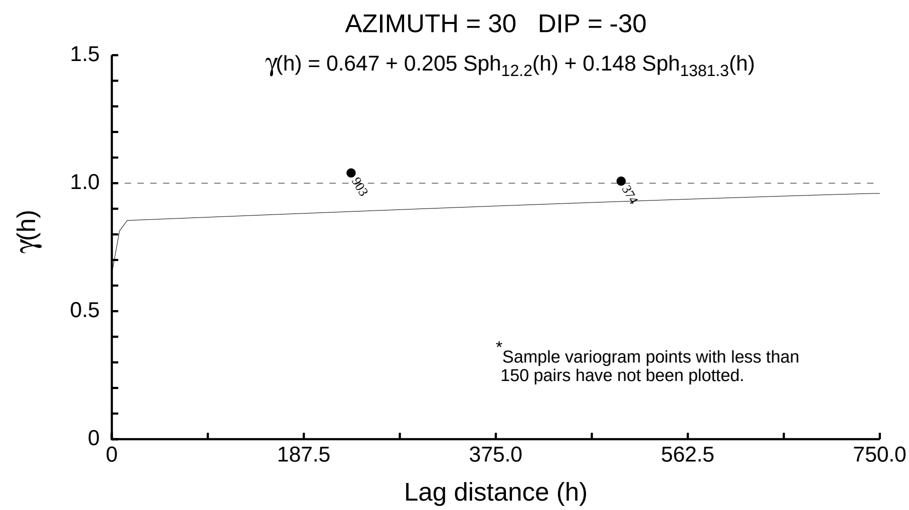
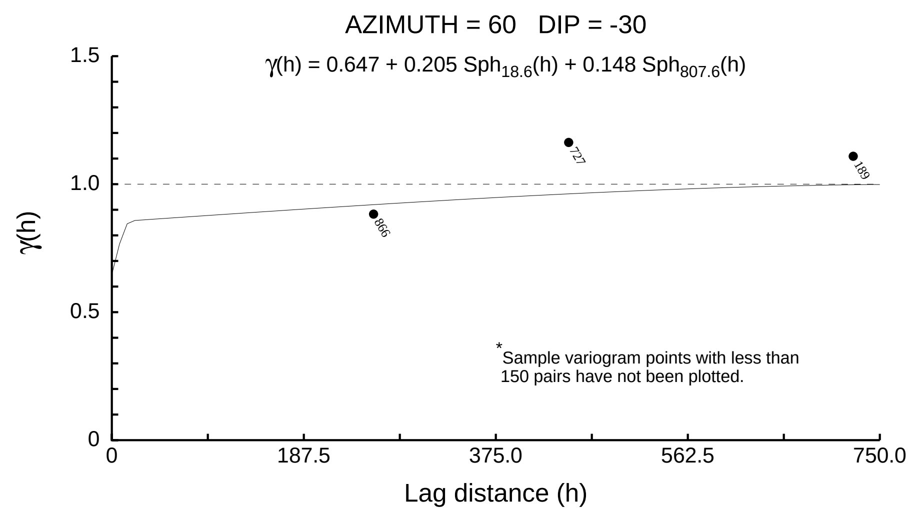
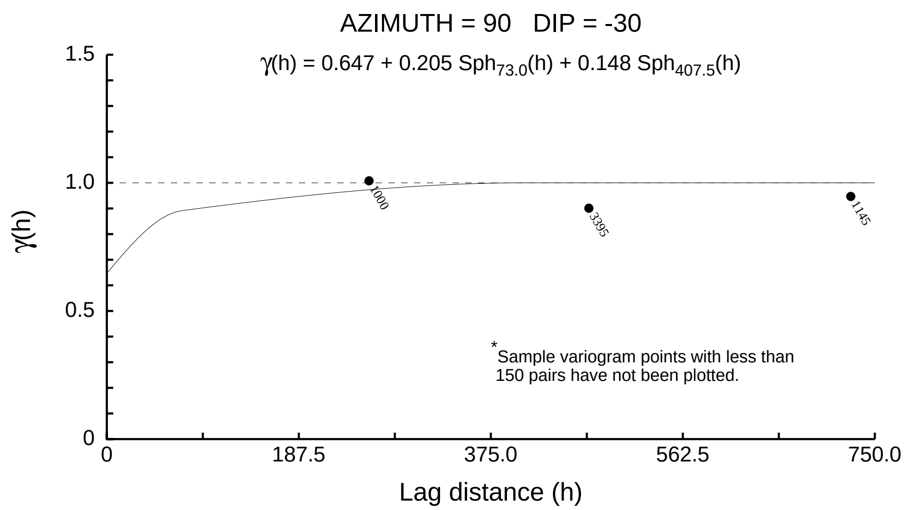
NorthMet U_1_Ni_MDIR

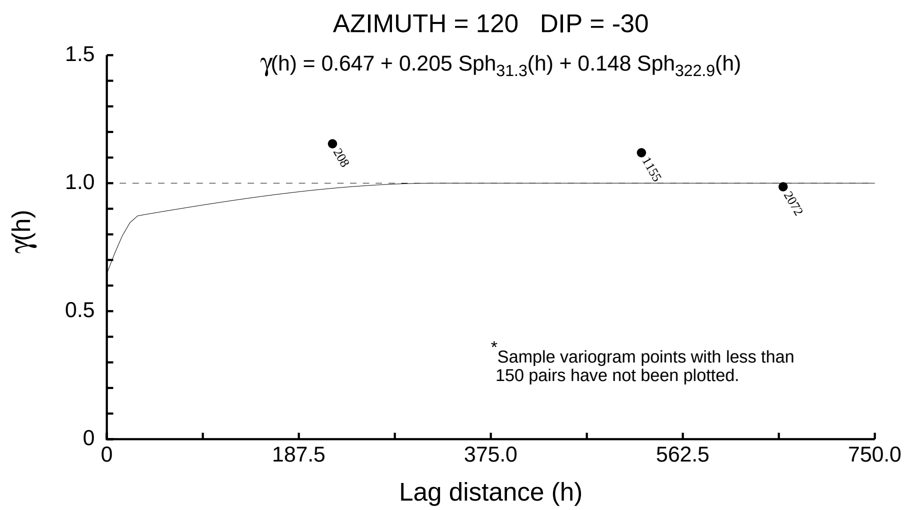


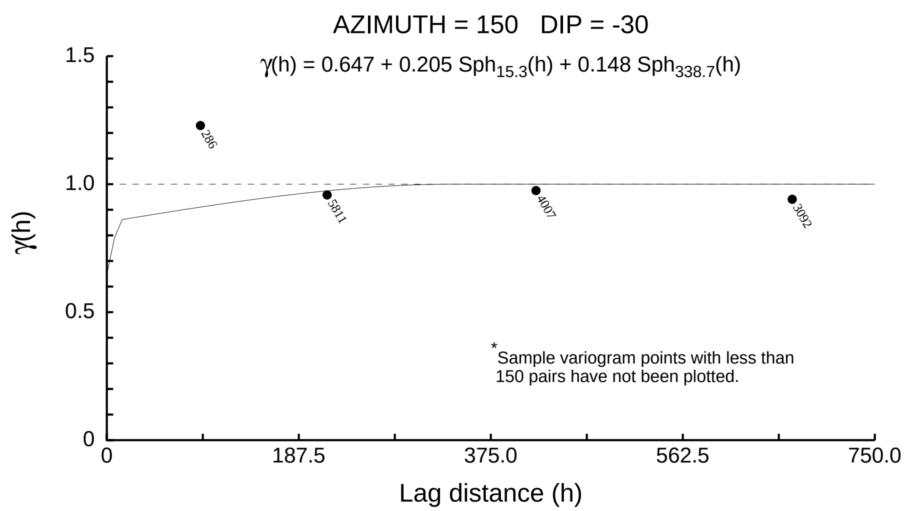




NorthMet U_1_Ni_MDIR

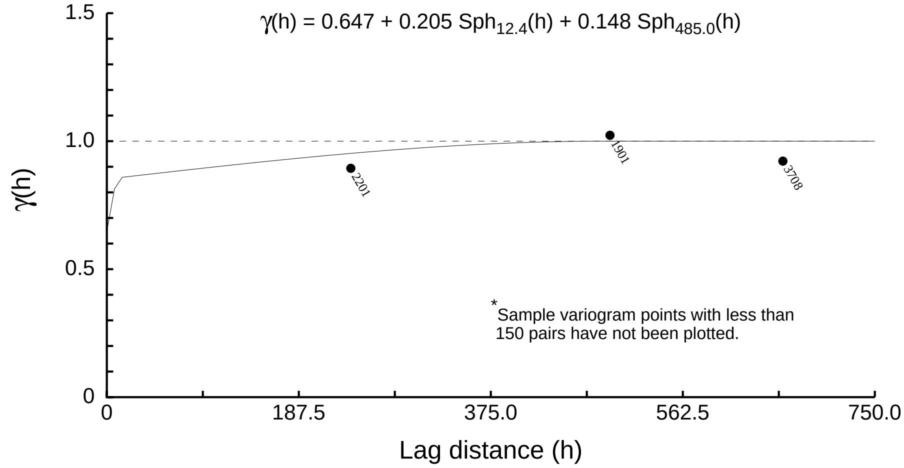




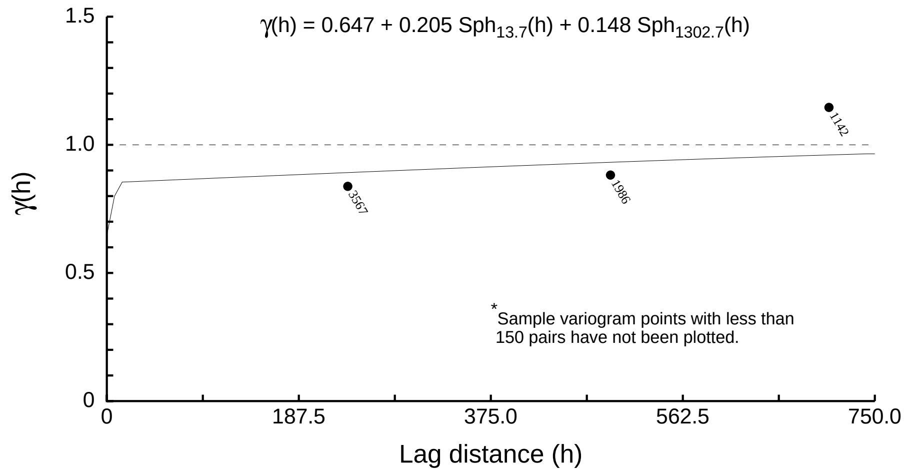


NorthMet U_1_Ni_MDIR

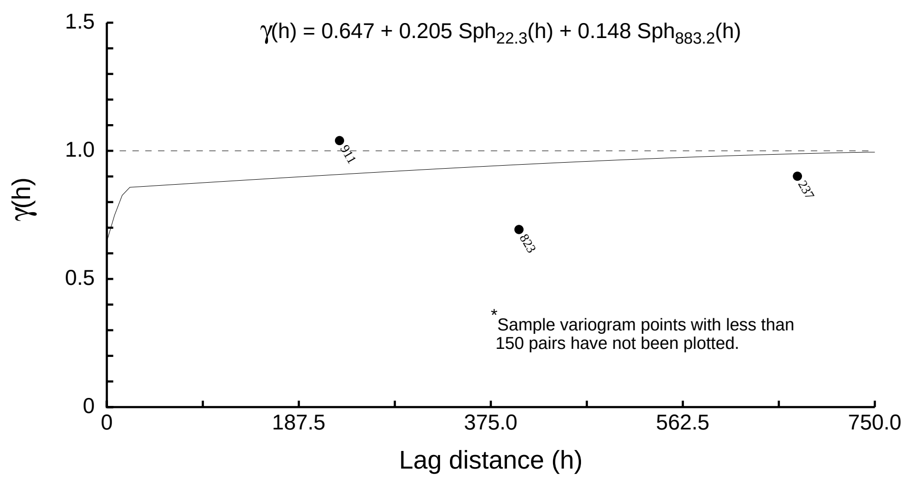
AZIMUTH = 180   DIP = -30



AZIMUTH = 210   DIP = -30

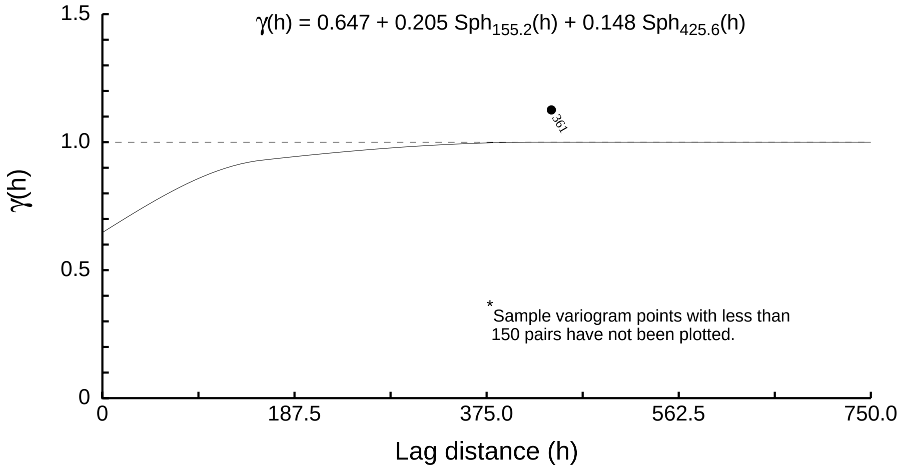


AZIMUTH = 240   DIP = -30

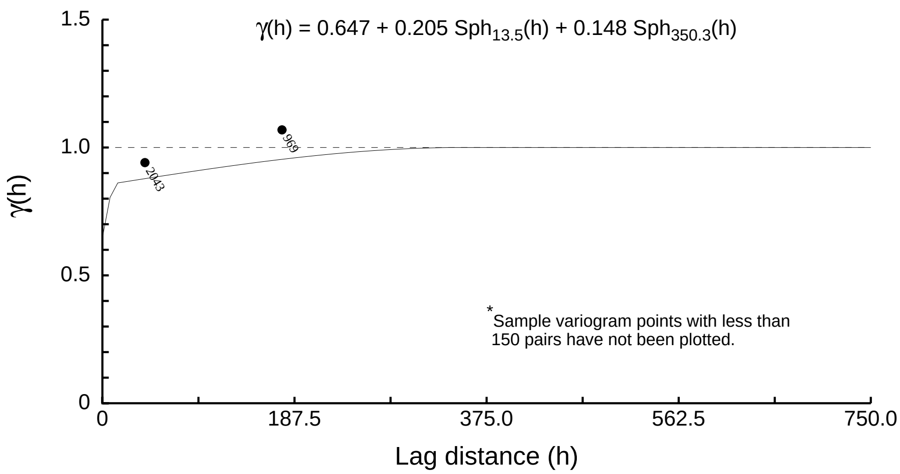


NorthMet U_1_Ni_MDIR

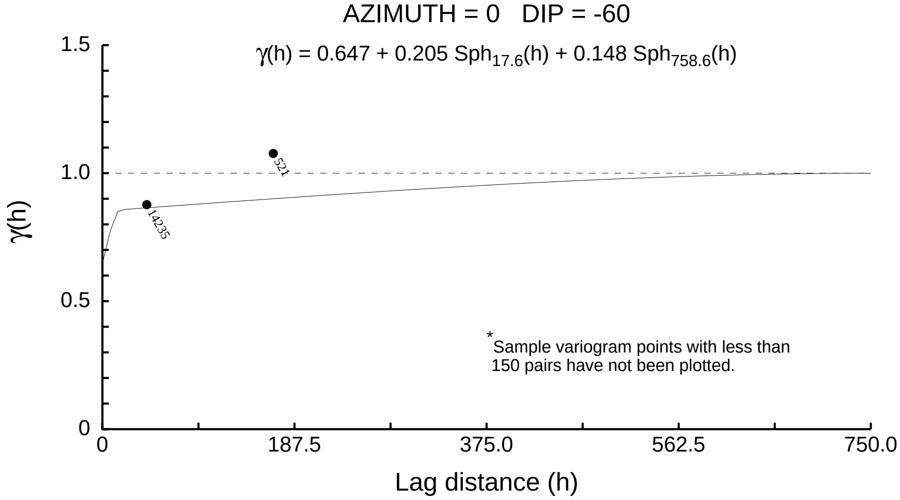
AZIMUTH = 270 DIP = -30



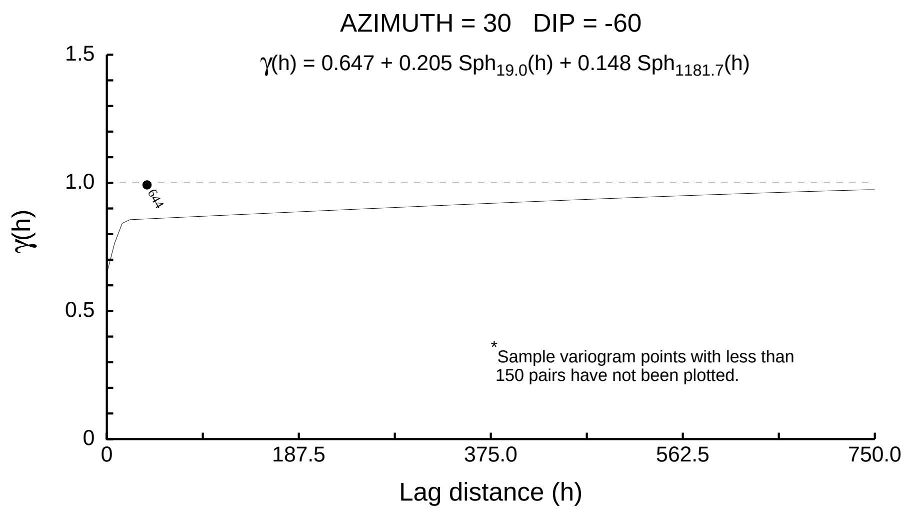
AZIMUTH = 330 DIP = -30

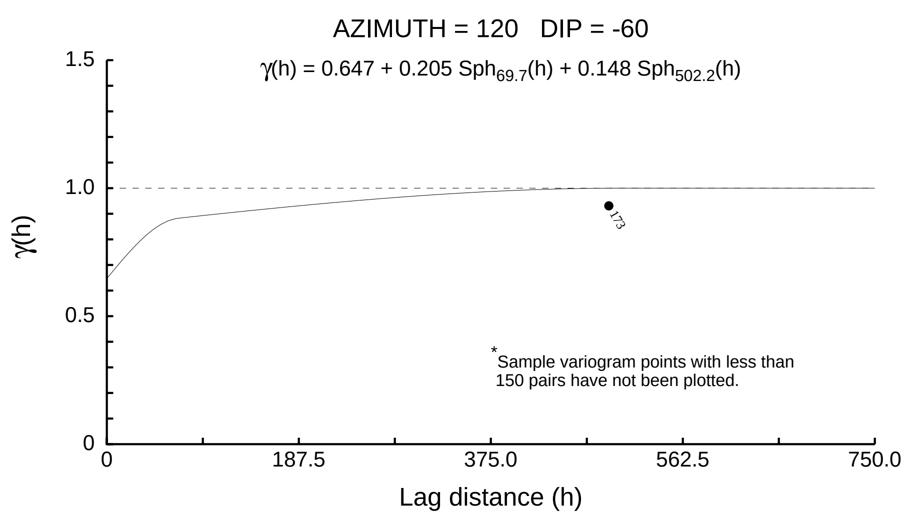


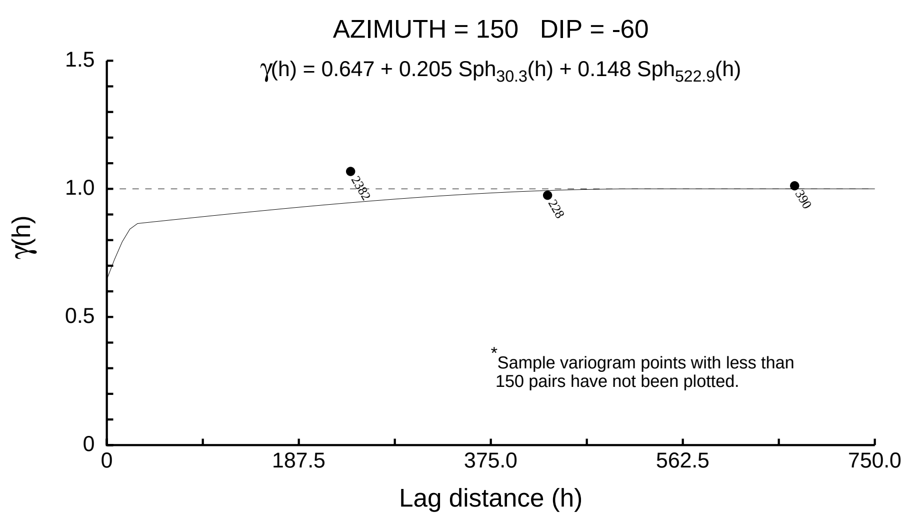
AZIMUTH = 0 DIP = -60



NorthMet U_1_Ni_MDIR







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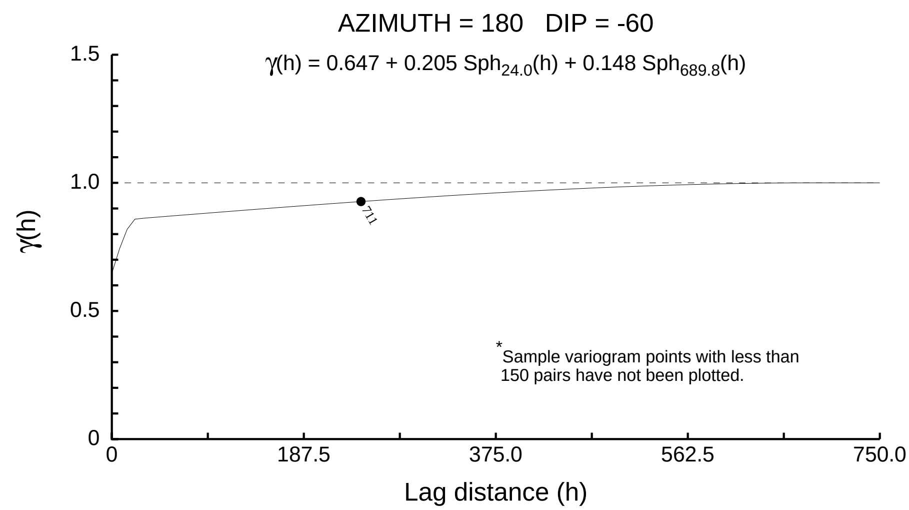
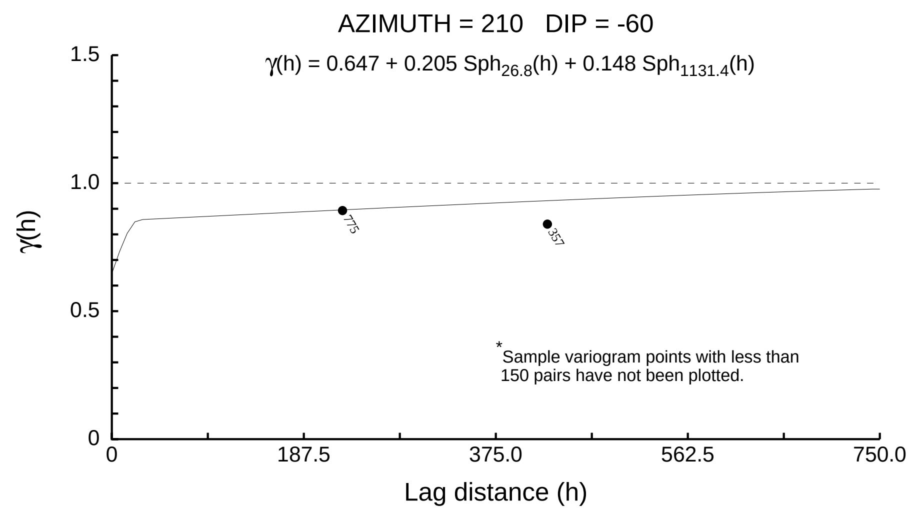
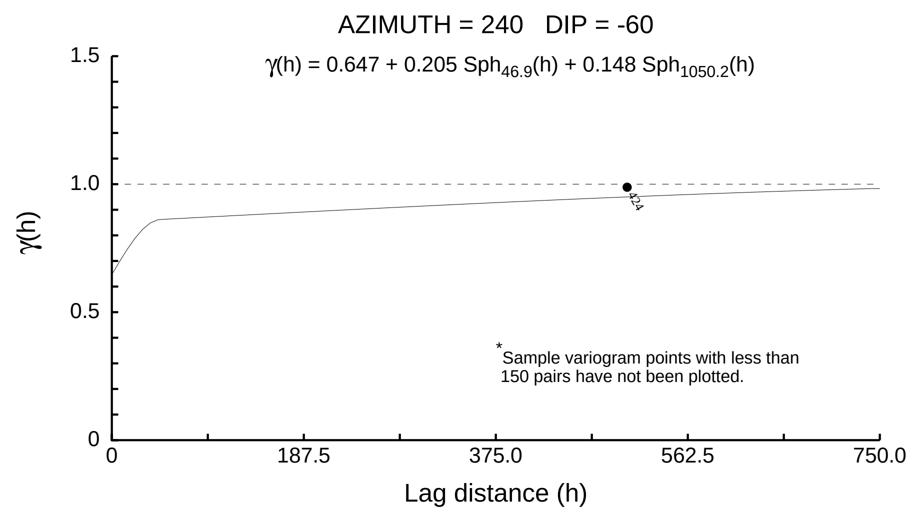
NorthMet U_1_Ni_MDIR







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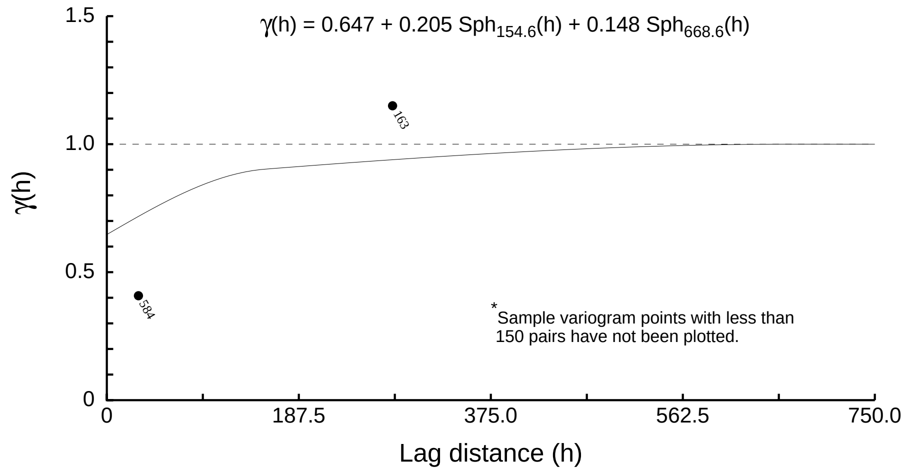
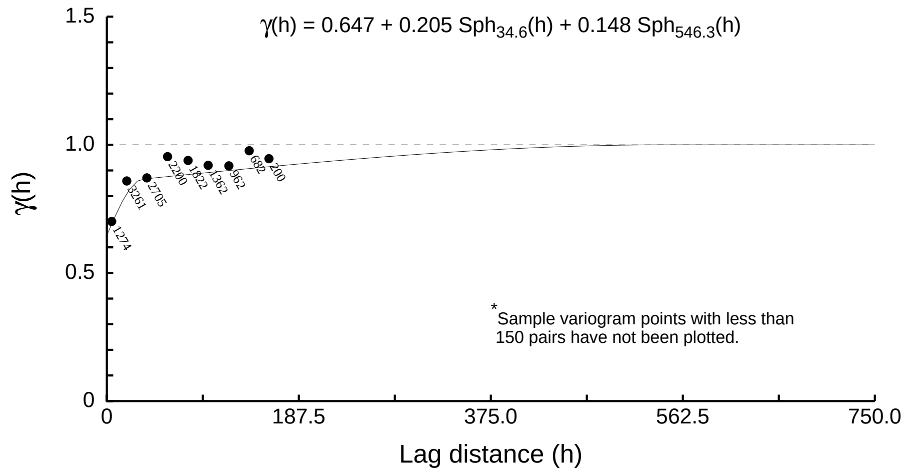
NorthMet U_1_Ni_MDIR

AZIMUTH = 270   DIP = -60



AZIMUTH = 300   DIP = -60



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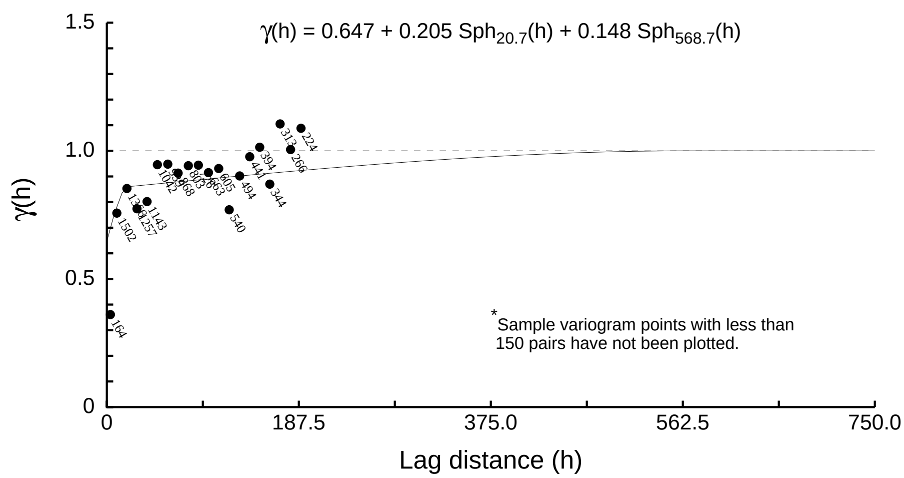

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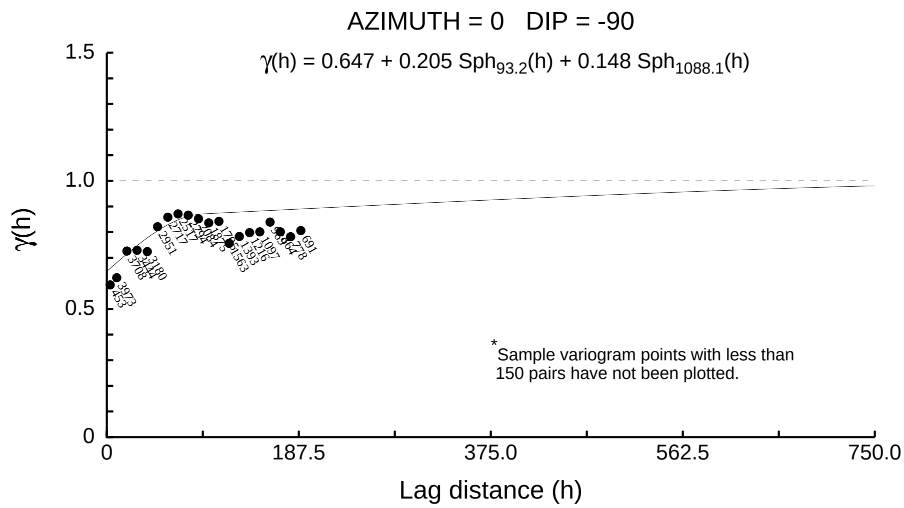
NorthMet U_1_Ni_MDIR



NorthMet U_1_Pd_MDIR

User Defined Rotation Conventions

Nugget ==> 0.508
C1 ==> 0.296
C2 ==> 0.196

First Structure -- Spherical

RH Rotation about the Z axis ==> -88
RH Rotation about the Y’ axis ==> 90
RH Rotation about the Z’ axis ==> 3

Range along the Z’ axis	==> 7.9	Azimuth ==> 178	Dip ==> -0
Range along the Y’ axis	==> 171.8	Azimuth ==> 88	Dip ==> 3
Range along the X’ axis	==> 306.0	Azimuth ==> 83	Dip ==> -87

Second Structure -- Spherical

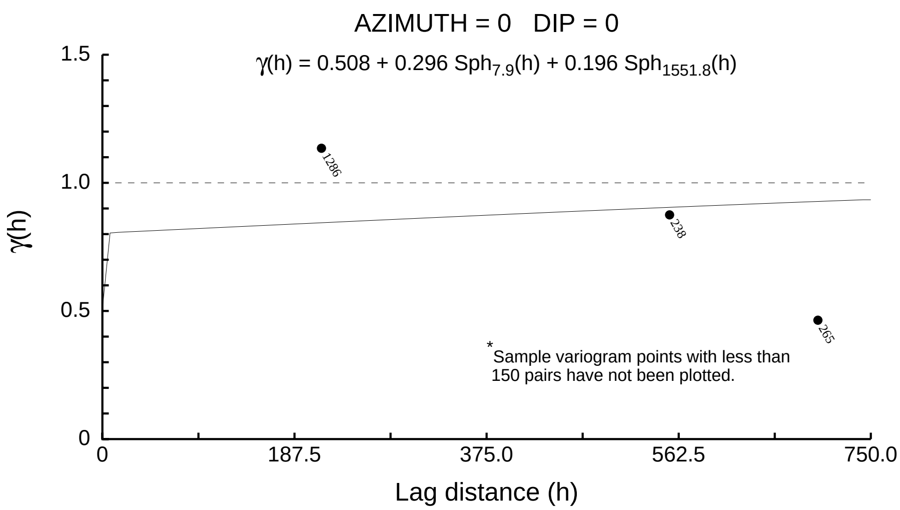
RH Rotation about the Z axis ==> -33
RH Rotation about the Y’ axis ==> 7
RH Rotation about the Z’ axis ==> 89

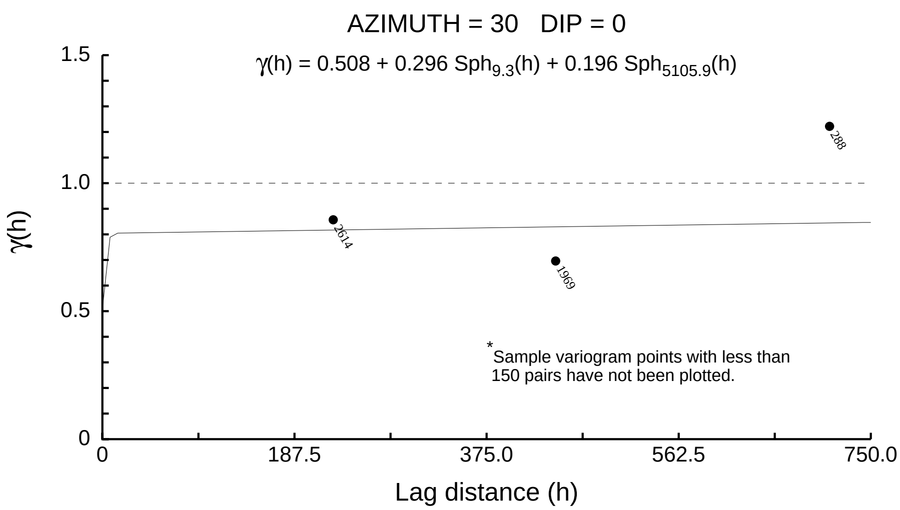
Range along the Z’ axis	==> 599.5	Azimuth ==> 123	Dip ==> 83
Range along the Y’ axis	==> 902.3	Azimuth ==> 304	Dip ==> 7
Range along the X’ axis	==> 5569.9	Azimuth ==> 34	Dip ==> -0

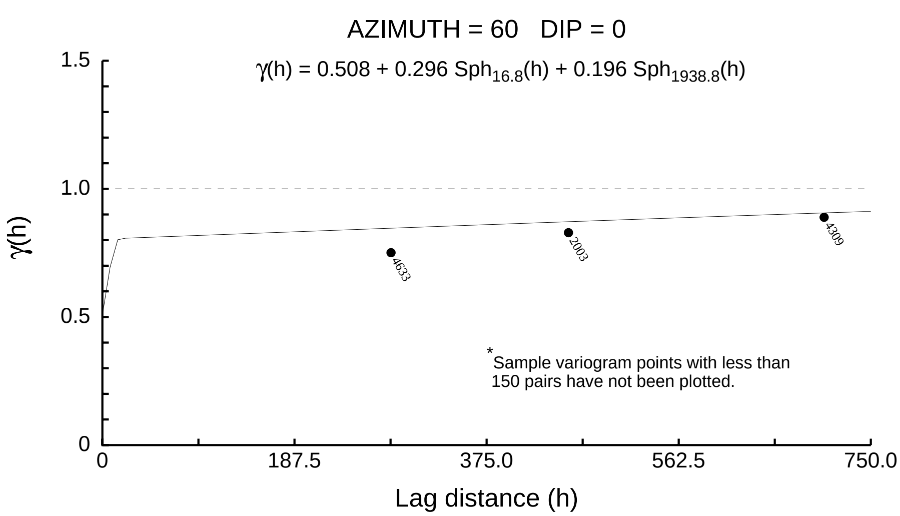
Modeling Criteria

Minimum number pairs req’d ==> 150
Sample variogram points weighted by # pairs

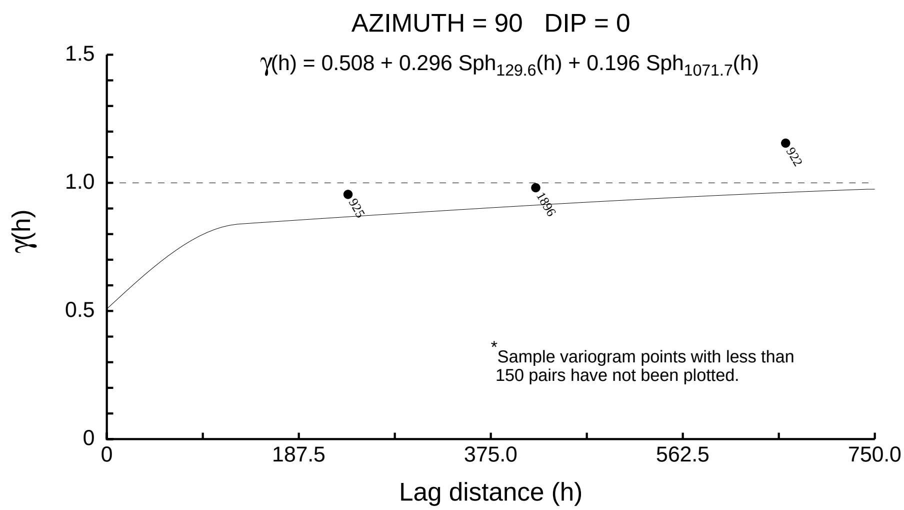
NorthMet U_1_Pd_MDIR

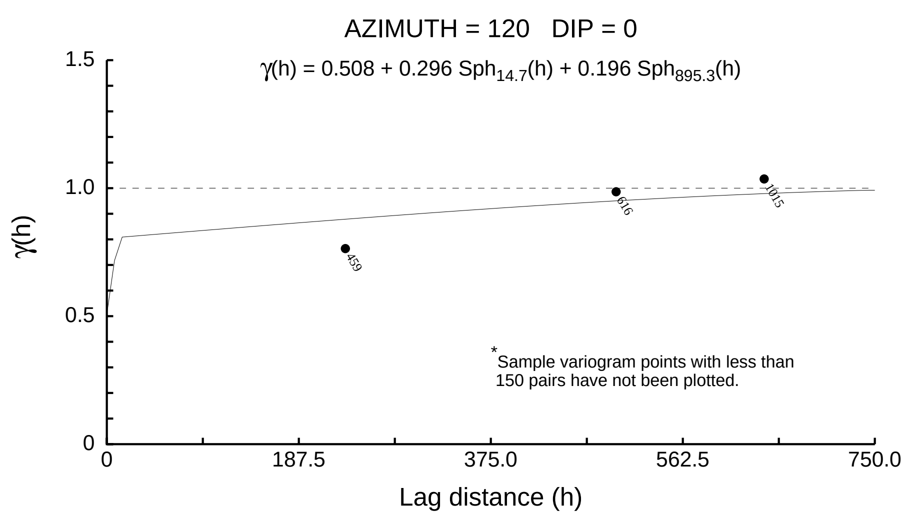


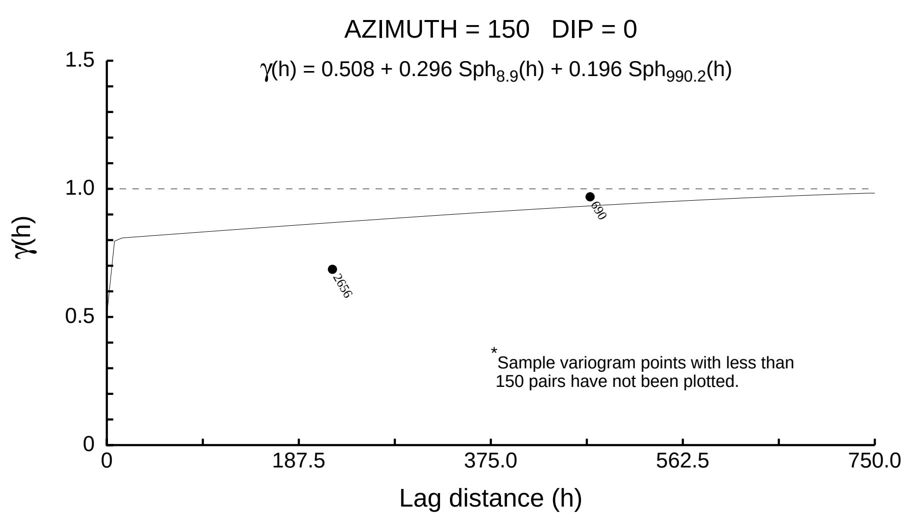




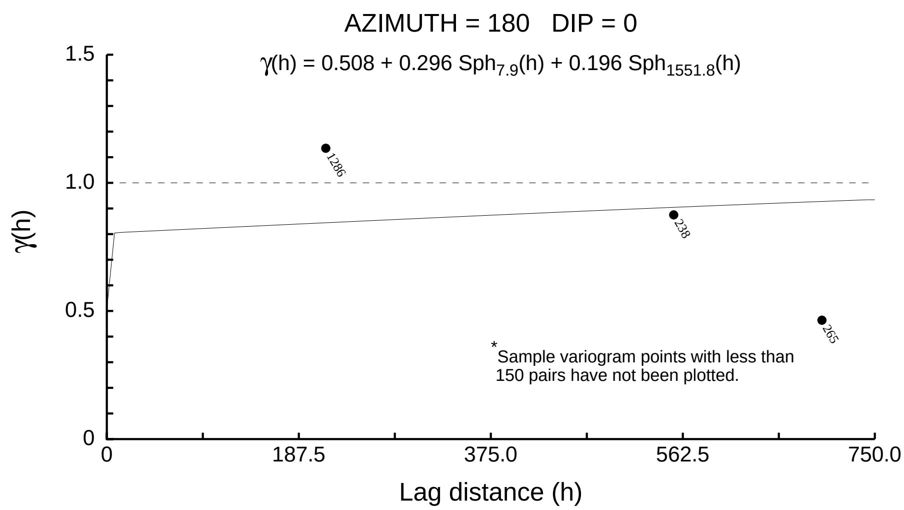
NorthMet U_1_Pd_MDIR

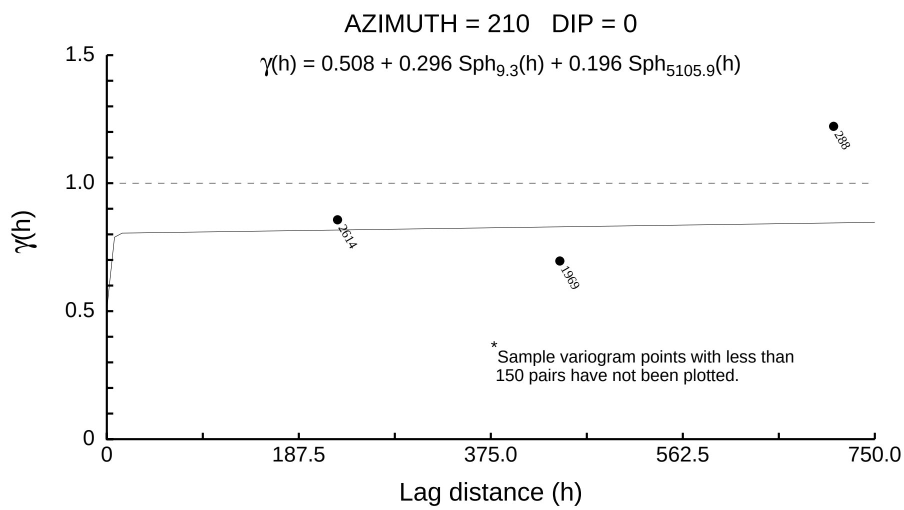


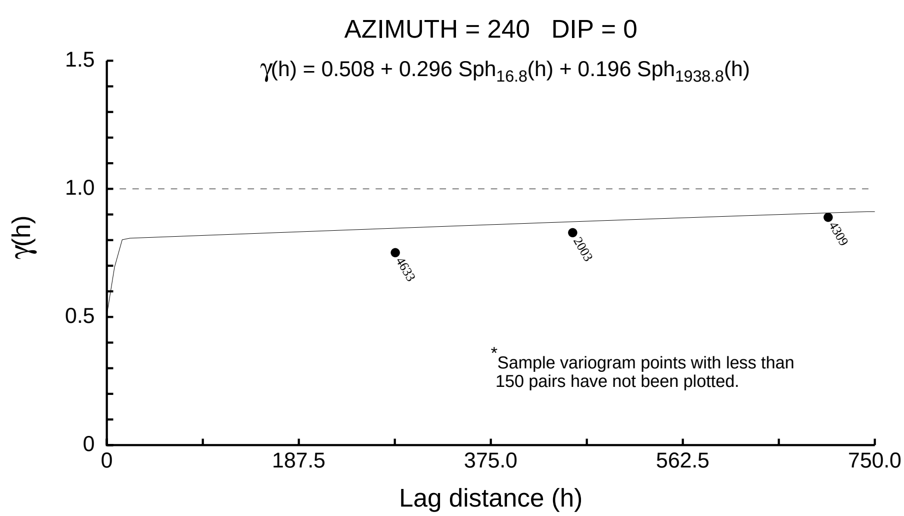




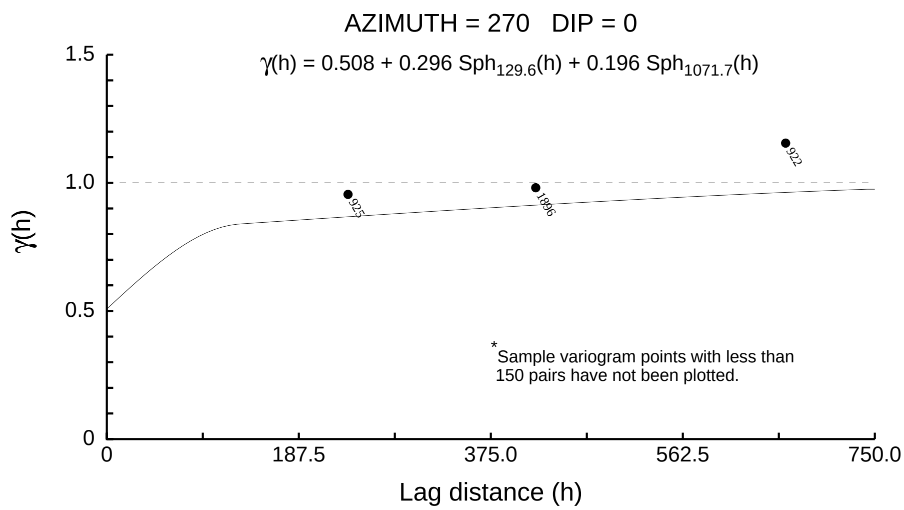
NorthMet U_1_Pd_MDIR

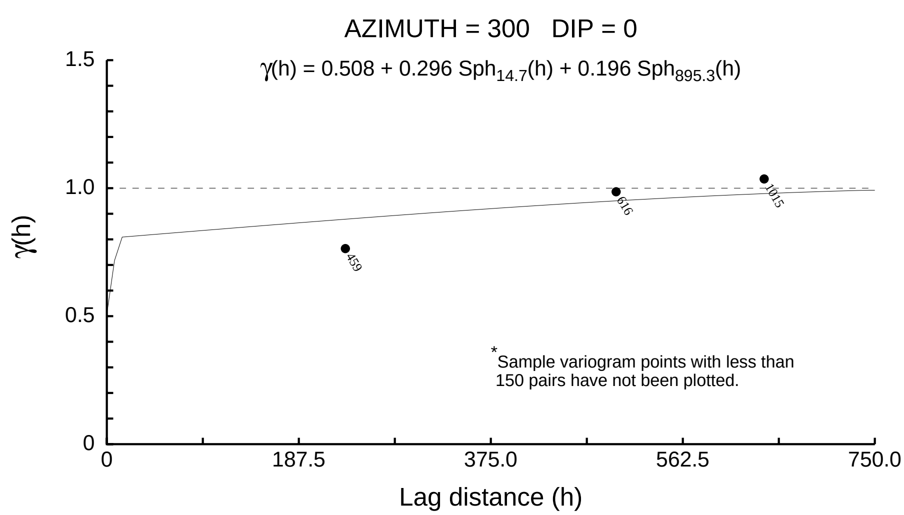


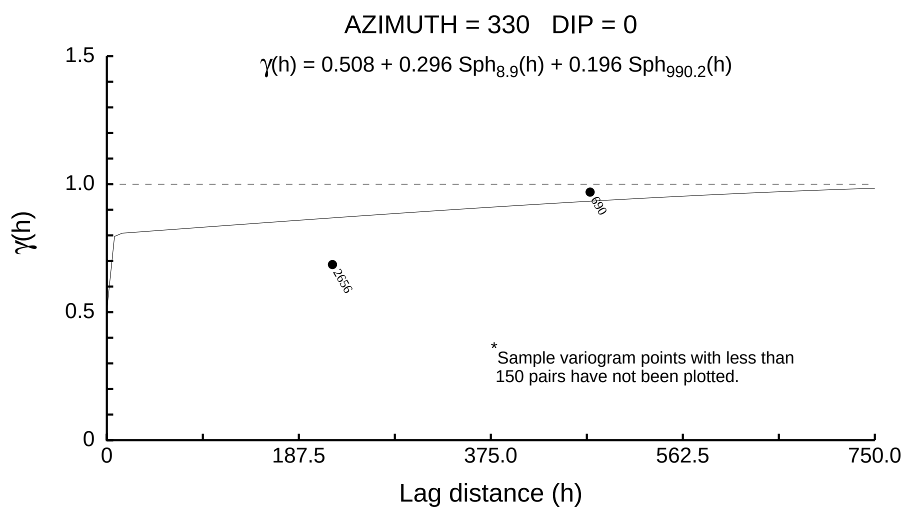




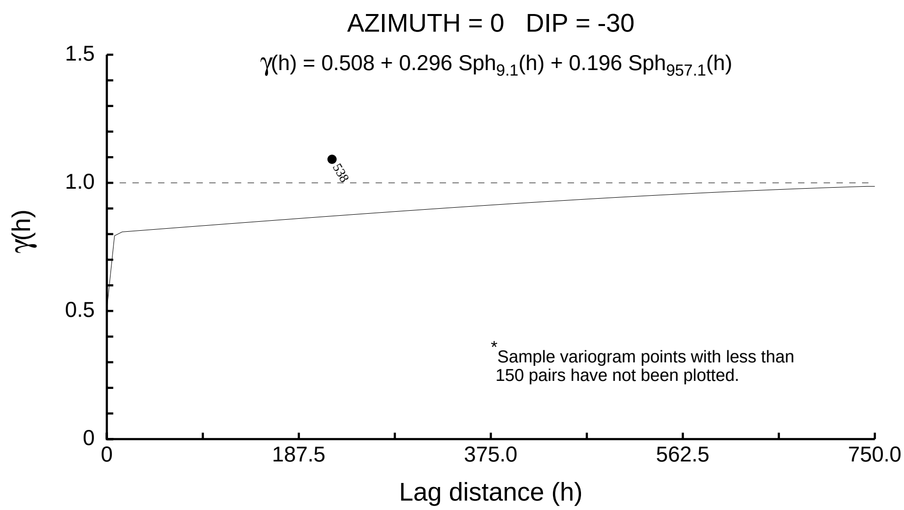
NorthMet U_1_Pd_MDIR

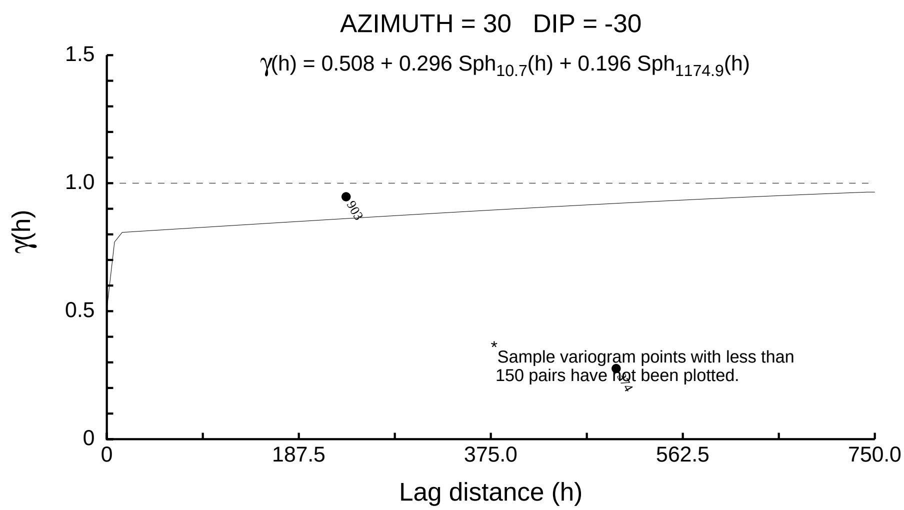


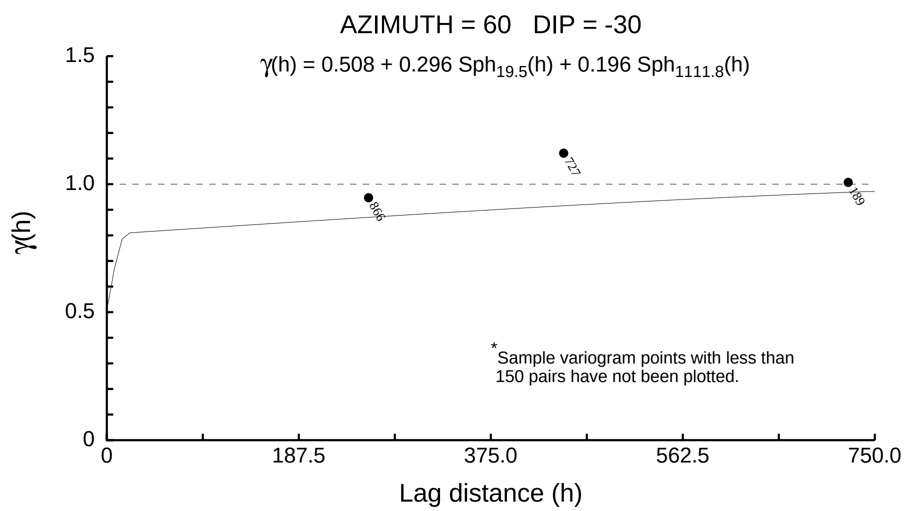




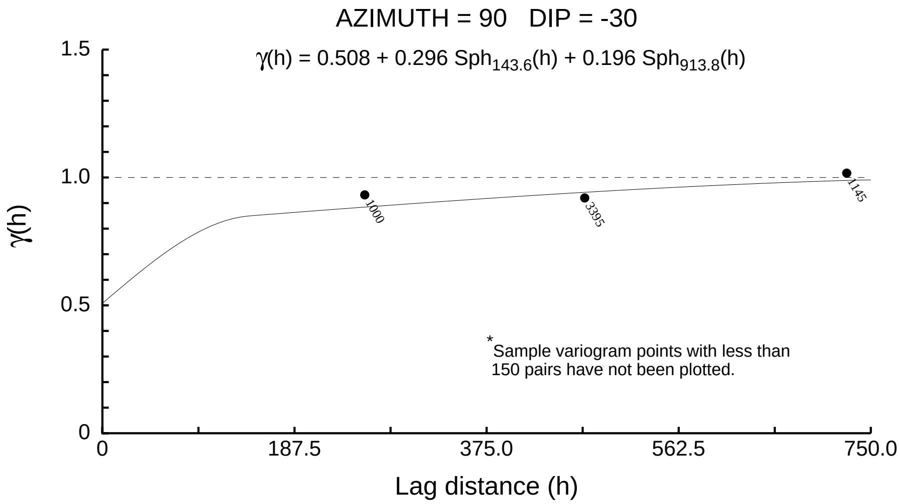
NorthMet U_1_Pd_MDIR

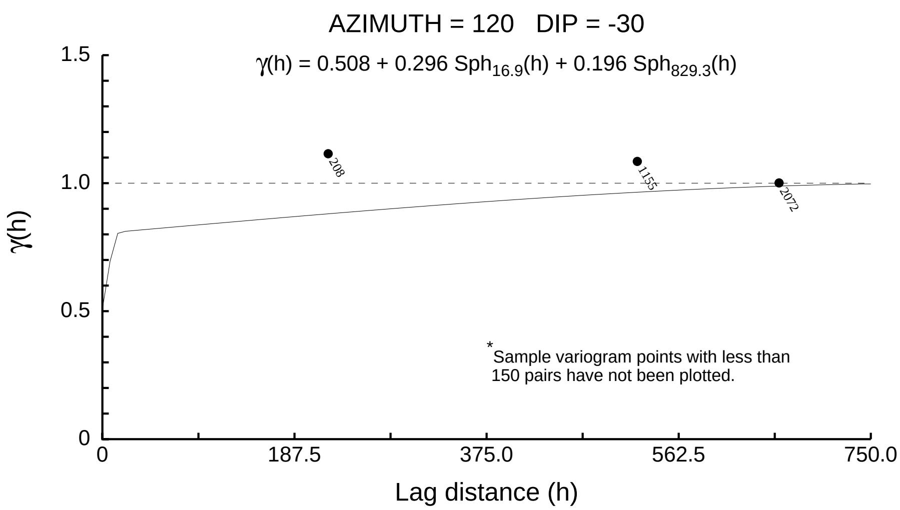


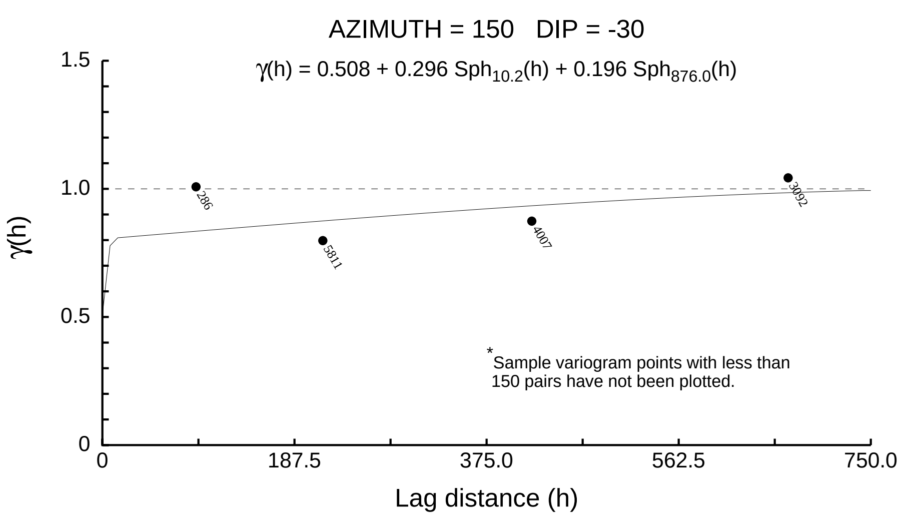




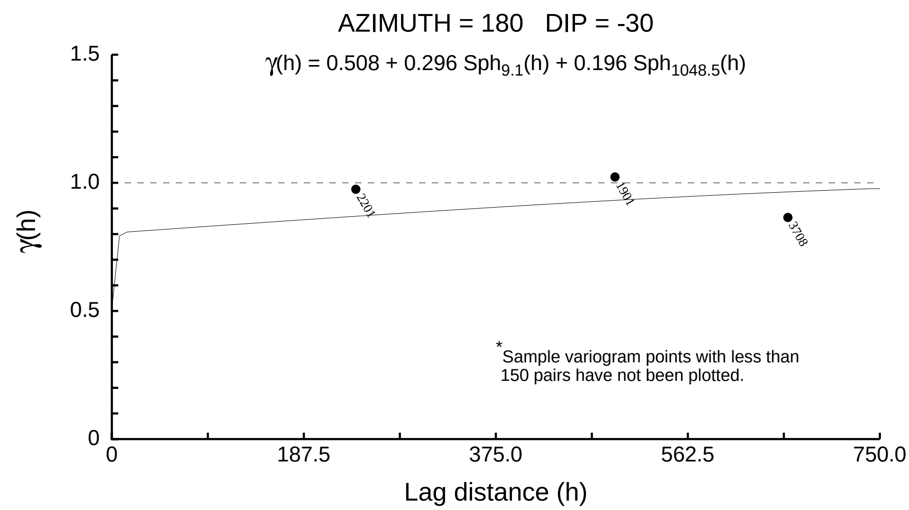
NorthMet U_1_Pd_MDIR

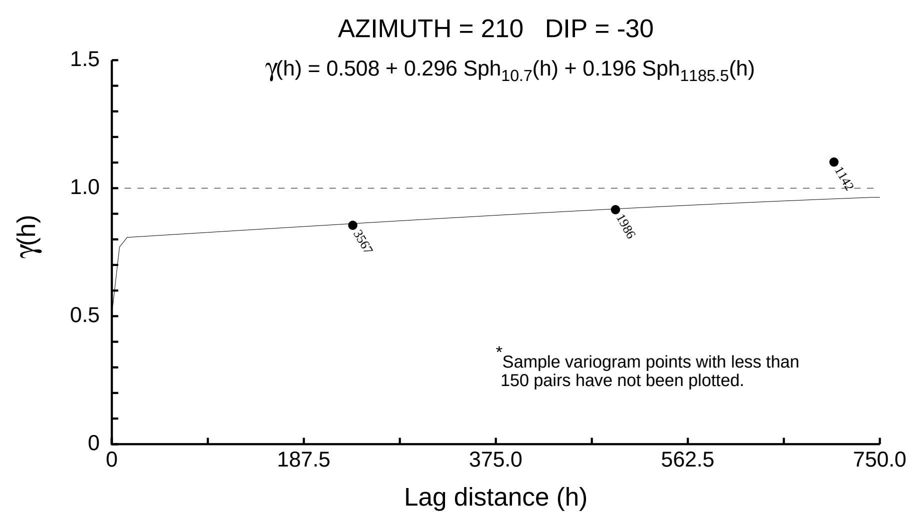


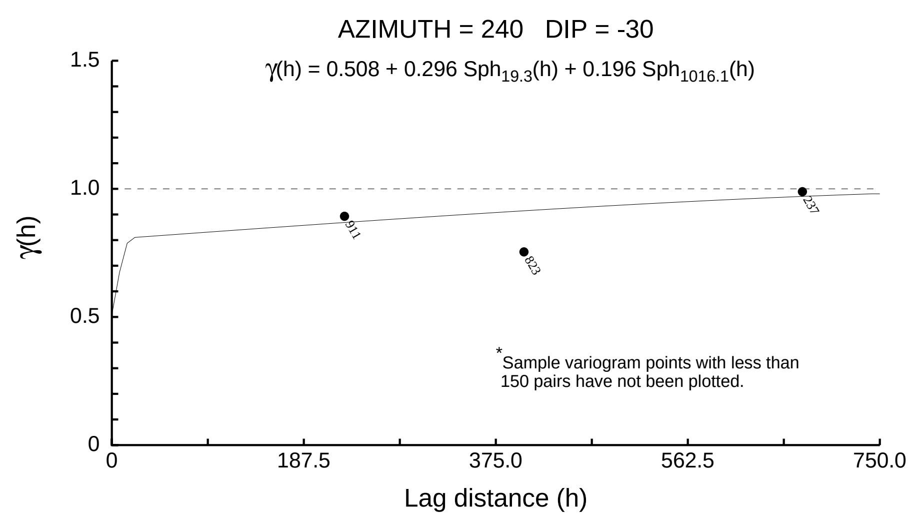




NorthMet U_1_Pd_MDIR







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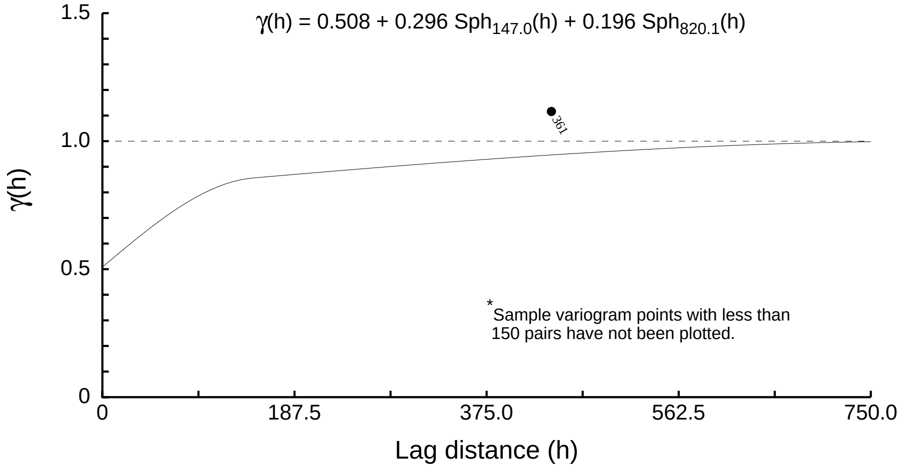
NorthMet U_1_Pd_MDIR

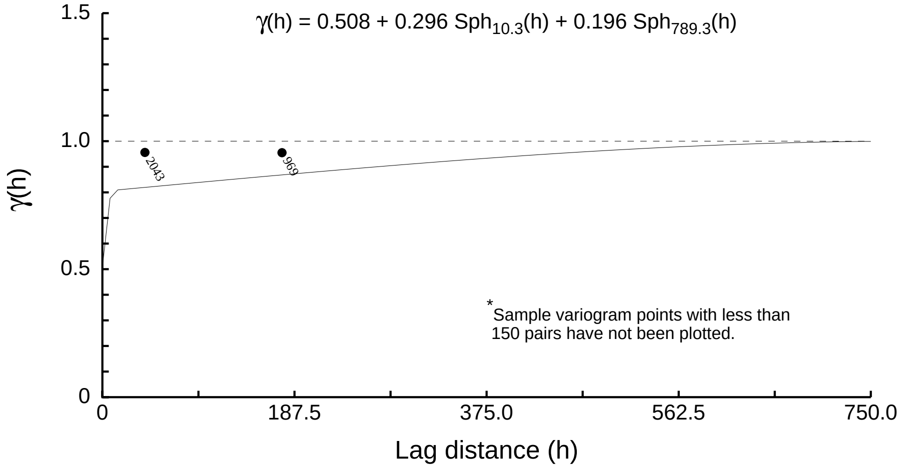
AZIMUTH = 270 DIP = -30

$\gamma(h) = 0.508 + 0.296\ Sph_{147.0}(h) + 0.196\ Sph_{820.1}(h)$



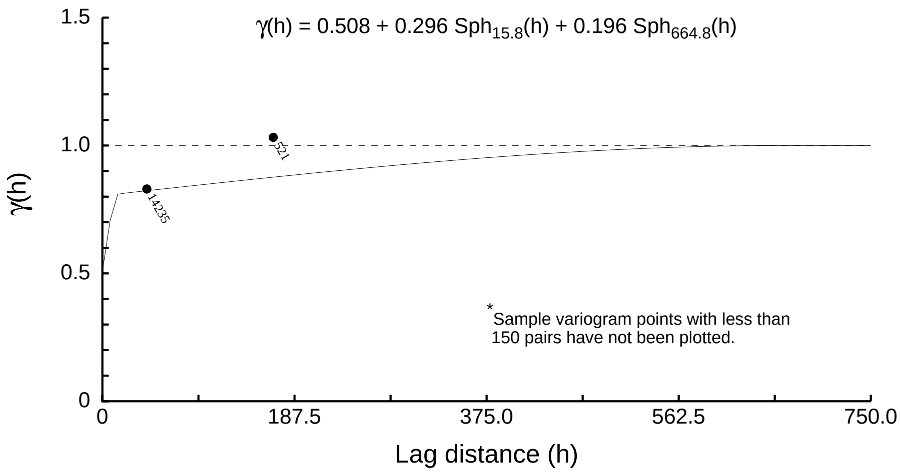
AZIMUTH = 330 DIP = -30

$\gamma(h) = 0.508 + 0.296\ Sph_{10.3}(h) + 0.196\ Sph_{789.3}(h)$

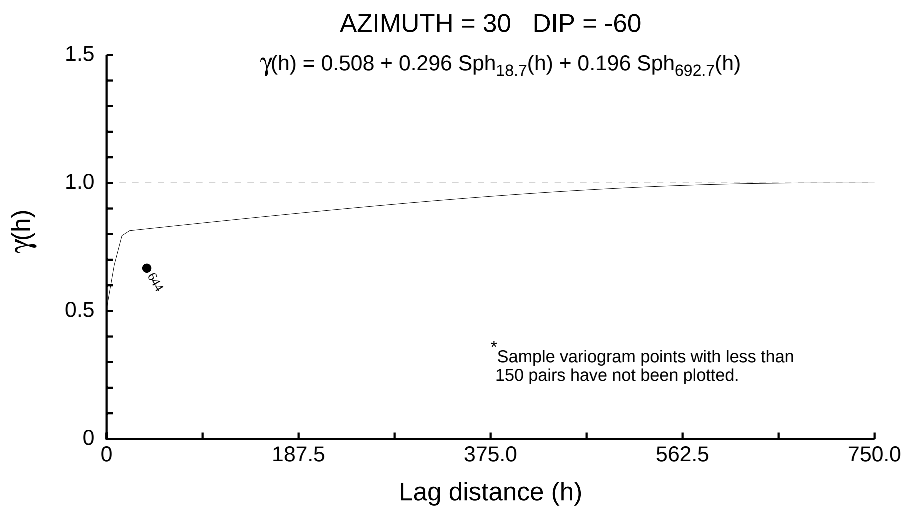


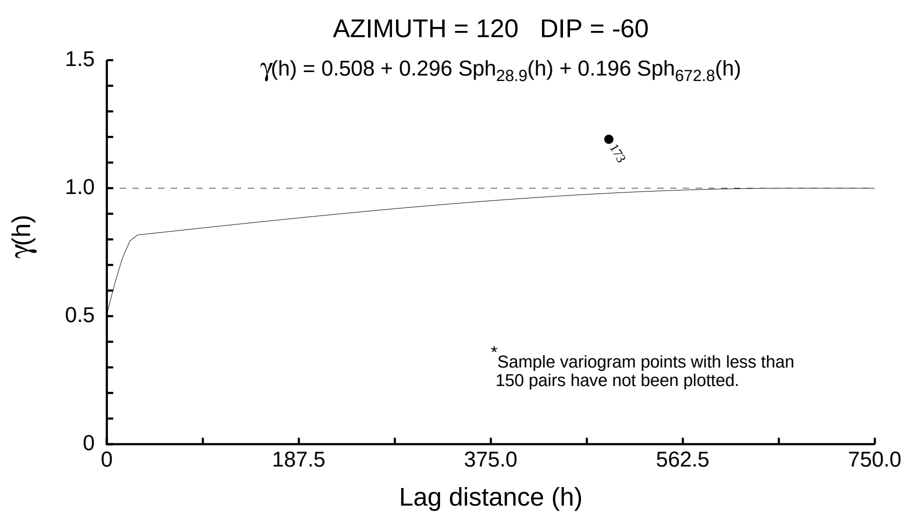
AZIMUTH = 0 DIP = -60

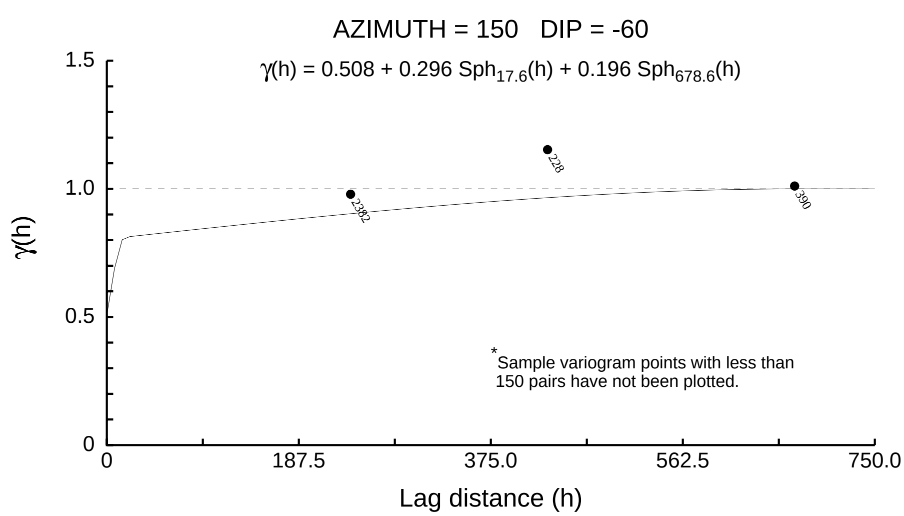
$\gamma(h) = 0.508 + 0.296\ Sph_{15.8}(h) + 0.196\ Sph_{664.8}(h)$



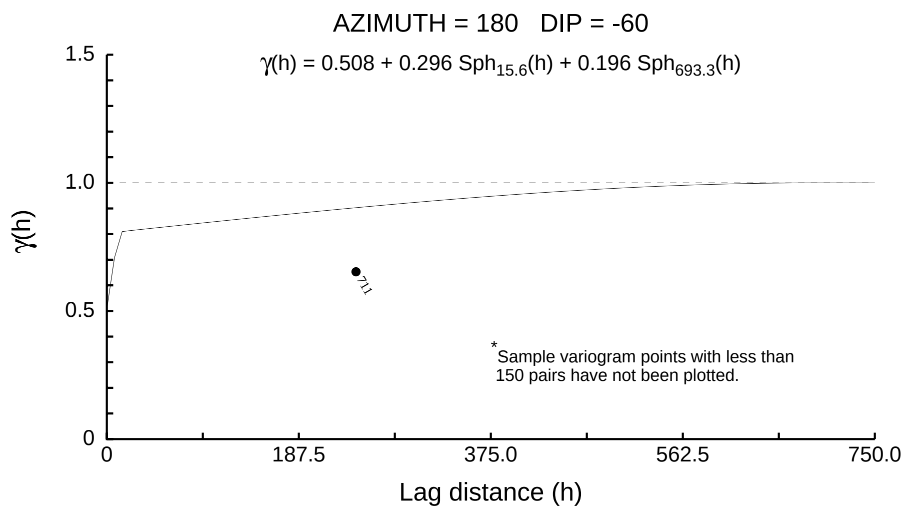
NorthMet U_1_Pd_MDIR

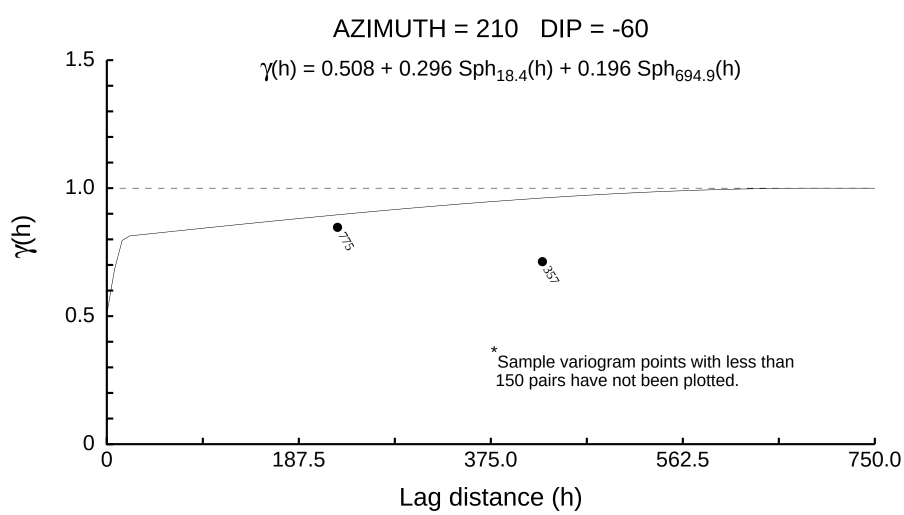


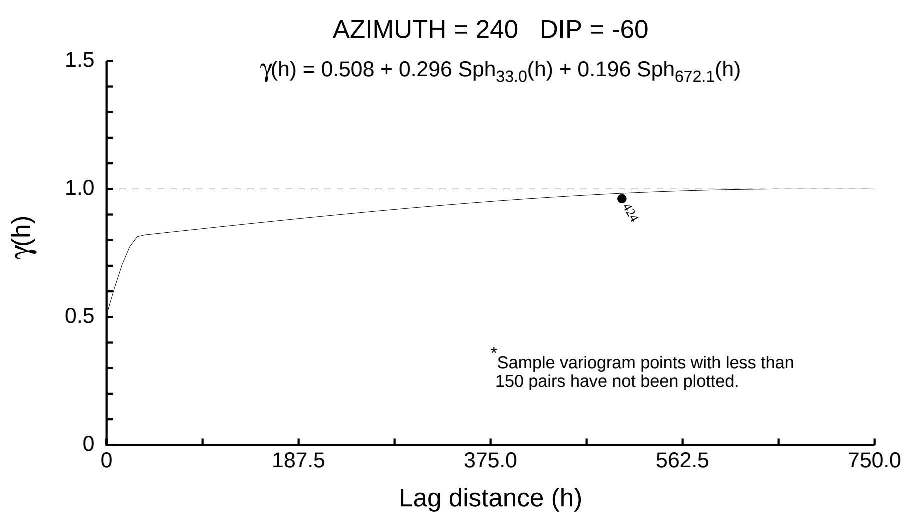




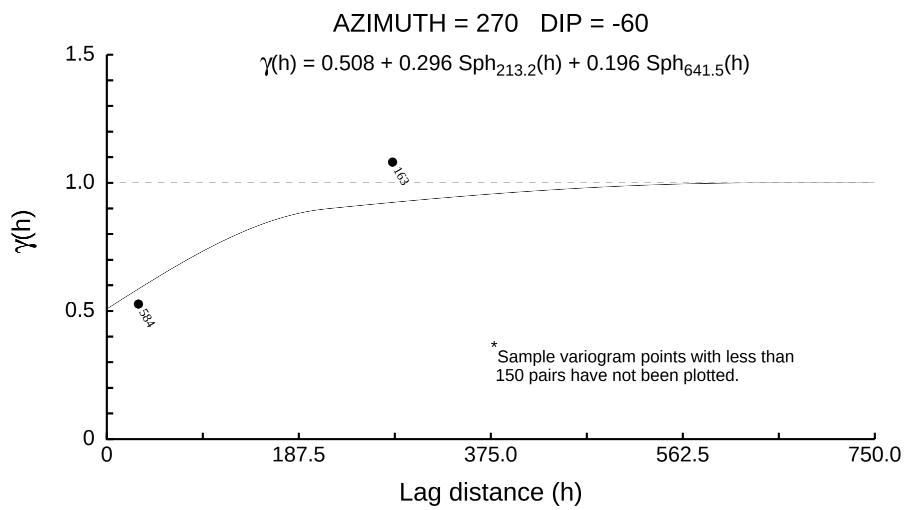
NorthMet U_1_Pd_MDIR

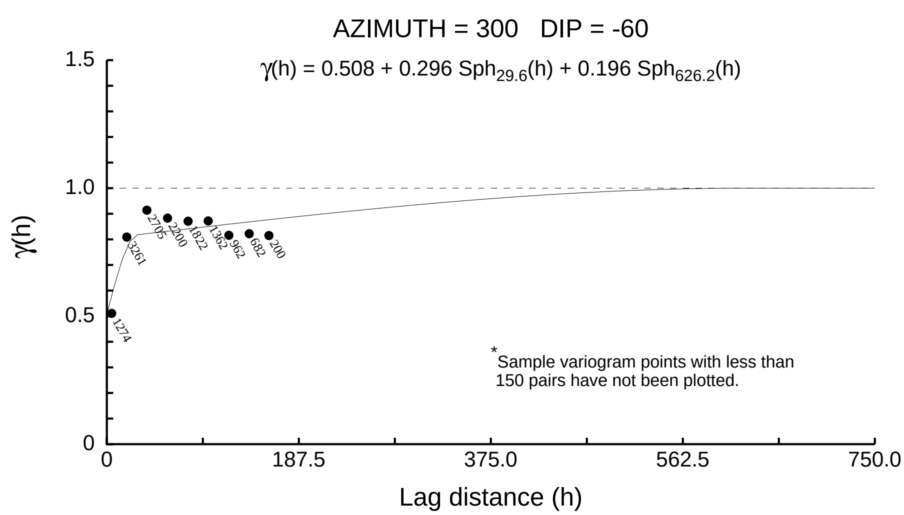


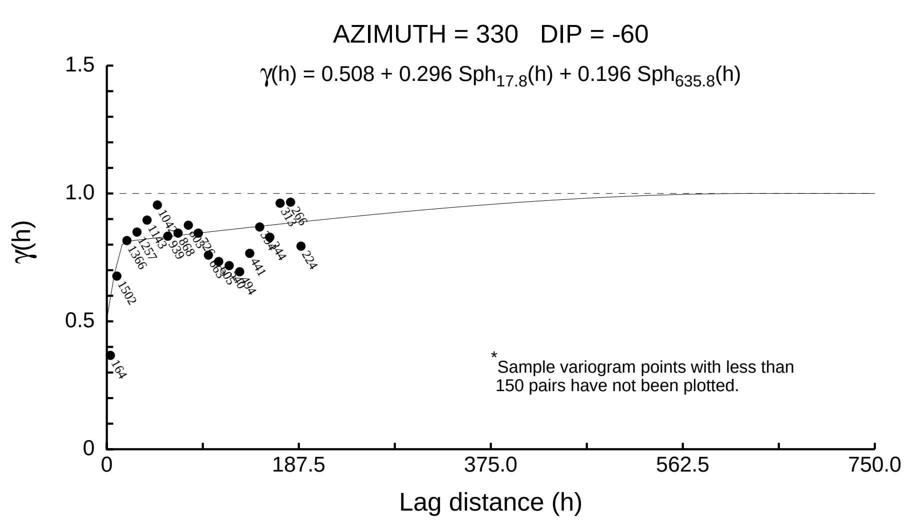




NorthMet U_1_Pd_MDIR







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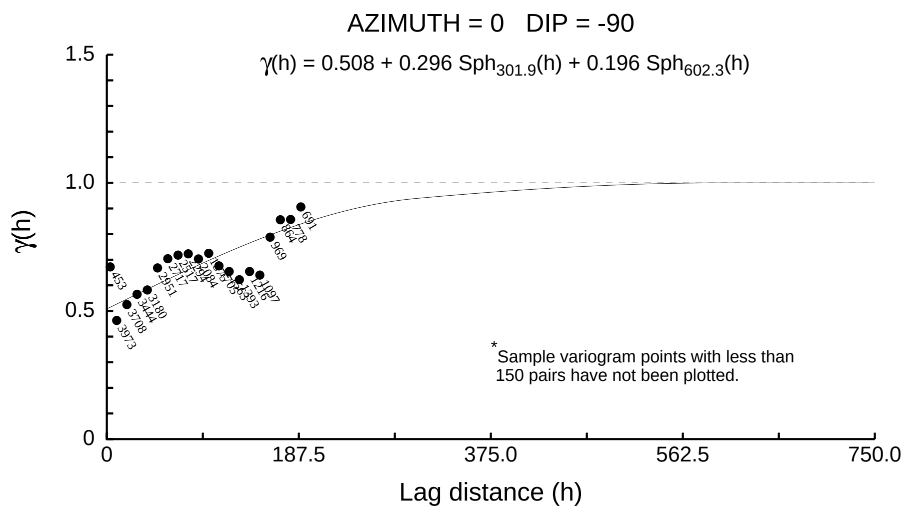
NorthMet U_1_Pd_MDIR



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NorthMet U_1_Pt_MDIR

User Defined Rotation Conventions

Nugget ==> 0.672
C1 ==> 0.234
C2 ==> 0.094

First Structure -- Spherical

RH Rotation about the Z axis ==> -89
RH Rotation about the Y' axis ==> 89
RH Rotation about the Z' axis ==> -35

Range along the Z' axis ==> 8.1	Azimuth ==> 179	Dip ==> 1
Range along the Y' axis ==> 213.9	Azimuth ==> 89	Dip ==> -35
Range along the X' axis ==> 313.8	Azimuth ==> 267	Dip ==> -55

Second Structure -- Spherical

RH Rotation about the Z axis ==> 63
RH Rotation about the Y' axis ==> -74
RH Rotation about the Z' axis ==> 47

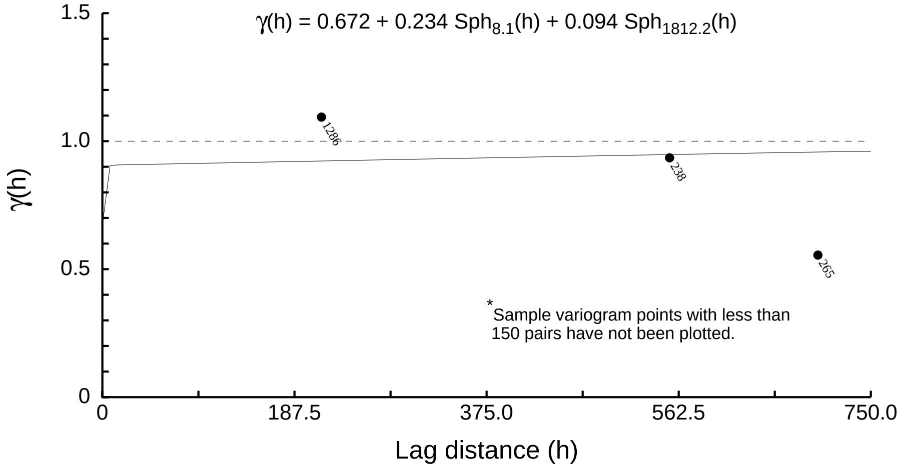
Range along the Z' axis ==> 2764.6	Azimuth ==> 207	Dip ==> 16
Range along the Y' axis ==> 765.1	Azimuth ==> 281	Dip ==> -45
Range along the X' axis ==> 1183.8	Azimuth ==> 311	Dip ==> 41

Modeling Criteria

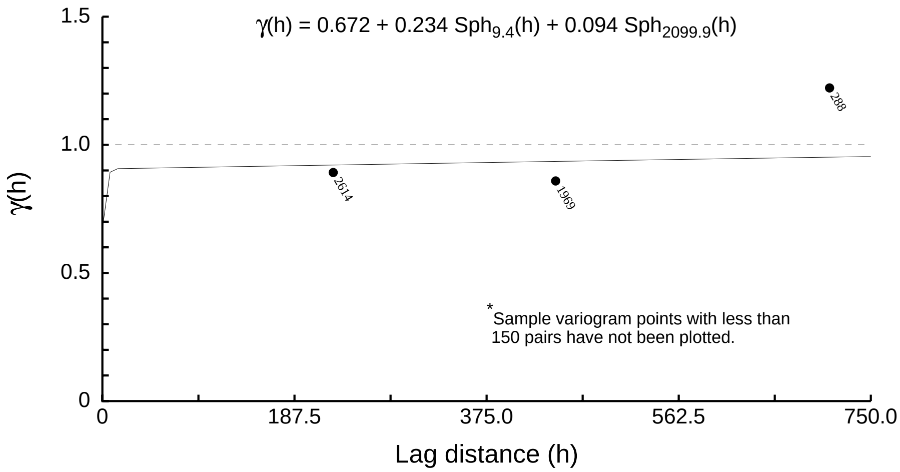
Minimum number pairs req'd ==> 150
Sample variogram points weighted by # pairs

NorthMet U_1_Pt_MDIR

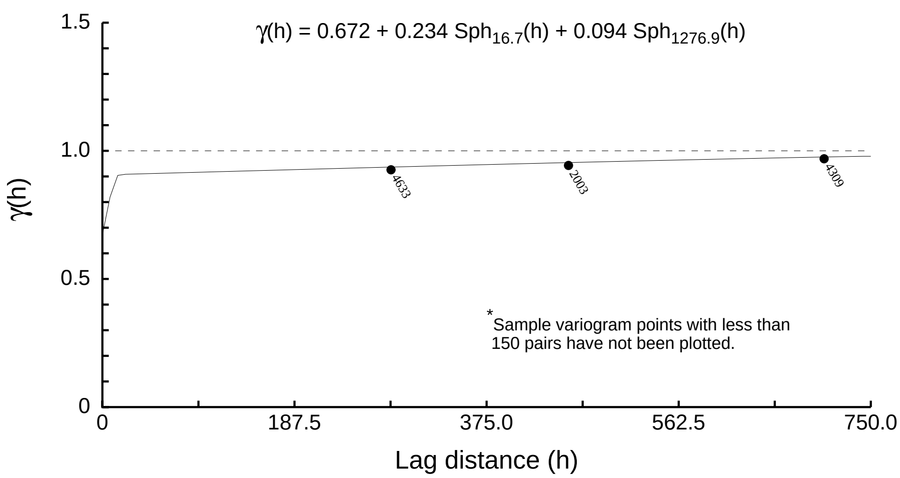
AZIMUTH = 0   DIP = 0



AZIMUTH = 30   DIP = 0



AZIMUTH = 60   DIP = 0



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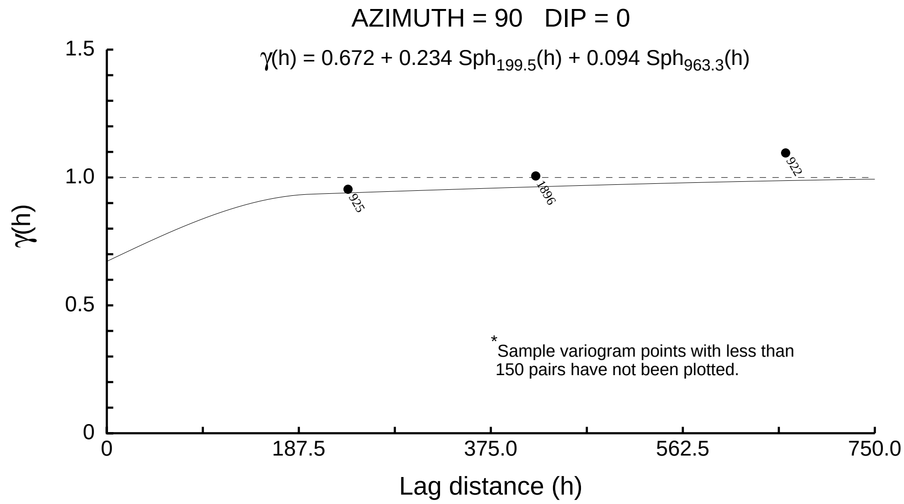
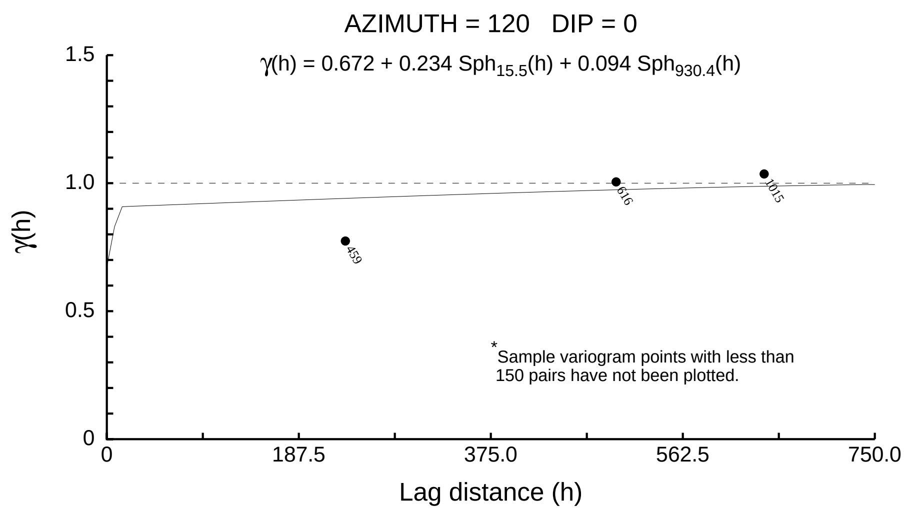
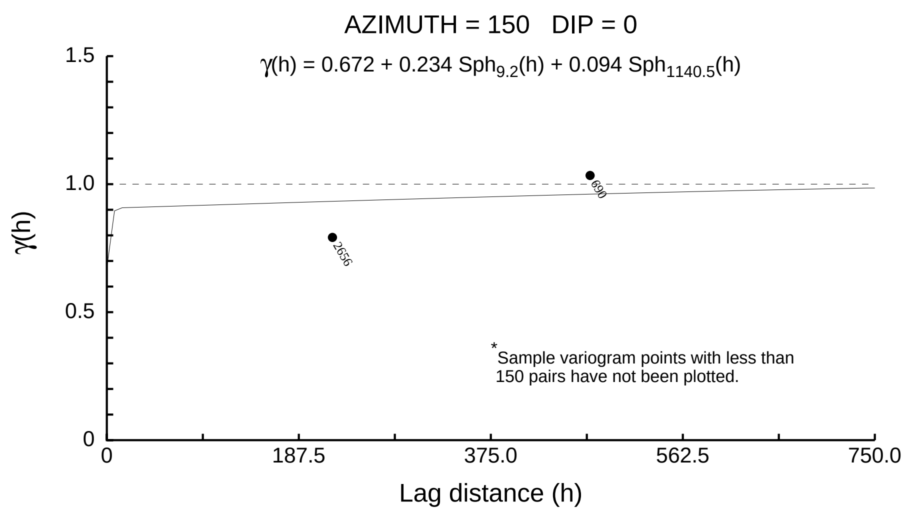
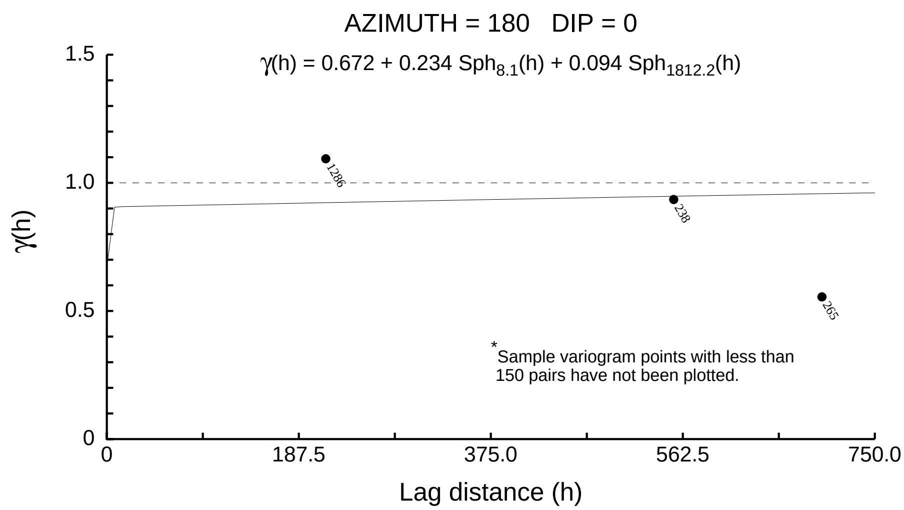
NorthMet U_1_Pt_MDIR

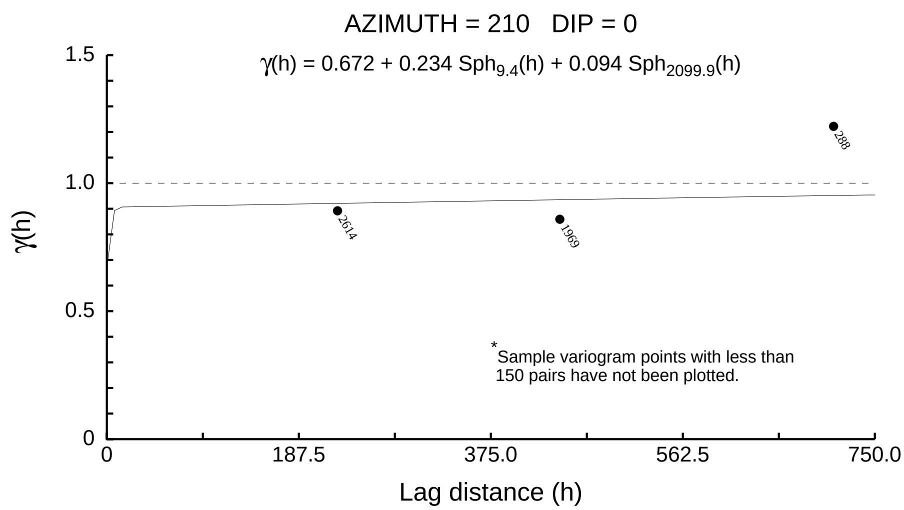


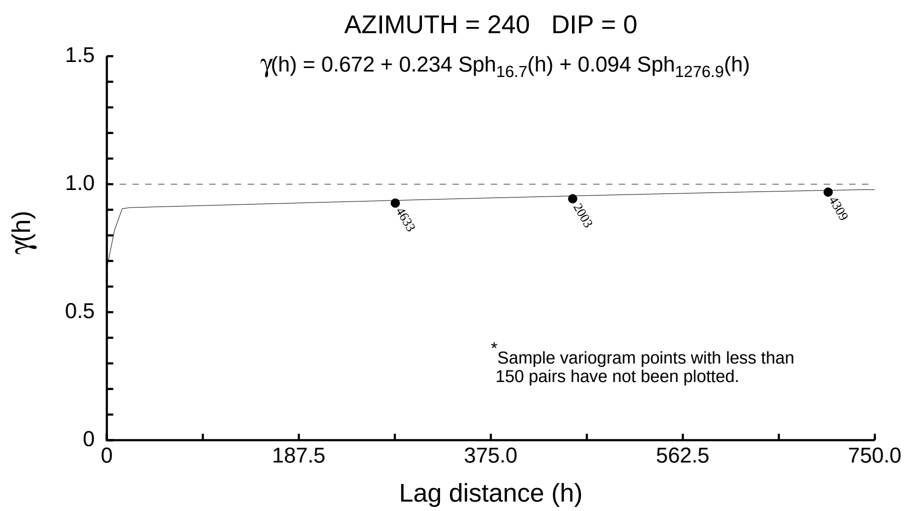




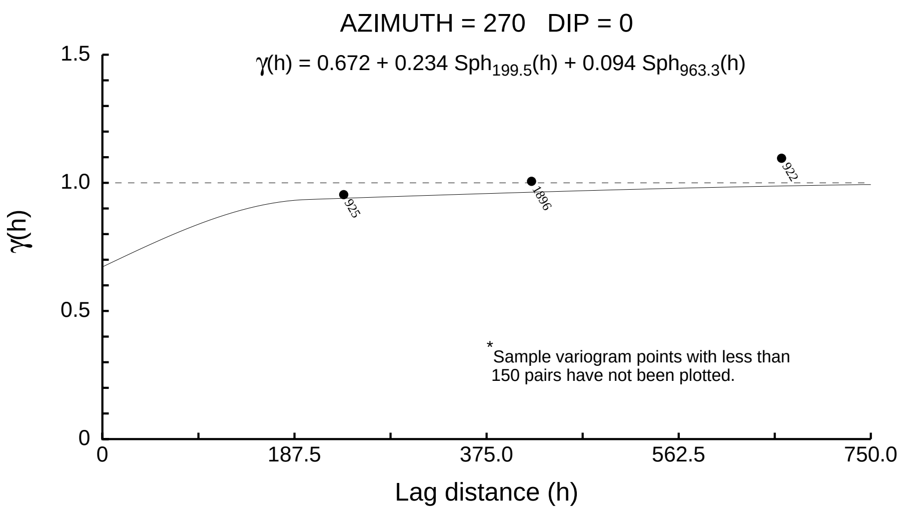
NorthMet U_1_Pt_MDIR

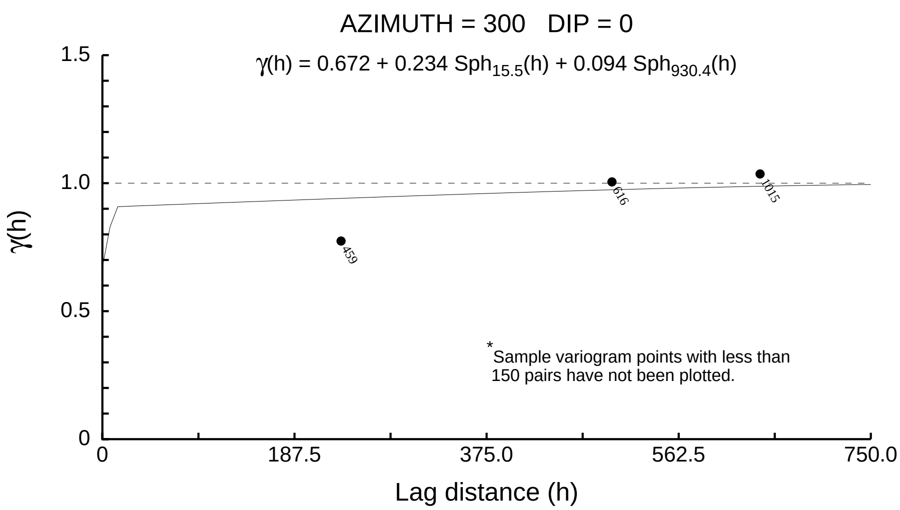


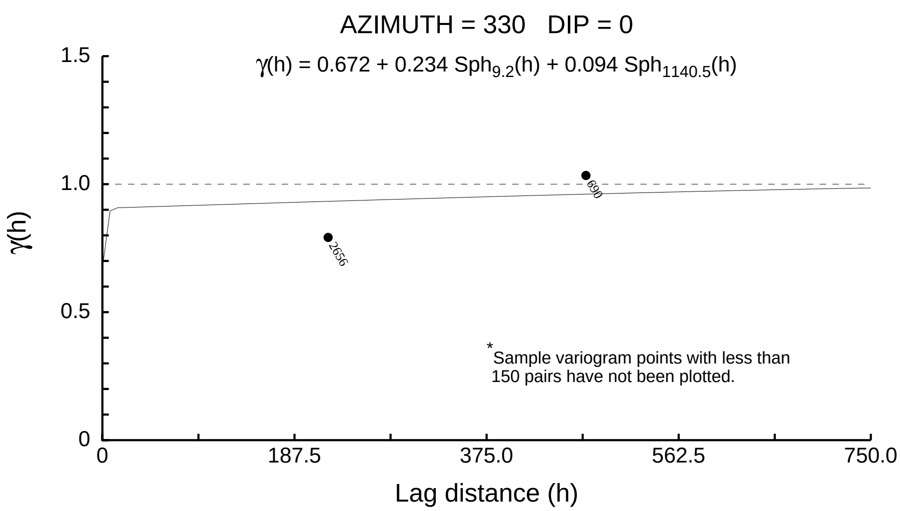




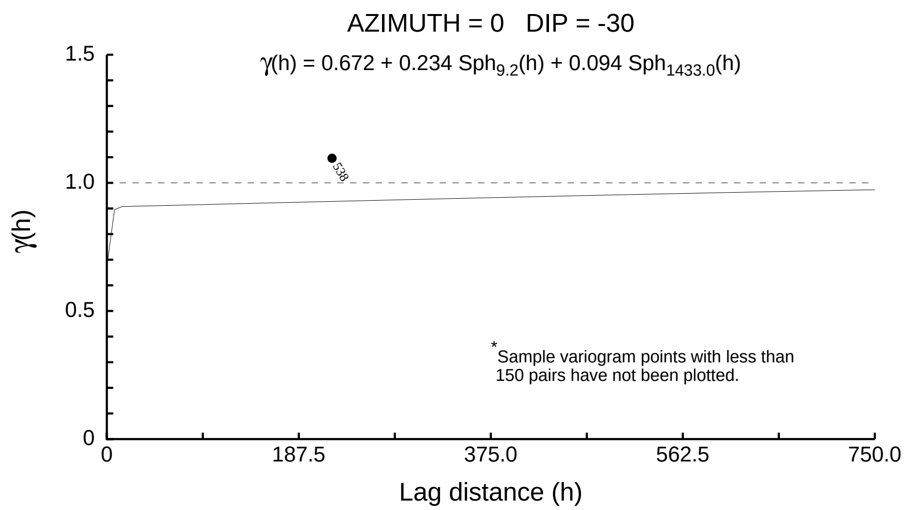
NorthMet U_1_Pt_MDIR

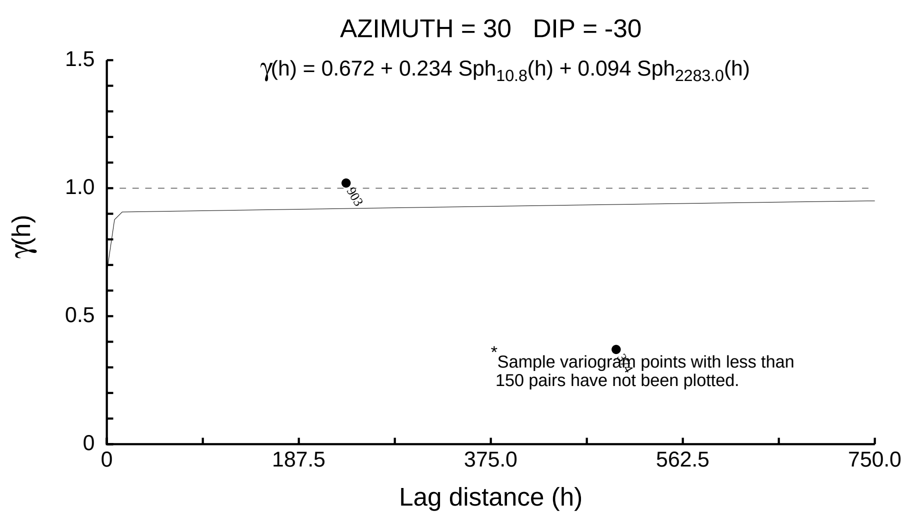


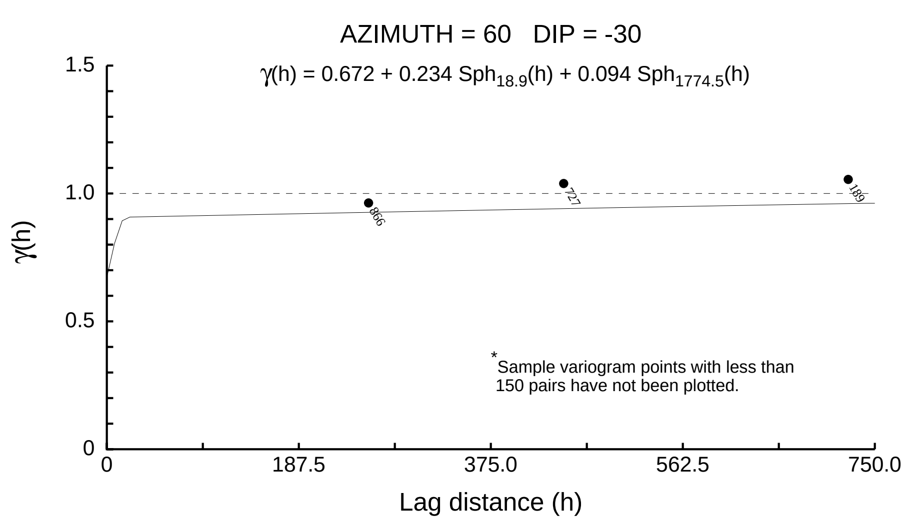




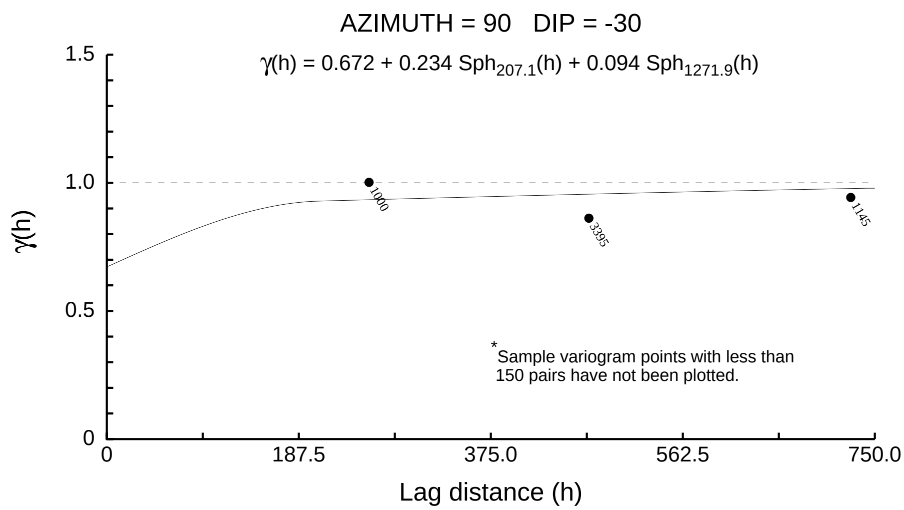
NorthMet U_1_Pt_MDIR

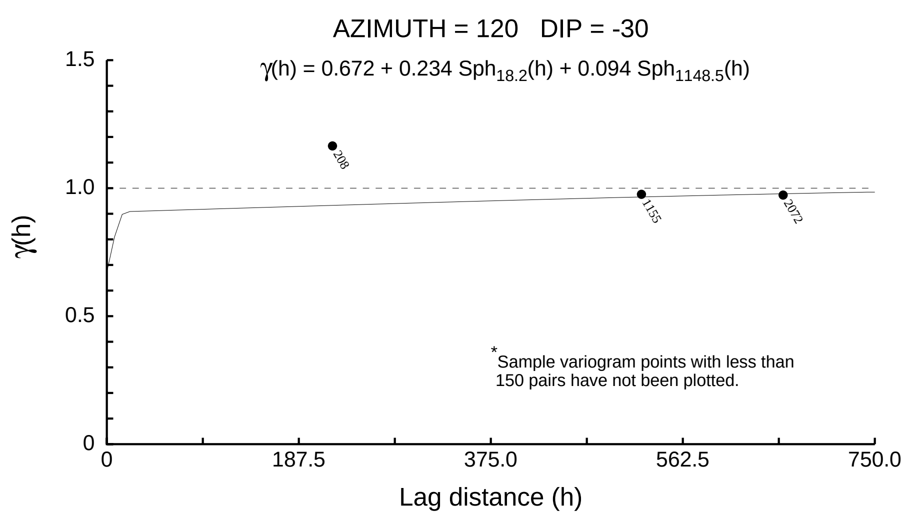


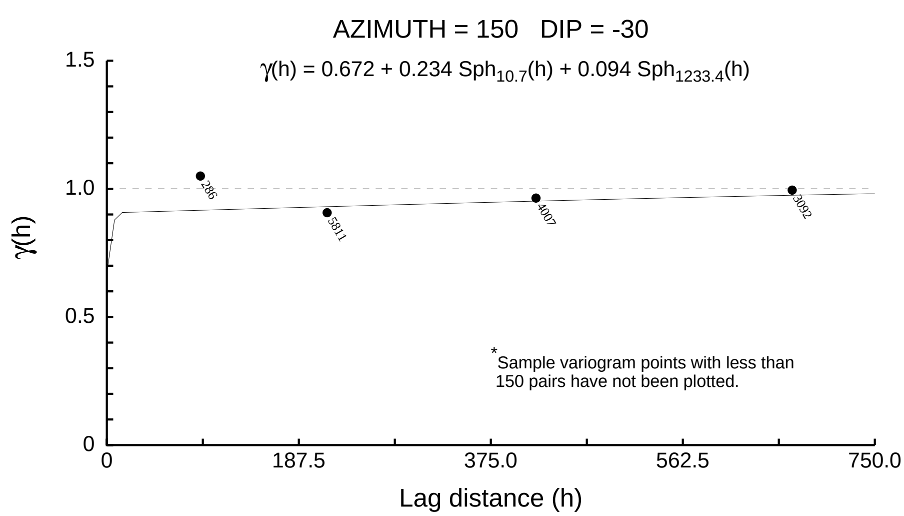




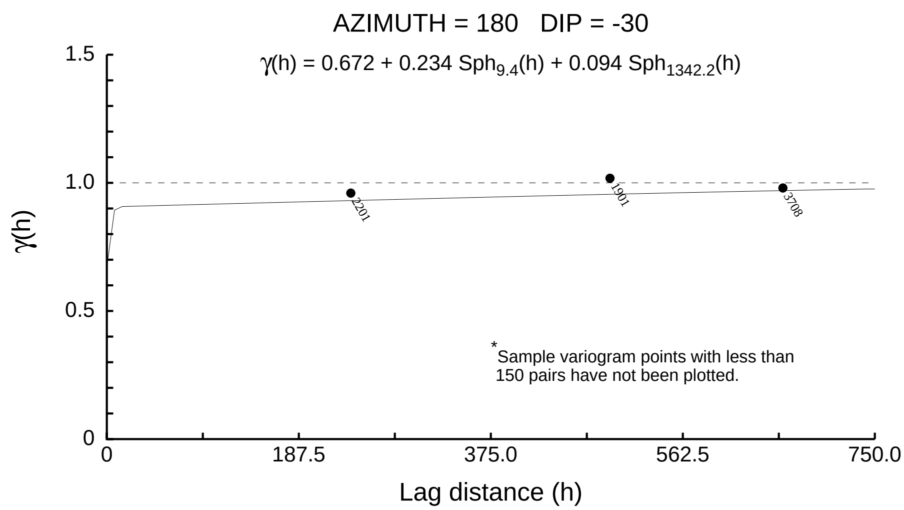
NorthMet U_1_Pt_MDIR

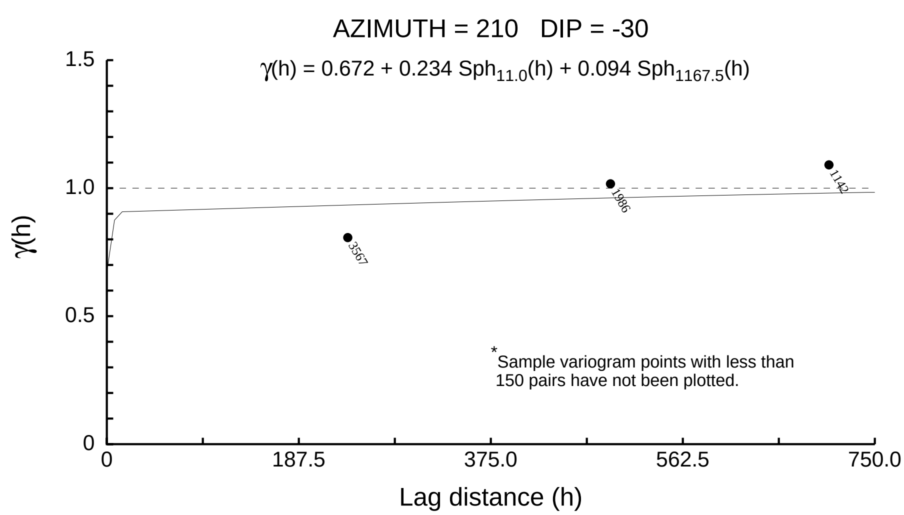


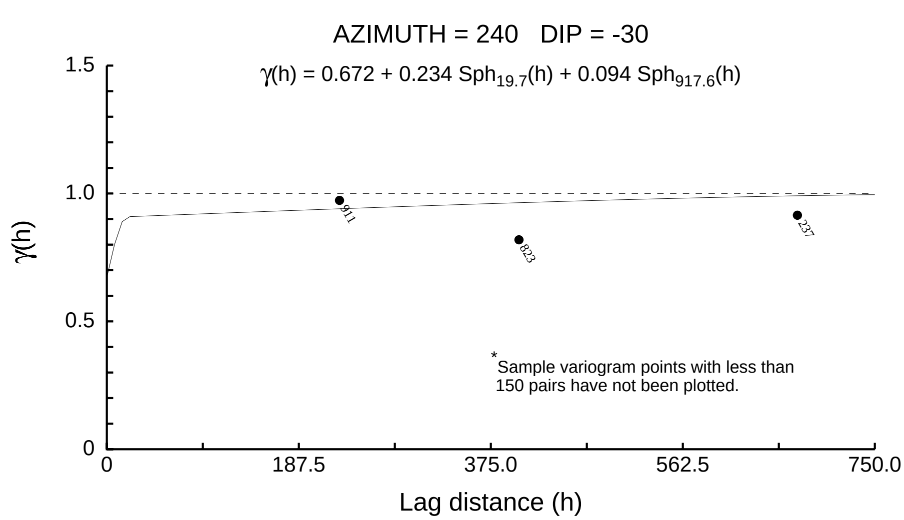




NorthMet U_1_Pt_MDIR

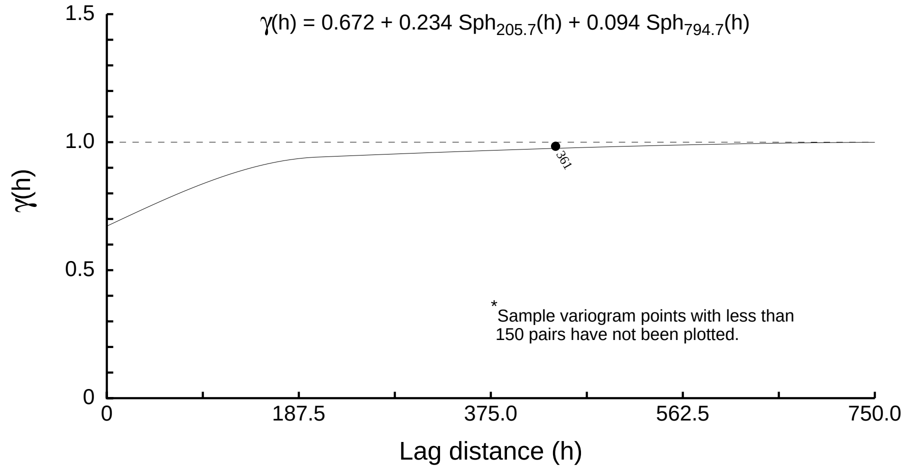




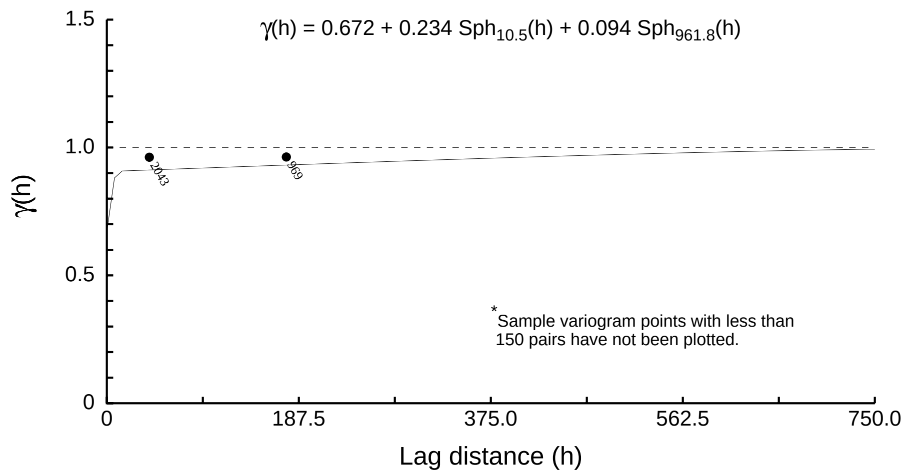


NorthMet U_1_Pt_MDIR

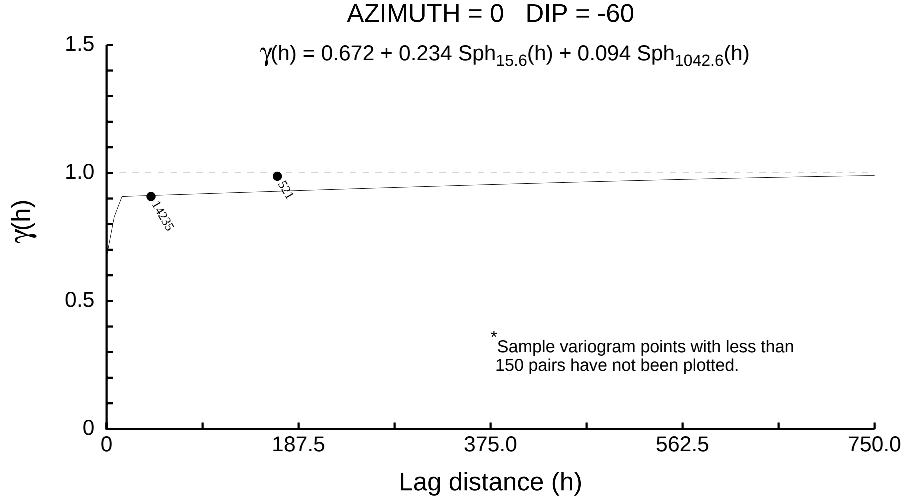
AZIMUTH = 270   DIP = -30



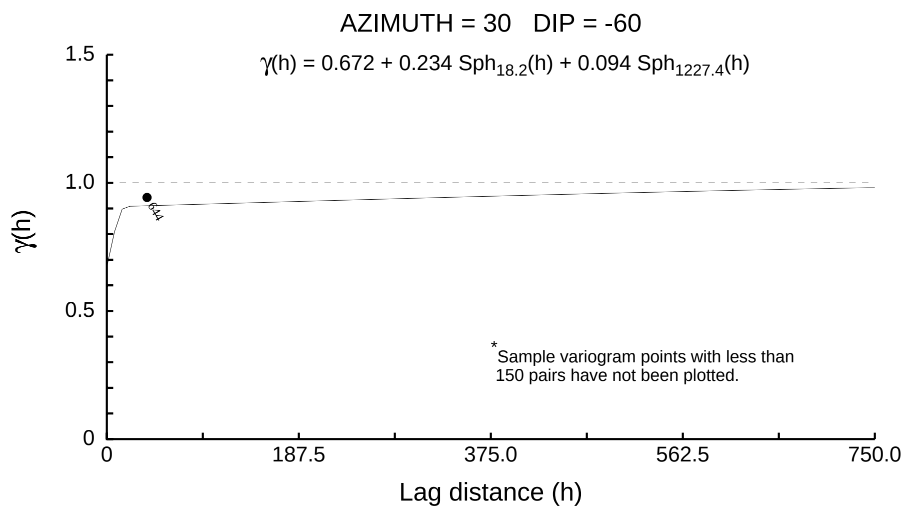
AZIMUTH = 330   DIP = -30

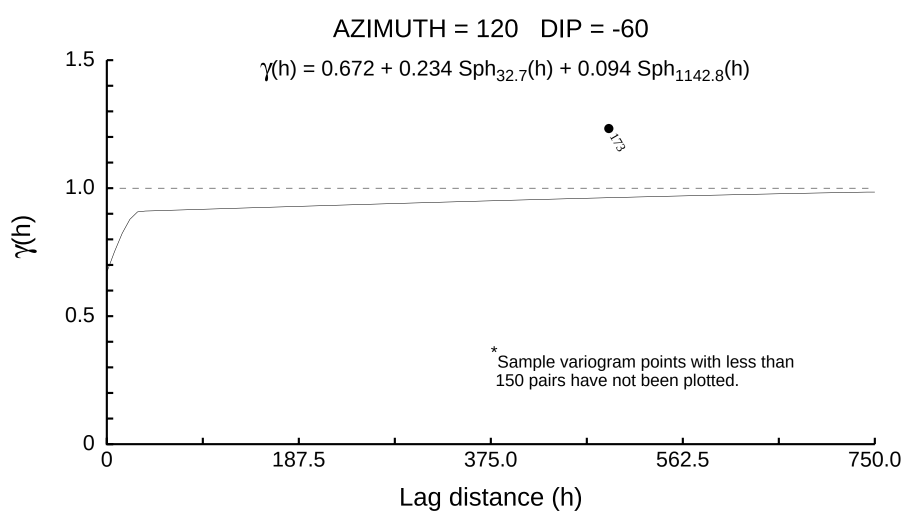


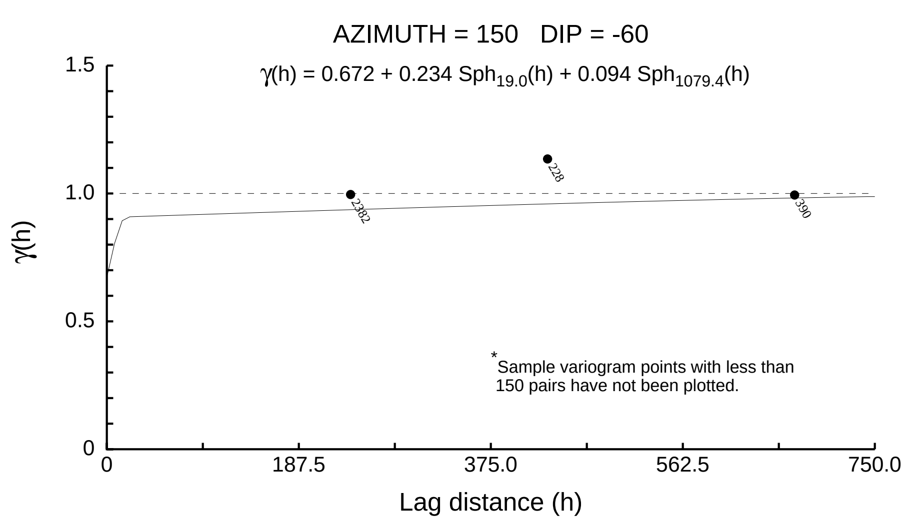
AZIMUTH = 0   DIP = -60



NorthMet U_1_Pt_MDIR







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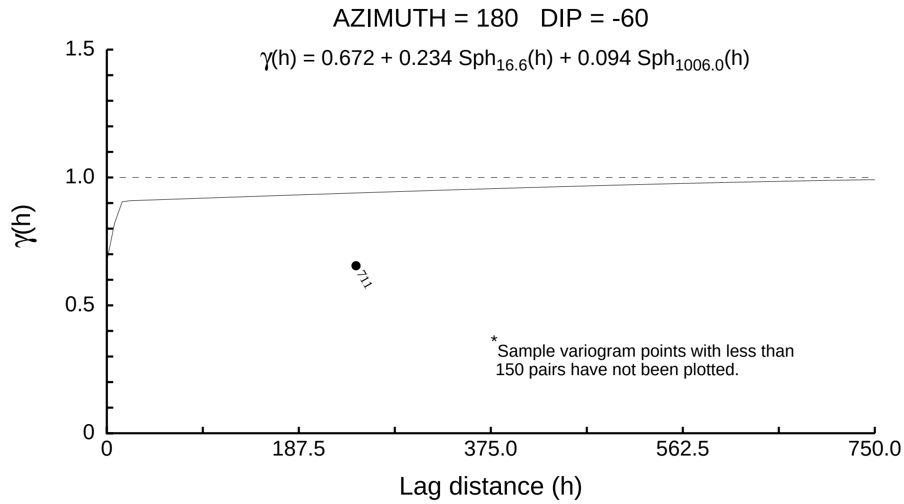
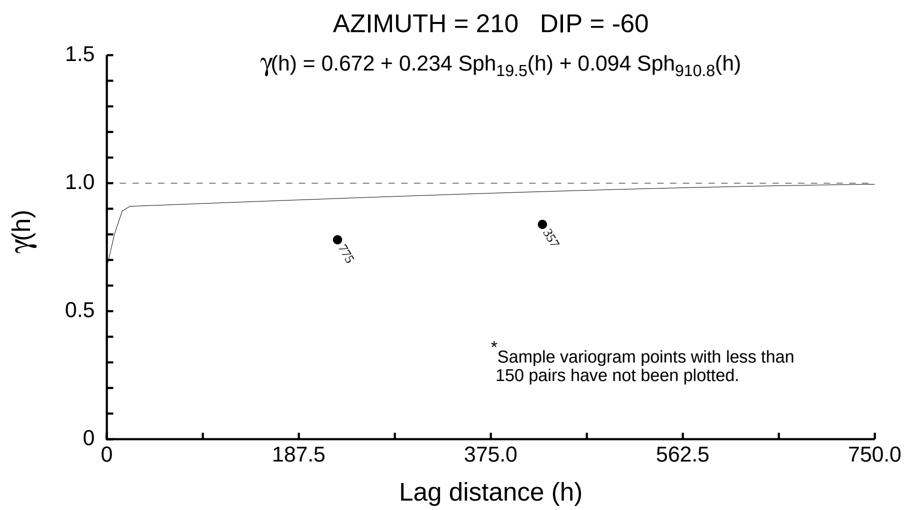
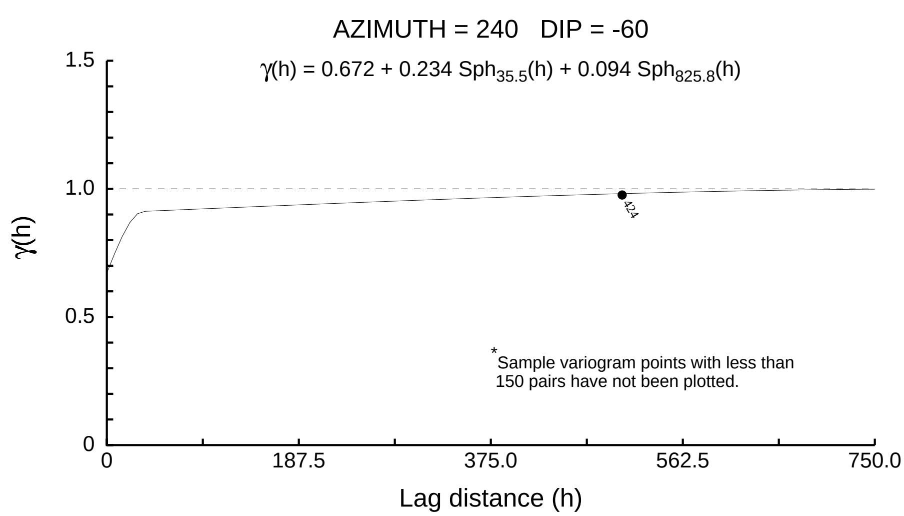
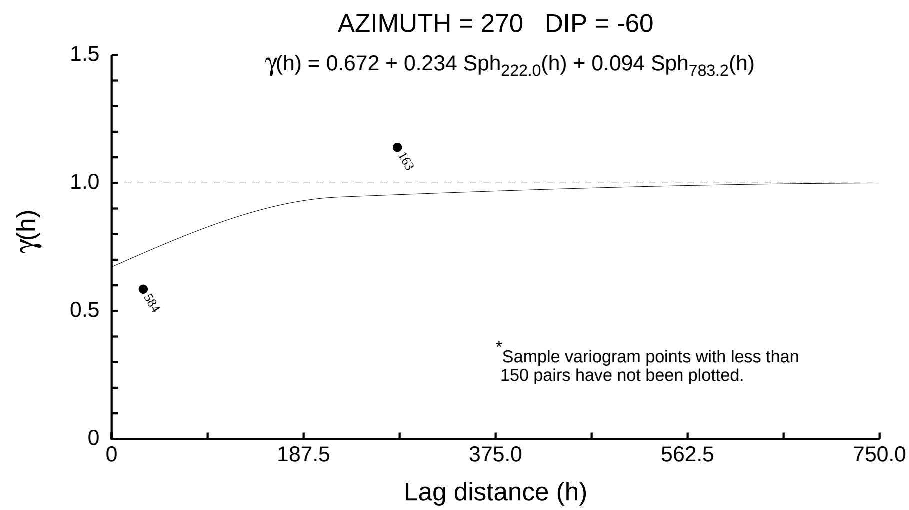
NorthMet U_1_Pt_MDIR

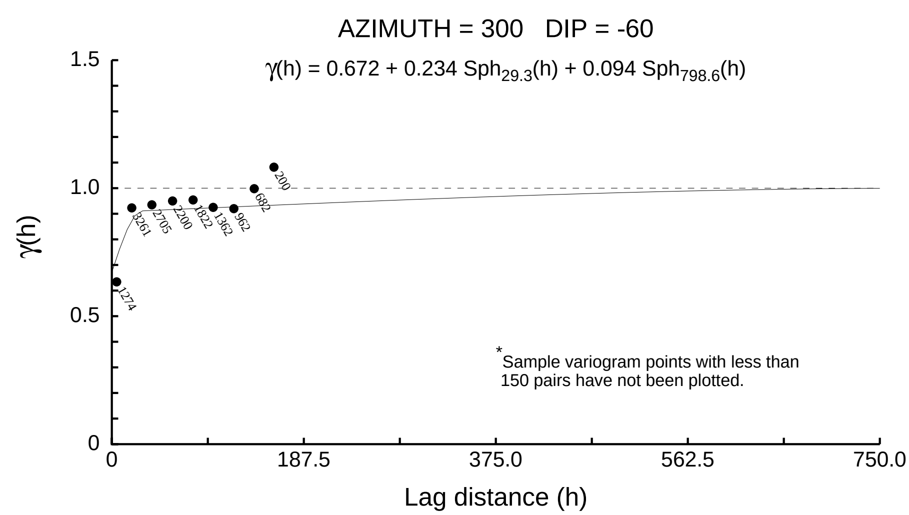


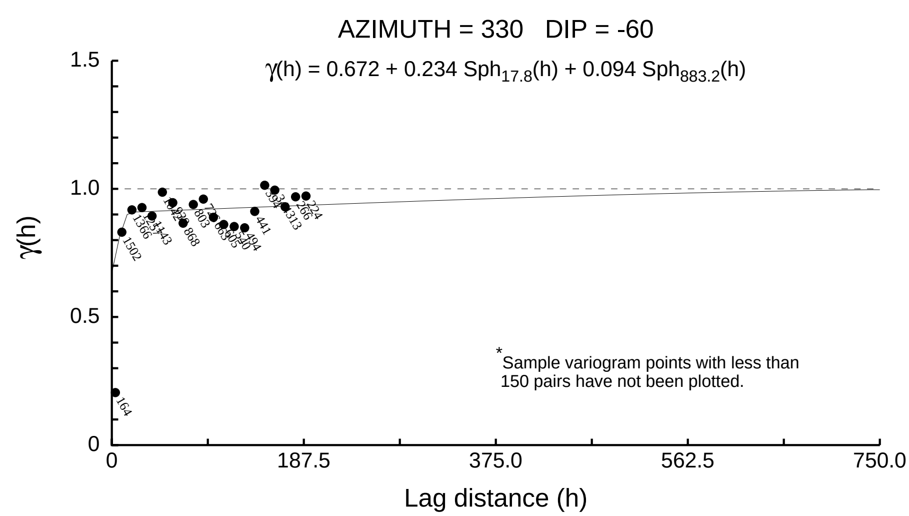




NorthMet U_1_Pt_MDIR







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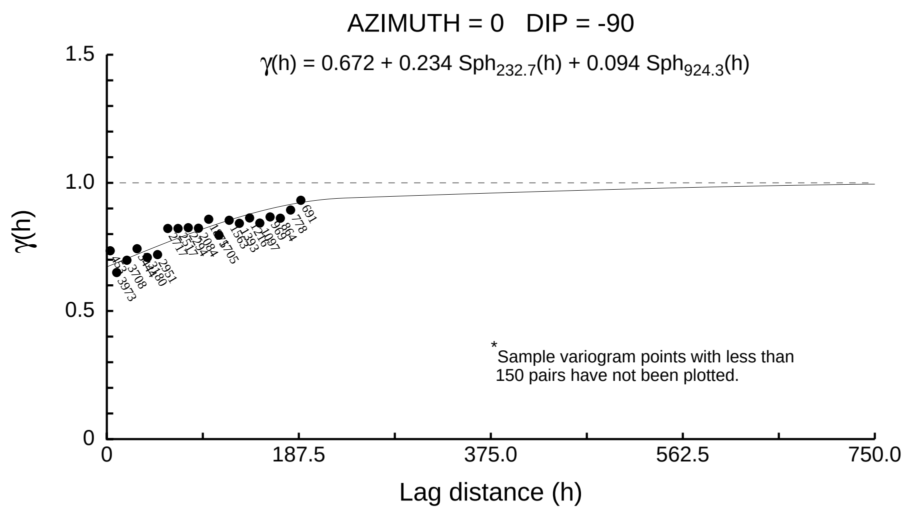
NorthMet U_1_Pt_MDIR



NorthMet U_1_Su_MDIR

User Defined Rotation Conventions

Nugget ==> 0.533
C1 ==> 0.300
C2 ==> 0.167

First Structure -- Spherical

RH Rotation about the Z axis ==> 153
RH Rotation about the Y' axis ==> 70
RH Rotation about the Z' axis ==> -16

Range along the Z' axis	==> 40.9	Azimuth ==> 297	Dip ==> 20
Range along the Y' axis	==> 93.5	Azimuth ==> 213	Dip ==> -15
Range along the X' axis	==> 316.1	Azimuth ==> 336	Dip ==> -65

Second Structure -- Spherical

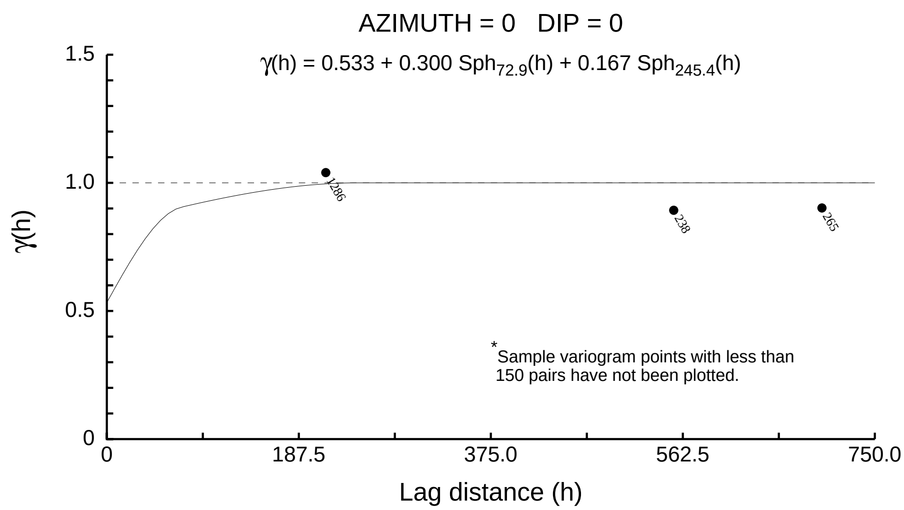
RH Rotation about the Z axis ==> -68
RH Rotation about the Y' axis ==> 39
RH Rotation about the Z' axis ==> 8

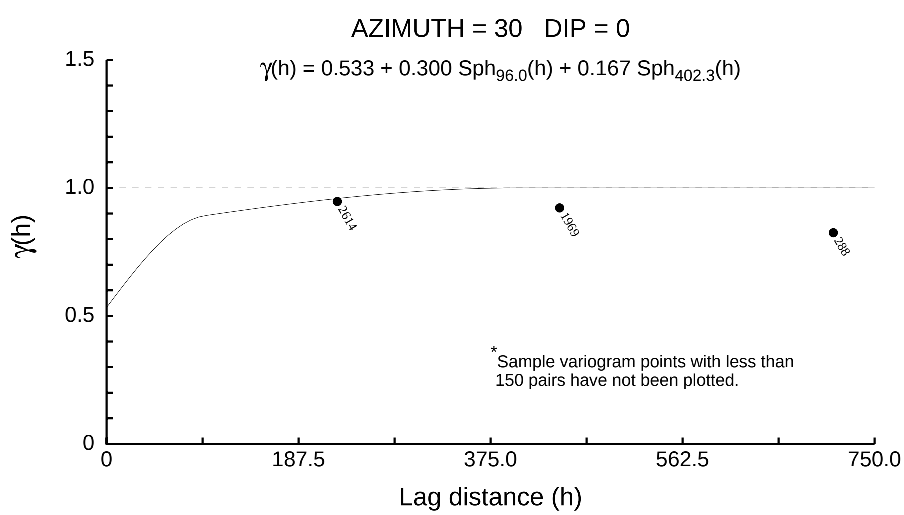
Range along the Z' axis	==> 214.2	Azimuth ==> 158	Dip ==> 51
Range along the Y' axis	==> 2008.7	Azimuth ==> 62	Dip ==> 5
Range along the X' axis	==> 218.4	Azimuth ==> 148	Dip ==> -38

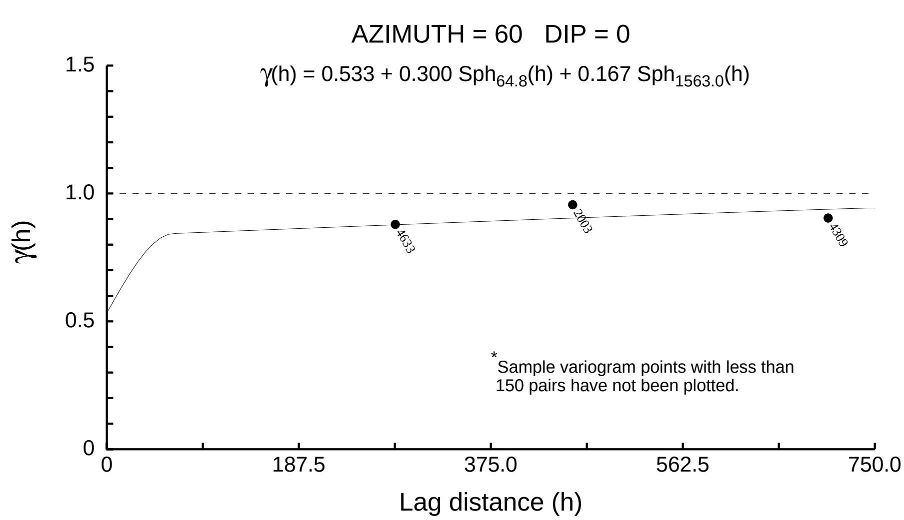
Modeling Criteria

Minimum number pairs req'd ==> 150
Sample variogram points weighted by # pairs

NorthMet U_1_Su_MDIR







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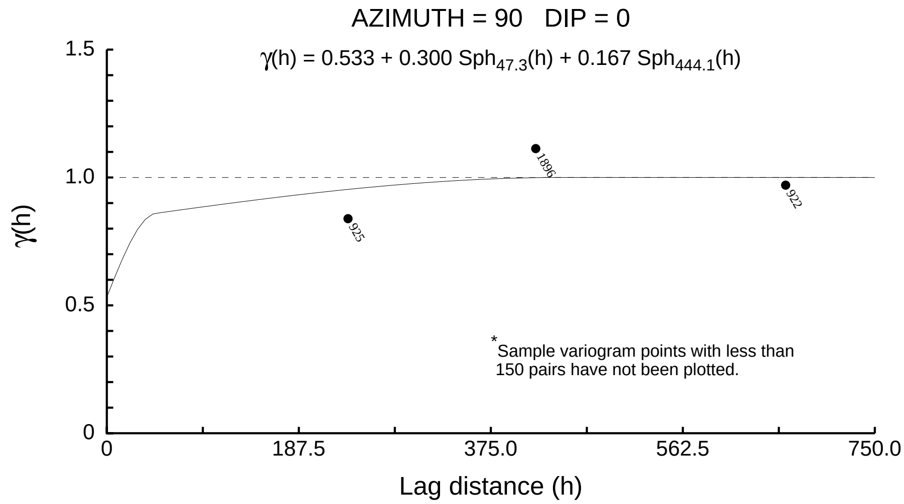
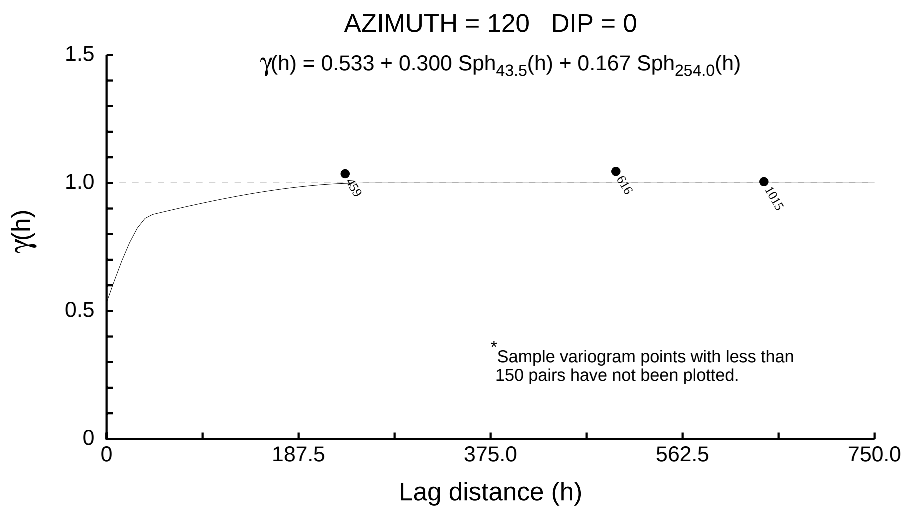
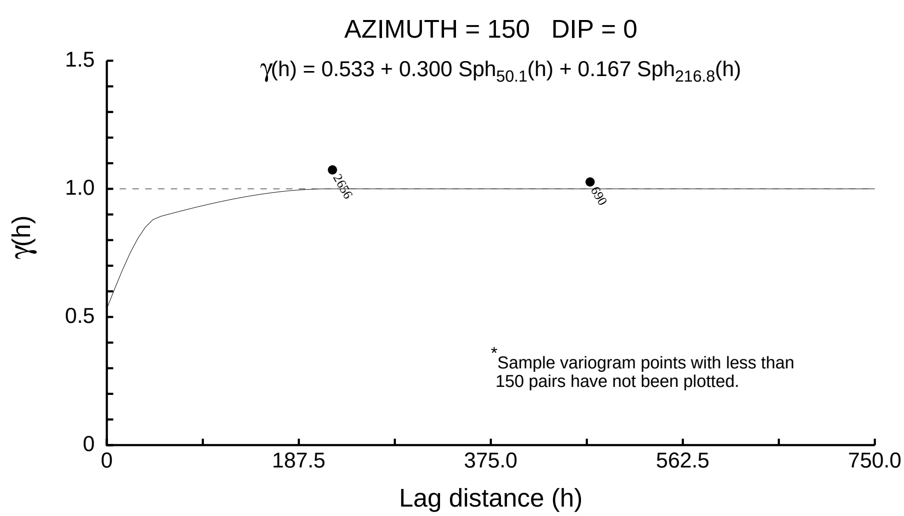
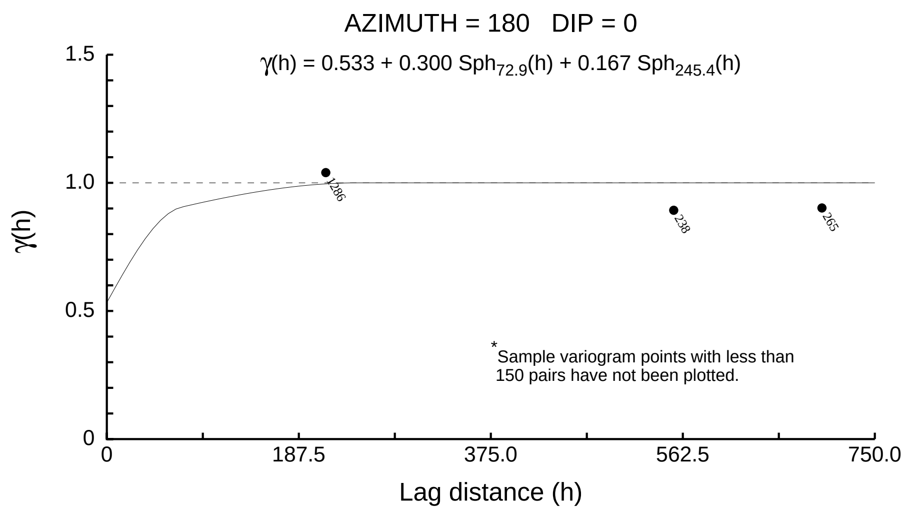
NorthMet U_1_Su_MDIR

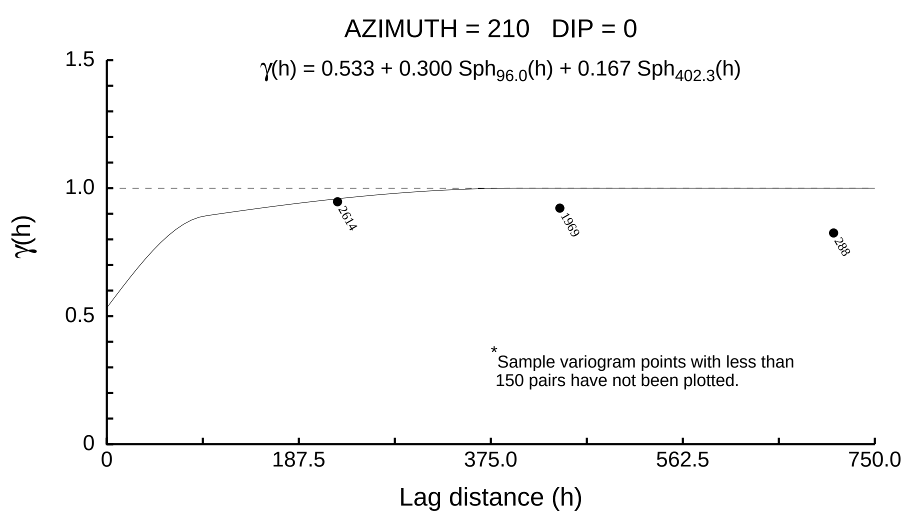


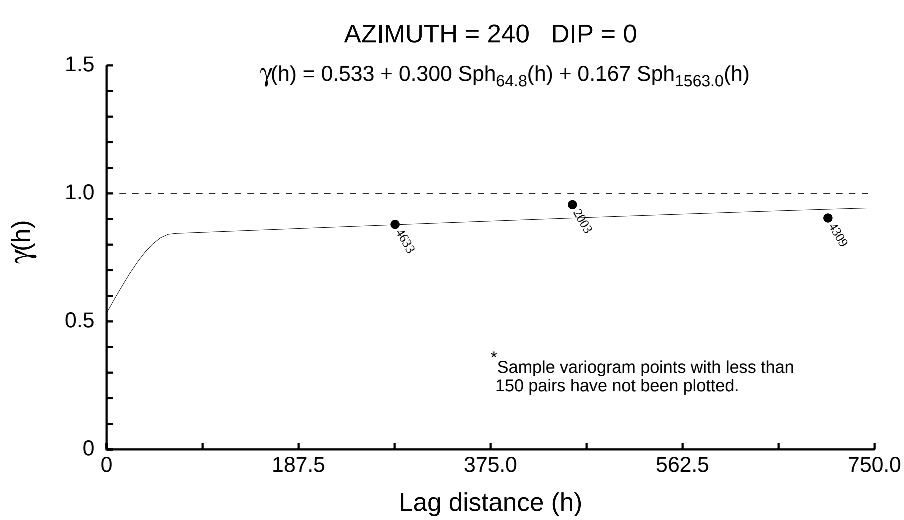




NorthMet U_1_Su_MDIR

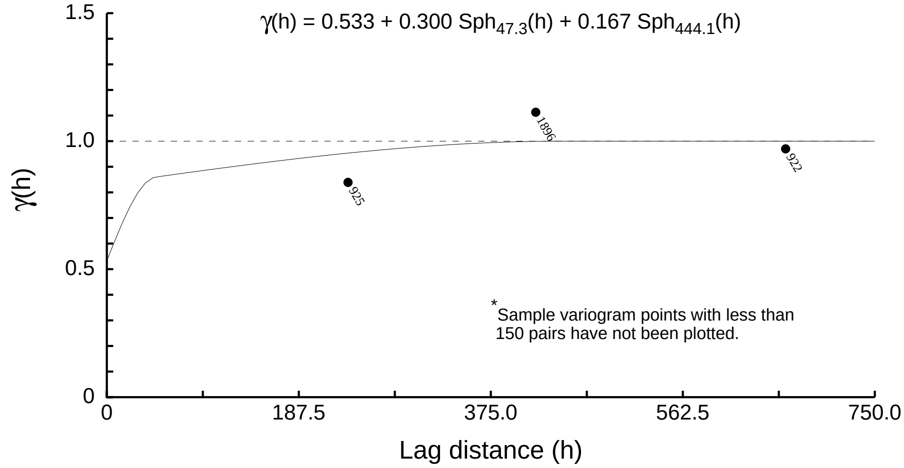




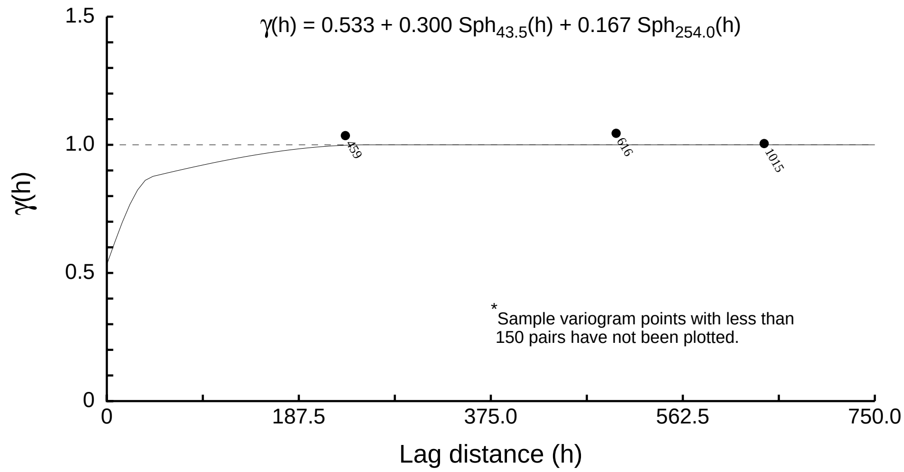


NorthMet U_1_Su_MDIR

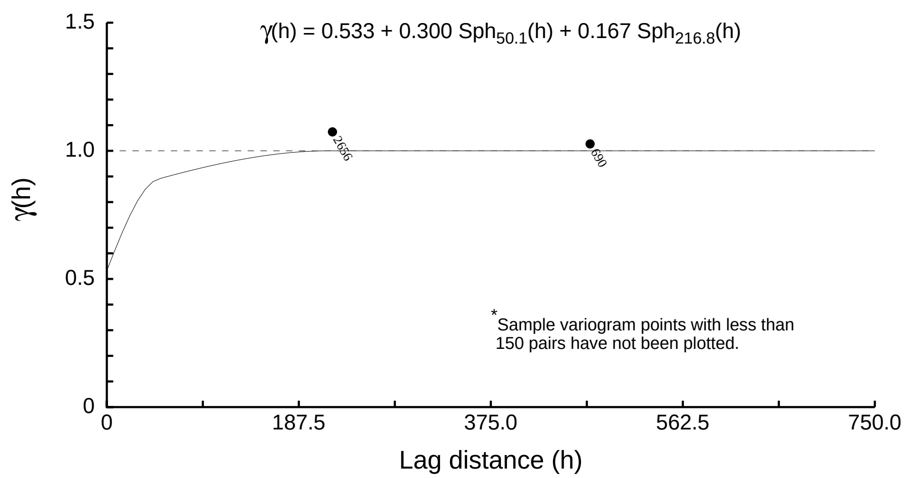
AZIMUTH = 270   DIP = 0



AZIMUTH = 300   DIP = 0



AZIMUTH = 330   DIP = 0



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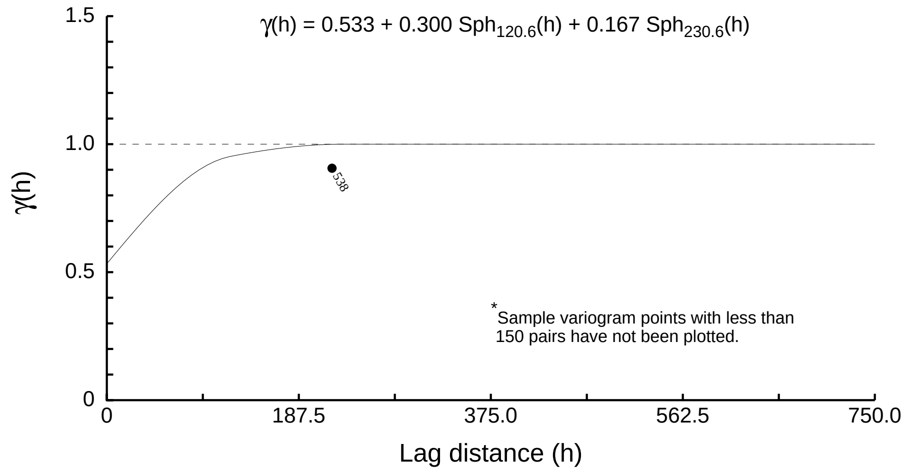
NorthMet U_1_Su_MDIR

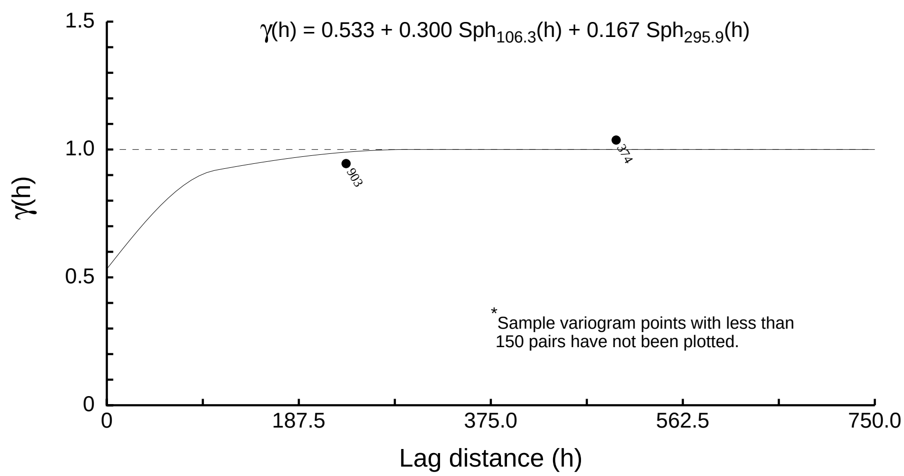
AZIMUTH = 0   DIP = -30

$\gamma(h) = 0.533 + 0.300\ Sph_{120.6}(h) + 0.167\ Sph_{230.6}(h)$



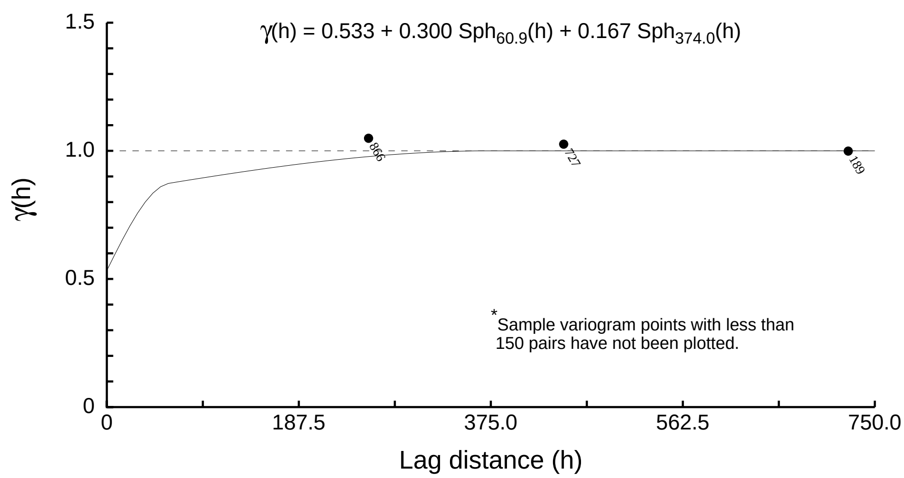
AZIMUTH = 30   DIP = -30

$\gamma(h) = 0.533 + 0.300\ Sph_{106.3}(h) + 0.167\ Sph_{295.9}(h)$



AZIMUTH = 60   DIP = -30

$\gamma(h) = 0.533 + 0.300\ Sph_{60.9}(h) + 0.167\ Sph_{374.0}(h)$



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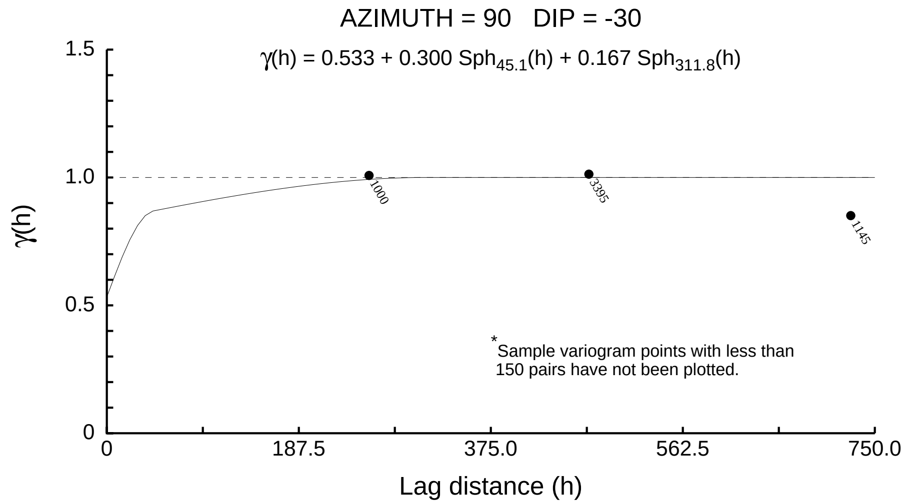
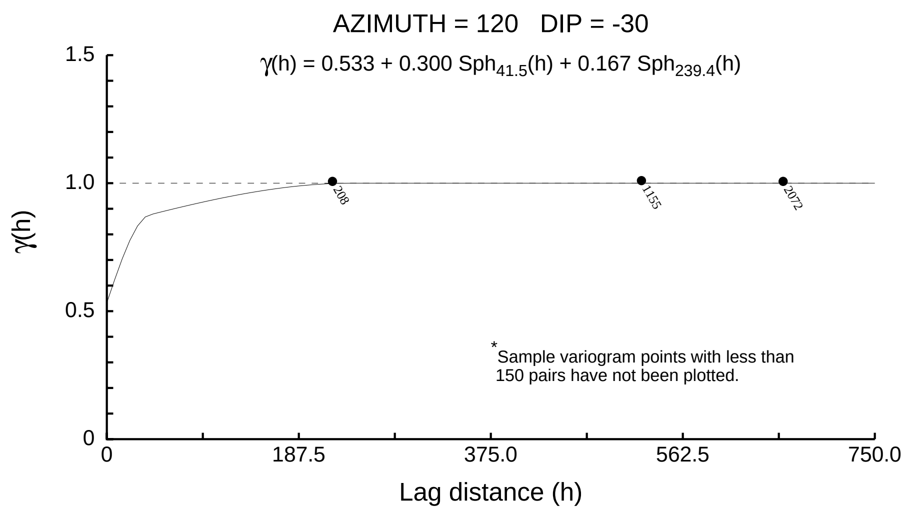
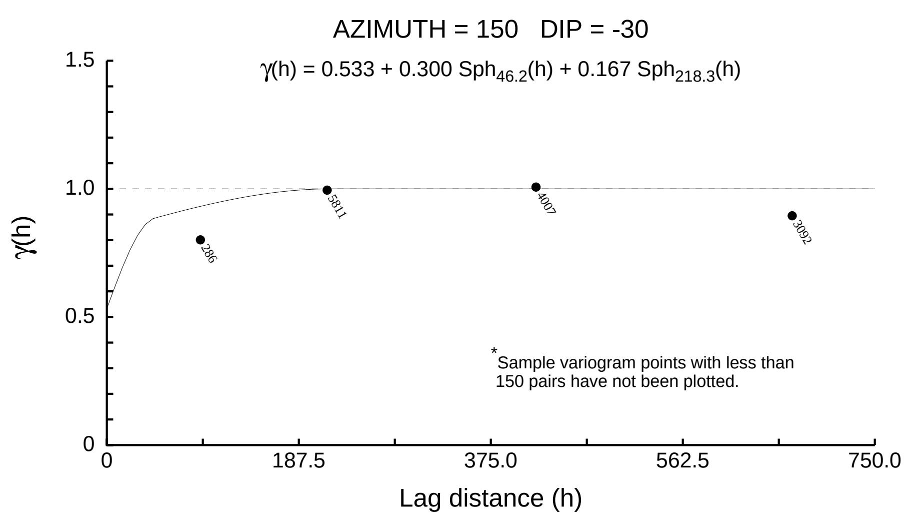
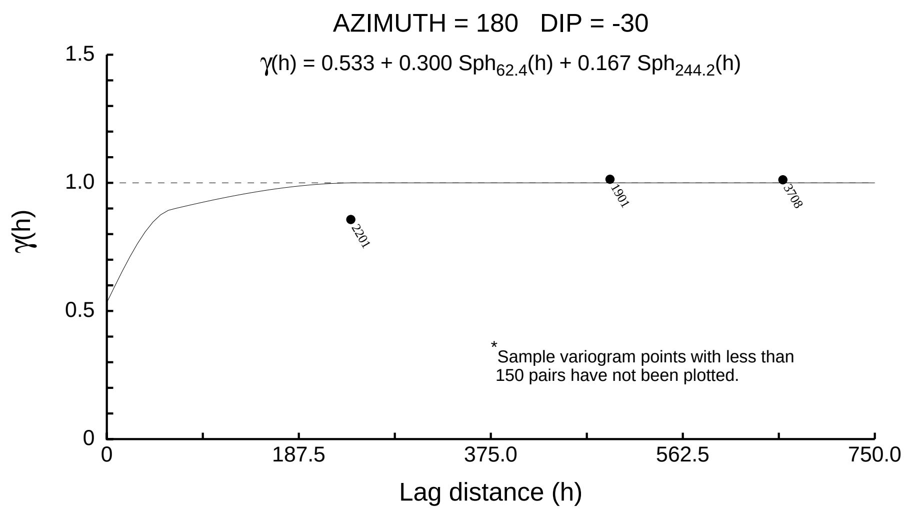
NorthMet U_1_Su_MDIR

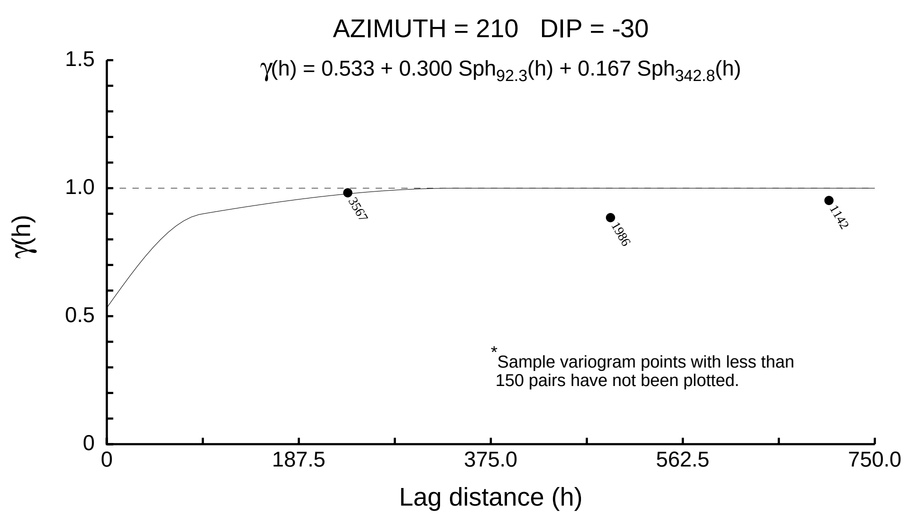


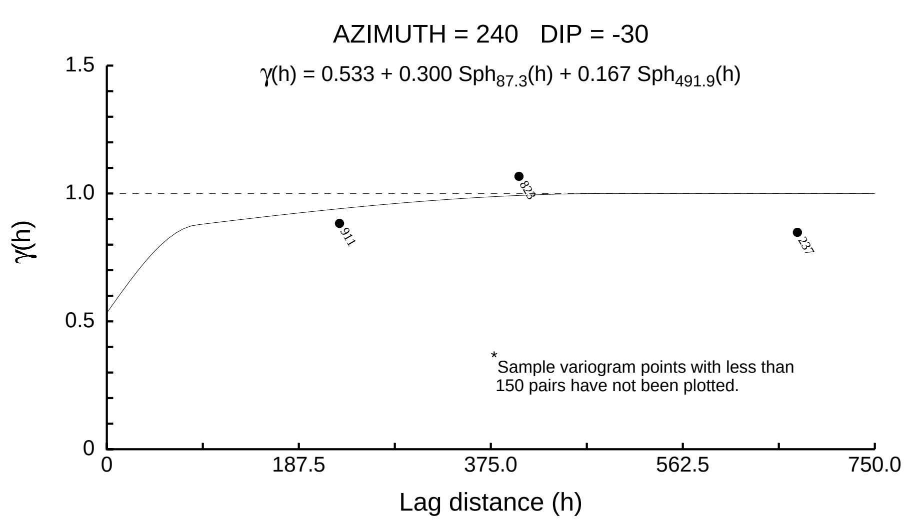




NorthMet U_1_Su_MDIR

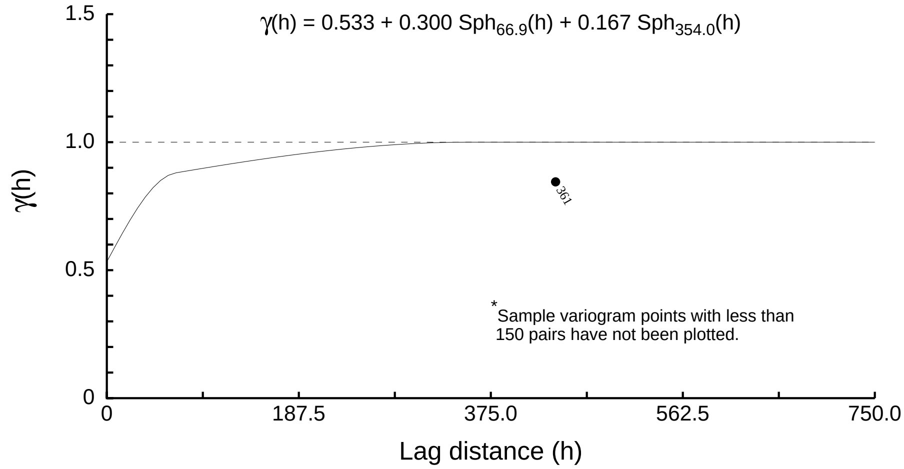




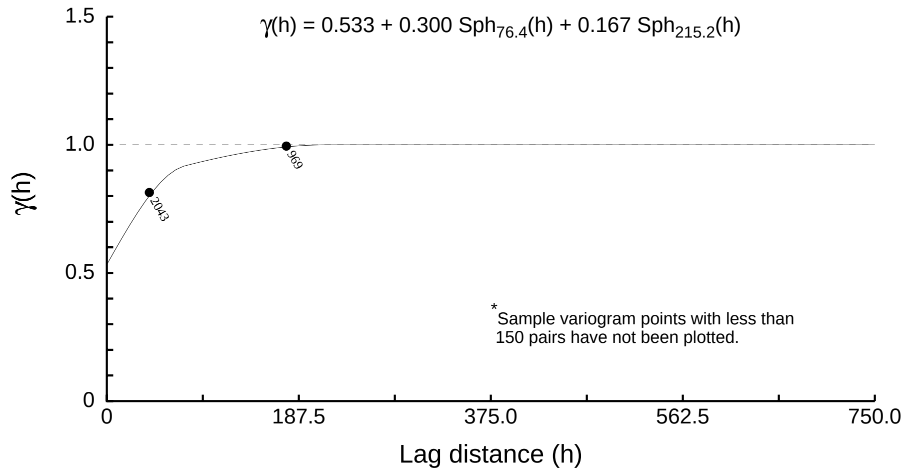


NorthMet U_1_Su_MDIR

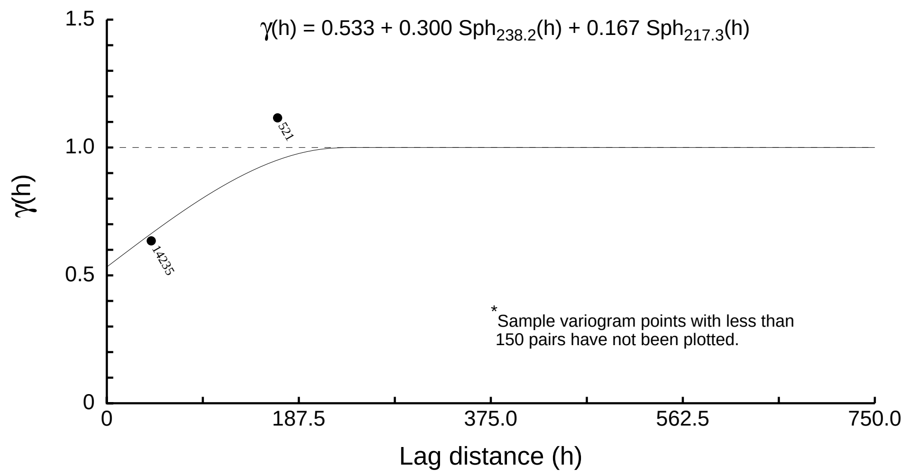
AZIMUTH = 270   DIP = -30



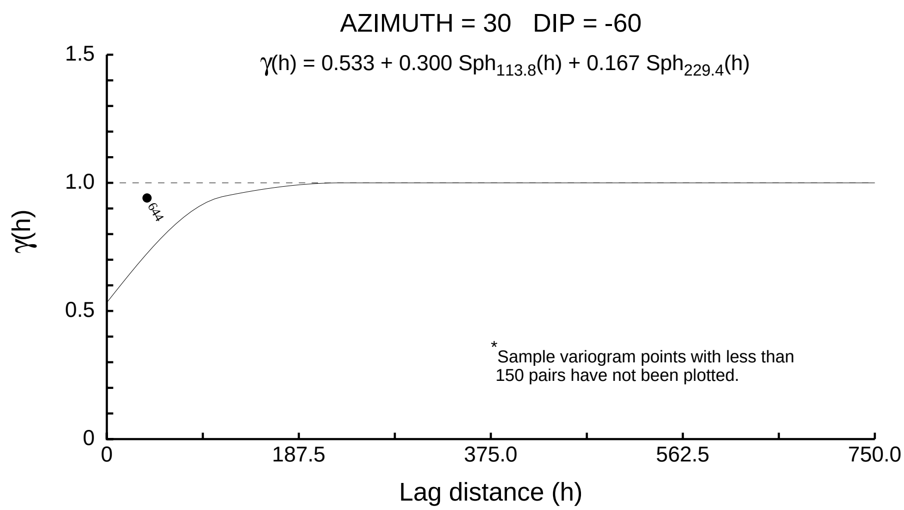
AZIMUTH = 330   DIP = -30

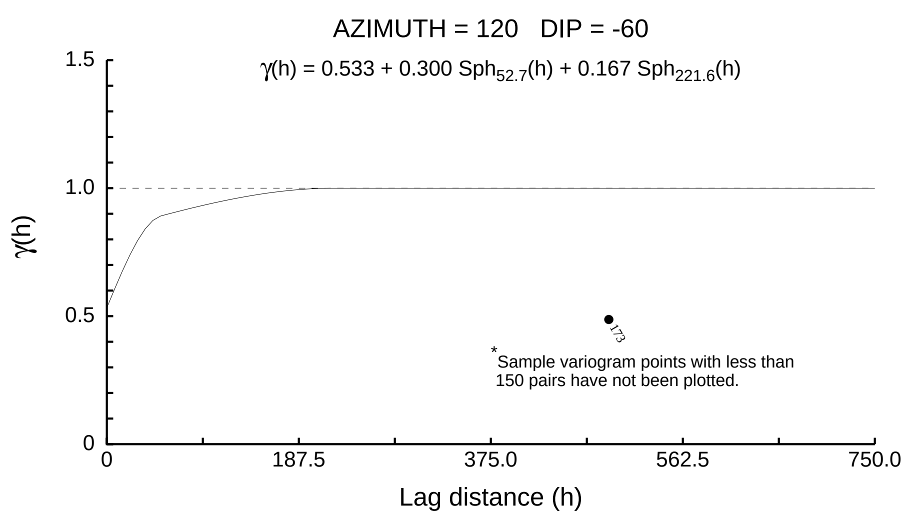


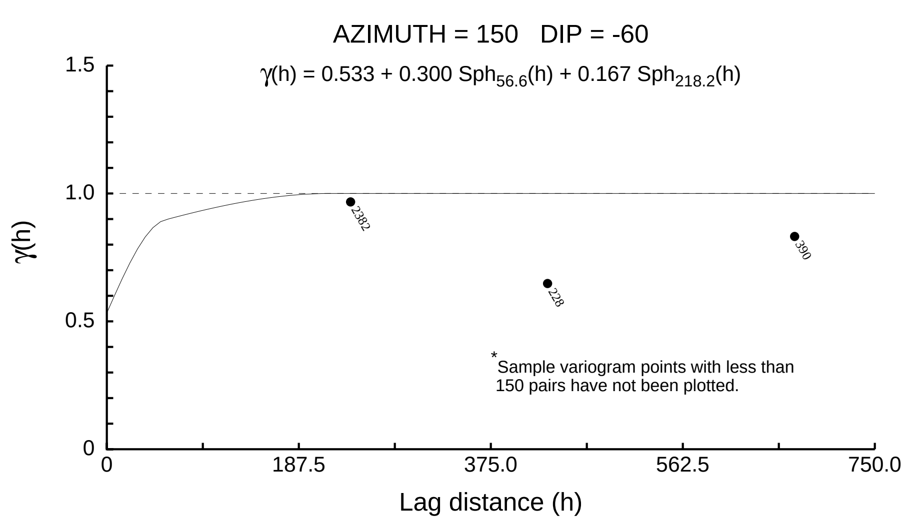
AZIMUTH = 0   DIP = -60



NorthMet U_1_Su_MDIR







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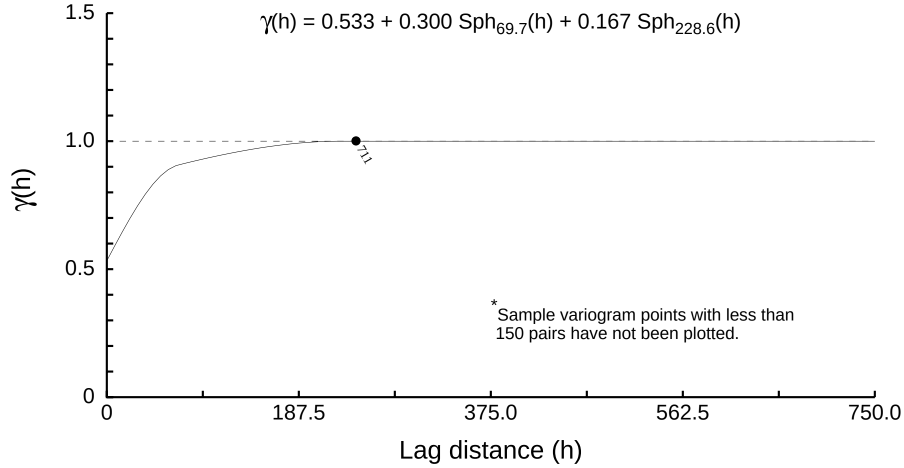
NorthMet U_1_Su_MDIR

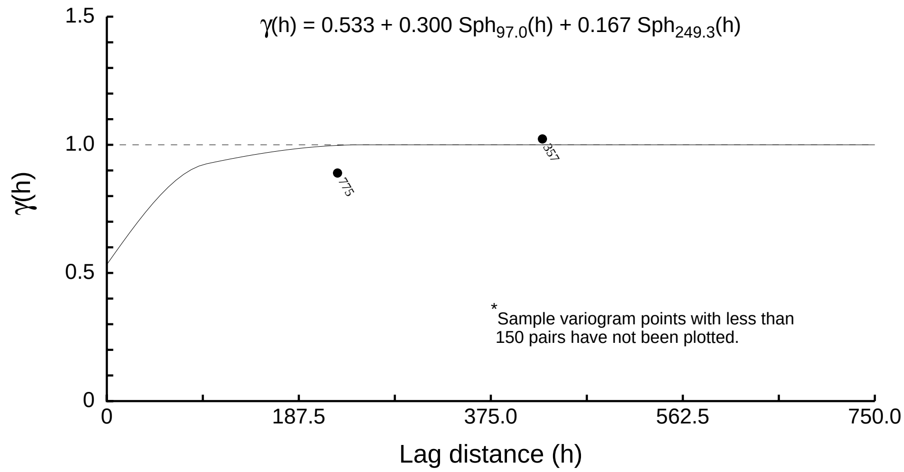
AZIMUTH = 180   DIP = -60

$\gamma(h) = 0.533 + 0.300\ Sph_{69.7}(h) + 0.167\ Sph_{228.6}(h)$



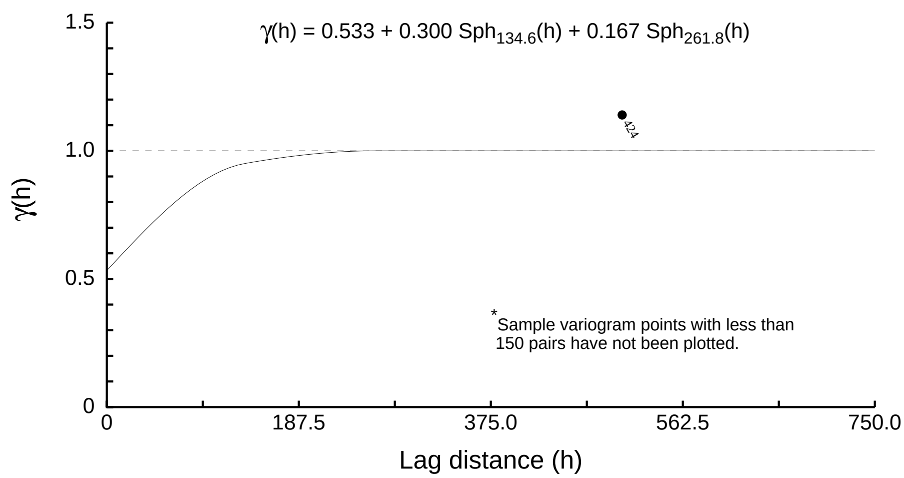
AZIMUTH = 210   DIP = -60

$\gamma(h) = 0.533 + 0.300\ Sph_{97.0}(h) + 0.167\ Sph_{249.3}(h)$

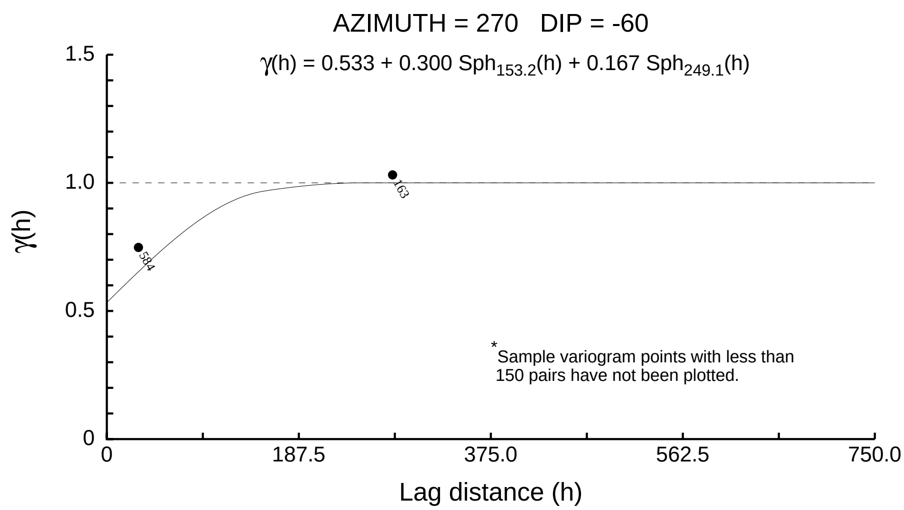


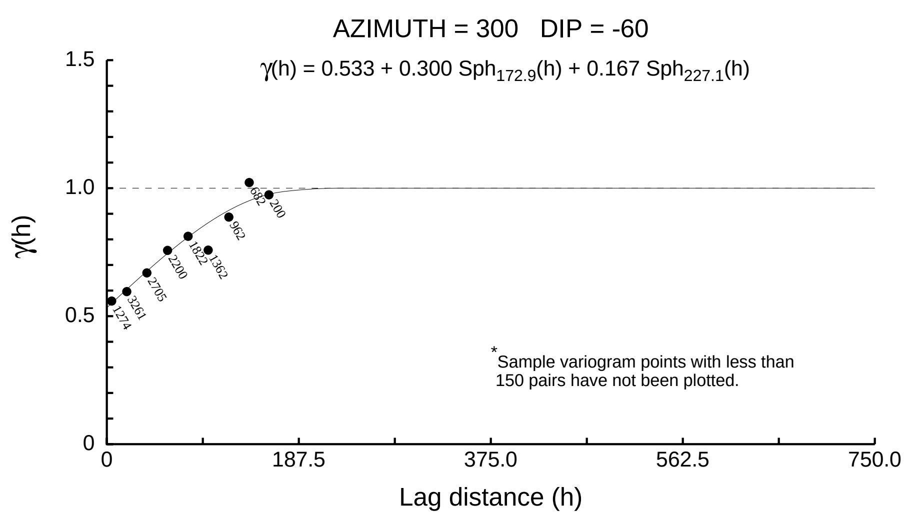
AZIMUTH = 240   DIP = -60

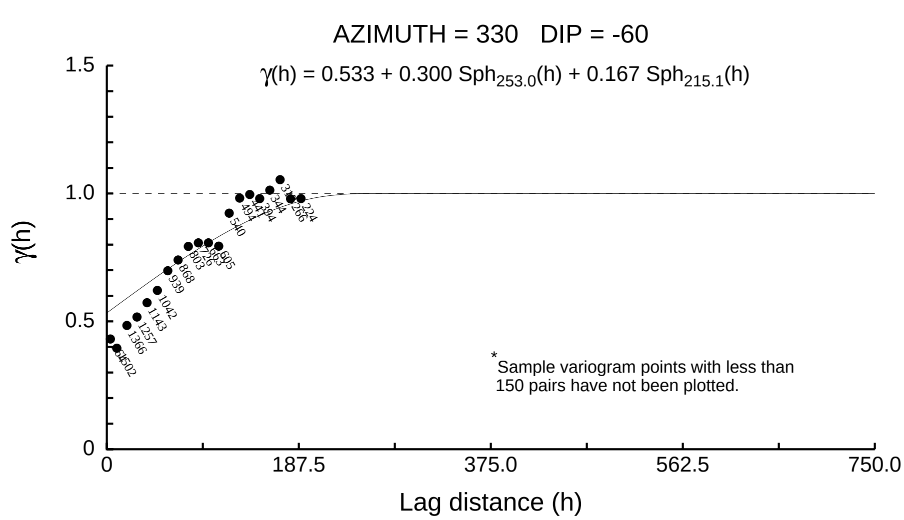
$\gamma(h) = 0.533 + 0.300\ Sph_{134.6}(h) + 0.167\ Sph_{261.8}(h)$



NorthMet U_1_Su_MDIR







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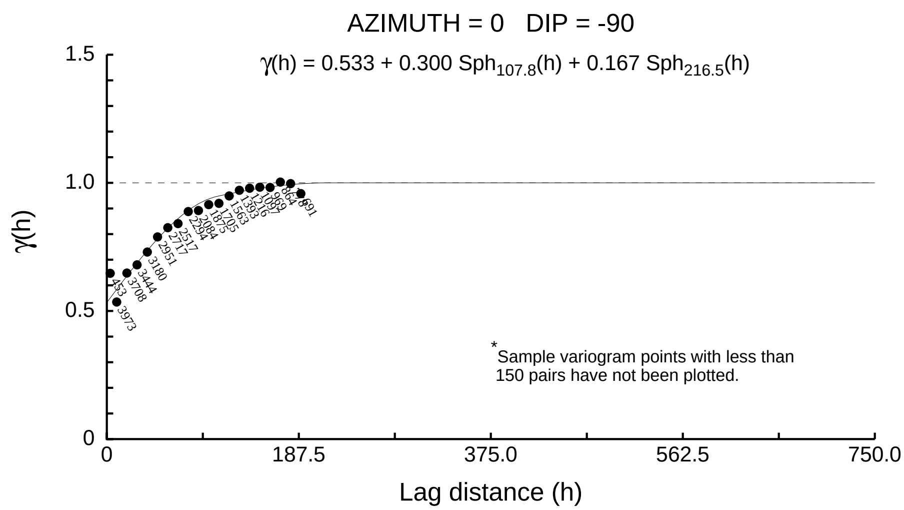
NorthMet U_1_Su_MDIR



NorthMet U_20_Au_MDIR

User Defined Rotation Conventions

Nugget ==> 0.368
C1 ==> 0.435
C2 ==> 0.197

First Structure -- Spherical

RH Rotation about the Z axis ==> -41
RH Rotation about the Y’ axis ==> 90
RH Rotation about the Z’ axis ==> 26

Range along the Z’ axis ==> 6.2	Azimuth ==> 131	Dip ==> -0
Range along the Y’ axis ==> 85.5	Azimuth ==> 41	Dip ==> 26
Range along the X’ axis ==> 66.6	Azimuth ==> 40	Dip ==> -64

Second Structure -- Spherical

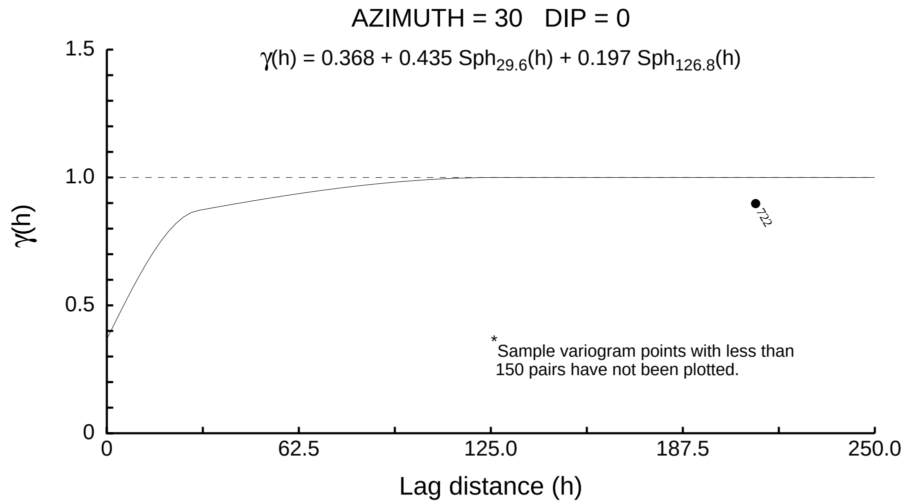
RH Rotation about the Z axis ==> -22
RH Rotation about the Y’ axis ==> -12
RH Rotation about the Z’ axis ==> 62

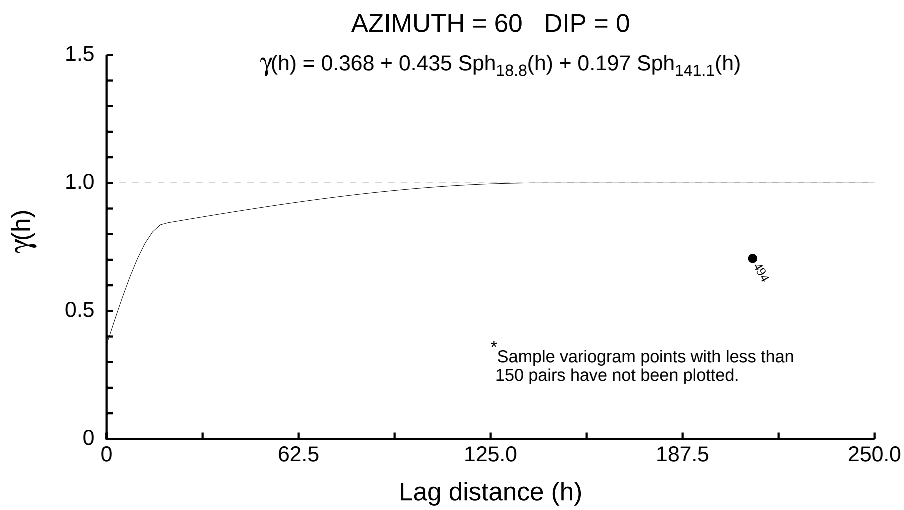
Range along the Z’ axis ==> 546.8	Azimuth ==> 292	Dip ==> 78
Range along the Y’ axis ==> 79.1	Azimuth ==> 321	Dip ==> -11
Range along the X’ axis ==> 143.8	Azimuth ==> 50	Dip ==> 6

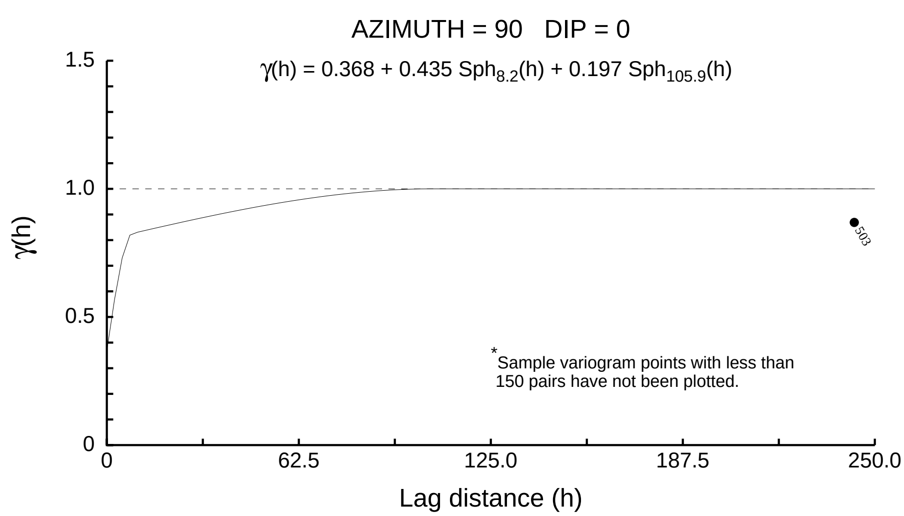
Modeling Criteria

Minimum number pairs req’d ==> 150
Sample variogram points weighted by # pairs

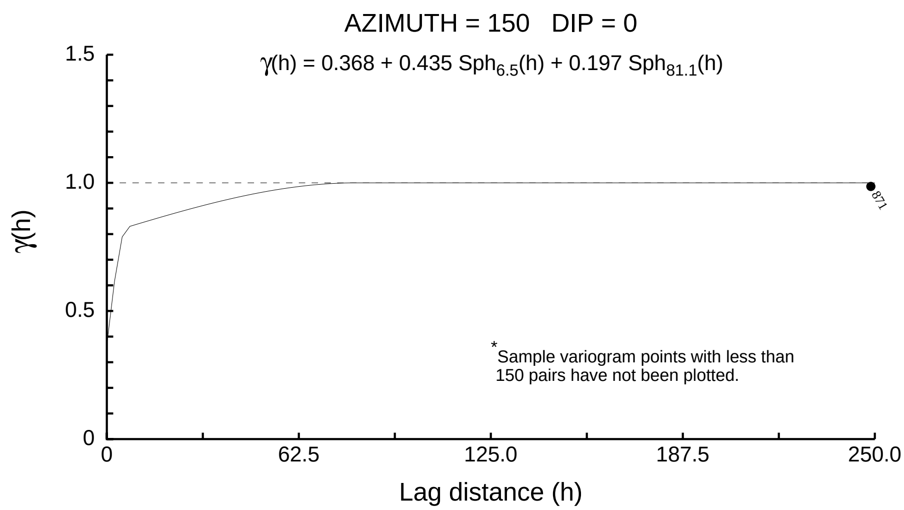
NorthMet U_20_Au_MDIR

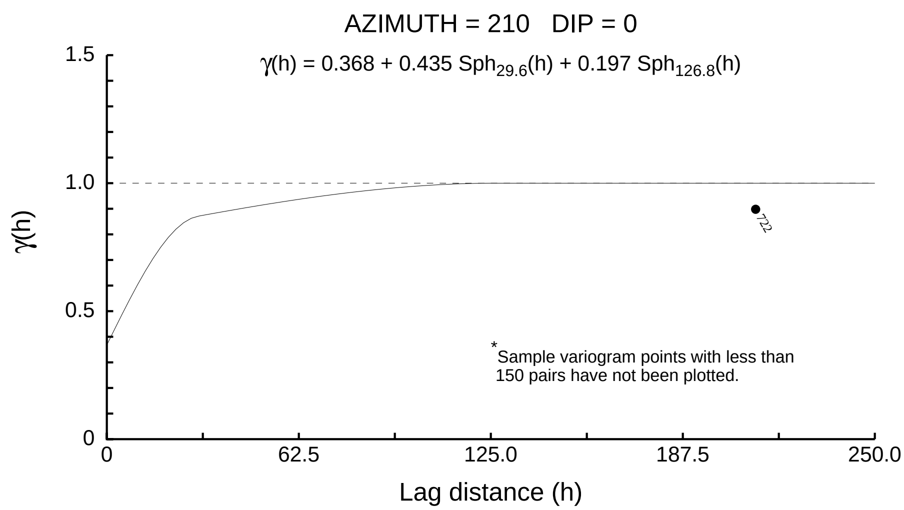


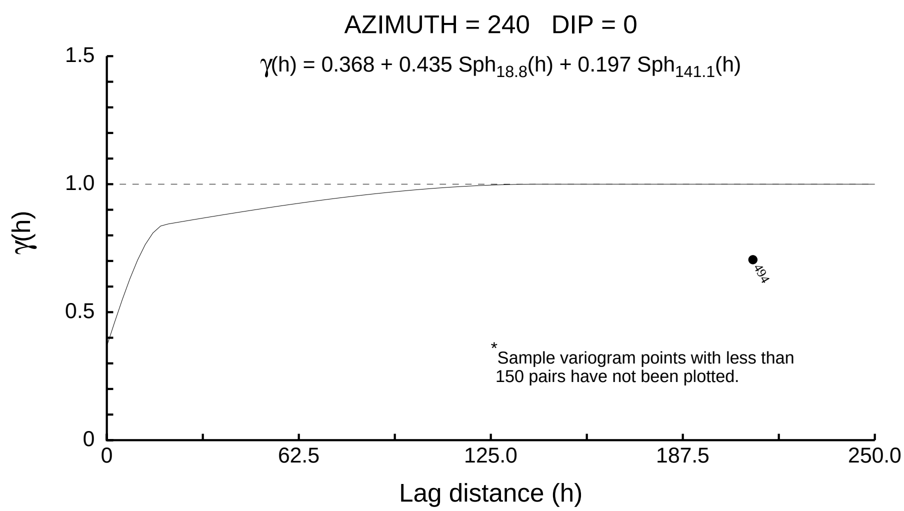




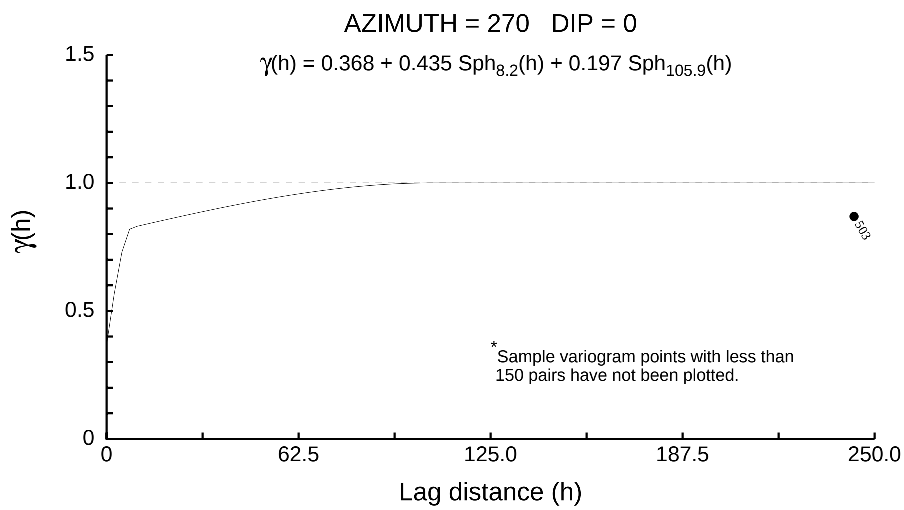
NorthMet U_20_Au_MDIR

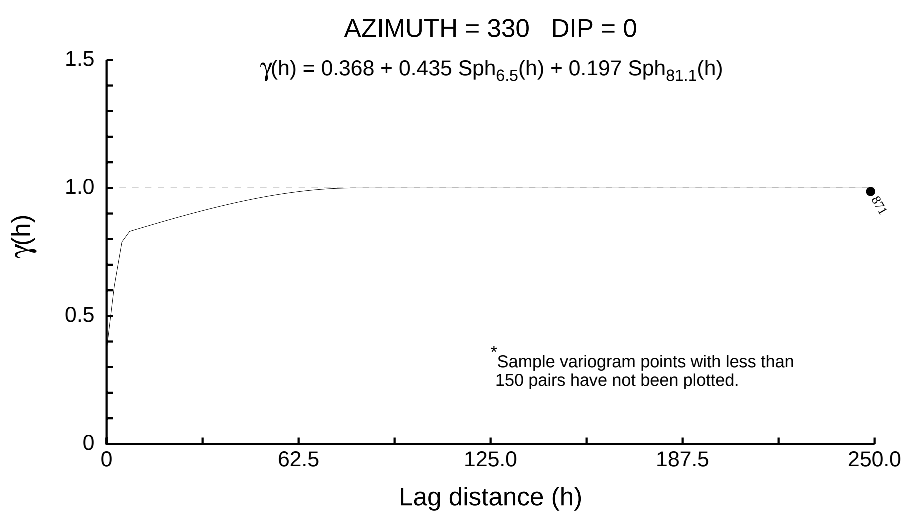


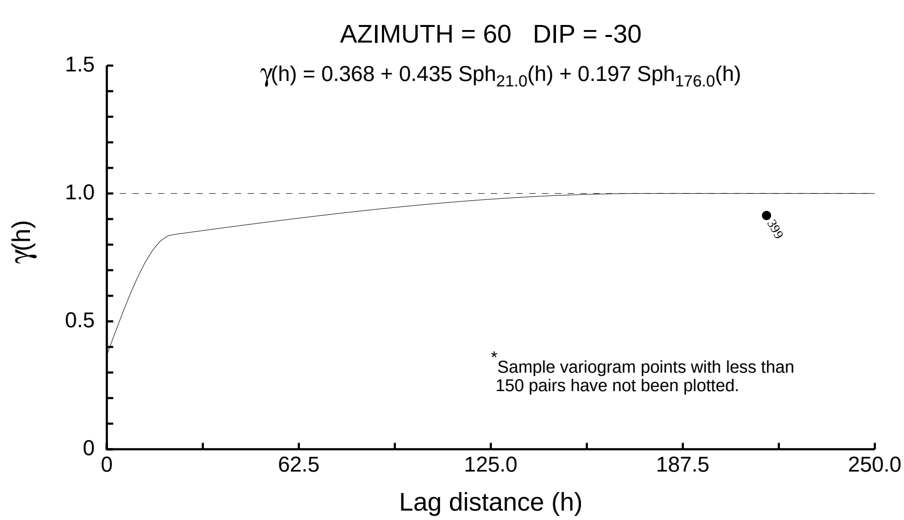




NorthMet U_20_Au_MDIR







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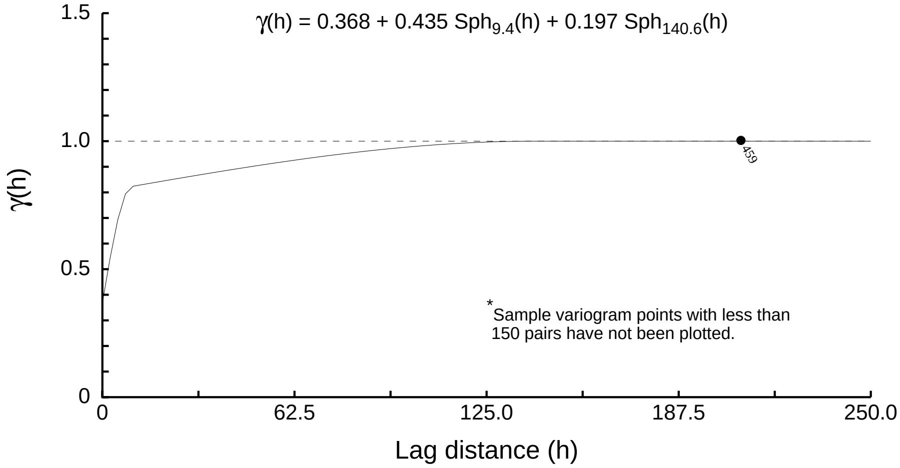
NorthMet U_20_Au_MDIR

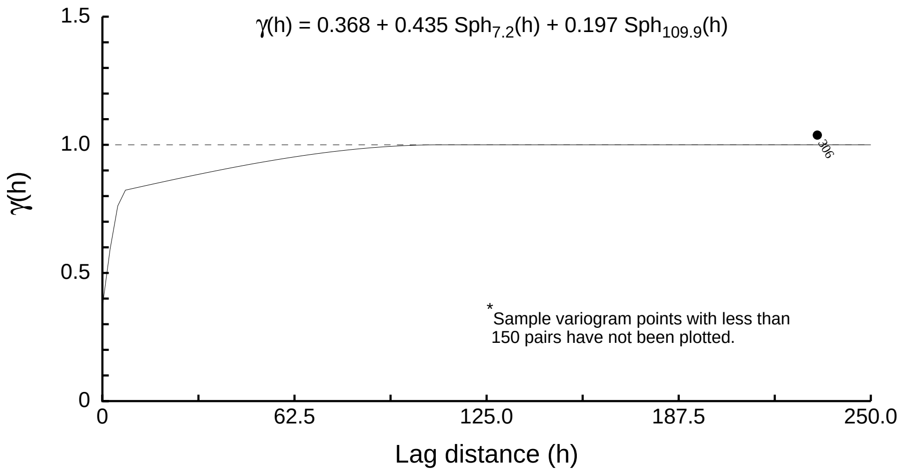
AZIMUTH = 90   DIP = -30

$\gamma(h) = 0.368 + 0.435\ Sph_{9.4}(h) + 0.197\ Sph_{140.6}(h)$



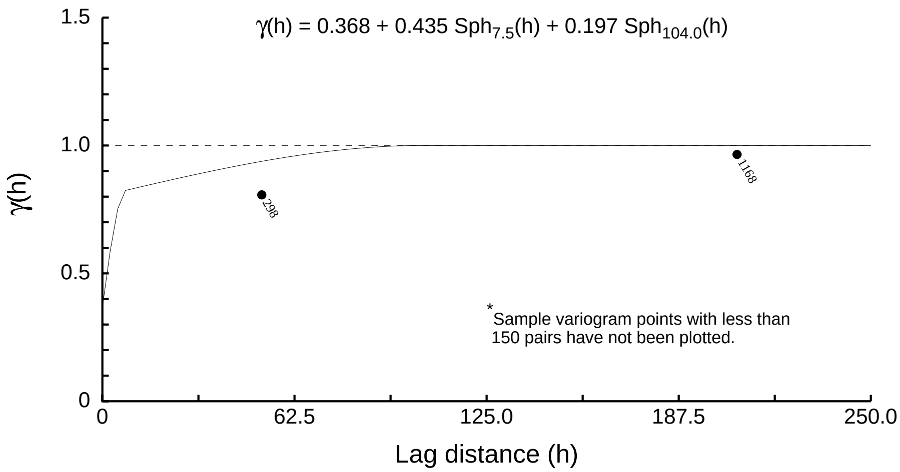
AZIMUTH = 120   DIP = -30

$\gamma(h) = 0.368 + 0.435\ Sph_{7.2}(h) + 0.197\ Sph_{109.9}(h)$



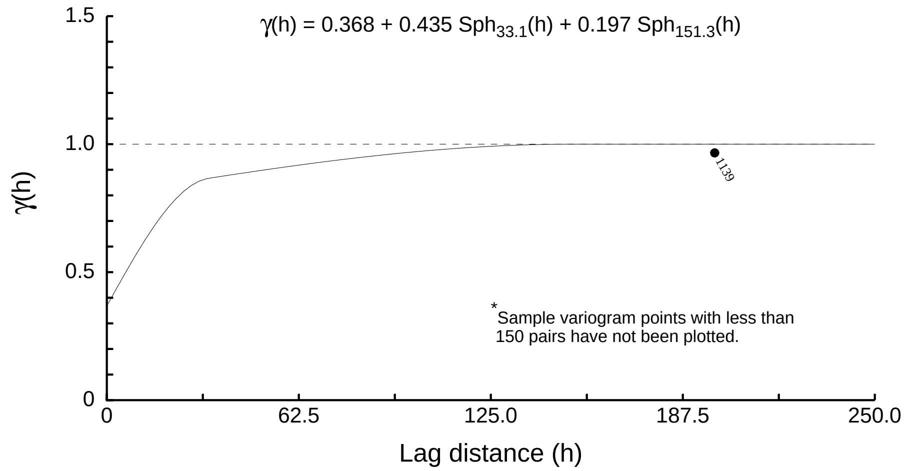
AZIMUTH = 150   DIP = -30

$\gamma(h) = 0.368 + 0.435\ Sph_{7.5}(h) + 0.197\ Sph_{104.0}(h)$

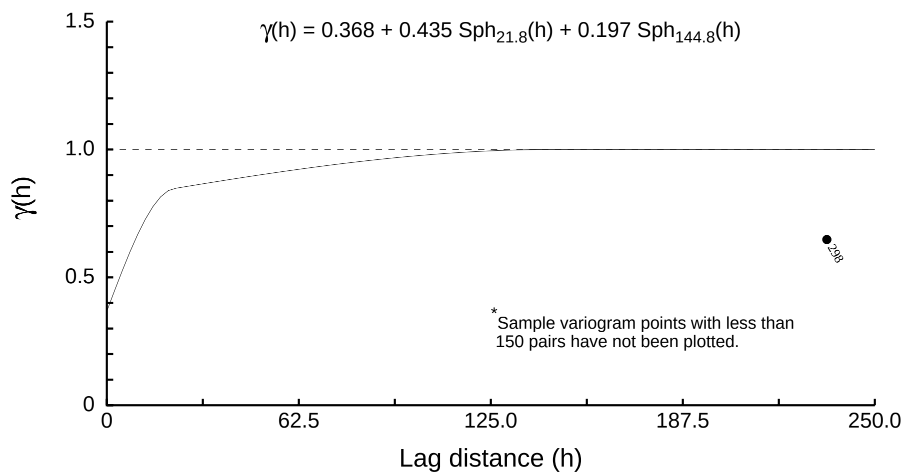


NorthMet U_20_Au_MDIR

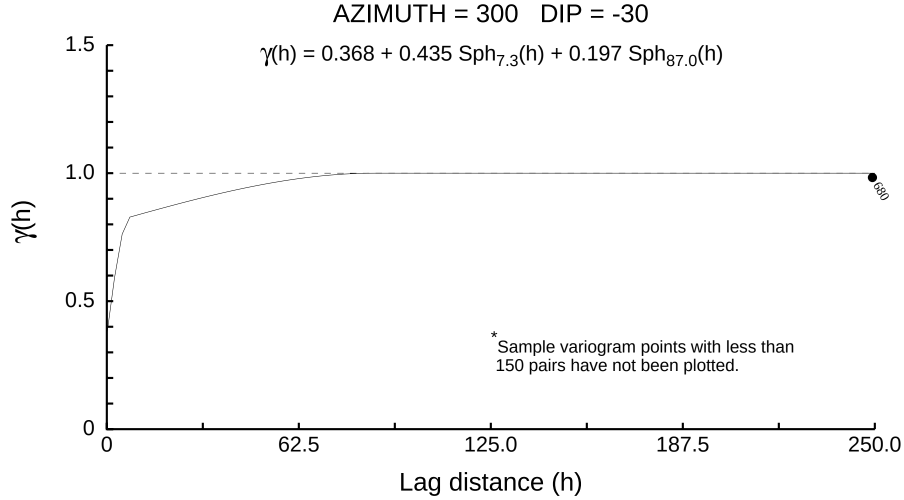
AZIMUTH = 210   DIP = -30



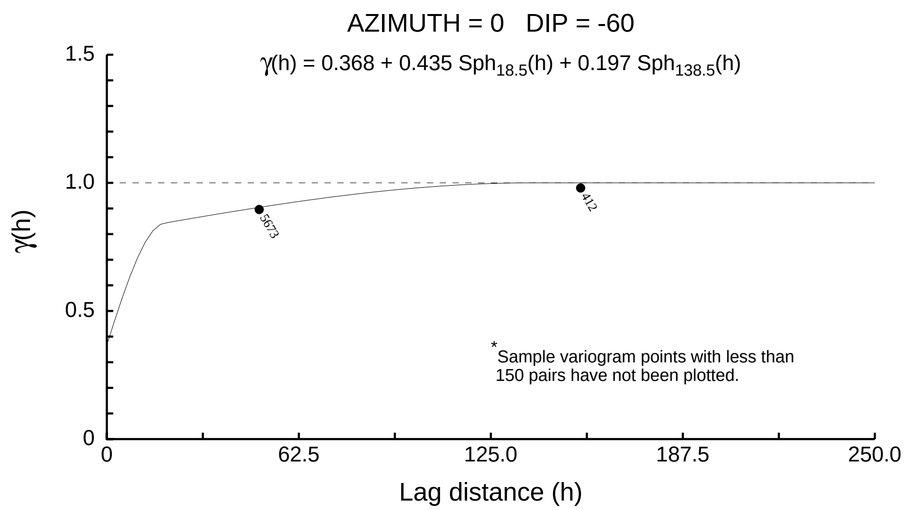
AZIMUTH = 240   DIP = -30

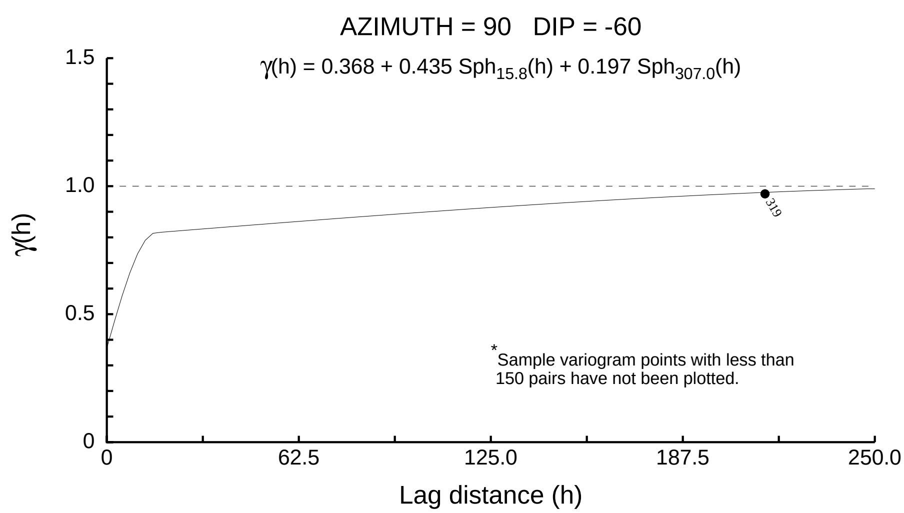


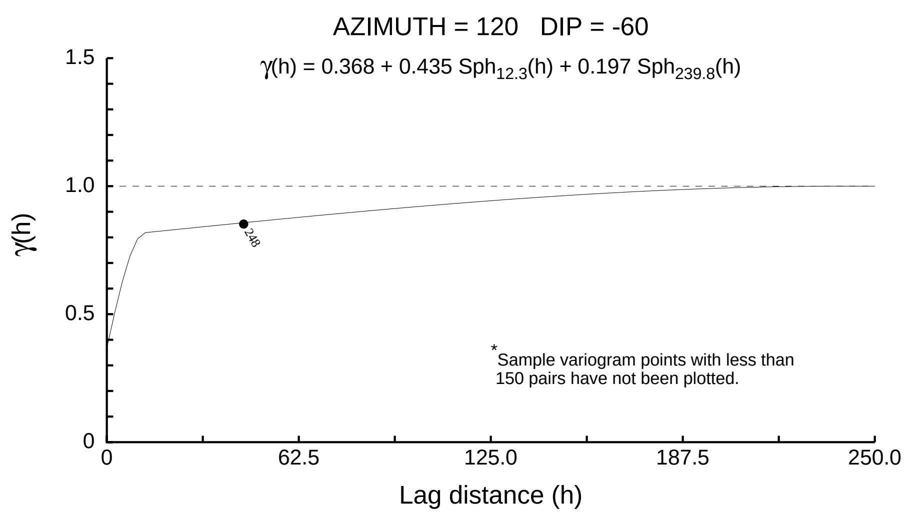
AZIMUTH = 300   DIP = -30



NorthMet U_20_Au_MDIR







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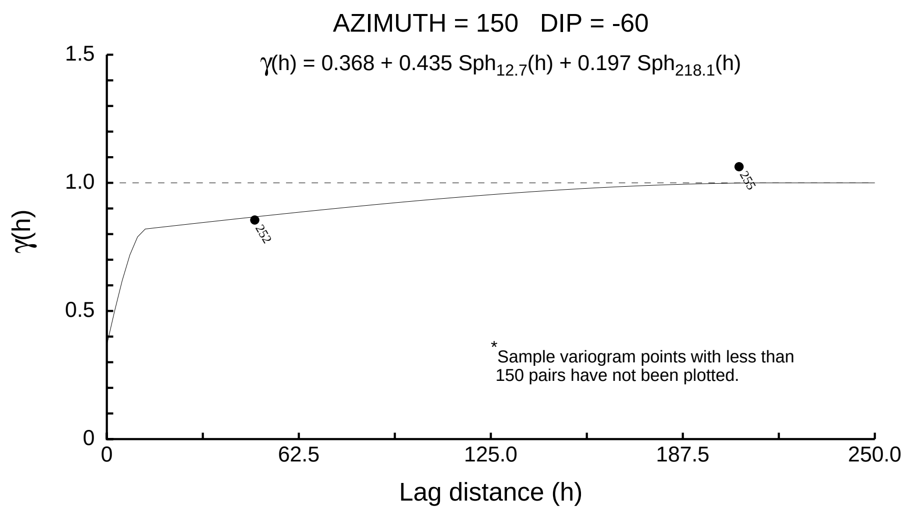

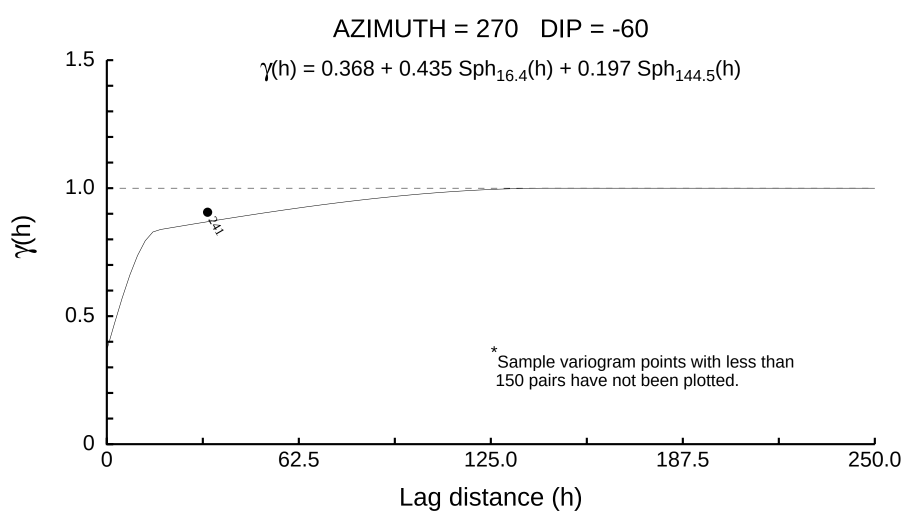

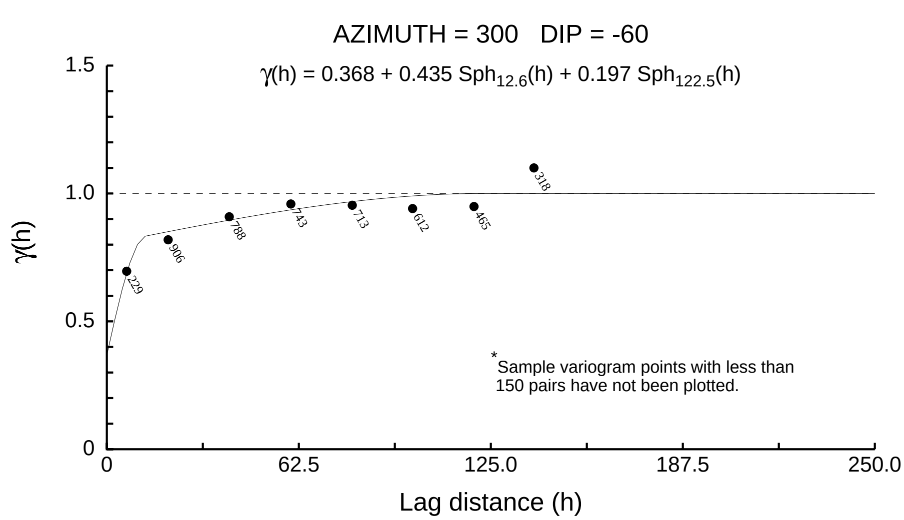

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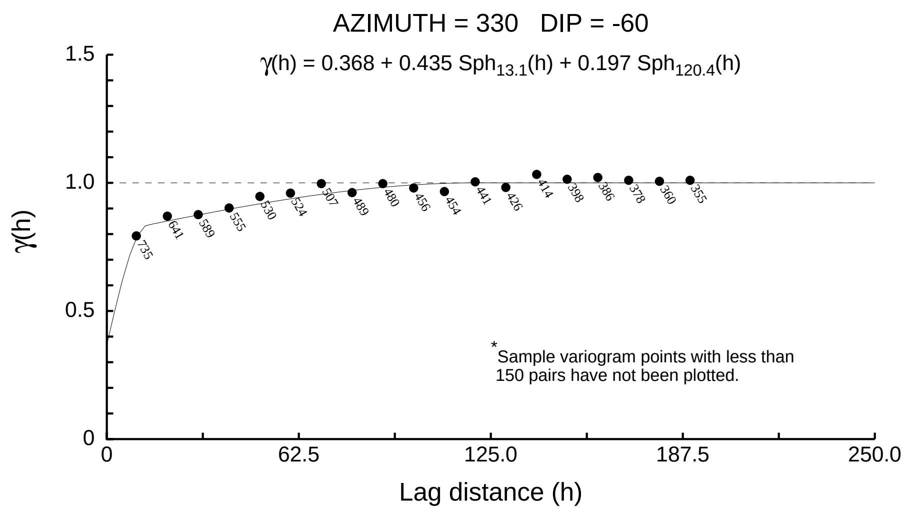
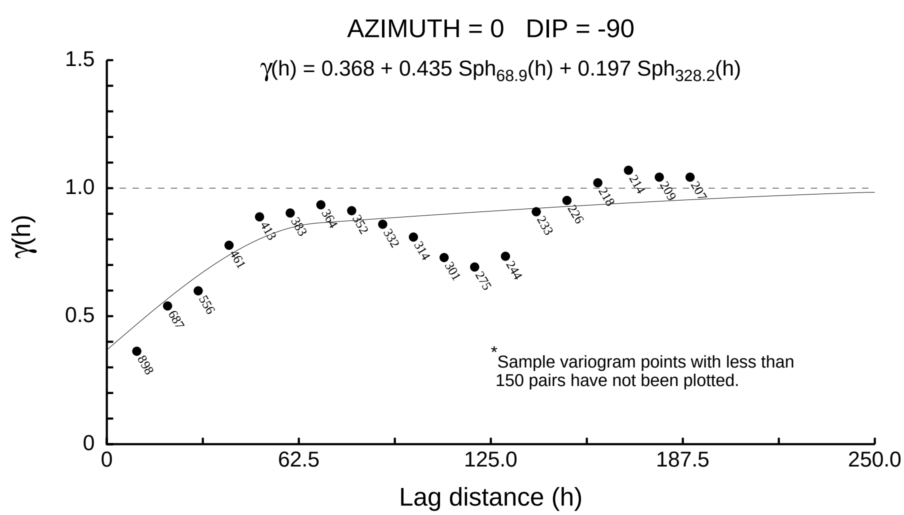
NorthMet U_20_Au_MDIR





NorthMet U_20_Co_MDIR

User Defined Rotation Conventions

Nugget ==> 0.398
C1 ==> 0.279
C2 ==> 0.323

First Structure -- Spherical

RH Rotation about the Z axis ==> -91
RH Rotation about the Y' axis ==> -62
RH Rotation about the Z' axis ==> 81
Range along the Z' axis ==> 11.4 Azimuth ==> 1 Dip ==> 28
Range along the Y' axis ==> 215.9 Azimuth ==> 20 Dip ==> -61
Range along the X' axis ==> 48.3 Azimuth ==> 95 Dip ==> 8

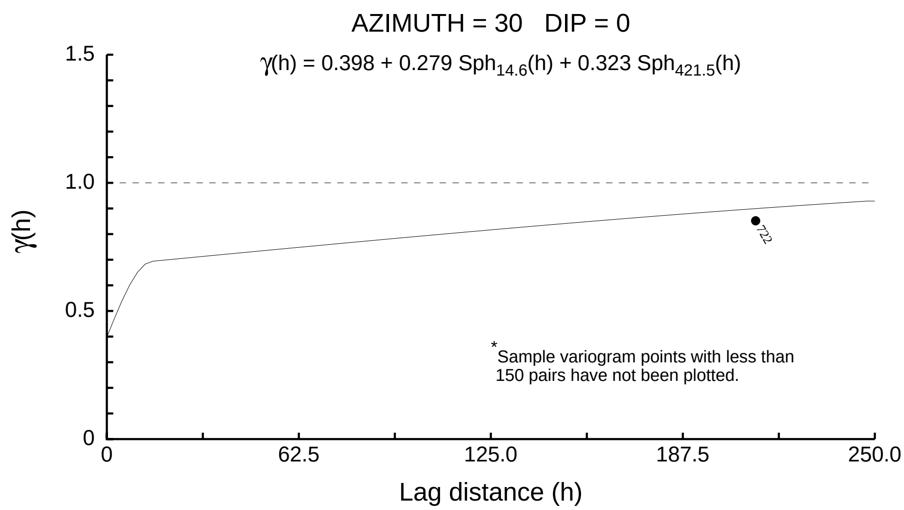
Second Structure -- Spherical

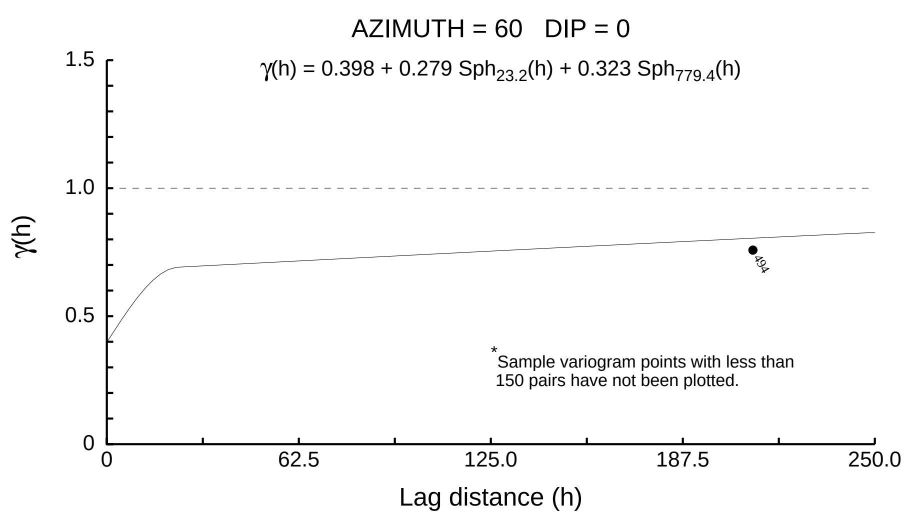
RH Rotation about the Z axis ==> -73
RH Rotation about the Y' axis ==> 50
RH Rotation about the Z' axis ==> 33
Range along the Z' axis ==> 223.2 Azimuth ==> 163 Dip ==> 40
Range along the Y' axis ==> 1859.6 Azimuth ==> 50 Dip ==> 25
Range along the X' axis ==> 457.0 Azimuth ==> 117 Dip ==> -39

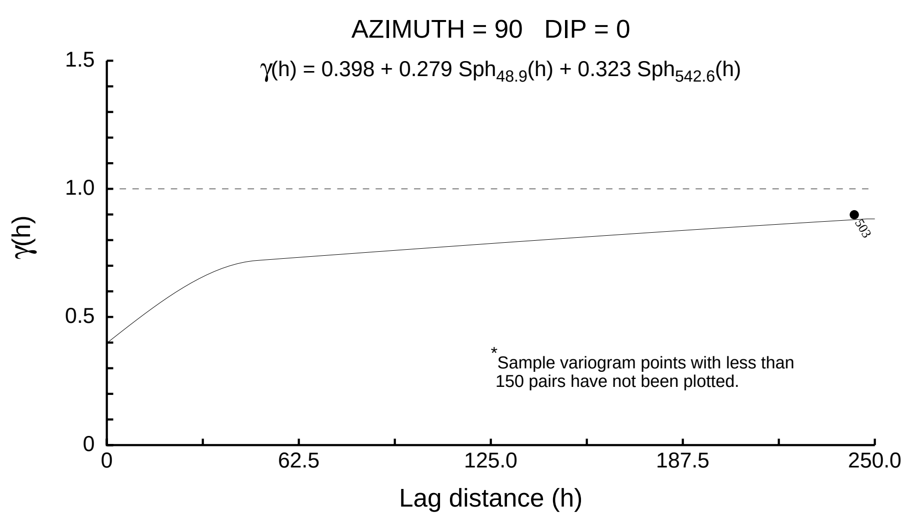
Modeling Criteria

Minimum number pairs req'd ==> 150
Sample variogram points weighted by # pairs

NorthMet U_20_Co_MDIR







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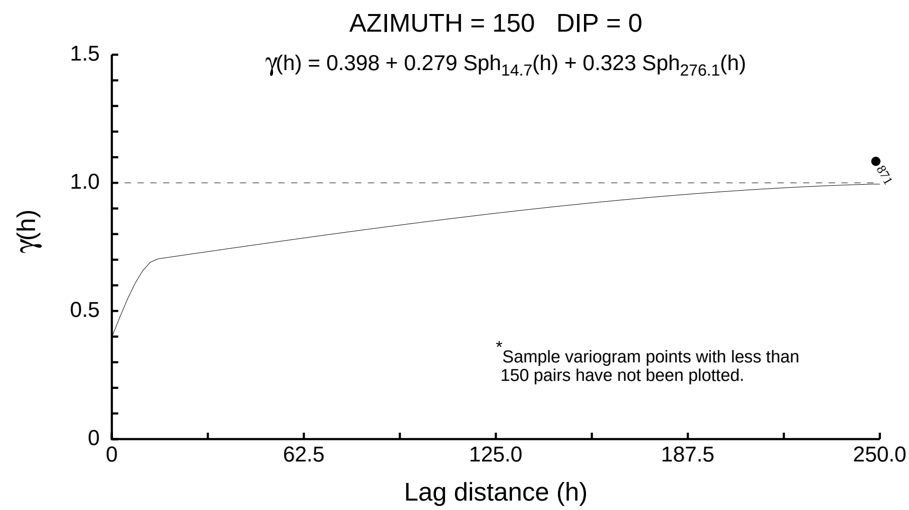
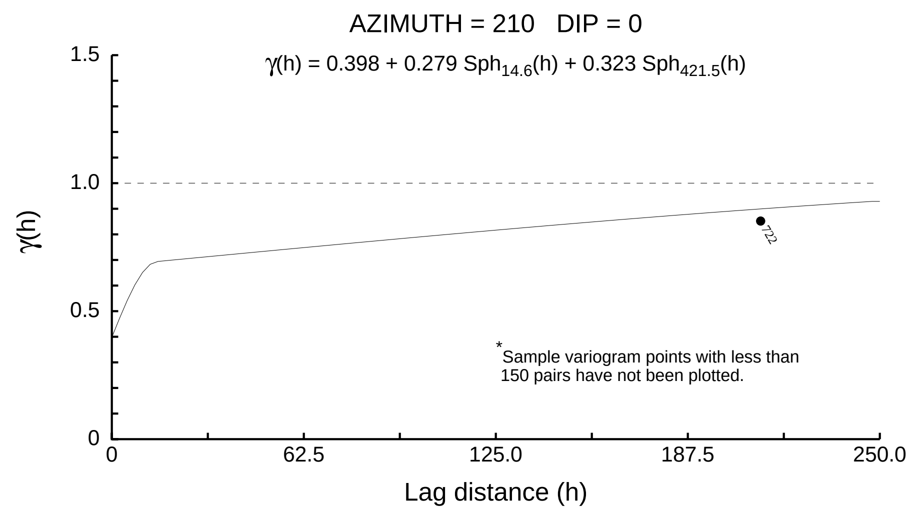
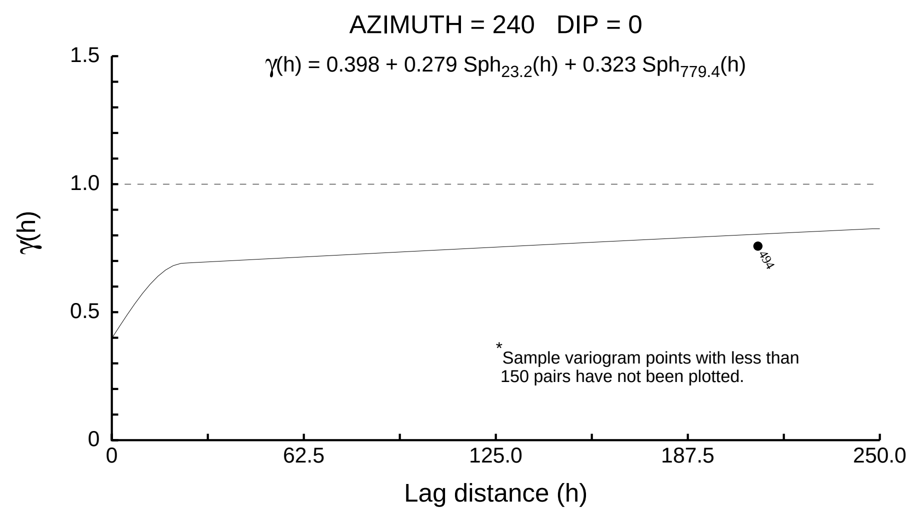
NorthMet U_20_Co_MDIR







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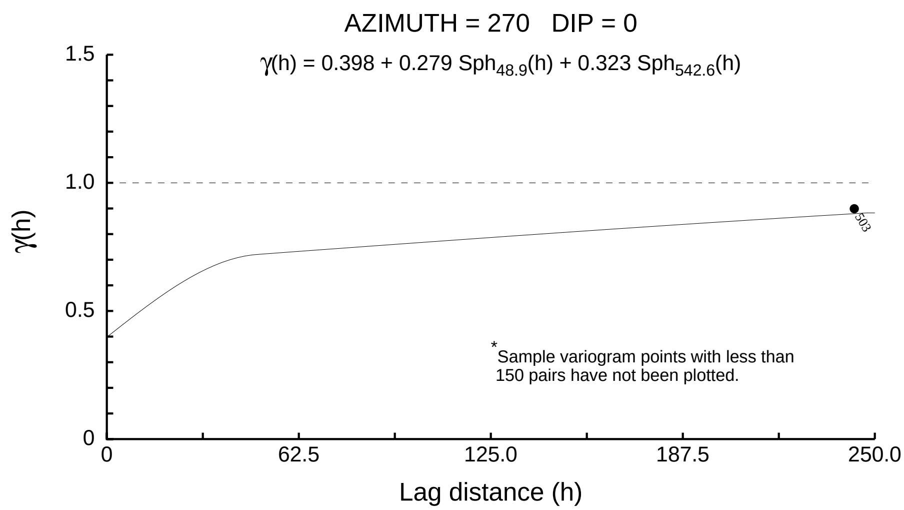
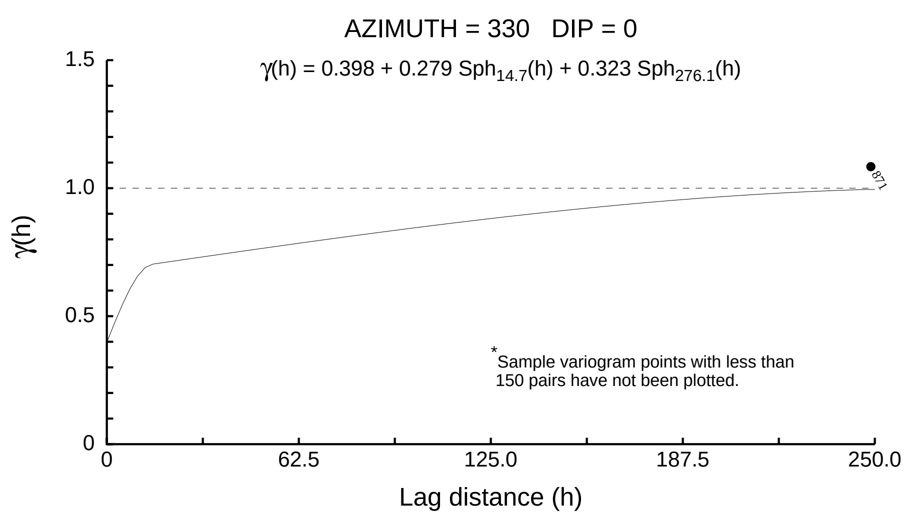
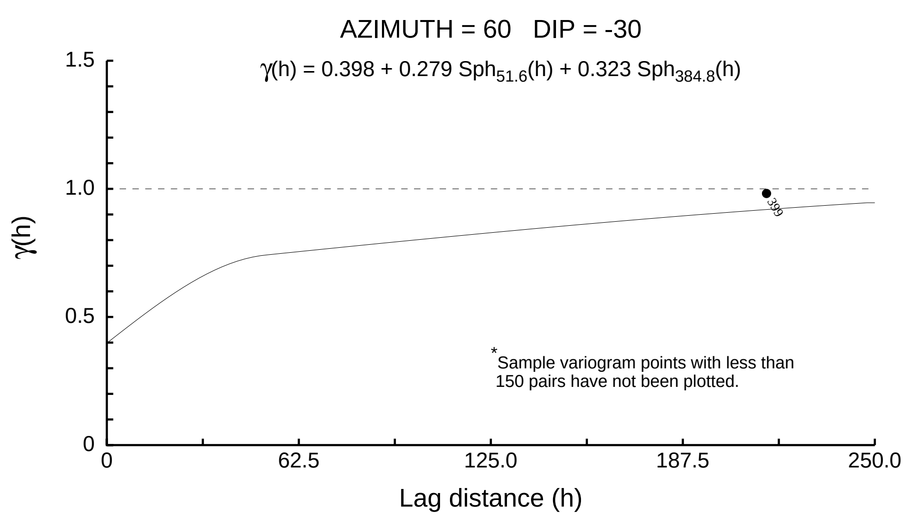
NorthMet U_20_Co_MDIR







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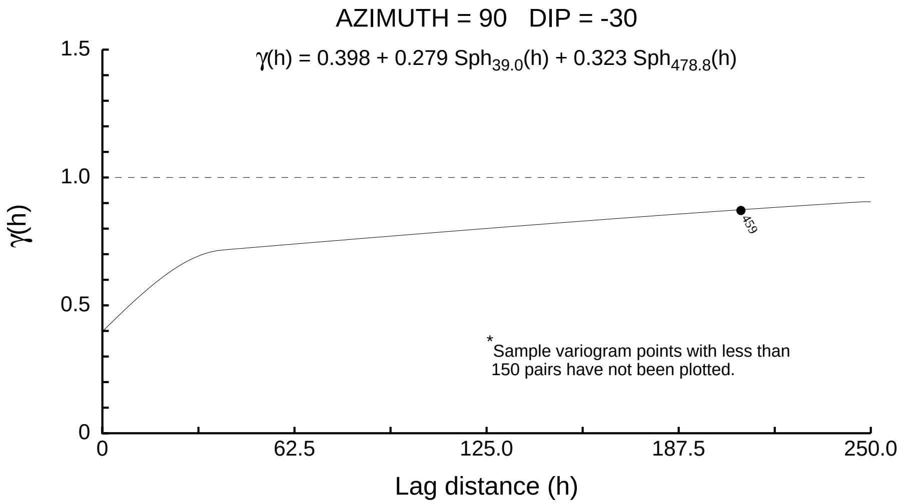

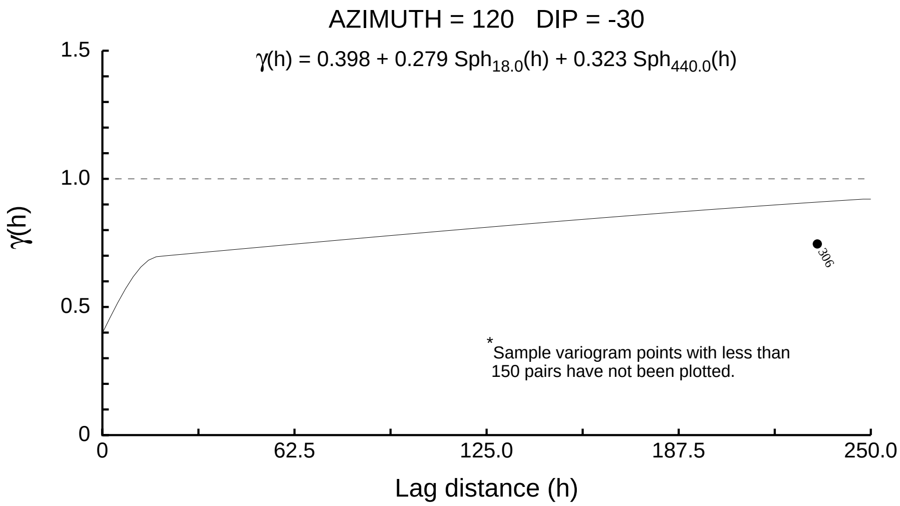

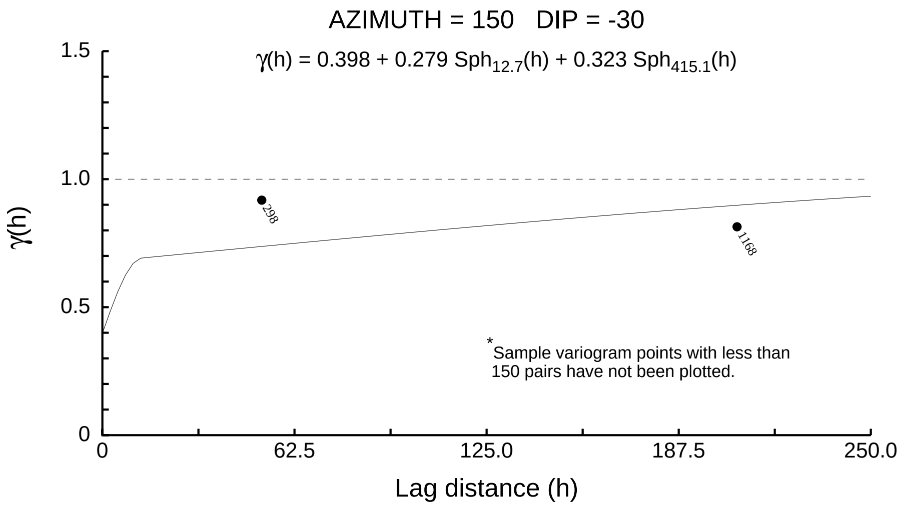

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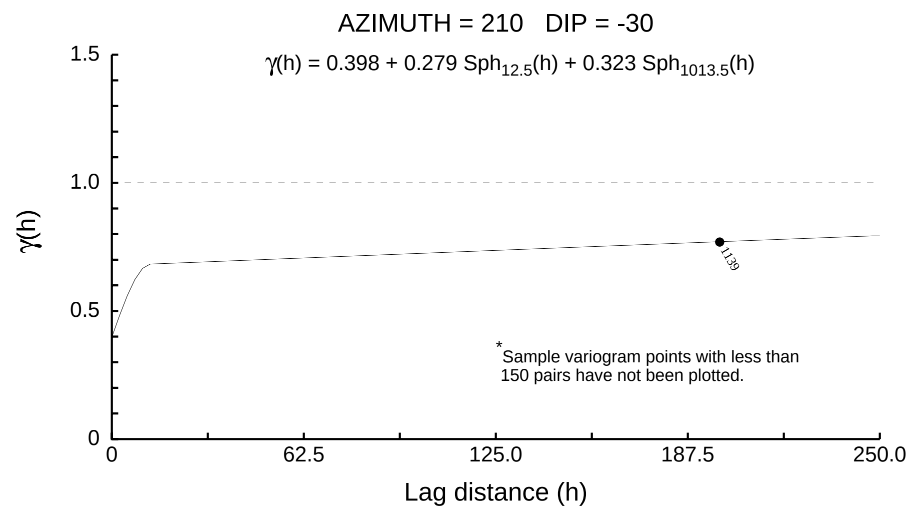
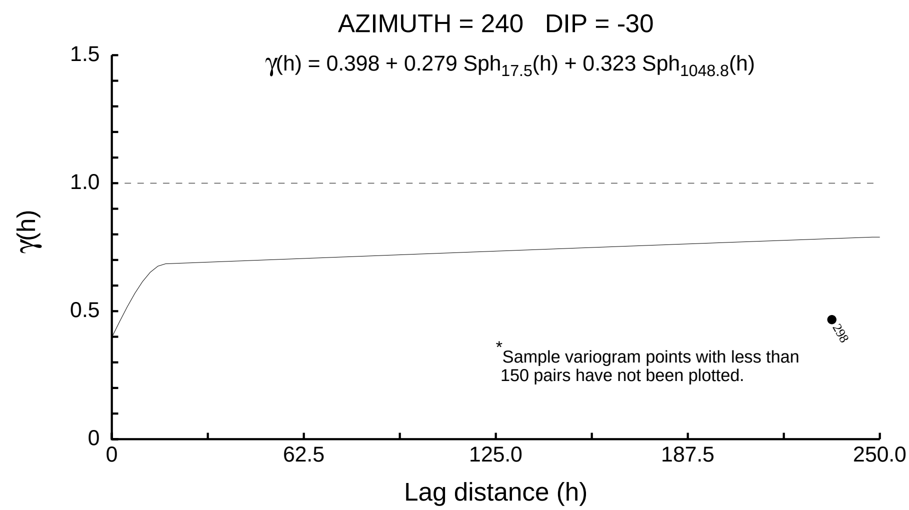
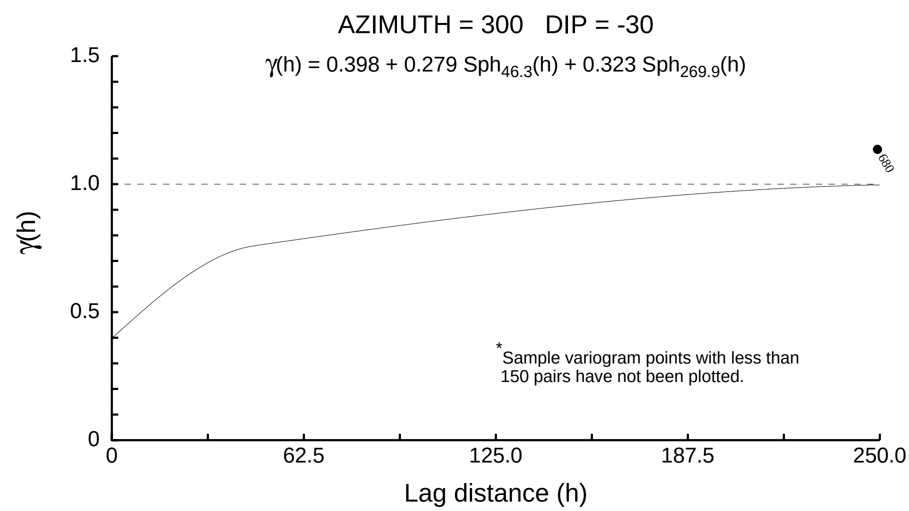
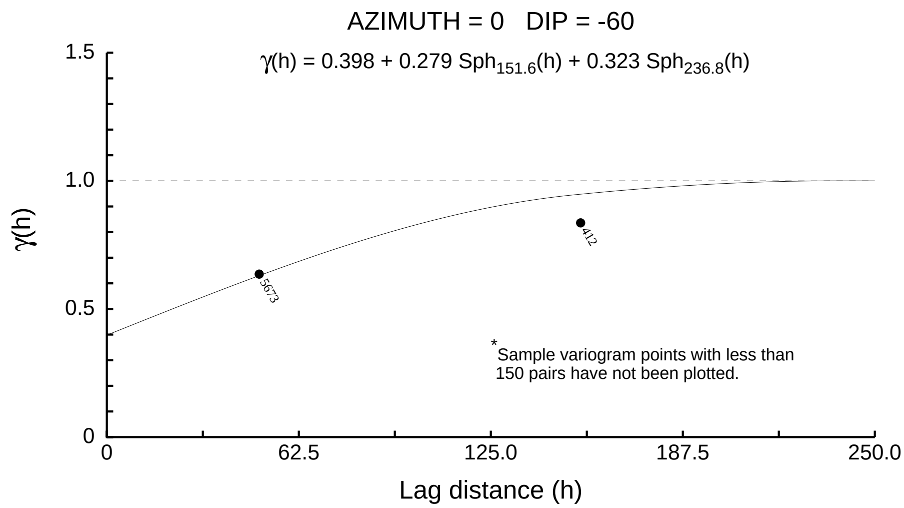
NorthMet U_20_Co_MDIR

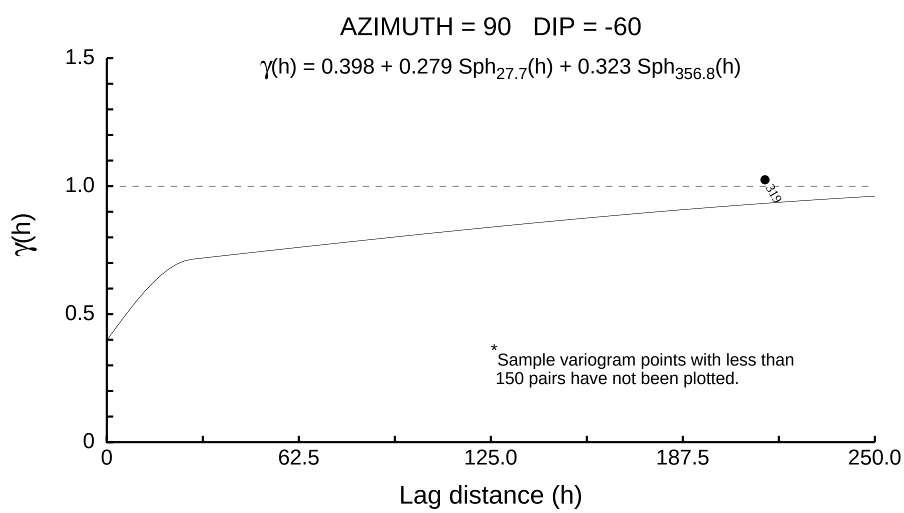


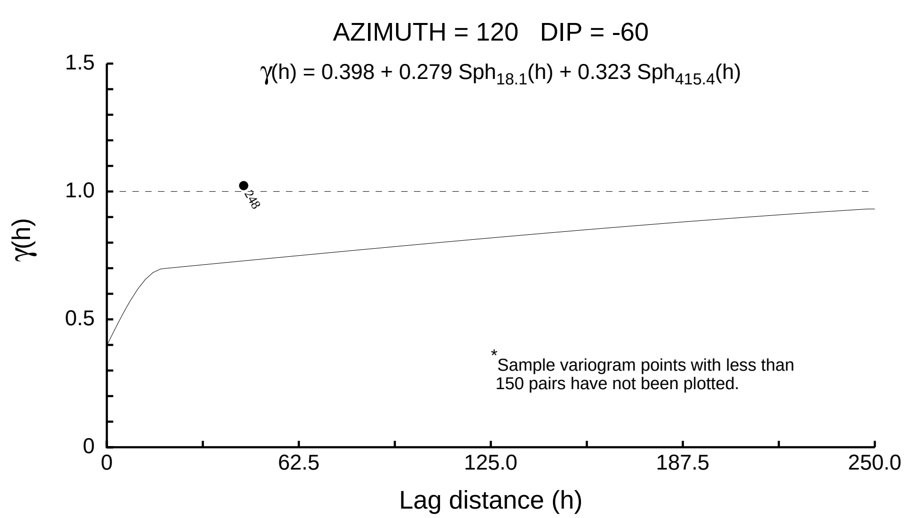




NorthMet U_20_Co_MDIR







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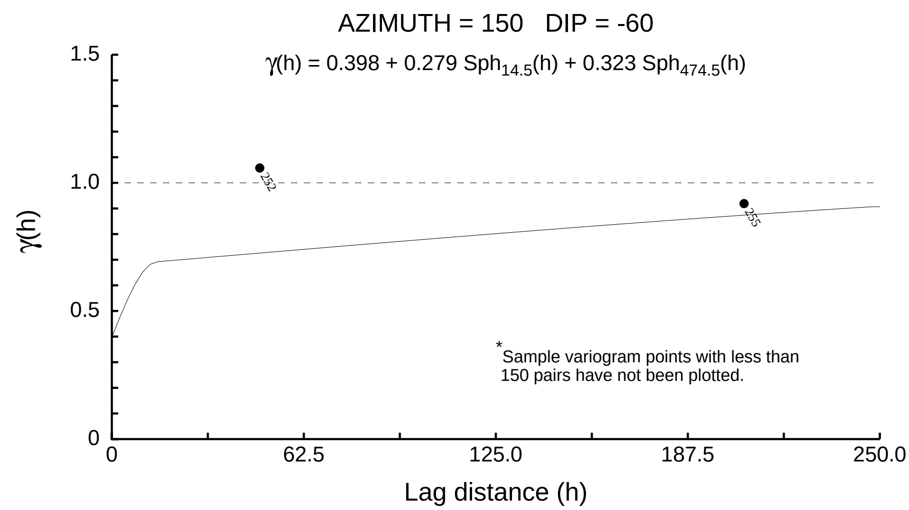
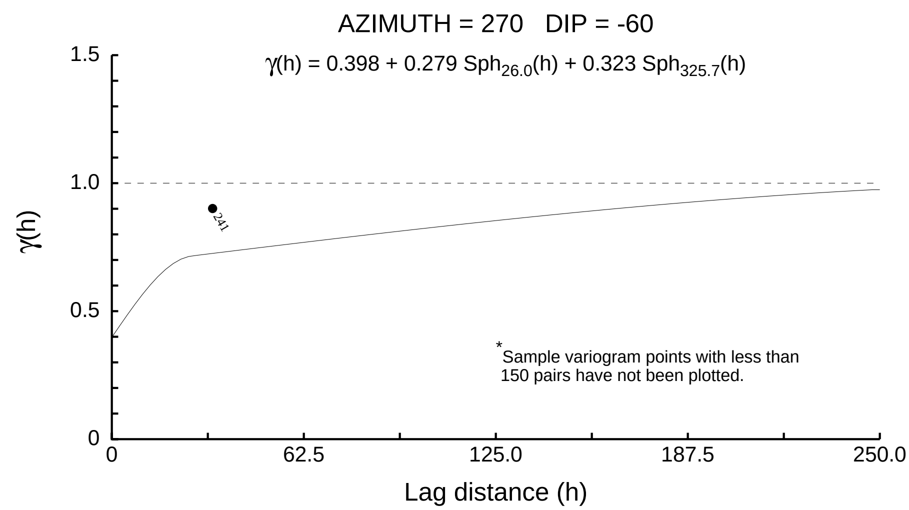
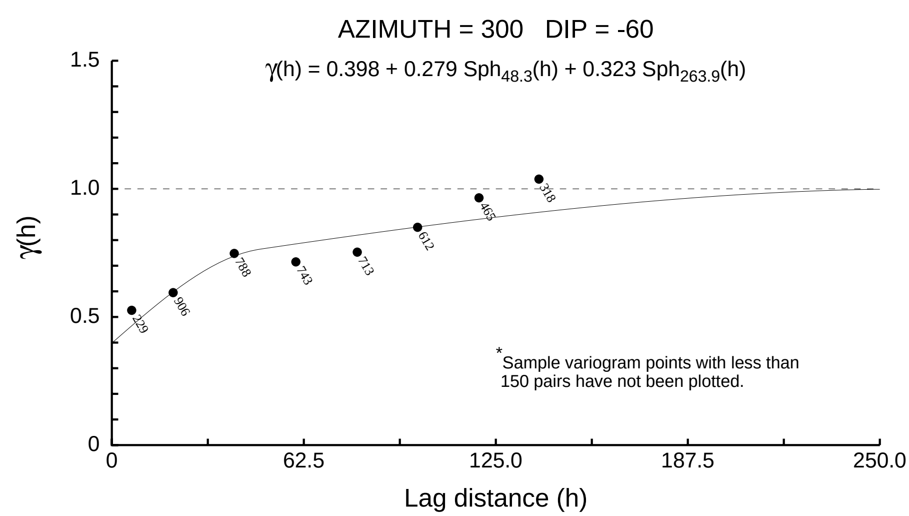
NorthMet U_20_Co_MDIR







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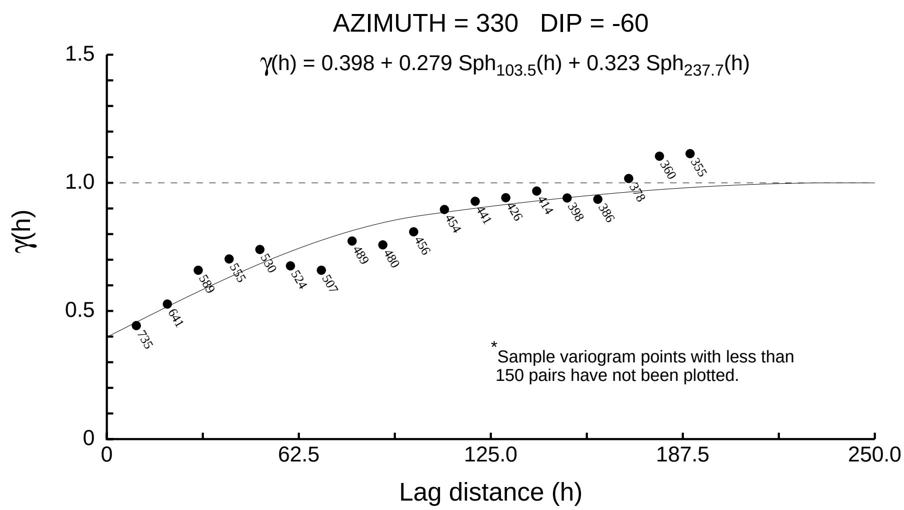
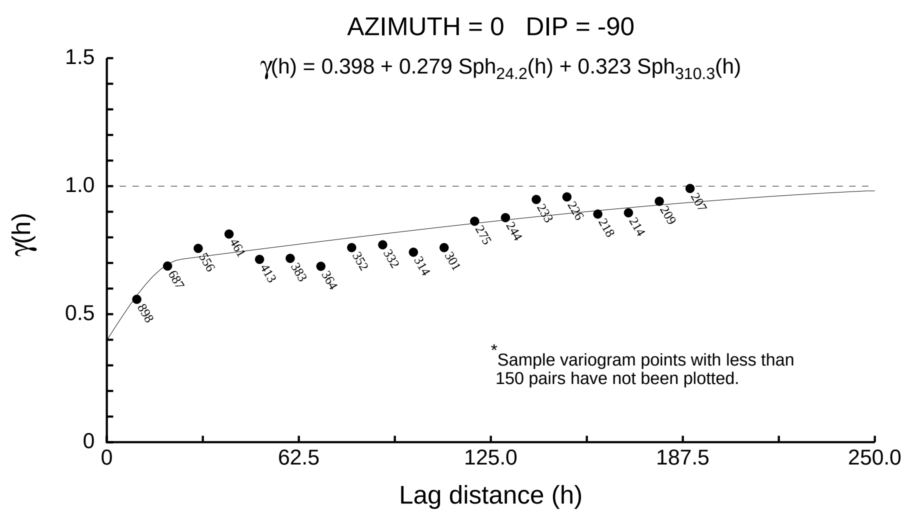
NorthMet U_20_Co_MDIR





NorthMet U_20_Cu_DIR

User Defined Rotation Conventions

Nugget ==> 0.450
C1 ==> 0.381
C2 ==> 0.169

First Structure -- Spherical

RH Rotation about the Z axis ==> -61
RH Rotation about the Y' axis ==> 87
RH Rotation about the Z' axis ==> -49

Range along the Z' axis	==> 9.5	Azimuth ==> 151	Dip ==> 3
Range along the Y' axis	==> 152.2	Azimuth ==> 65	Dip ==> -49
Range along the X' axis	==> 163.5	Azimuth ==> 238	Dip ==> -41

Second Structure -- Spherical

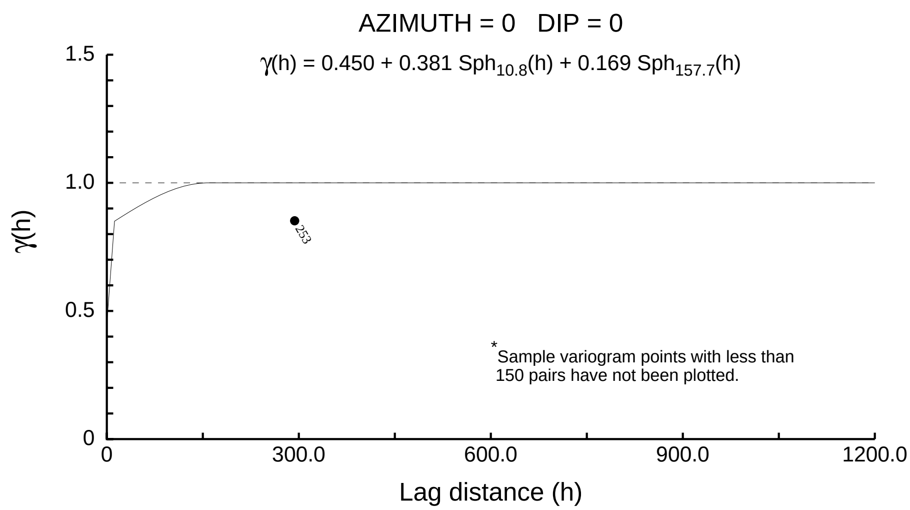
RH Rotation about the Z axis ==> -27
RH Rotation about the Y' axis ==> -5
RH Rotation about the Z' axis ==> -54

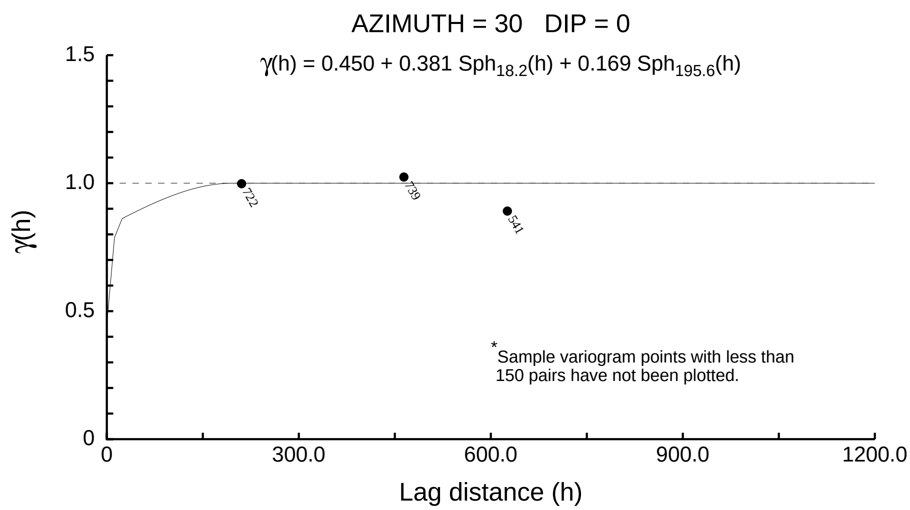
Range along the Z' axis	==> 1200.0	Azimuth ==> 297	Dip ==> 85
Range along the Y' axis	==> 500.0	Azimuth ==> 80	Dip ==> 4
Range along the X' axis	==> 155.5	Azimuth ==> 170	Dip ==> 3

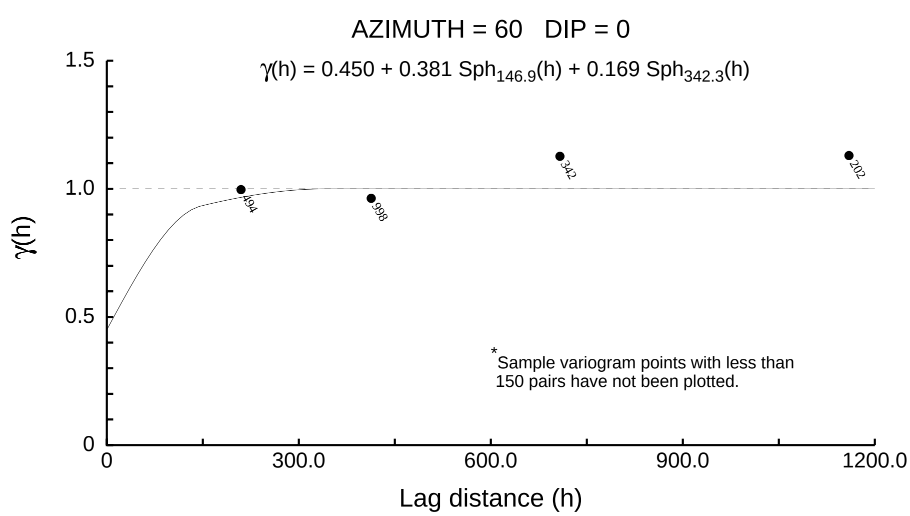
Modeling Criteria

Minimum number pairs req'd ==> 150
Sample variogram points weighted by # pairs

NorthMet U_20_Cu_DIR







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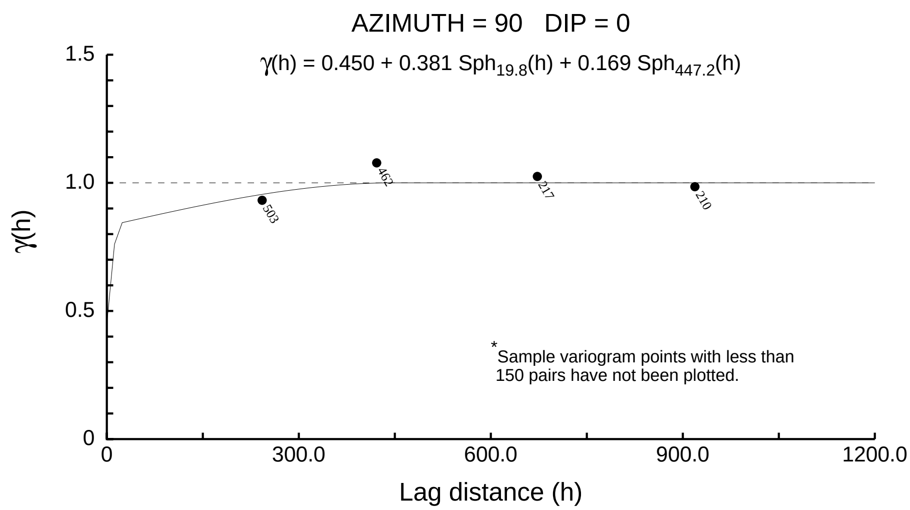
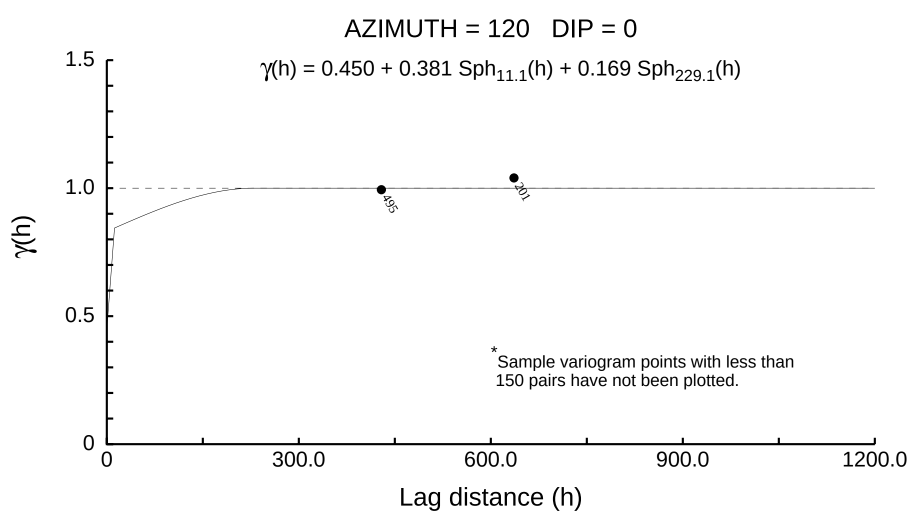
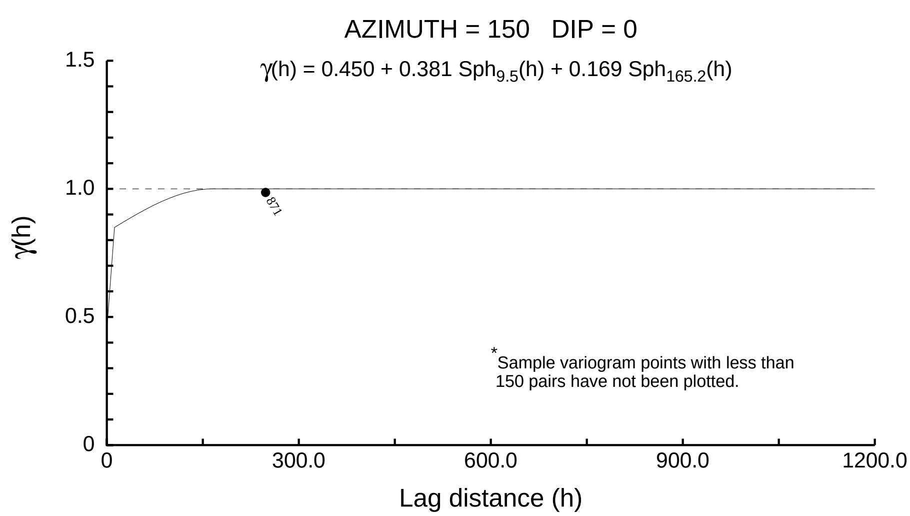
NorthMet U_20_Cu_DIR







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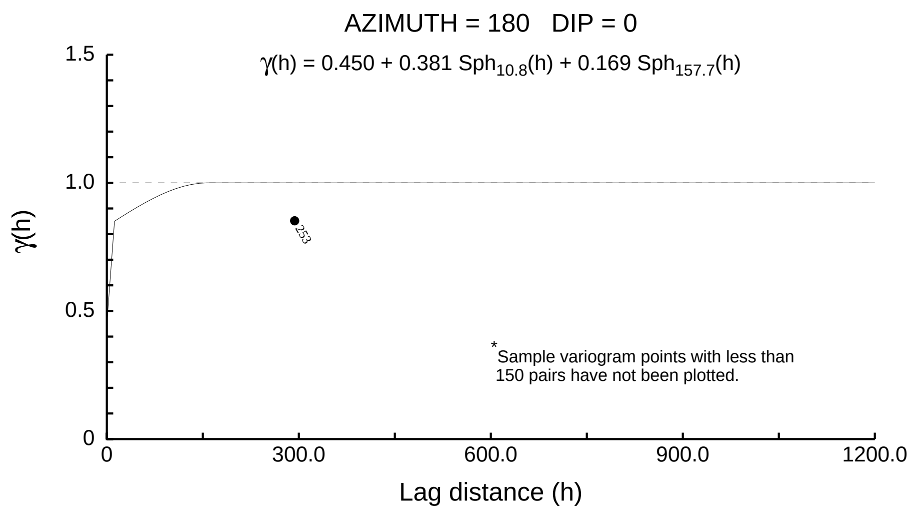
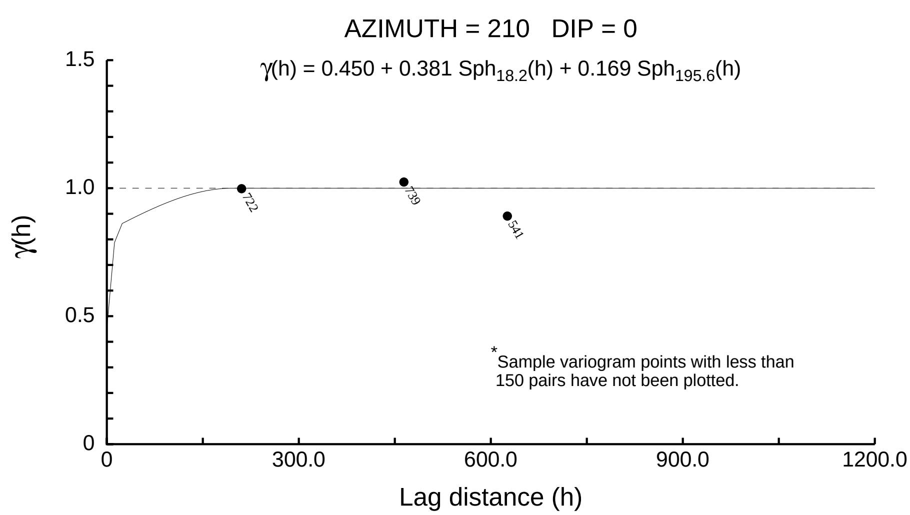
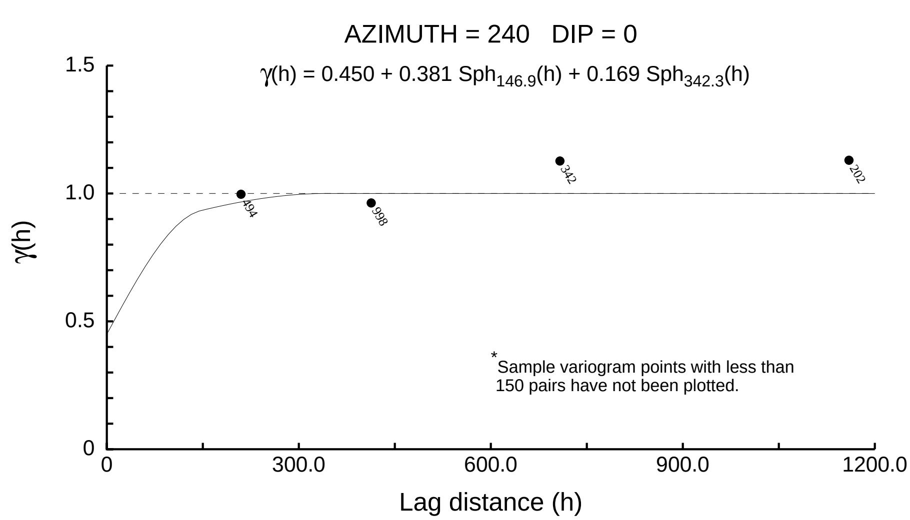
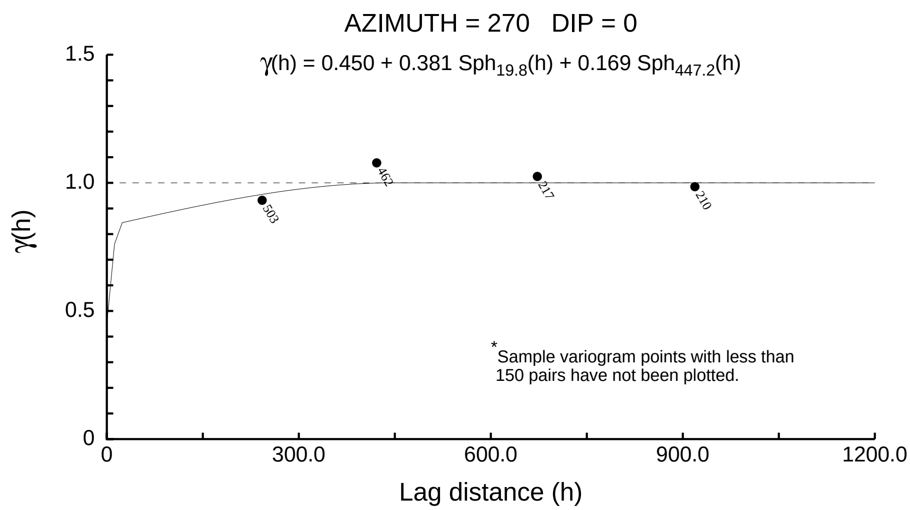
NorthMet U_20_Cu_DIR

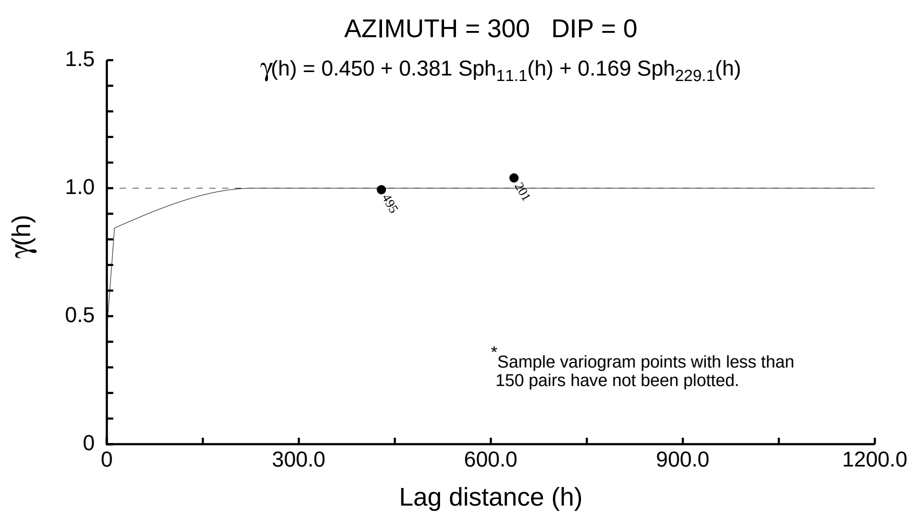


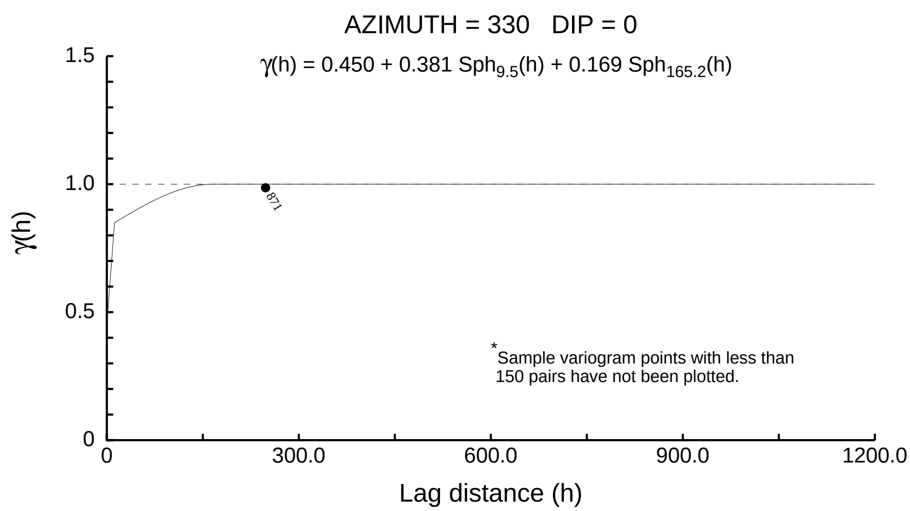




NorthMet U_20_Cu_DIR







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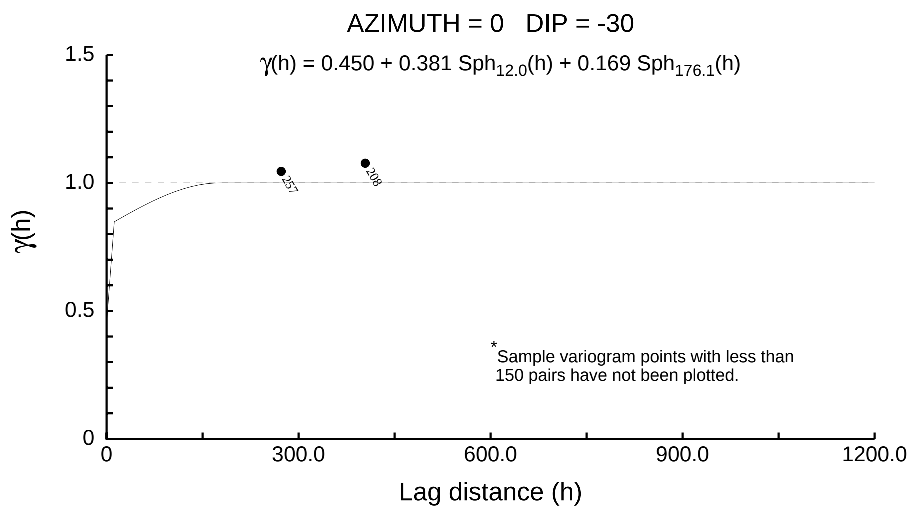

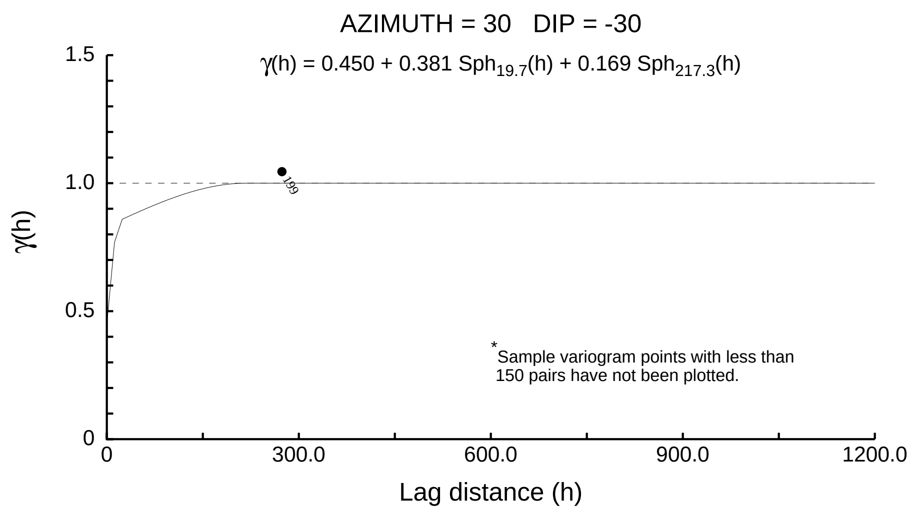

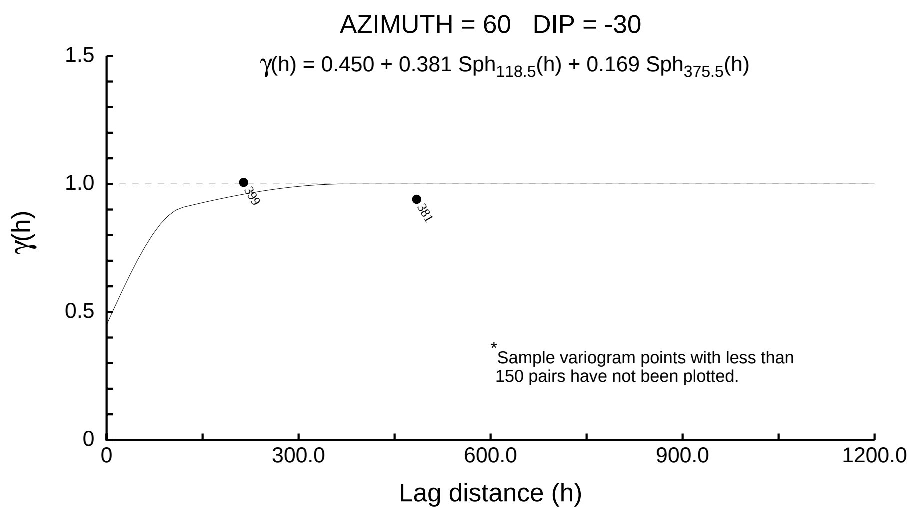

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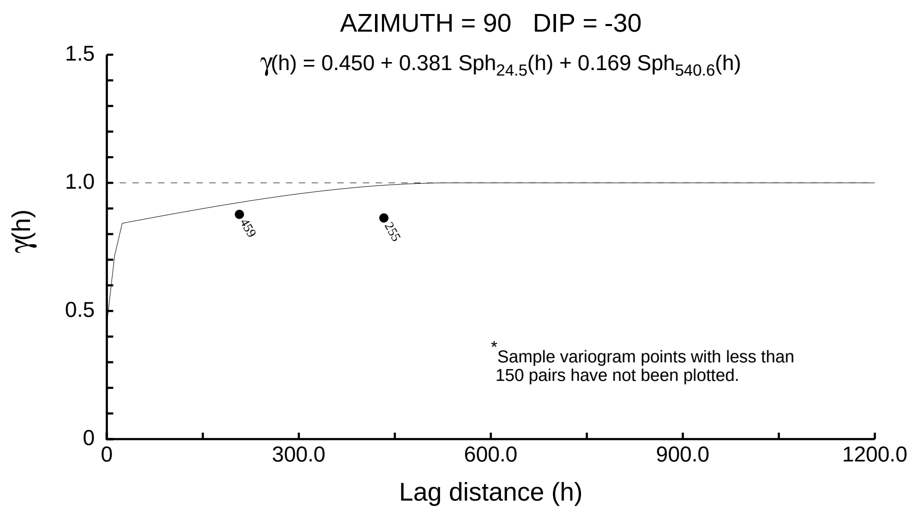
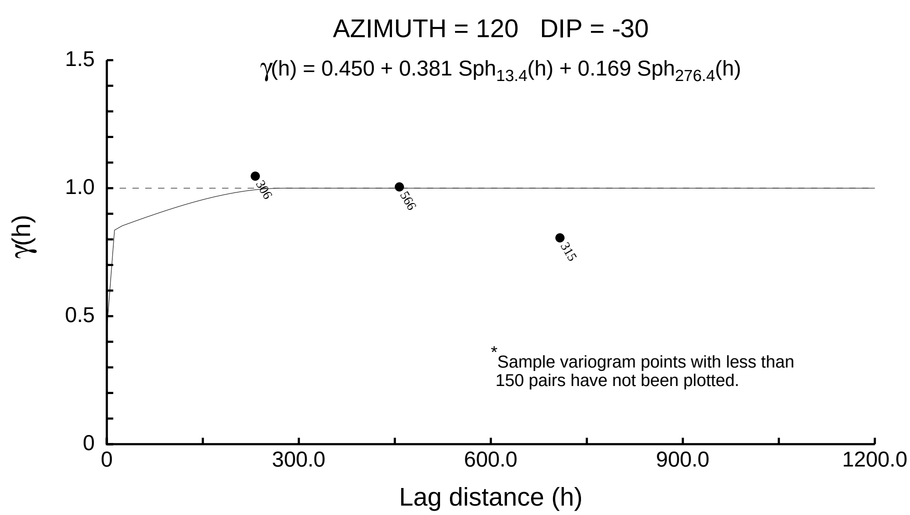
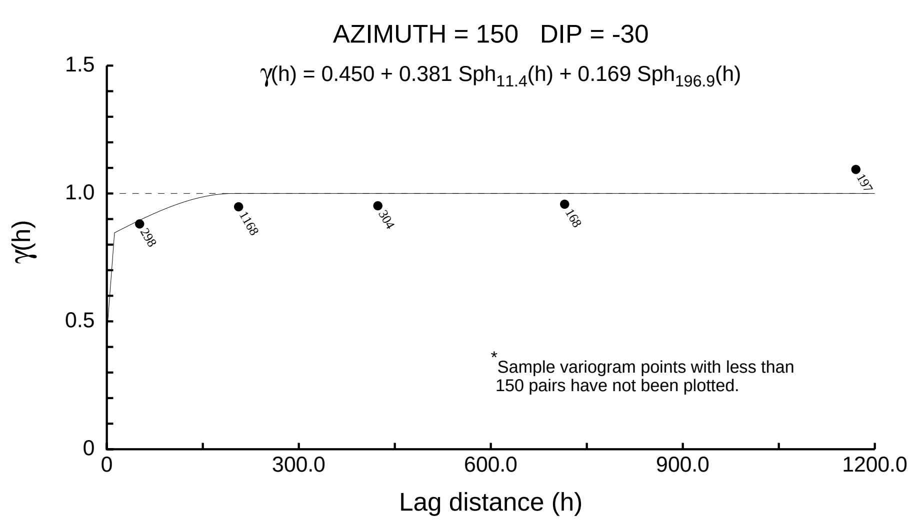
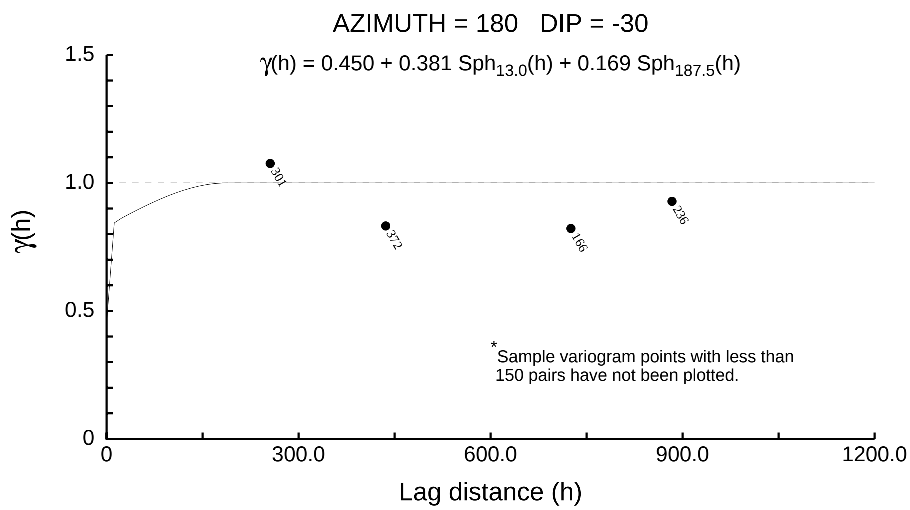
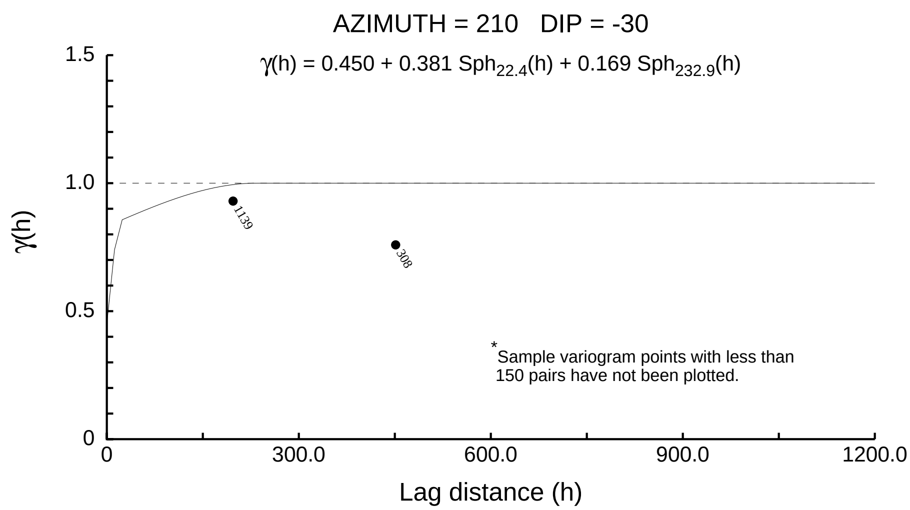


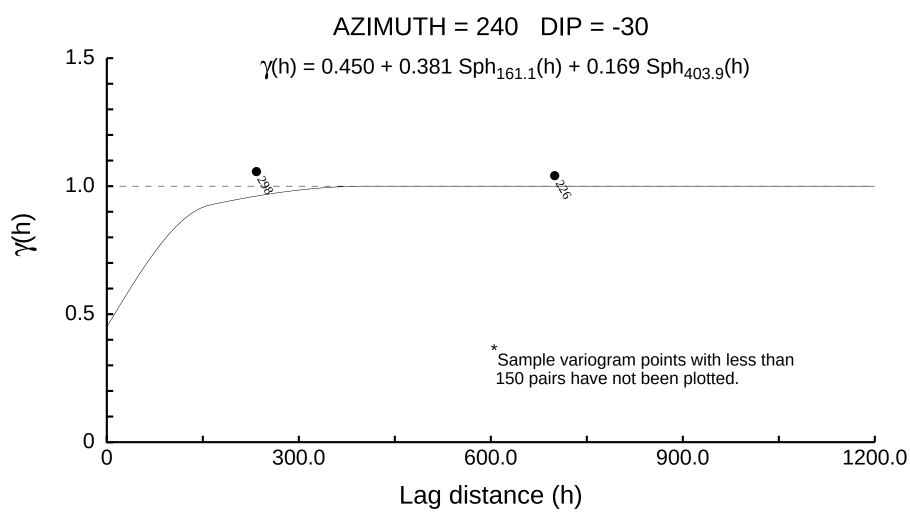




NorthMet U_20_Cu_DIR



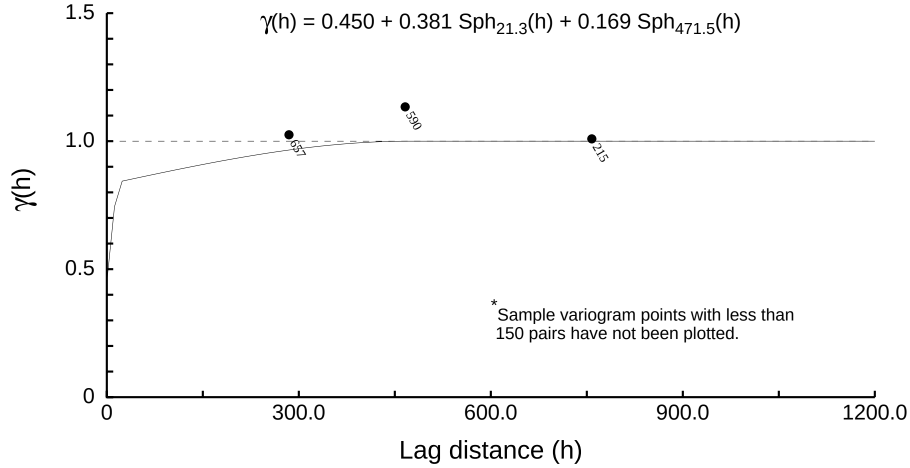




NorthMet U_20_Cu_DIR

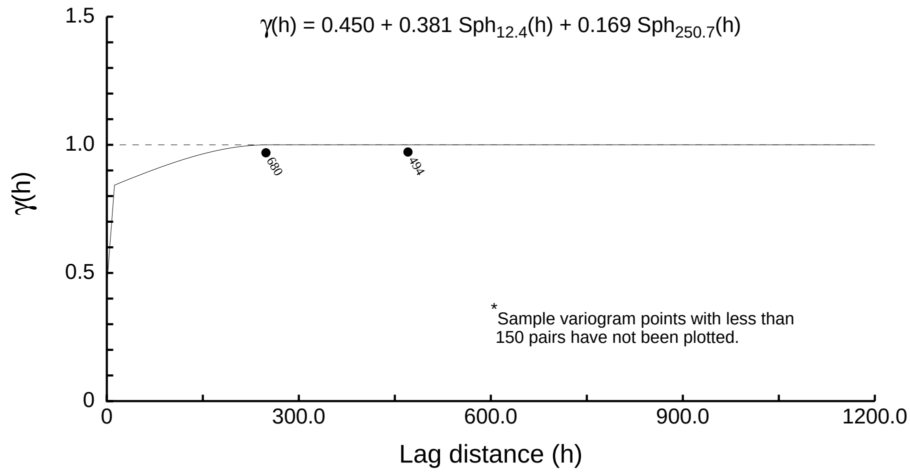
AZIMUTH = 270   DIP = -30

$\gamma(h) = 0.450 + 0.381\ Sph_{21.3}(h) + 0.169\ Sph_{471.5}(h)$



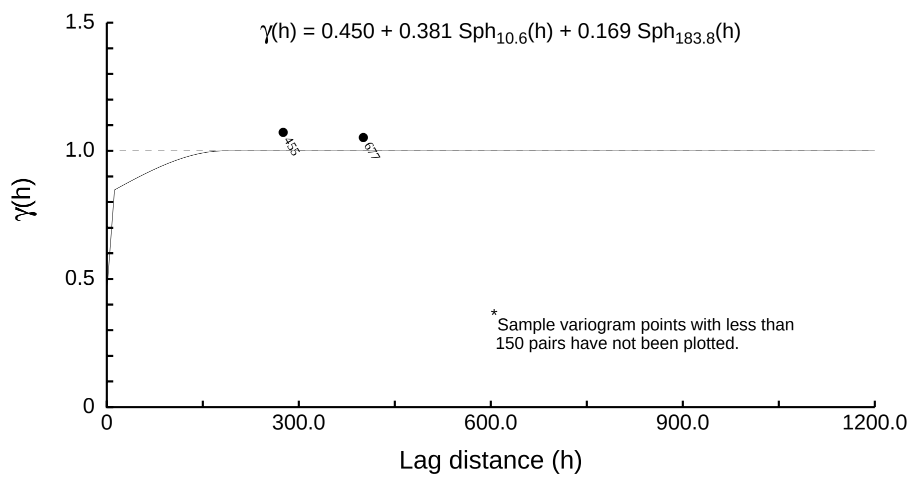
AZIMUTH = 300   DIP = -30

$\gamma(h) = 0.450 + 0.381\ Sph_{12.4}(h) + 0.169\ Sph_{250.7}(h)$



AZIMUTH = 330   DIP = -30

$\gamma(h) = 0.450 + 0.381\ Sph_{10.6}(h) + 0.169\ Sph_{183.8}(h)$



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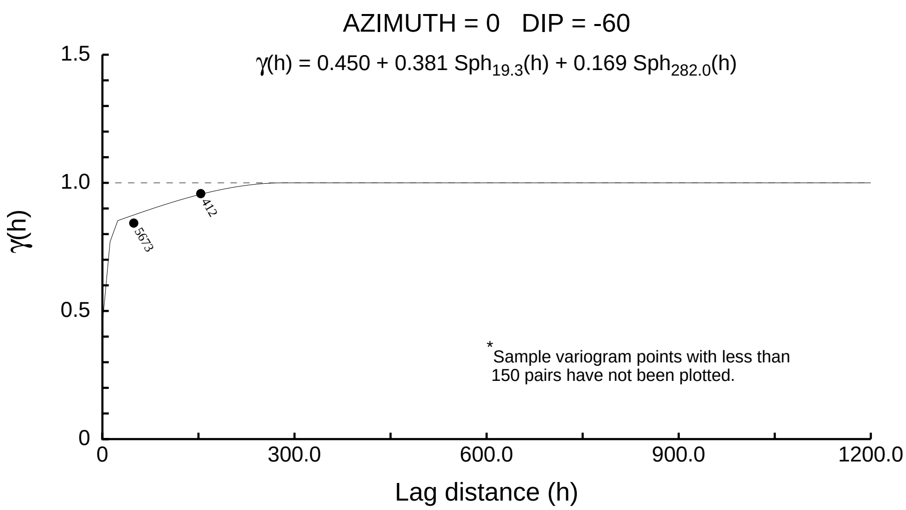
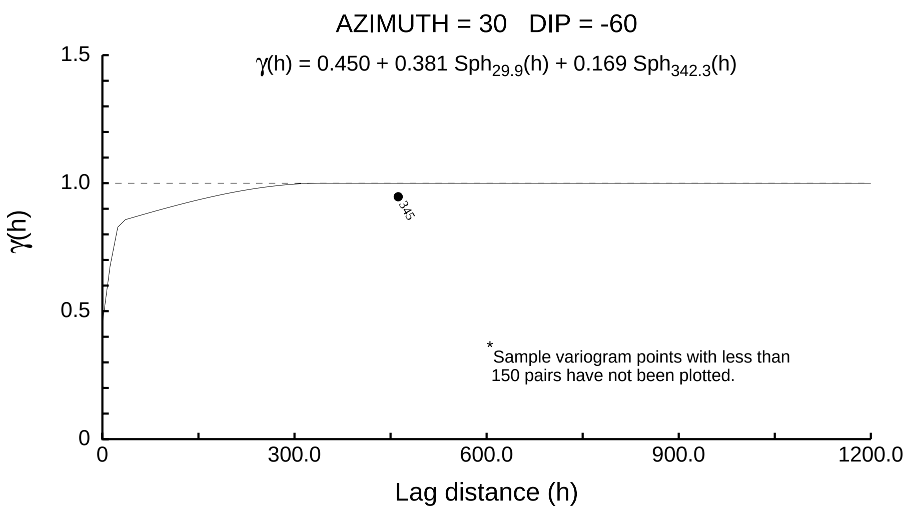
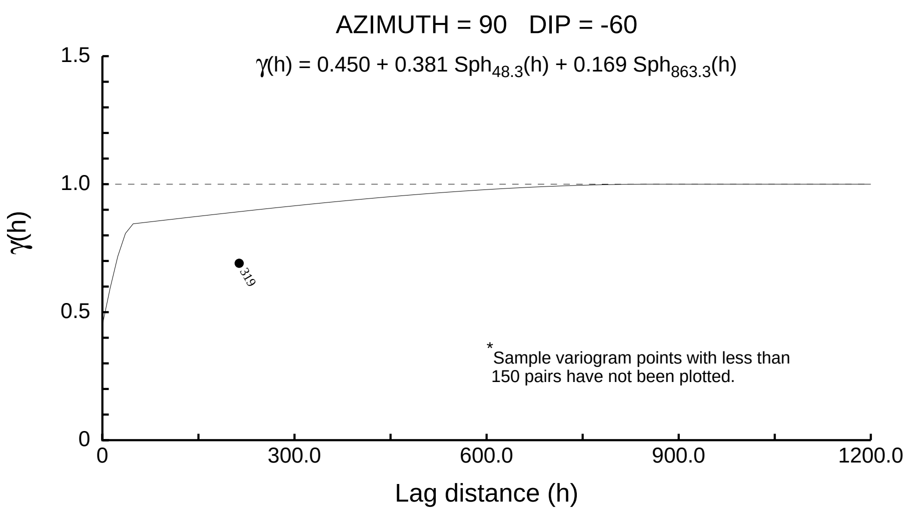
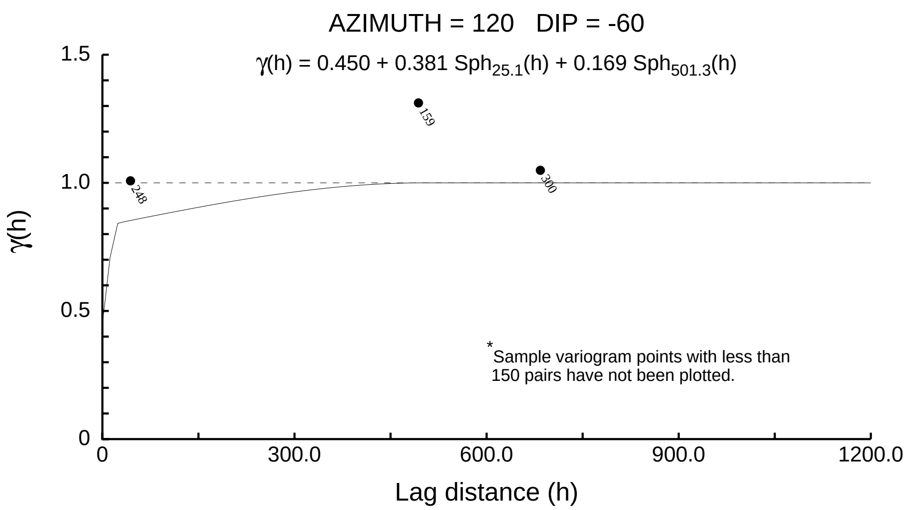
NorthMet U_20_Cu_DIR

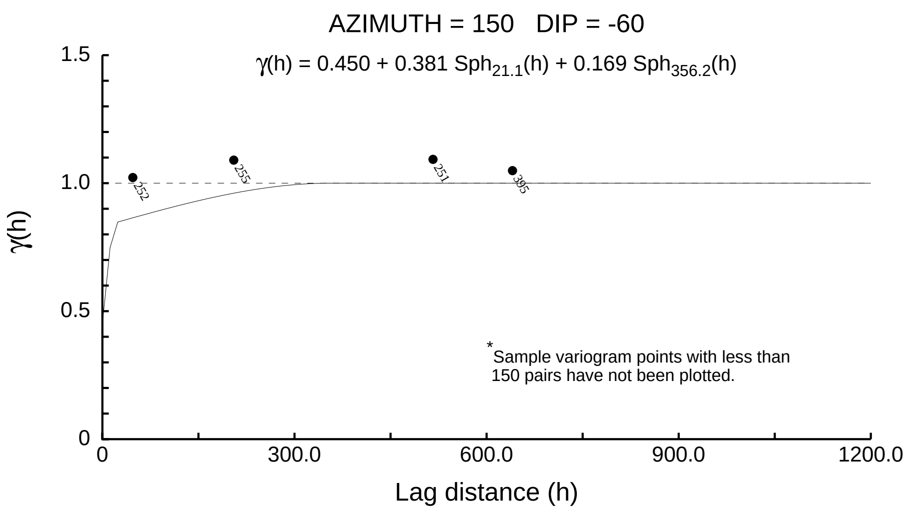


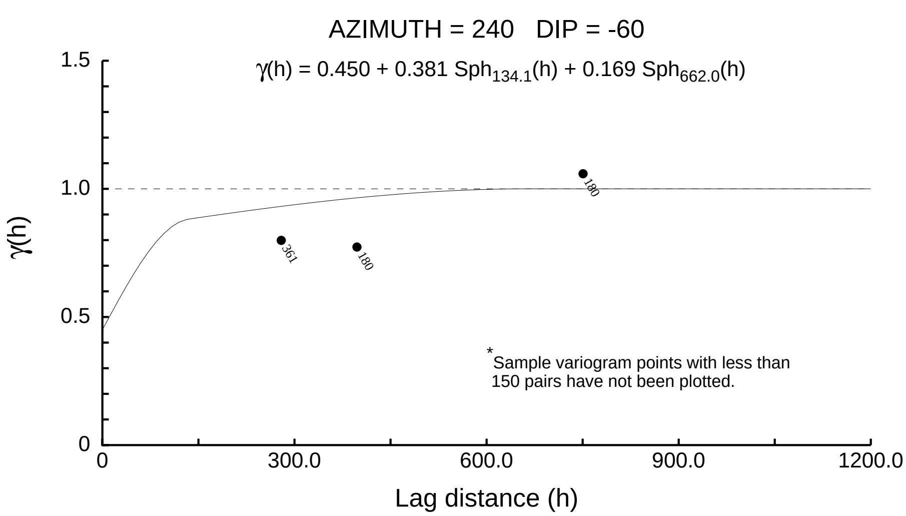




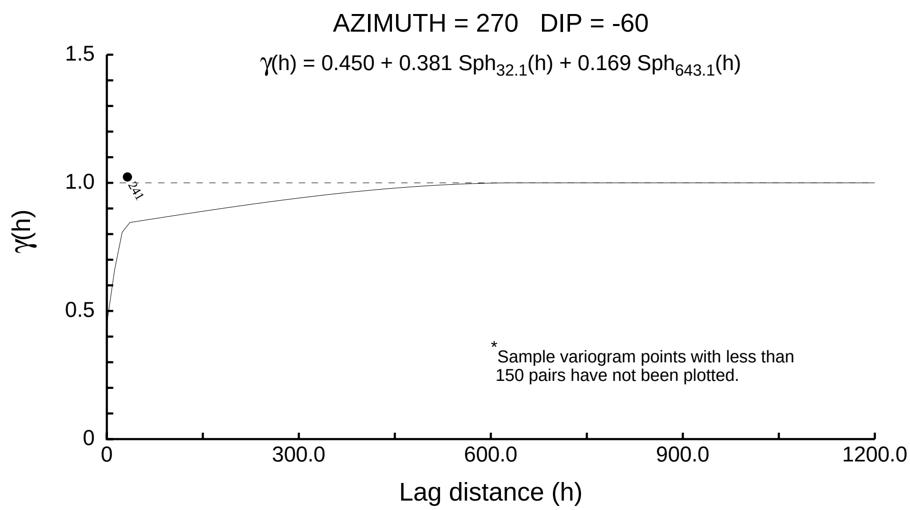
NorthMet U_20_Cu_DIR

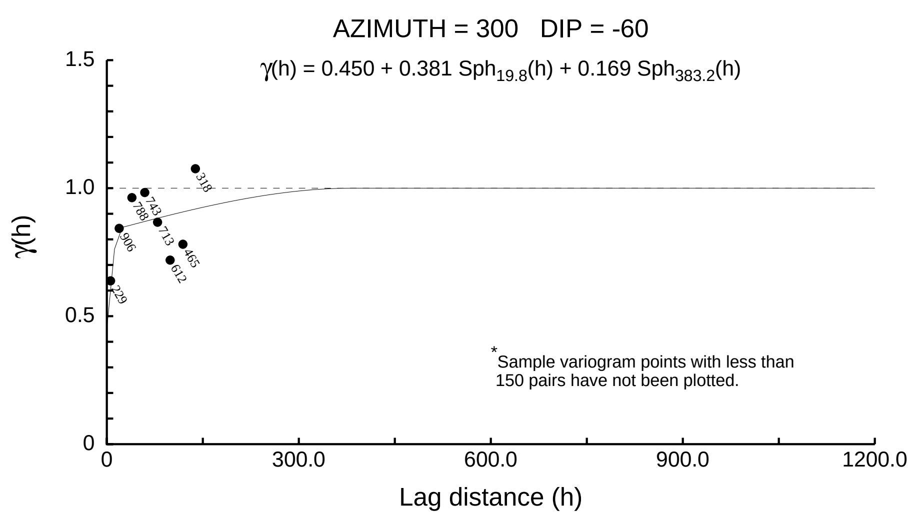


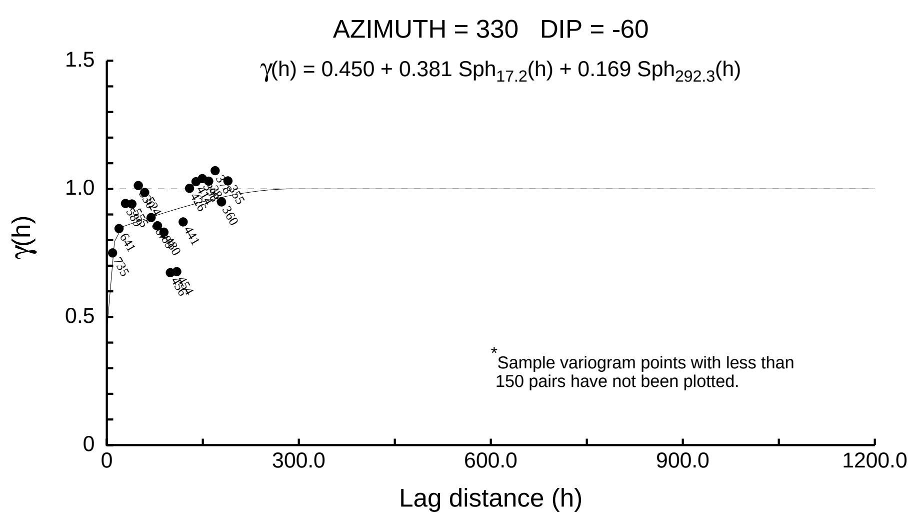




NorthMet U_20_Cu_DIR







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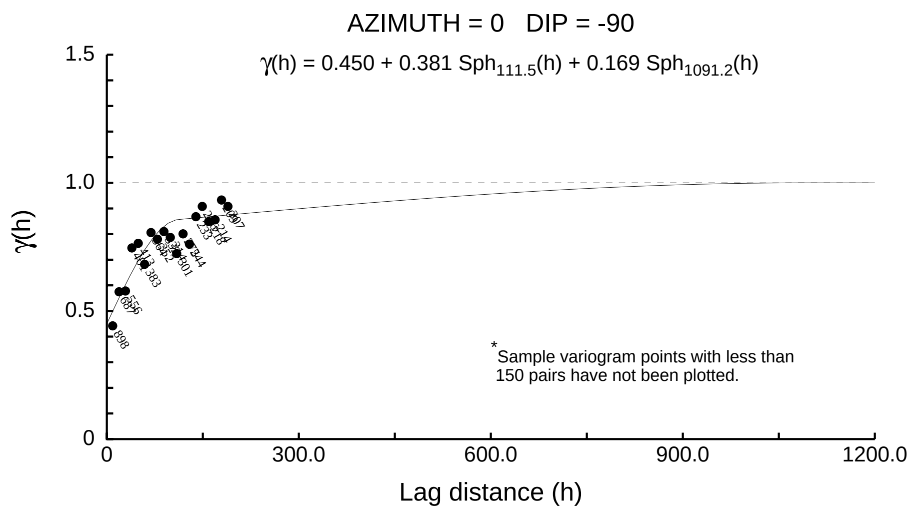


NorthMet U_20_Ni_MDIR

User Defined Rotation Conventions

Nugget ==> 0.406
C1 ==> 0.340
C2 ==> 0.254

First Structure -- Spherical

RH Rotation about the Z axis ==> -47
RH Rotation about the Y' axis ==> 90
RH Rotation about the Z' axis ==> 3
Range along the Z' axis ==> 7.9 Azimuth ==> 137 Dip ==> -0
Range along the Y' axis ==> 67.1 Azimuth ==> 47 Dip ==> 3
Range along the X' axis ==> 182.4 Azimuth ==> 45 Dip ==> -87

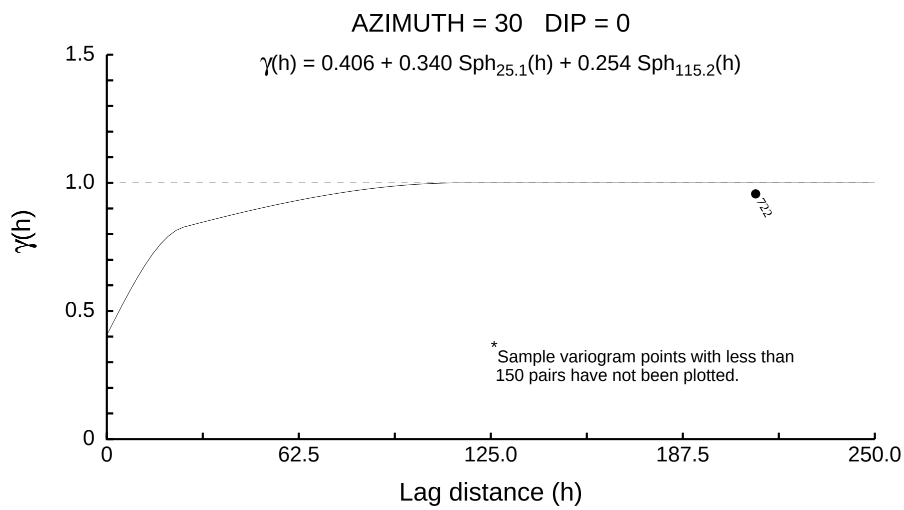
Second Structure -- Spherical

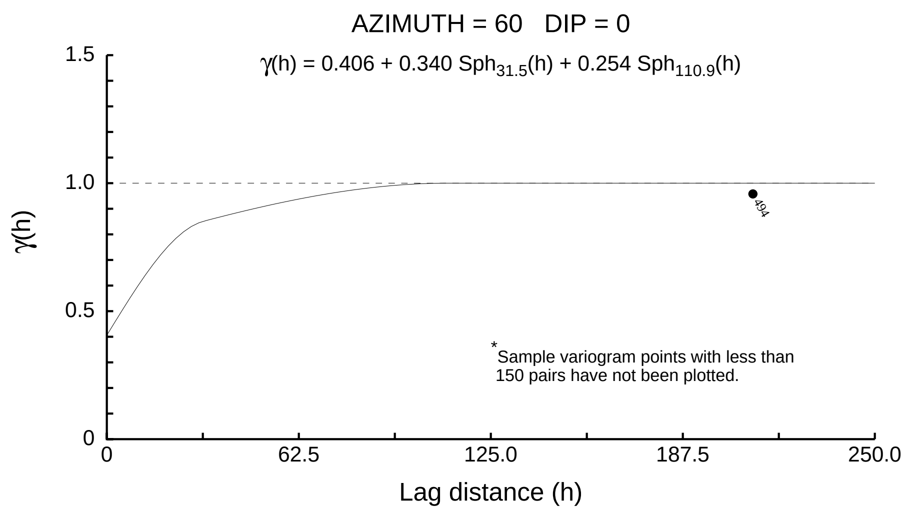
RH Rotation about the Z axis ==> -50
RH Rotation about the Y' axis ==> 11
RH Rotation about the Z' axis ==> 9
Range along the Z' axis ==> 1190.4 Azimuth ==> 140 Dip ==> 79
Range along the Y' axis ==> 117.5 Azimuth ==> 42 Dip ==> 2
Range along the X' axis ==> 78.3 Azimuth ==> 131 Dip ==> -11

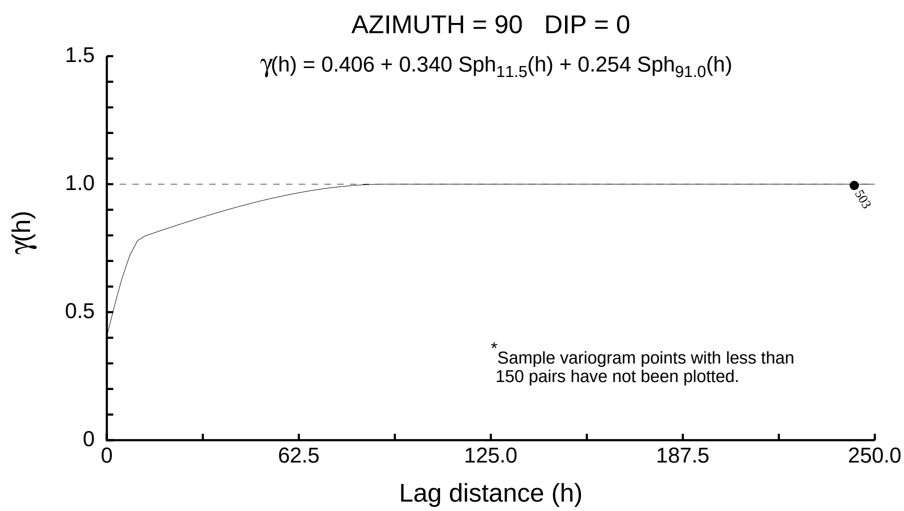
Modeling Criteria

Minimum number pairs req'd ==> 150
Sample variogram points weighted by # pairs

NorthMet U_20_Ni_MDIR







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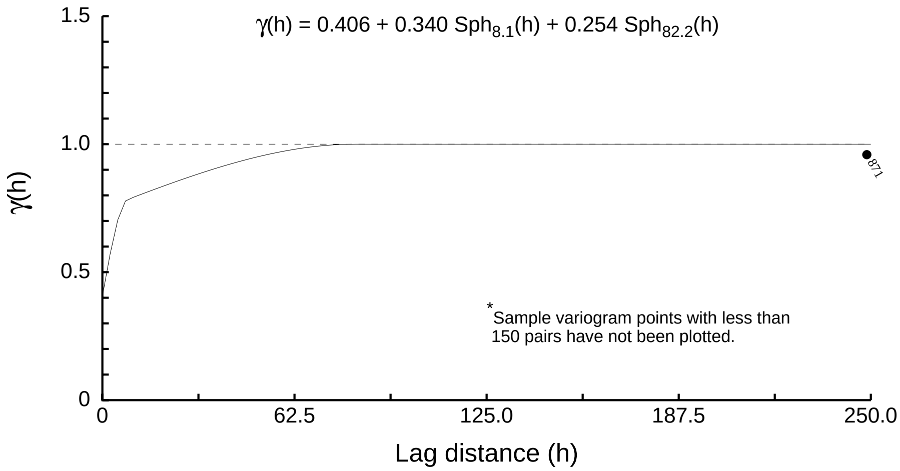
NorthMet U_20_Ni_MDIR

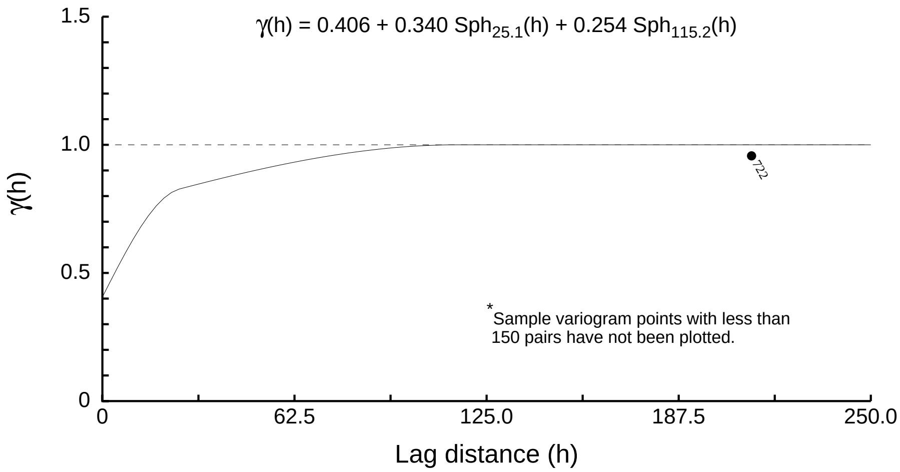
AZIMUTH = 150   DIP = 0

$\gamma(h) = 0.406 + 0.340\ Sph_{8.1}(h) + 0.254\ Sph_{82.2}(h)$



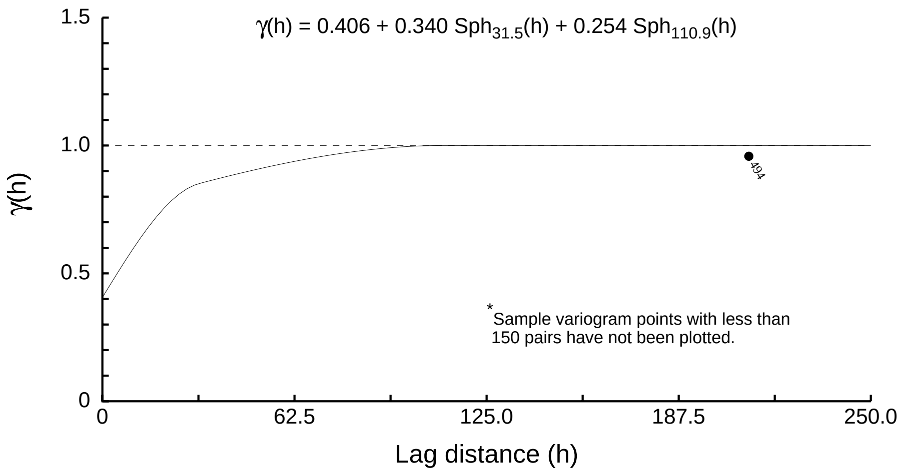
AZIMUTH = 210   DIP = 0

$\gamma(h) = 0.406 + 0.340\ Sph_{25.1}(h) + 0.254\ Sph_{115.2}(h)$



AZIMUTH = 240   DIP = 0

$\gamma(h) = 0.406 + 0.340\ Sph_{31.5}(h) + 0.254\ Sph_{110.9}(h)$



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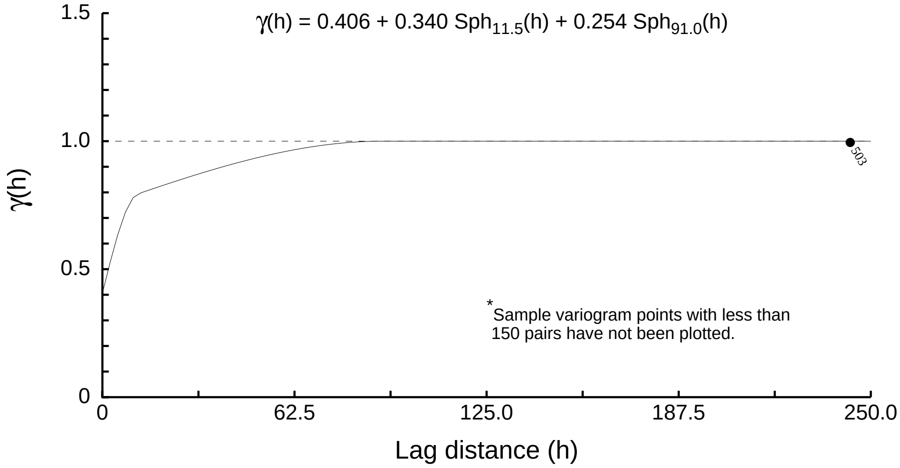
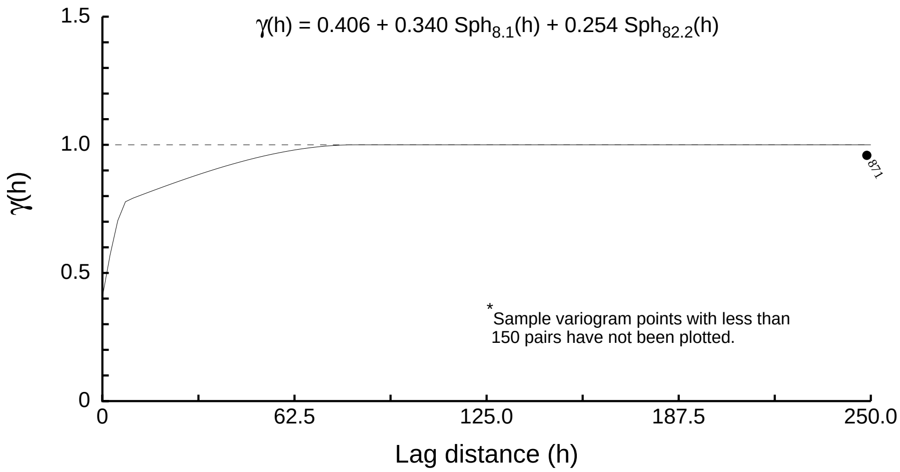
NorthMet U_20_Ni_MDIR

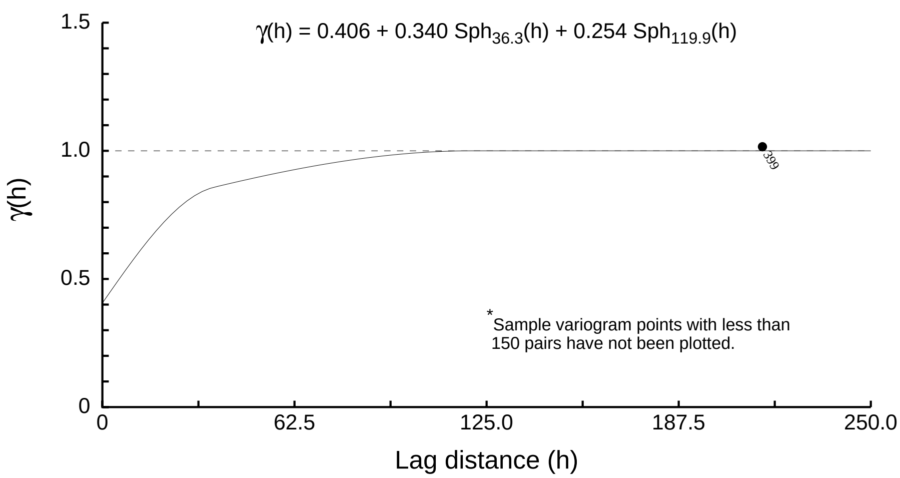
AZIMUTH = 270   DIP = 0



AZIMUTH = 330   DIP = 0



AZIMUTH = 60   DIP = -30



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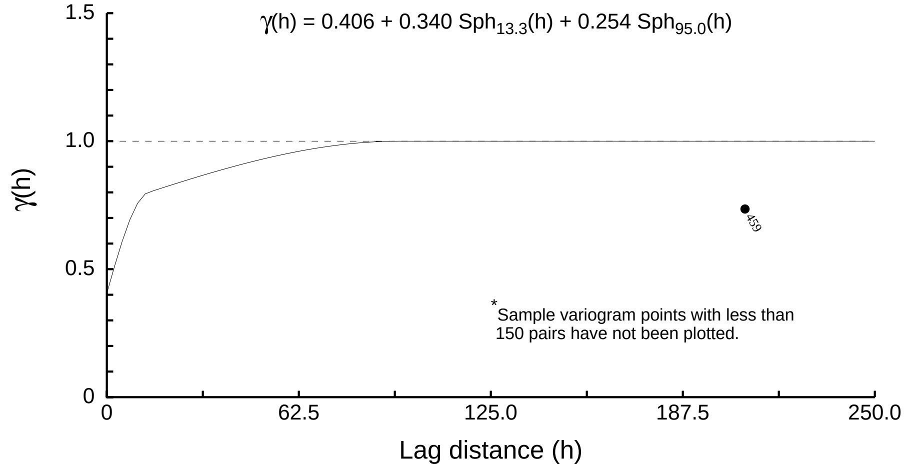
NorthMet U_20_Ni_MDIR

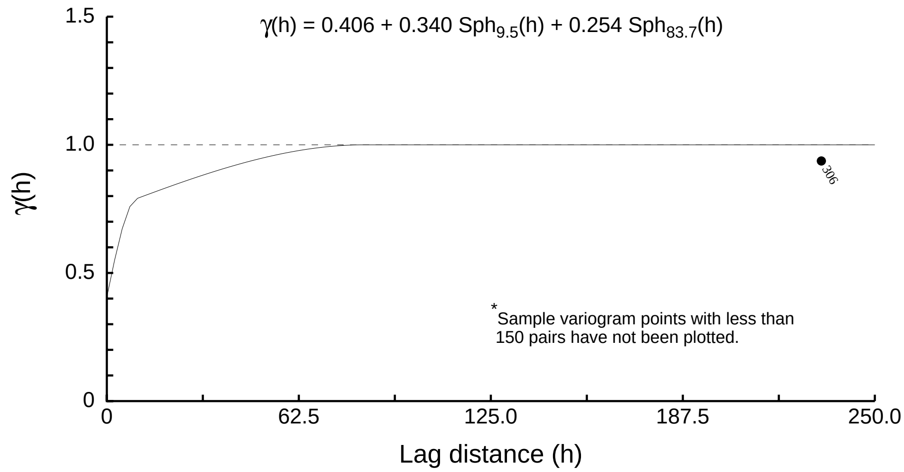
AZIMUTH = 90 DIP = -30

$\gamma(h) = 0.406 + 0.340\ Sph_{13.3}(h) + 0.254\ Sph_{95.0}(h)$



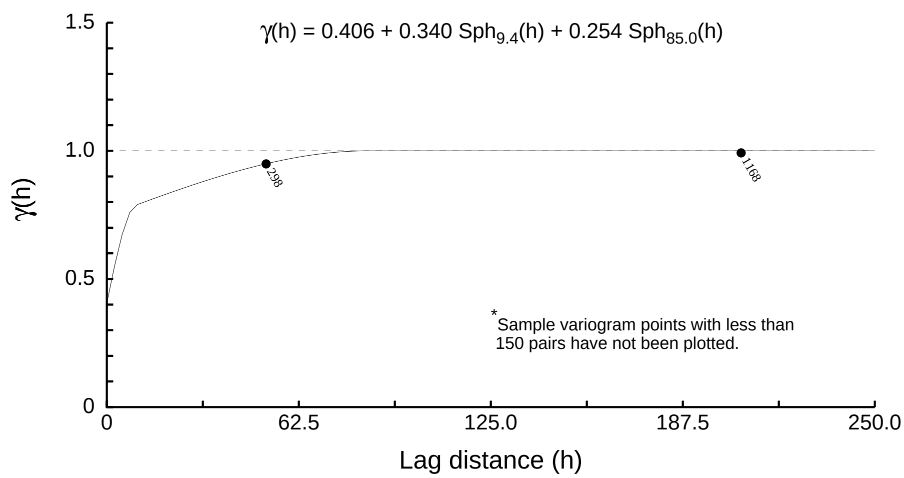
AZIMUTH = 120 DIP = -30

$\gamma(h) = 0.406 + 0.340\ Sph_{9.5}(h) + 0.254\ Sph_{83.7}(h)$



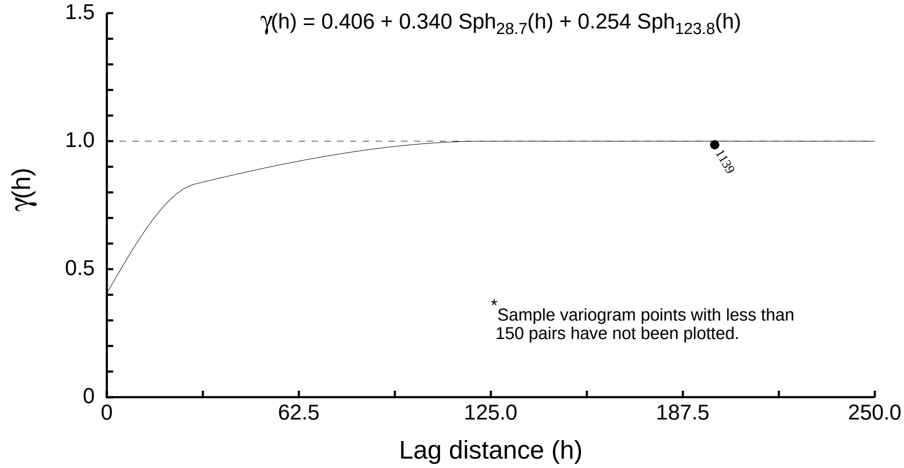
AZIMUTH = 150 DIP = -30

$\gamma(h) = 0.406 + 0.340\ Sph_{9.4}(h) + 0.254\ Sph_{85.0}(h)$

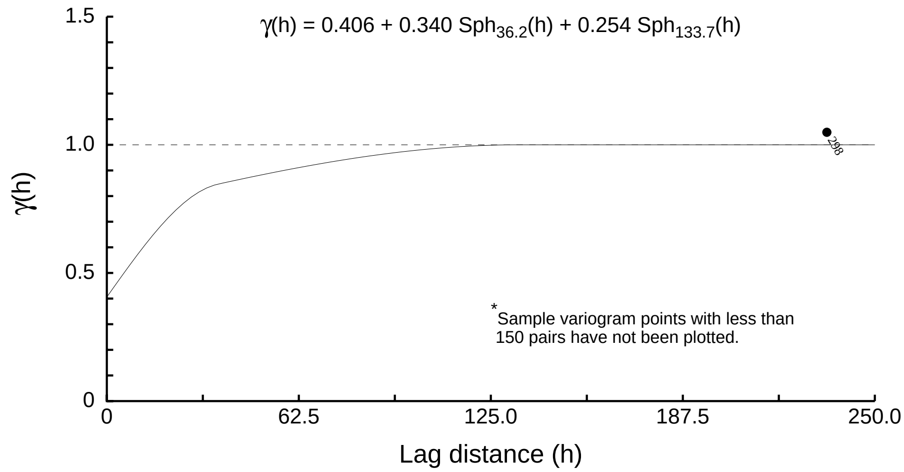


NorthMet U_20_Ni_MDIR

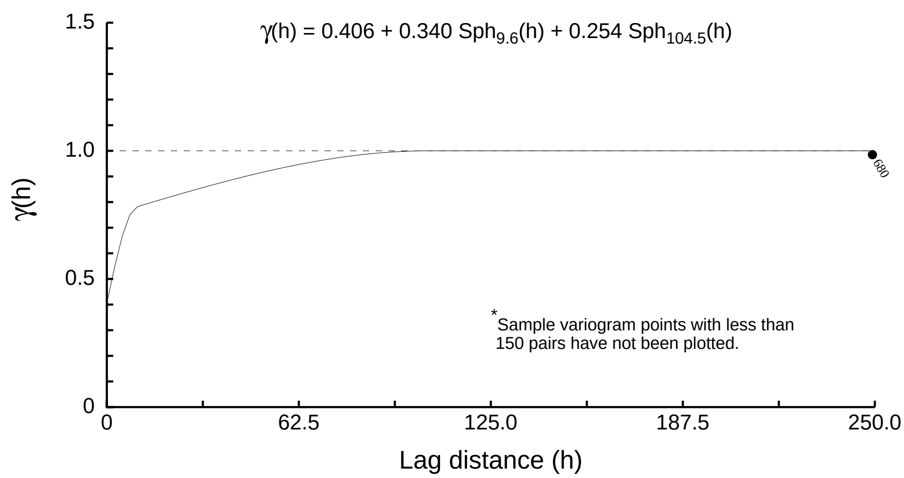
AZIMUTH = 210   DIP = -30



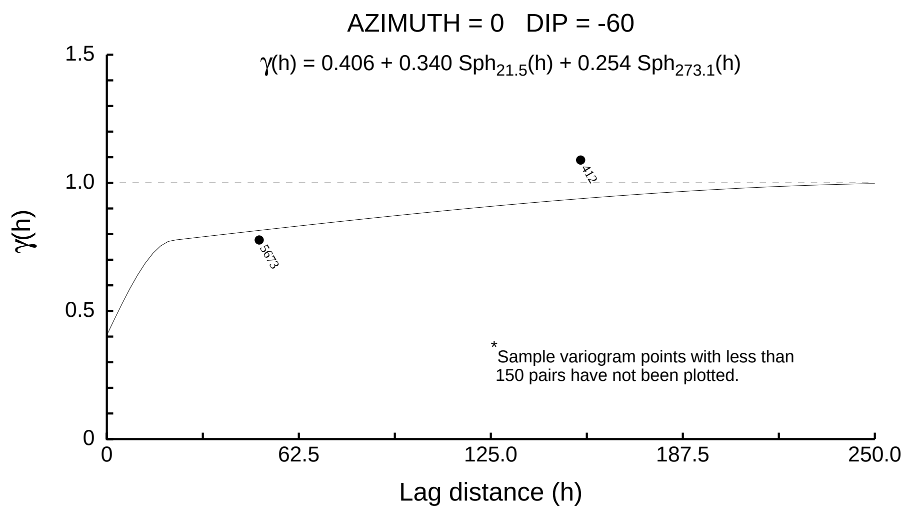
AZIMUTH = 240   DIP = -30

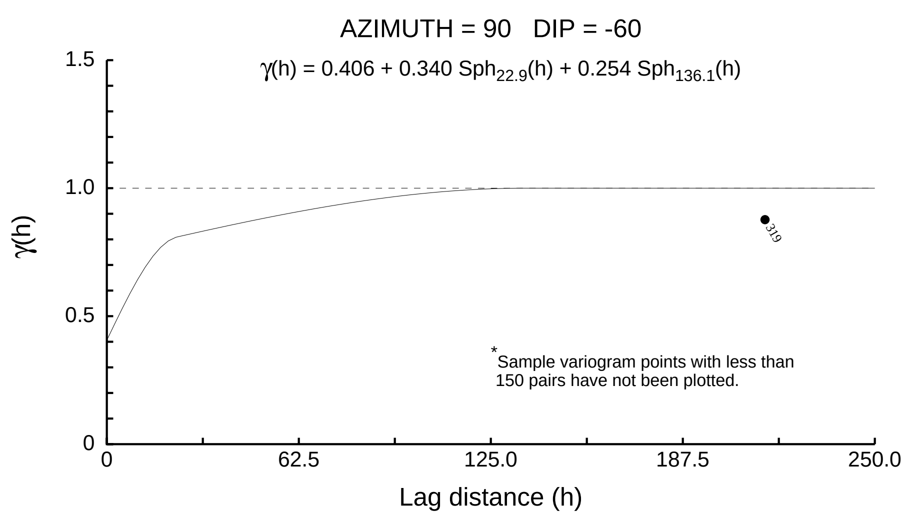


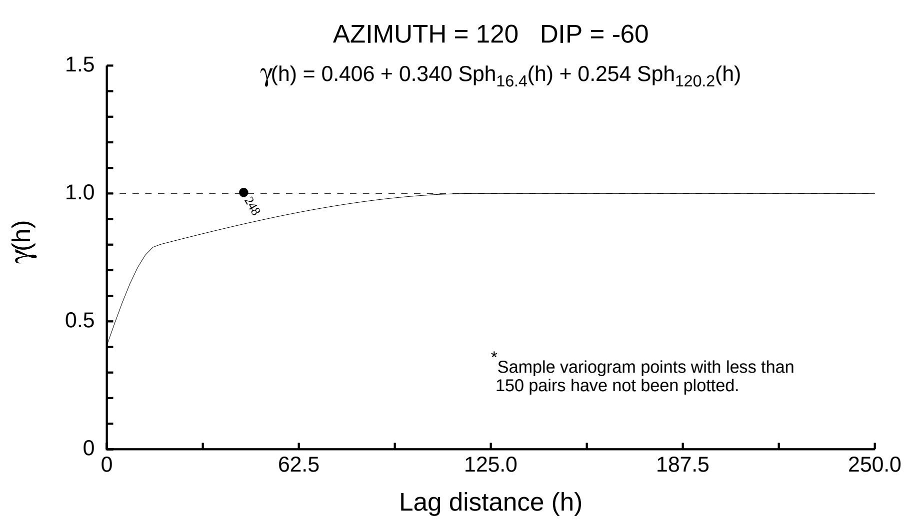
AZIMUTH = 300   DIP = -30



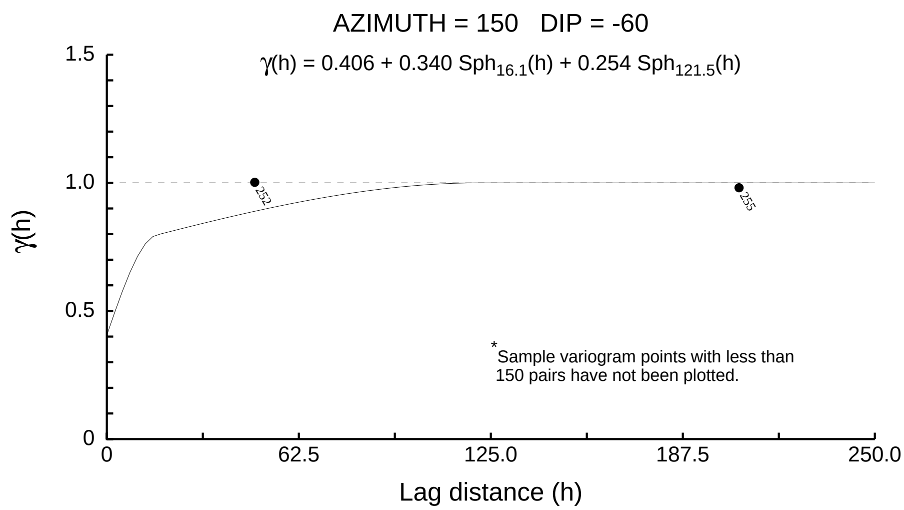
NorthMet U_20_Ni_MDIR

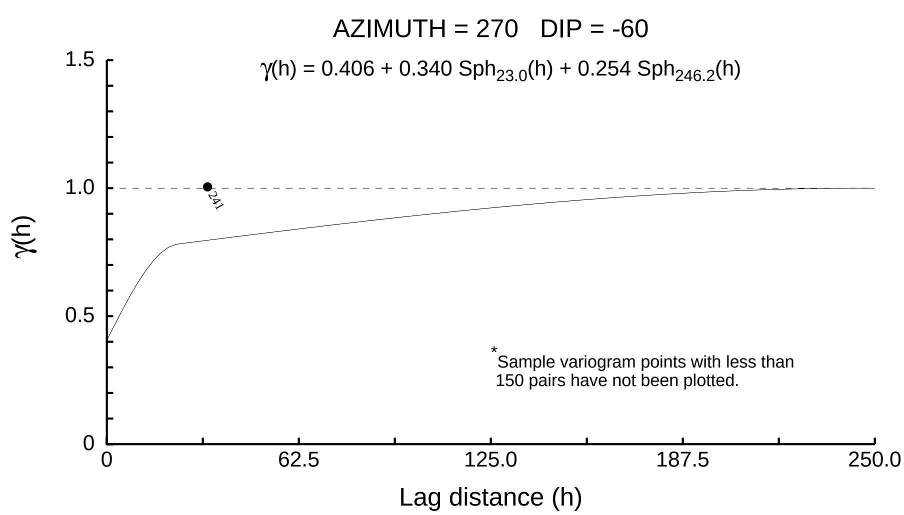


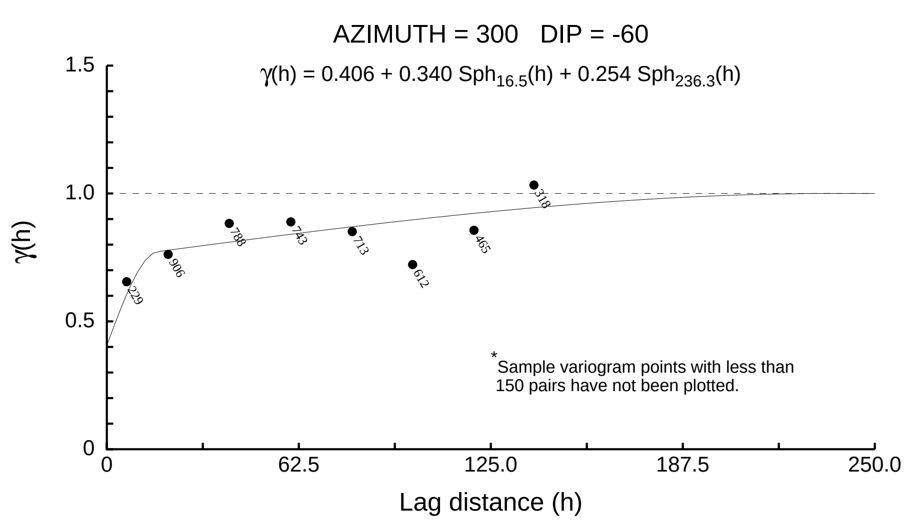




NorthMet U_20_Ni_MDIR







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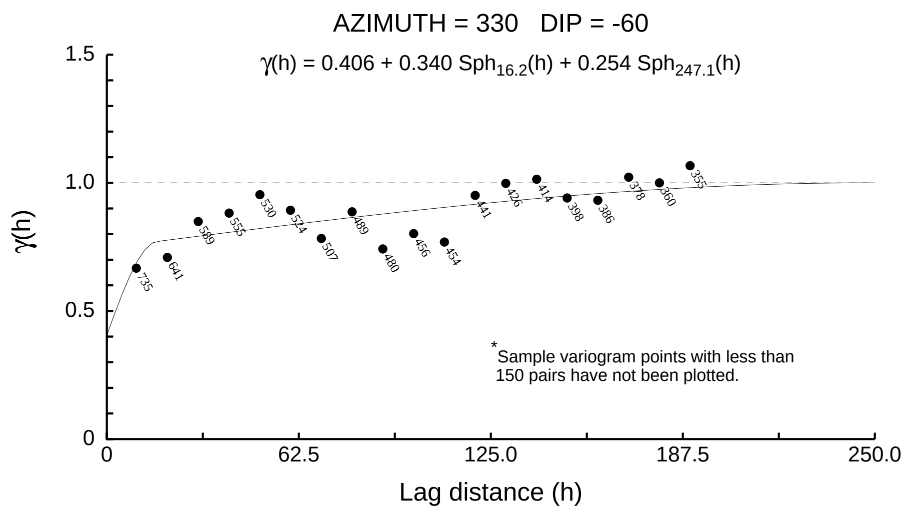
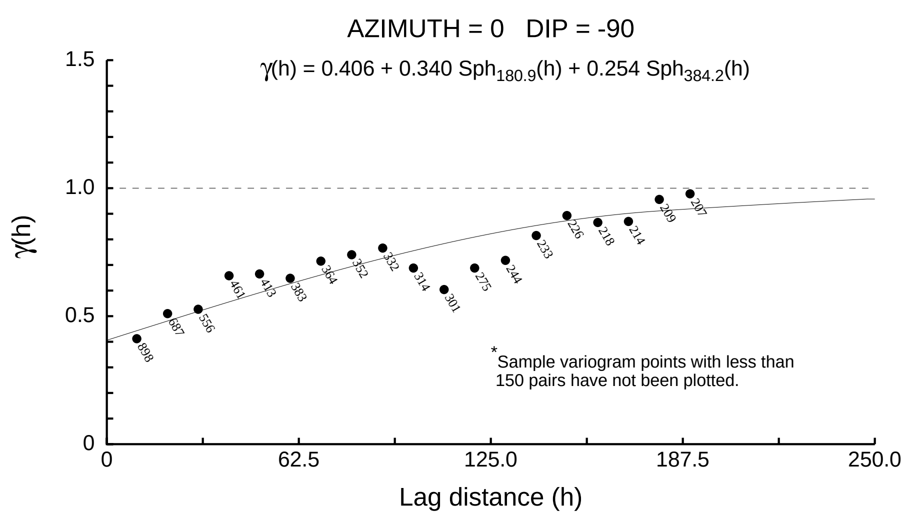
NorthMet U_20_Ni_MDIR





NorthMet U_20_Pd_MDIR

User Defined Rotation Conventions

Nugget ==> 0.571
C1 ==> 0.198
C2 ==> 0.231

First Structure -- Spherical

RH Rotation about the Z axis ==> -35
RH Rotation about the Y' axis ==> 61
RH Rotation about the Z' axis ==> -55
Range along the Z' axis ==> 163.5 Azimuth ==> 125 Dip ==> 29
Range along the Y' axis ==> 140.4 Azimuth ==> 70 Dip ==> -46
Range along the X' axis ==> 44.1 Azimuth ==> 196 Dip ==> -30

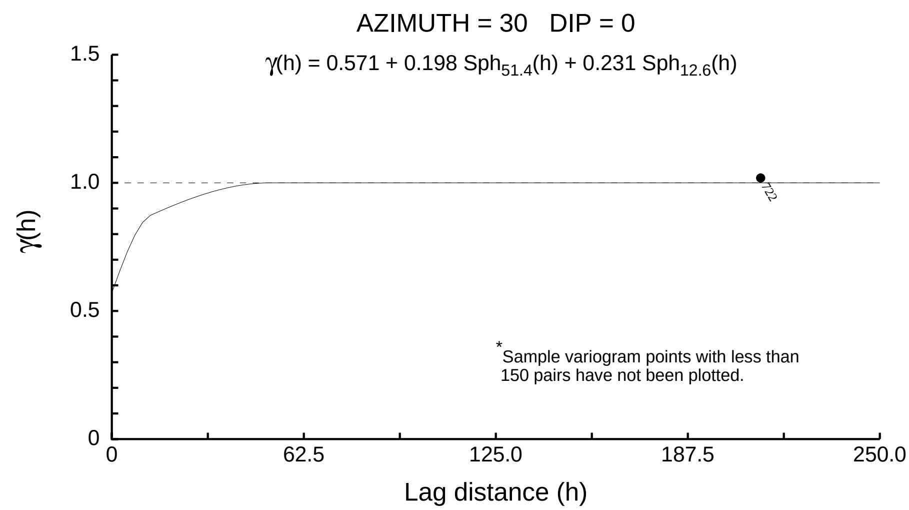
Second Structure -- Spherical

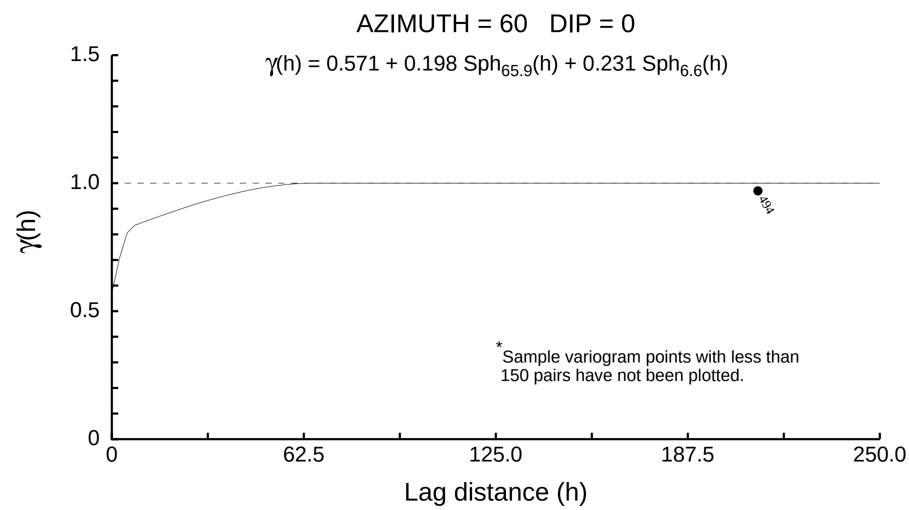
RH Rotation about the Z axis ==> 19
RH Rotation about the Y' axis ==> 0
RH Rotation about the Z' axis ==> -24
Range along the Z' axis ==> 609.0 Azimuth ==> 360 Dip ==> 90
Range along the Y' axis ==> 50.9 Azimuth ==> 5 Dip ==> -0
Range along the X' axis ==> 5.4 Azimuth ==> 95 Dip ==> -0

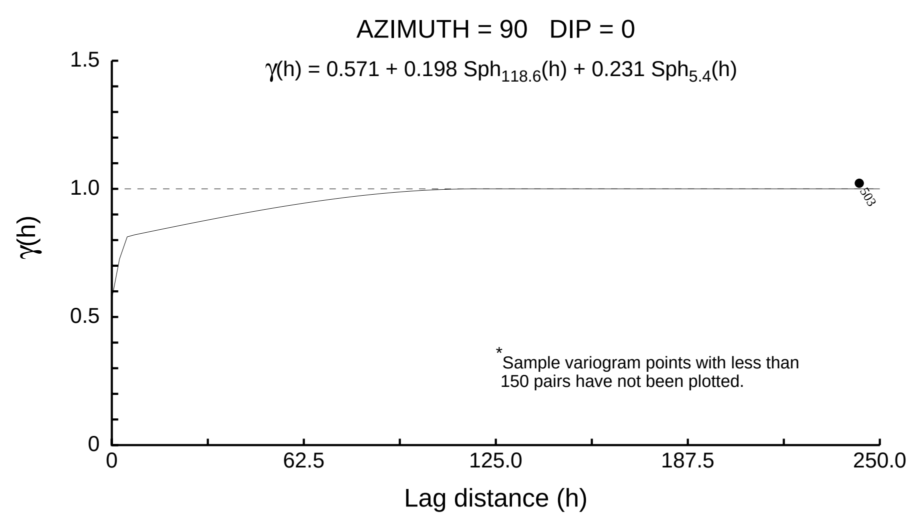
Modeling Criteria

Minimum number pairs req'd ==> 150
Sample variogram points weighted by # pairs

NorthMet U_20_Pd_MDIR







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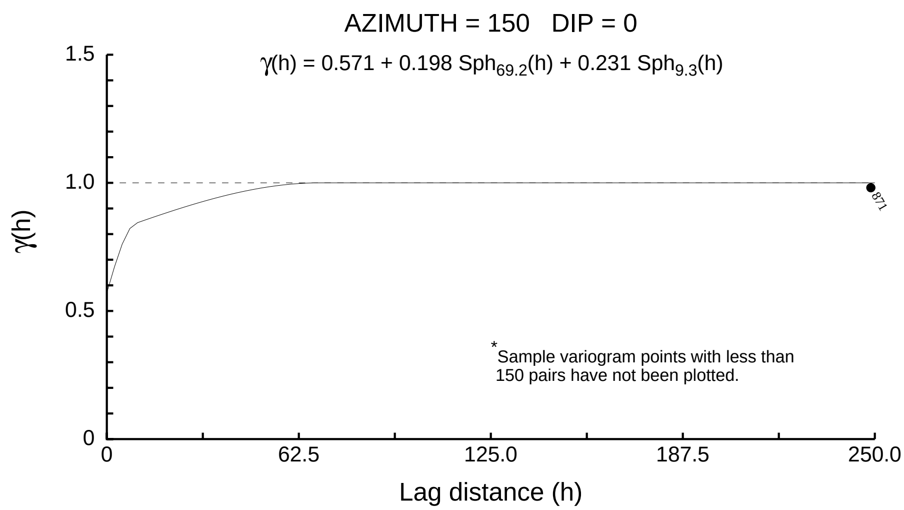
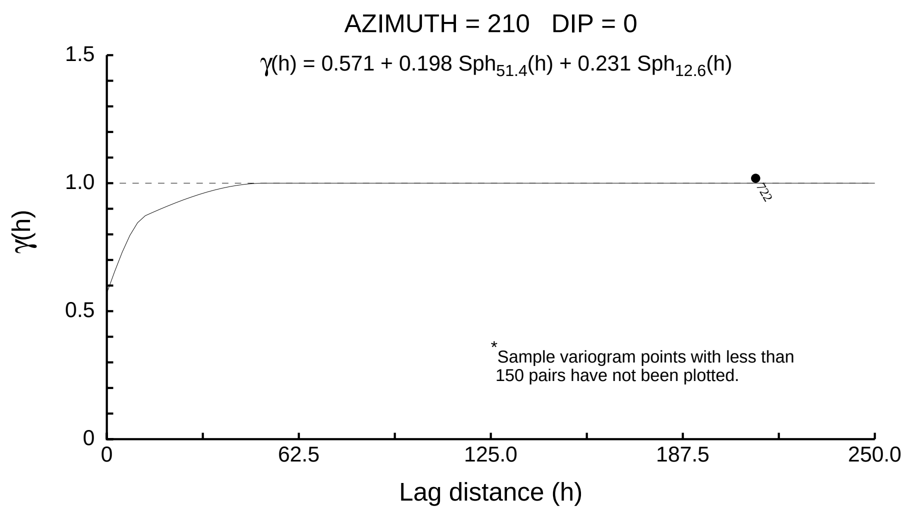
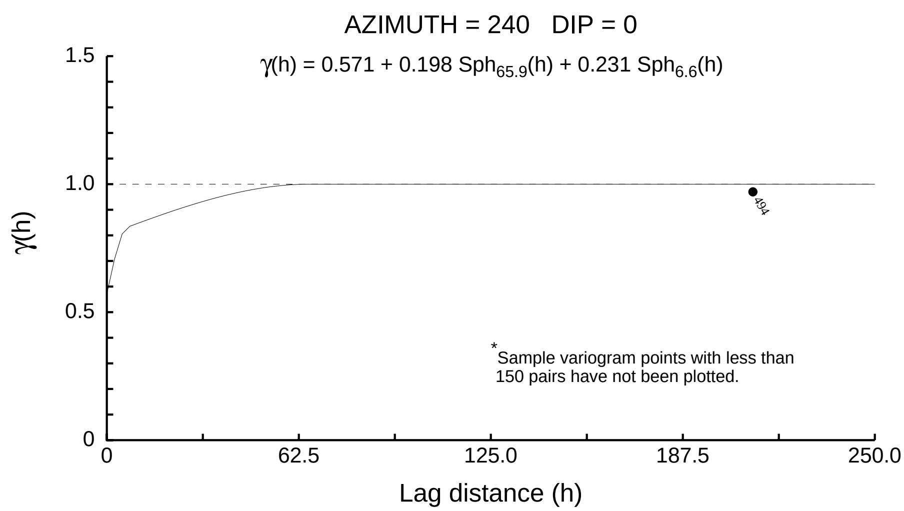
NorthMet U_20_Pd_MDIR







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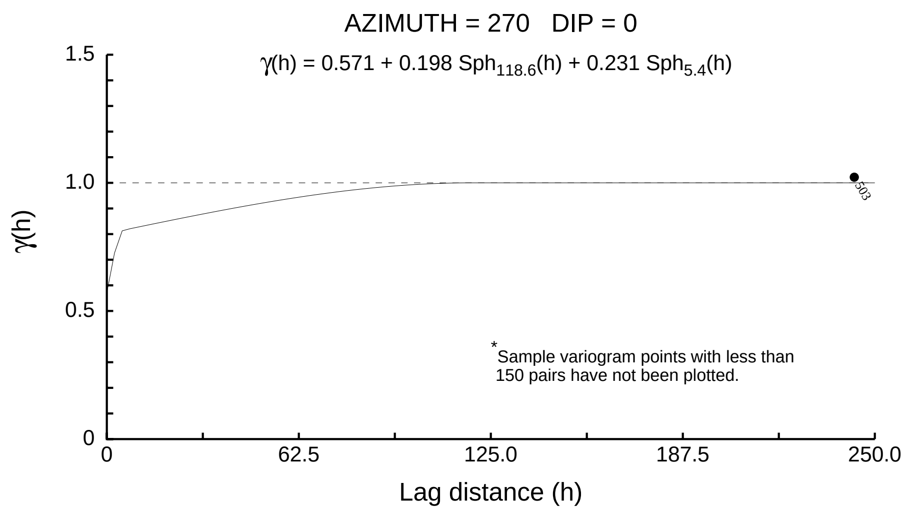

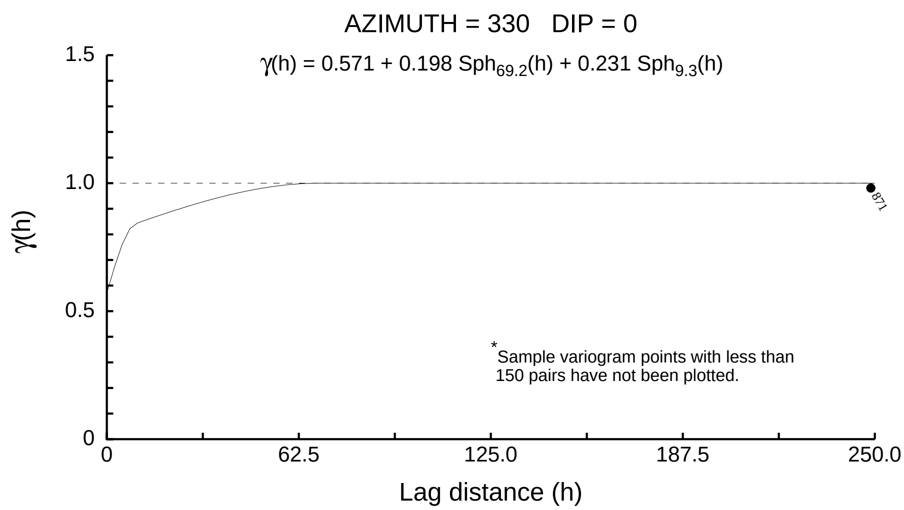

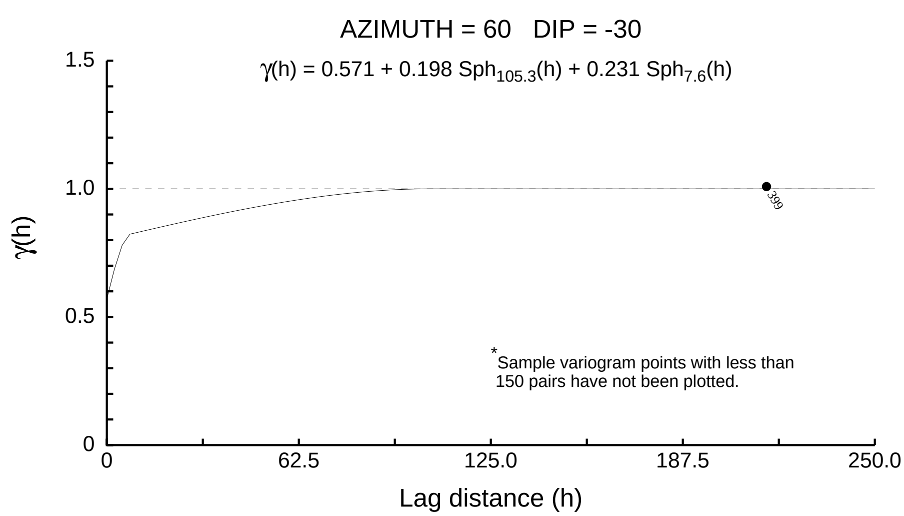

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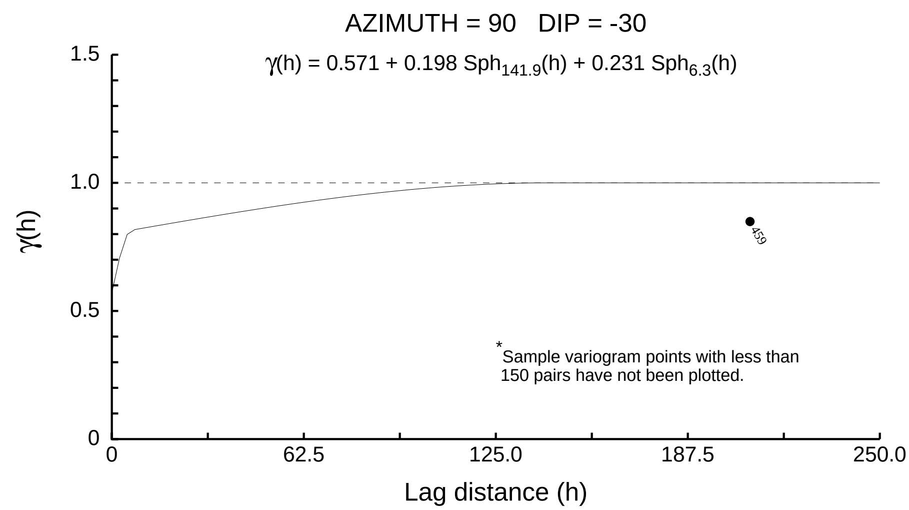

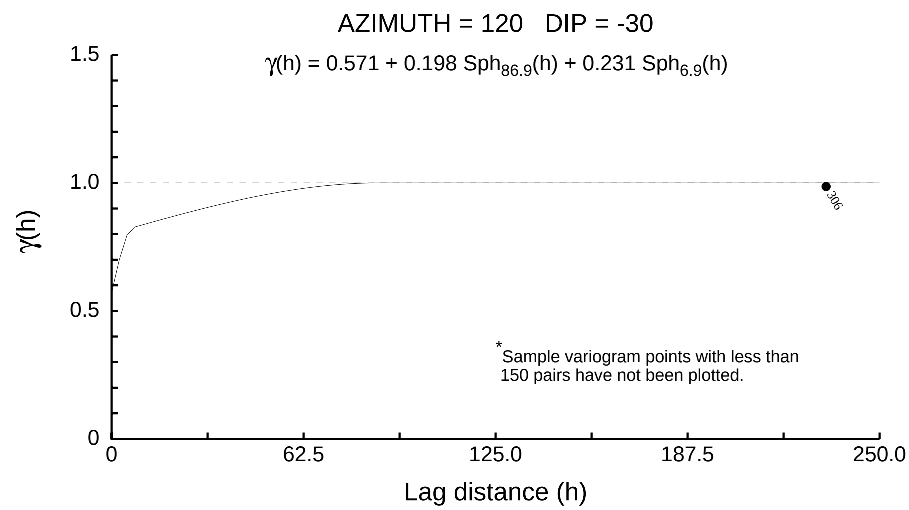

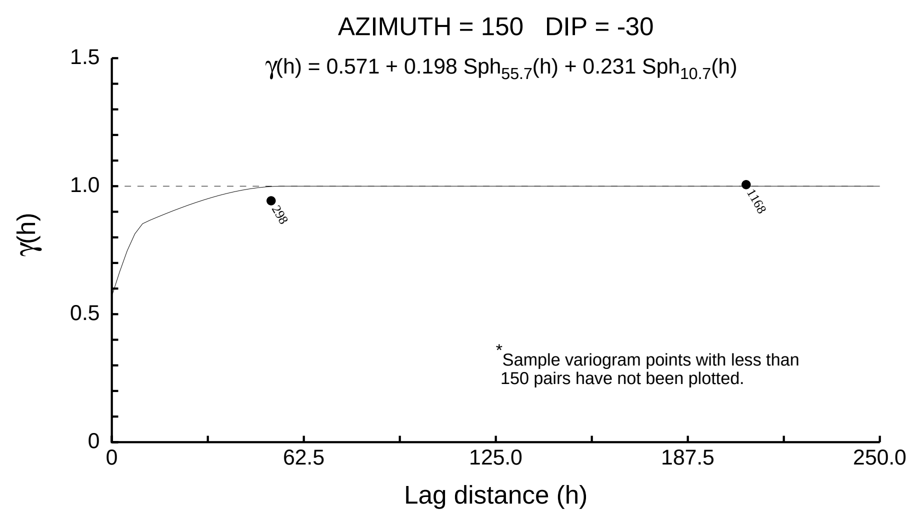

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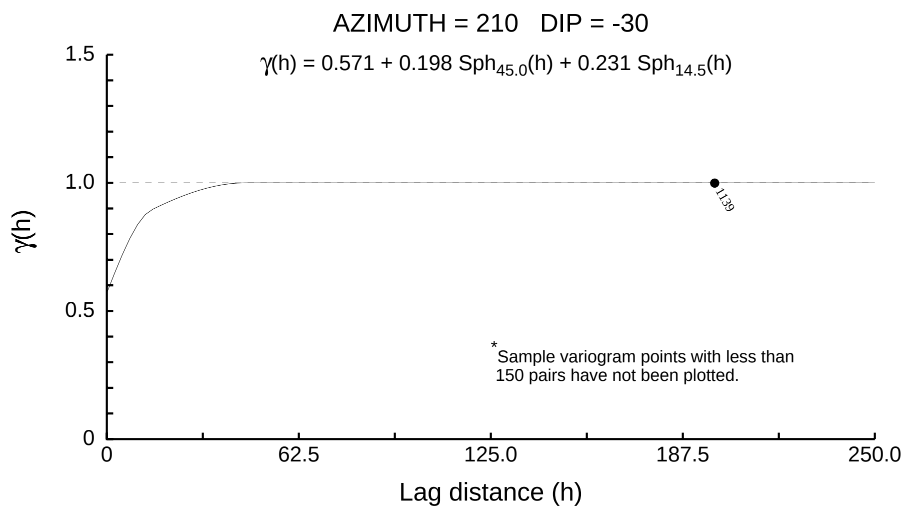

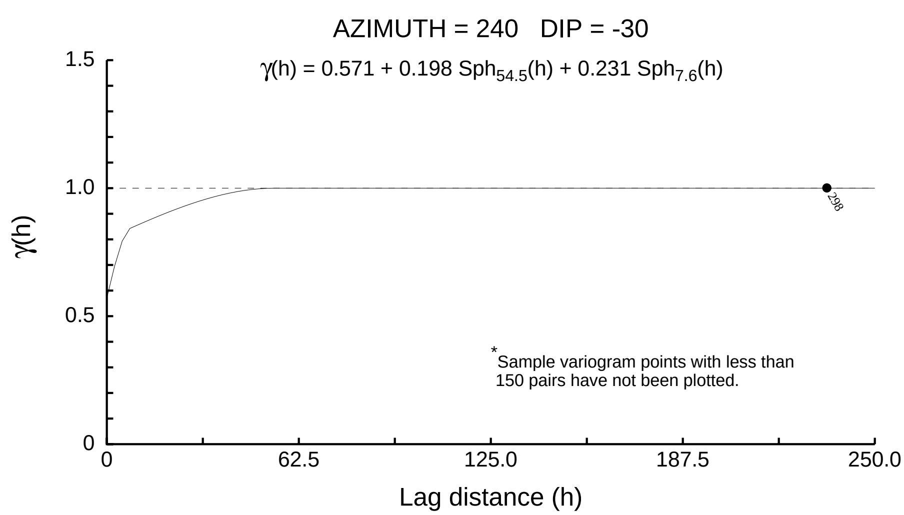

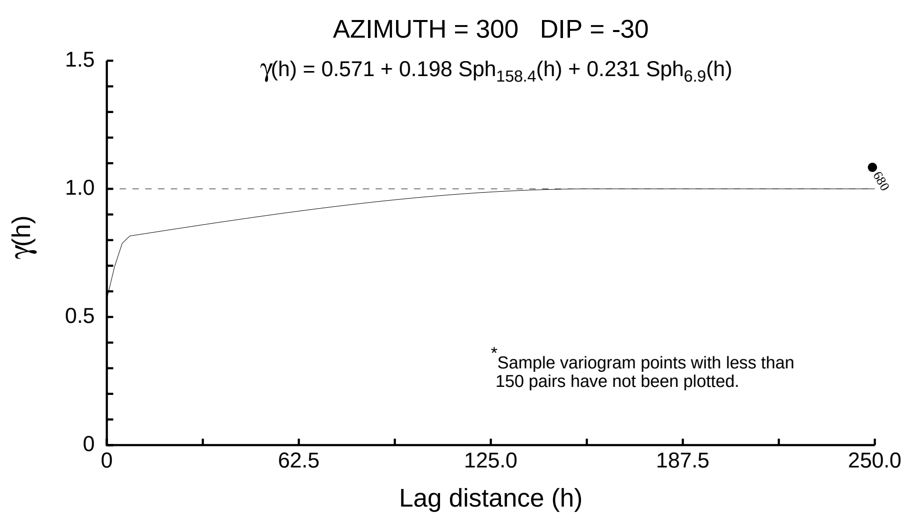

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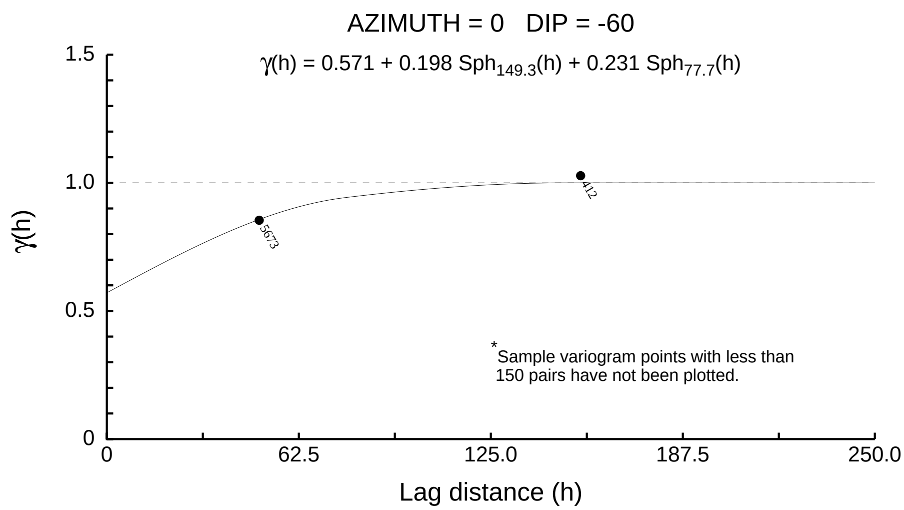
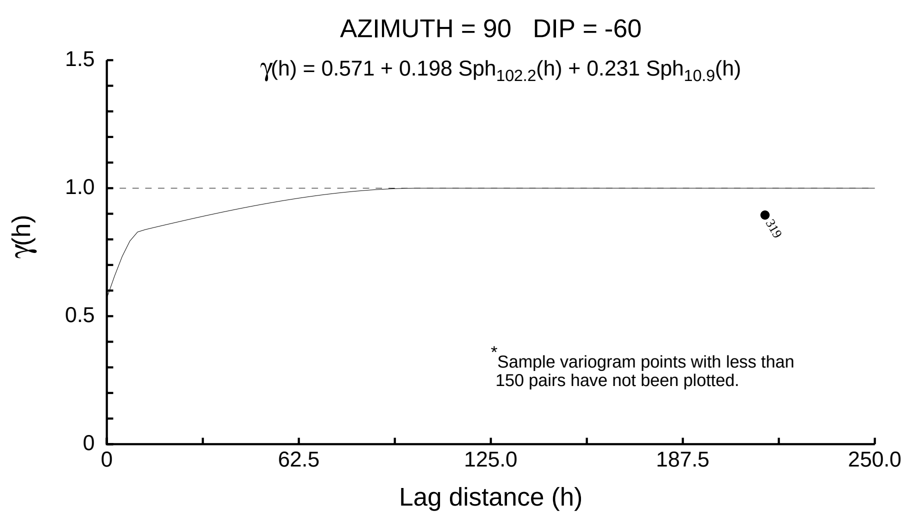
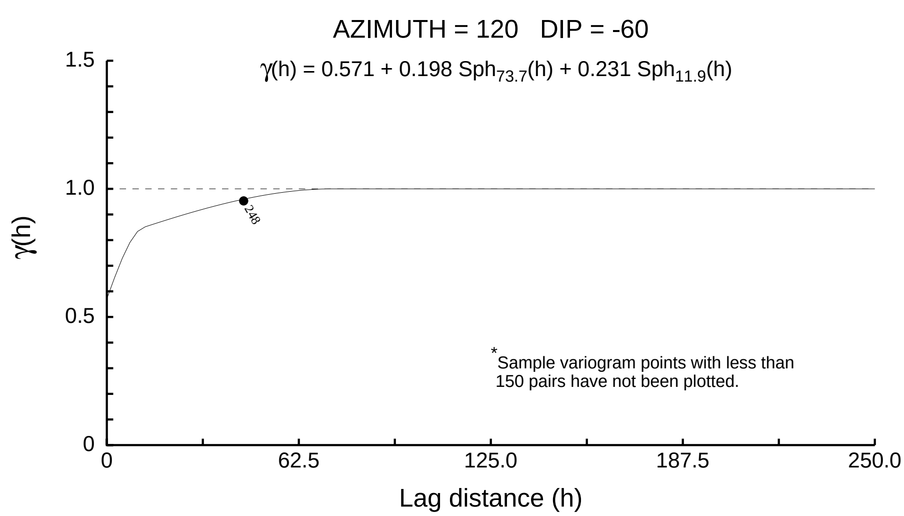
NorthMet U_20_Pd_MDIR







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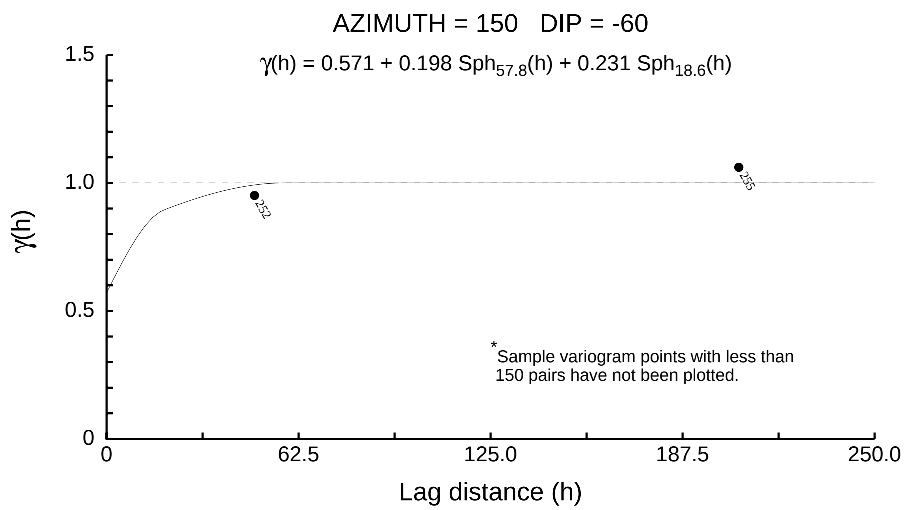
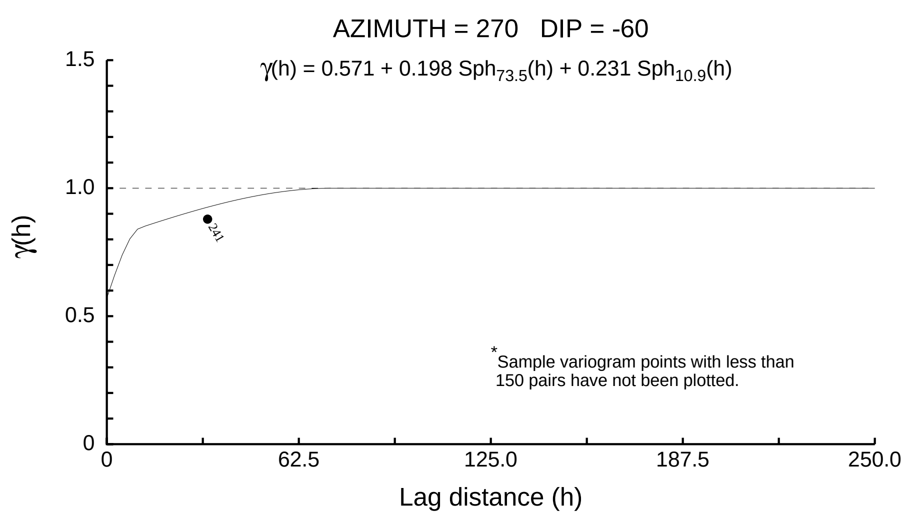
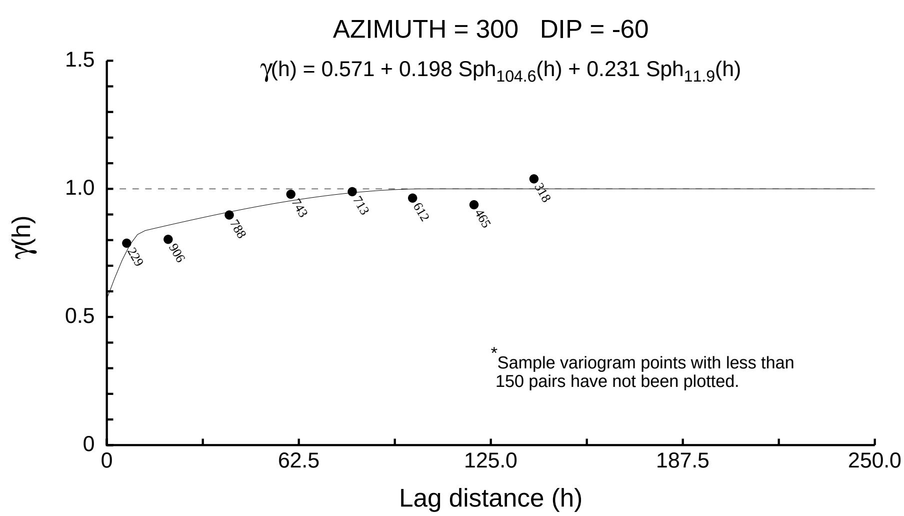
NorthMet U_20_Pd_MDIR







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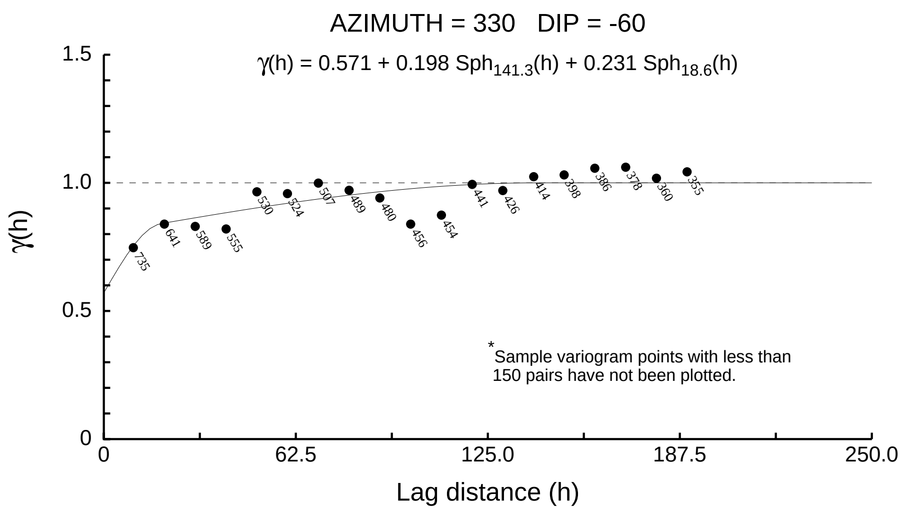
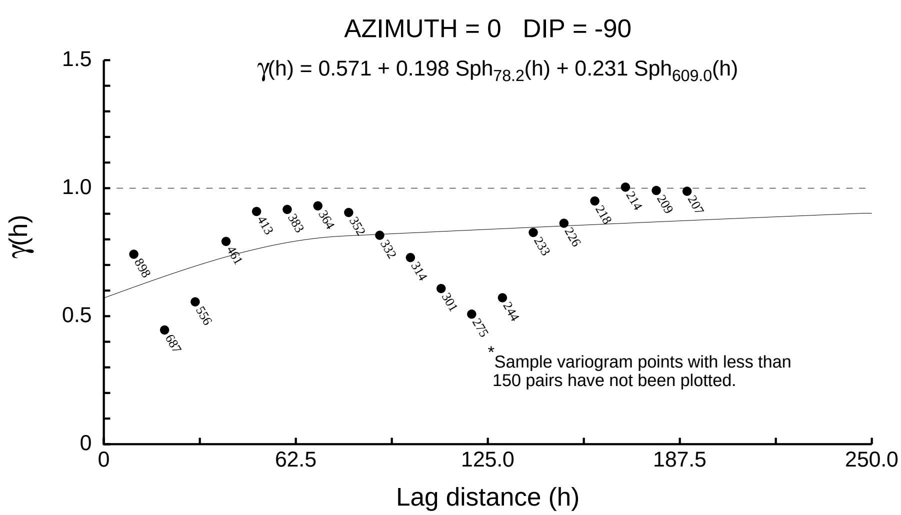
NorthMet U_20_Pd_MDIR





NorthMet U_20_Pt_MDIR

User Defined Rotation Conventions

Nugget ==> 0.434
C1 ==> 0.402
C2 ==> 0.164

First Structure -- Spherical

RH Rotation about the Z axis ==> -14
RH Rotation about the Y' axis ==> 89
RH Rotation about the Z' axis ==> -47

Range along the Z' axis	==> 4.9	Azimuth ==> 104	Dip ==> 1
Range along the Y' axis	==> 52.1	Azimuth ==> 14	Dip ==> -47
Range along the X' axis	==> 81.3	Azimuth ==> 193	Dip ==> -43

Second Structure -- Spherical

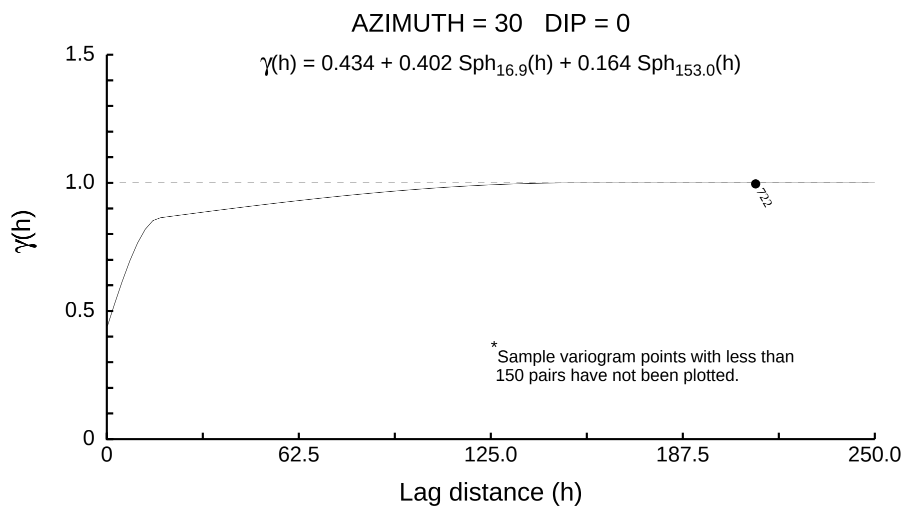
RH Rotation about the Z axis ==> -6
RH Rotation about the Y' axis ==> 3
RH Rotation about the Z' axis ==> 82

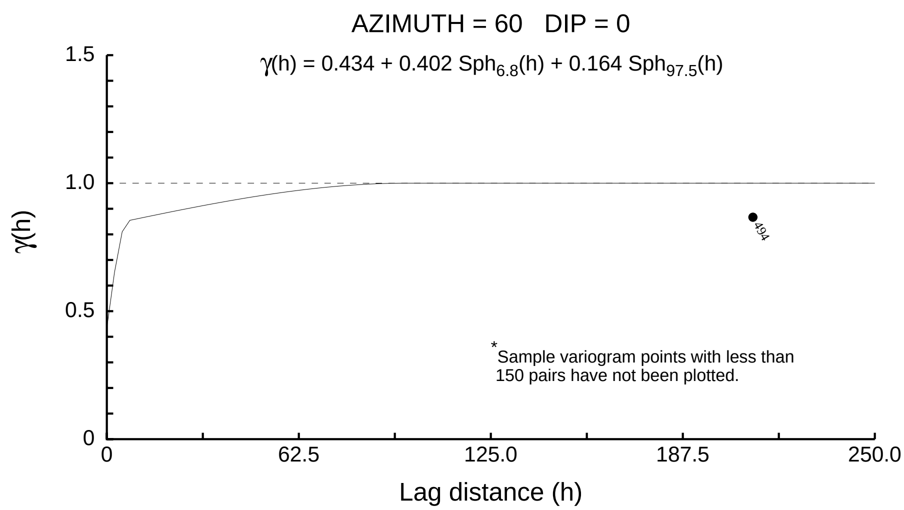
Range along the Z' axis	==> 759.2	Azimuth ==> 96	Dip ==> 87
Range along the Y' axis	==> 76.5	Azimuth ==> 283	Dip ==> 3
Range along the X' axis	==> 179.3	Azimuth ==> 13	Dip ==> -0

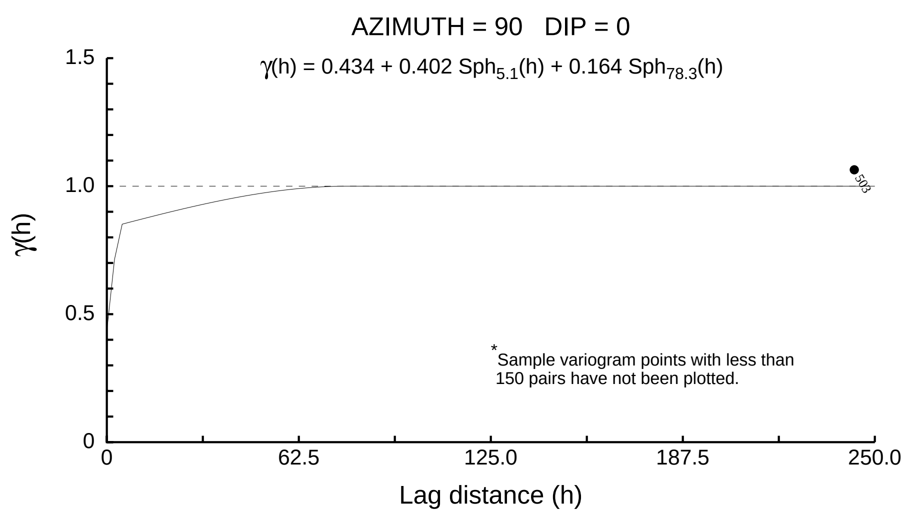
Modeling Criteria

Minimum number pairs req'd ==> 150
Sample variogram points weighted by # pairs

NorthMet U_20_Pt_MDIR







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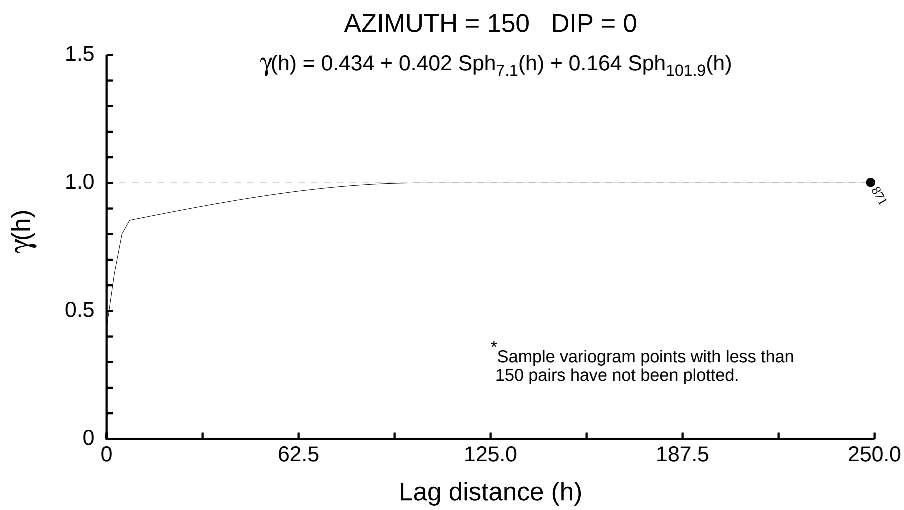
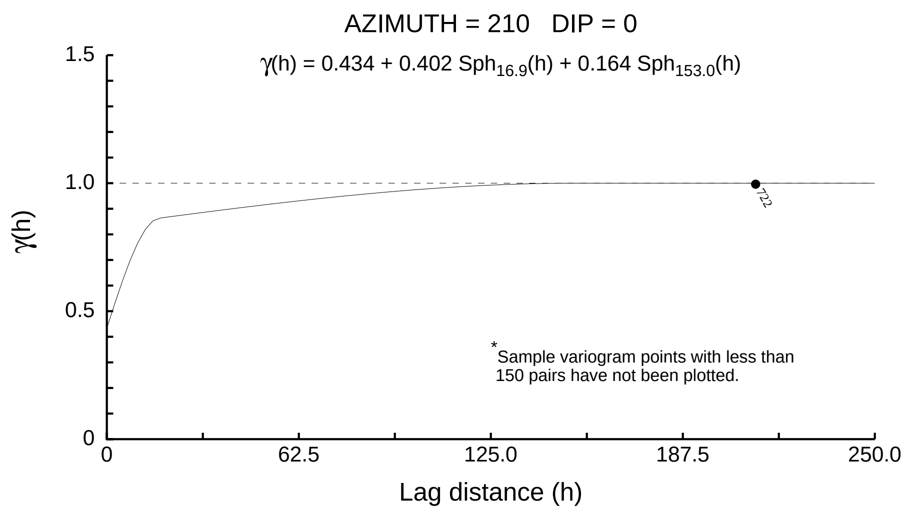
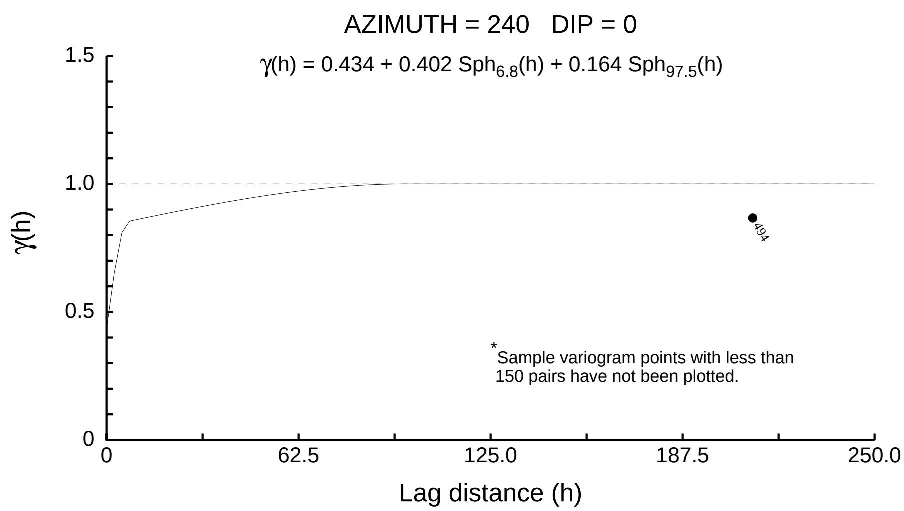
NorthMet U_20_Pt_MDIR







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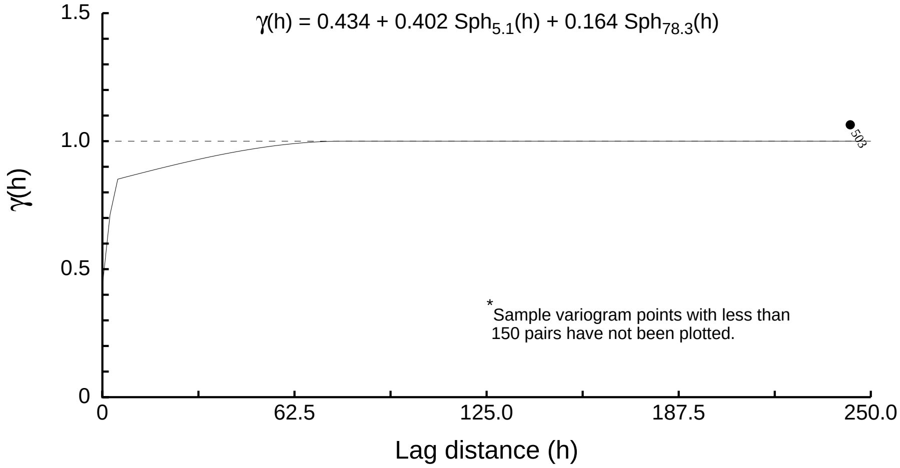
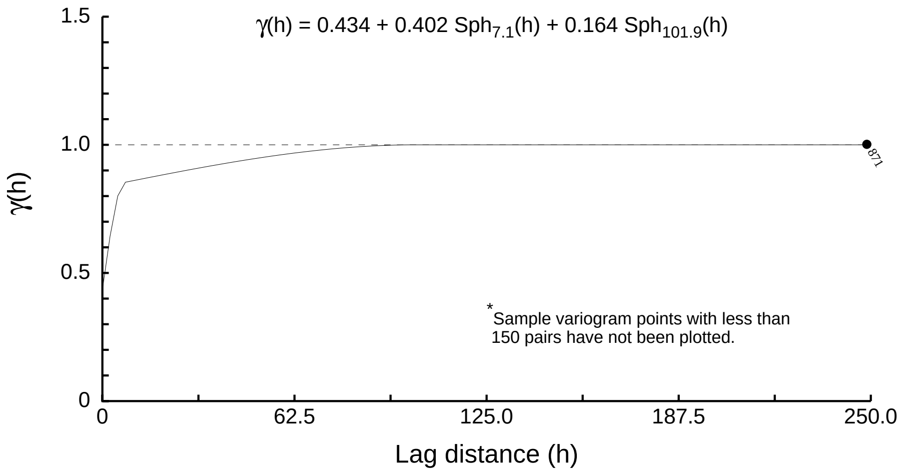
NorthMet U_20_Pt_MDIR

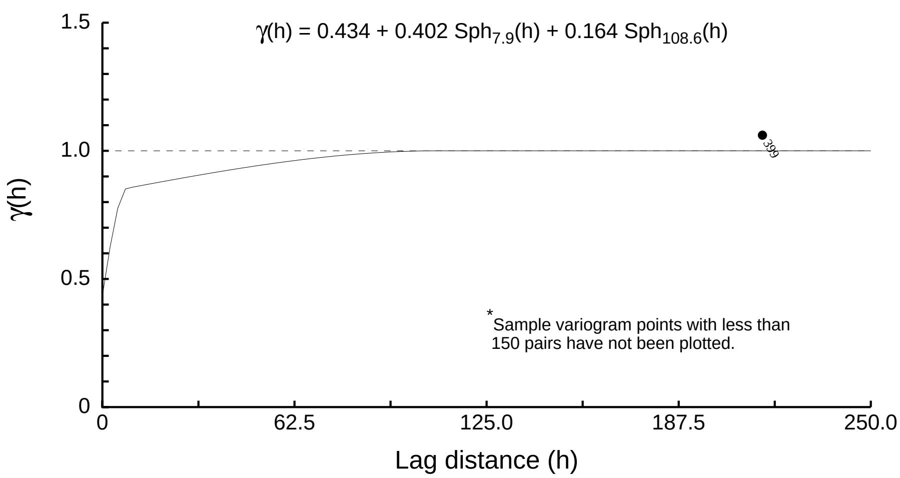
AZIMUTH = 270   DIP = 0



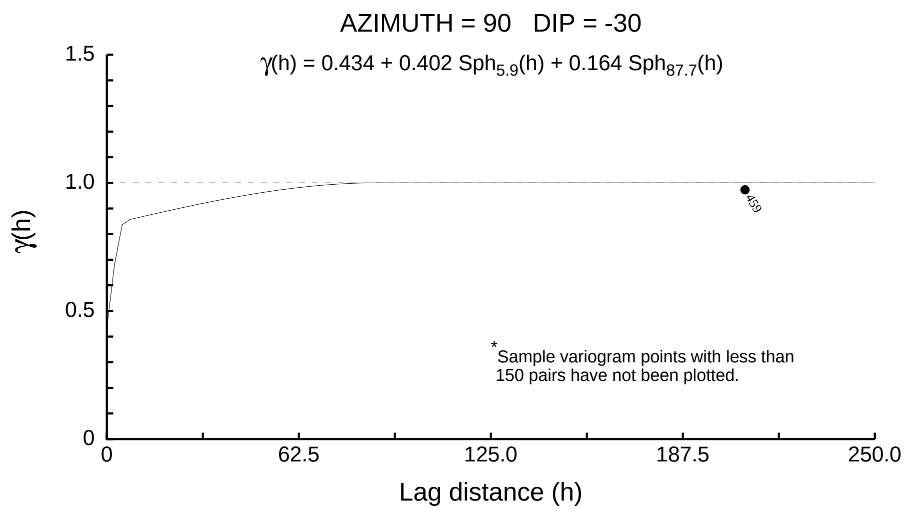
AZIMUTH = 330   DIP = 0

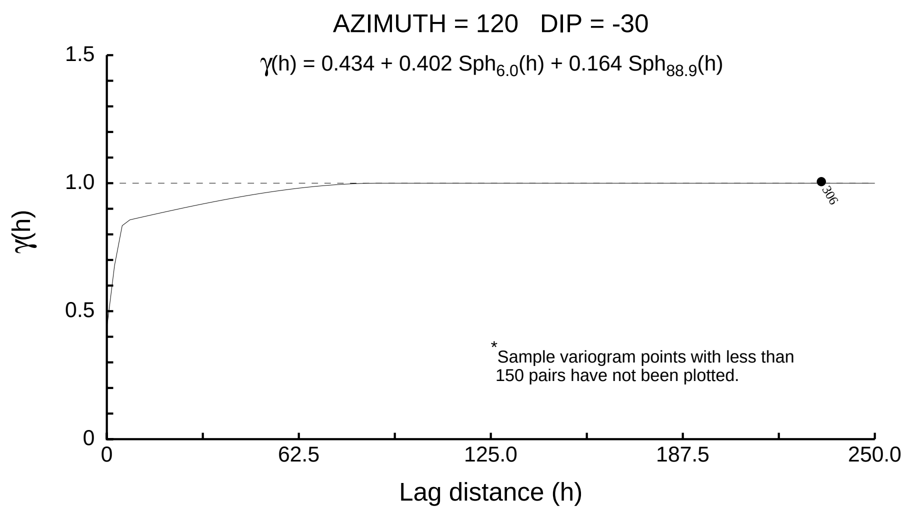


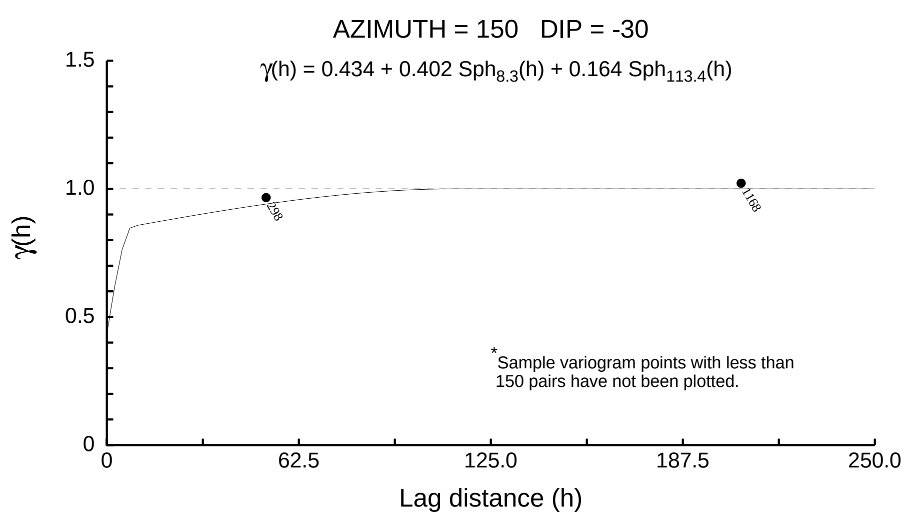
AZIMUTH = 60   DIP = -30



NorthMet U_20_Pt_MDIR







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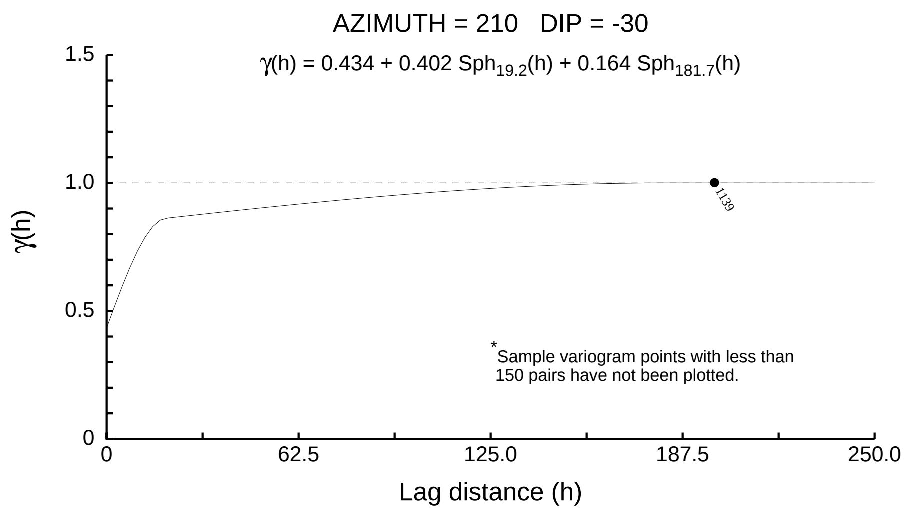
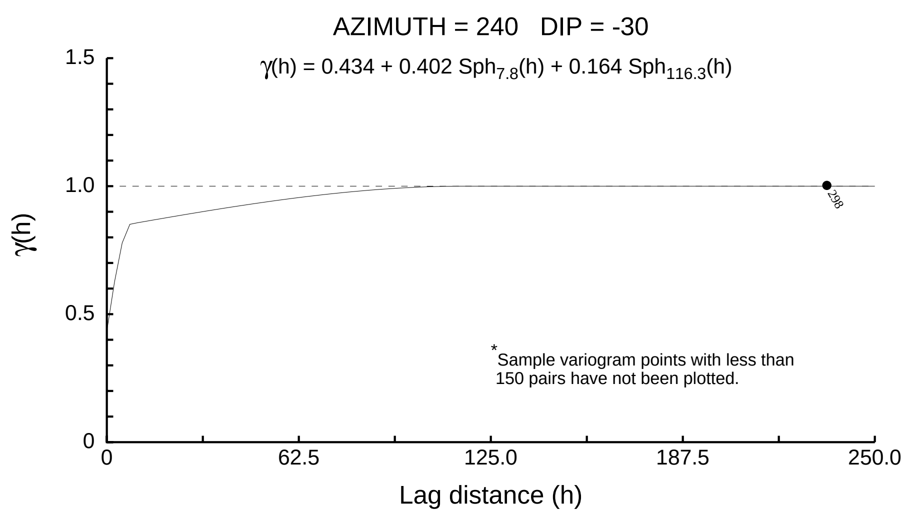
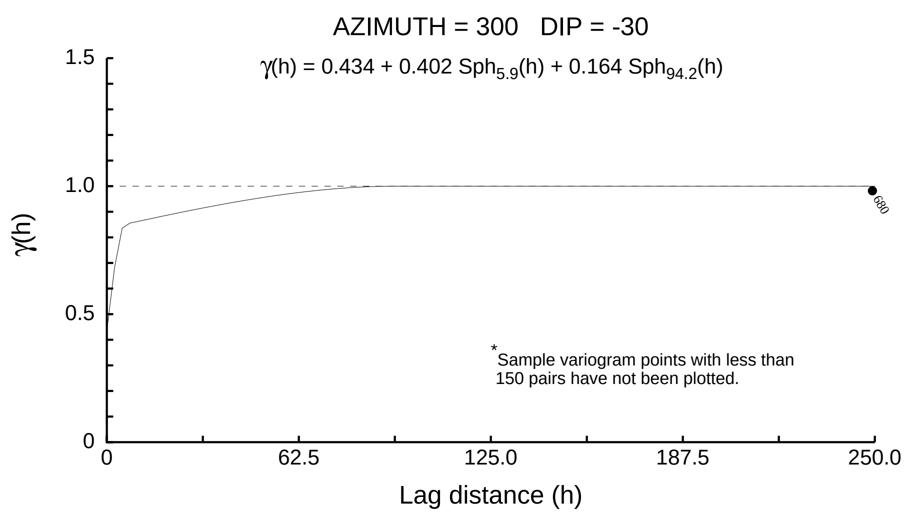
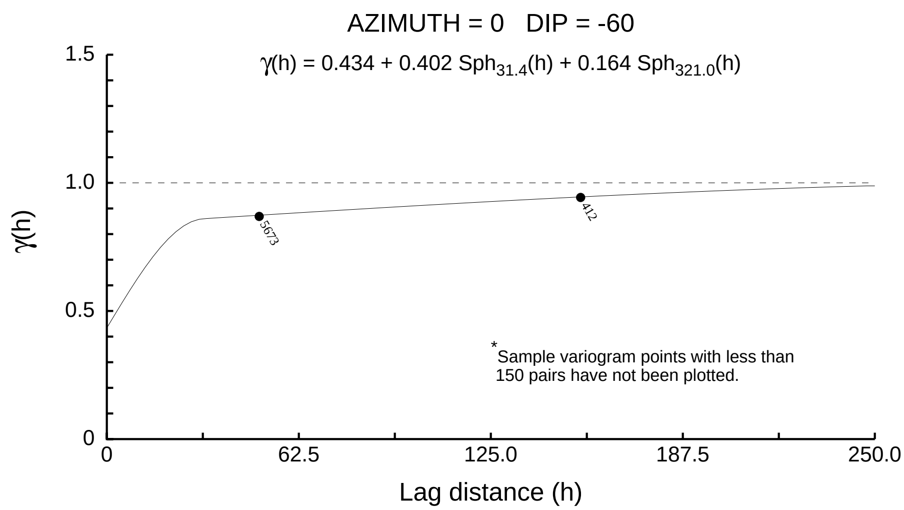
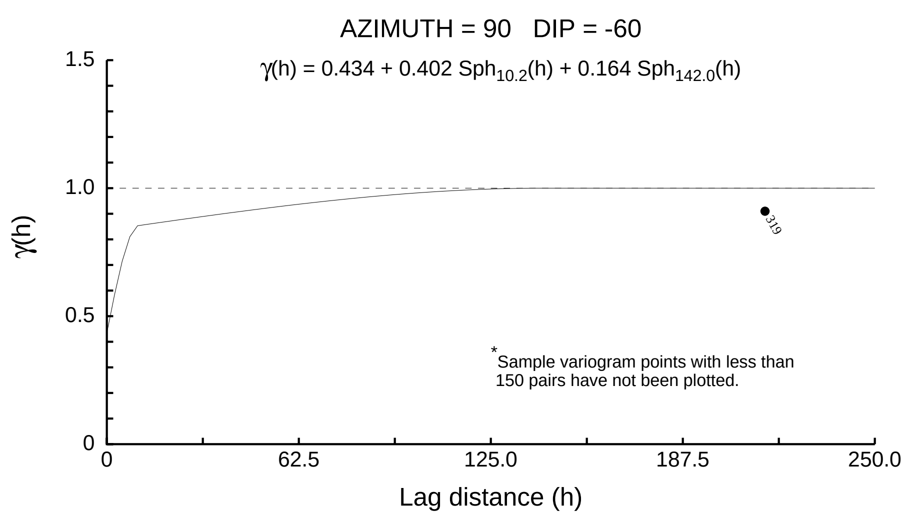


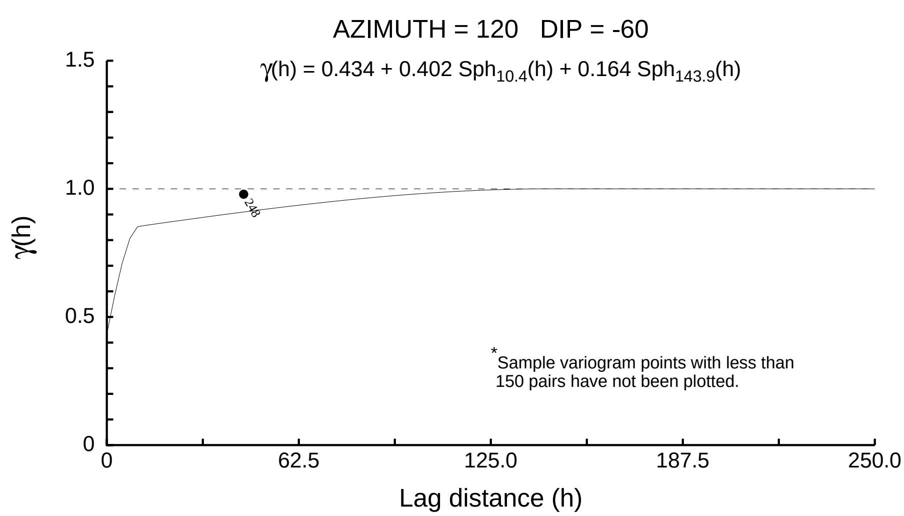




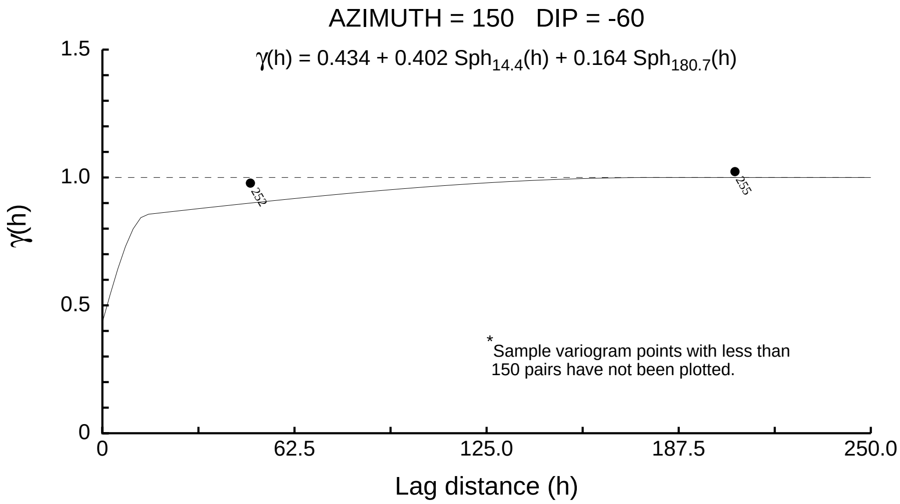
NorthMet U_20_Pt_MDIR

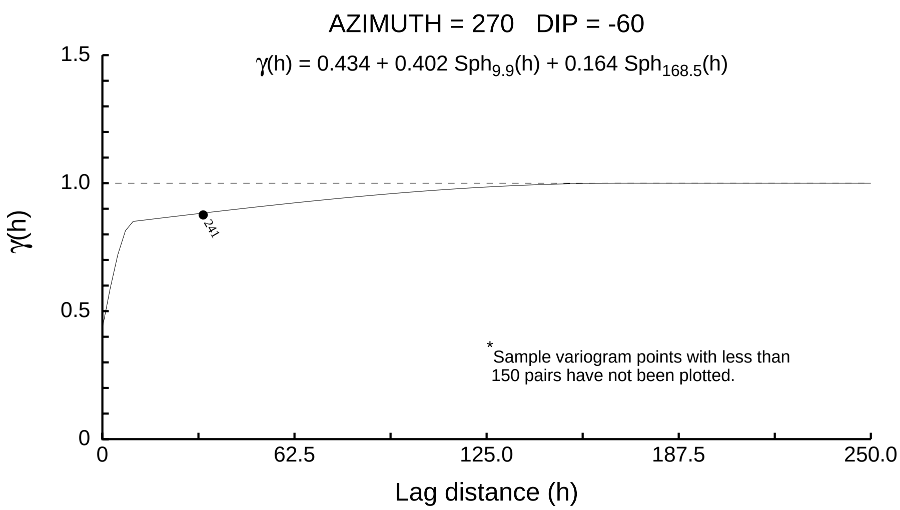


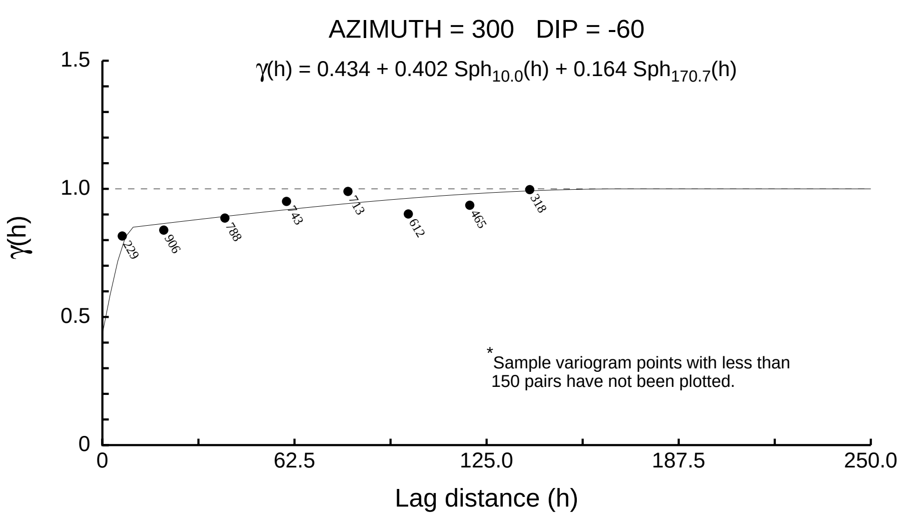




NorthMet U_20_Pt_MDIR







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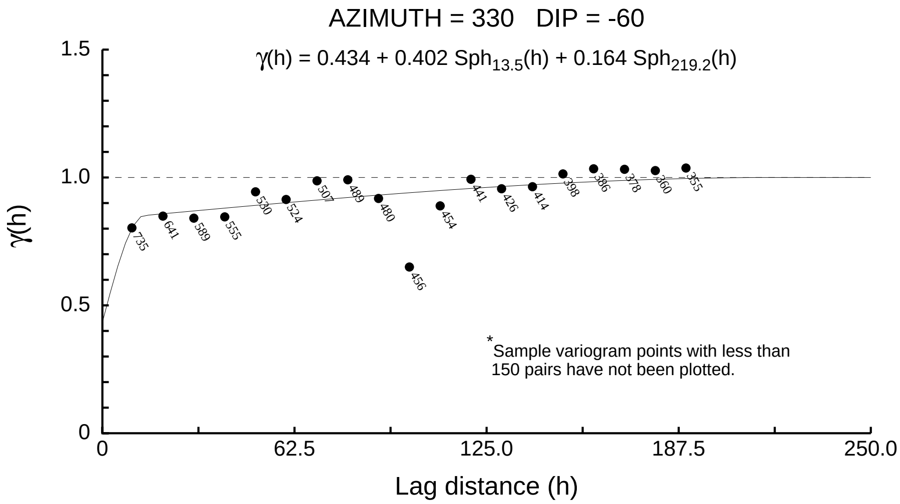
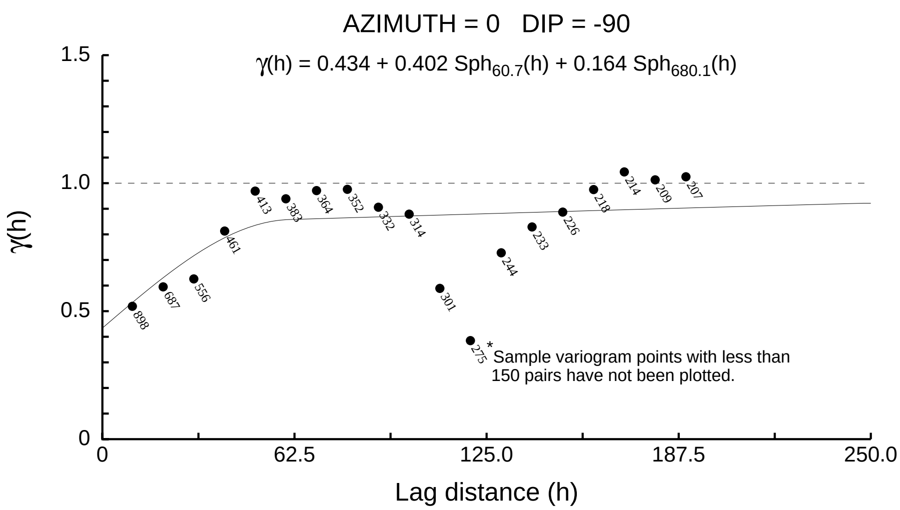
NorthMet U_20_Pt_MDIR





NorthMet U_20_Su_MDIR

User Defined Rotation Conventions

Nugget ==> 0.227
C1 ==> 0.389
C2 ==> 0.384

First Structure -- Spherical

RH Rotation about the Z axis ==> -117
RH Rotation about the Y' axis ==> 28
RH Rotation about the Z' axis ==> 3

Range along the Z' axis	==> 138.8	Azimuth ==> 207	Dip ==> 62
Range along the Y' axis	==> 60.8	Azimuth ==> 114	Dip ==> 1
Range along the X' axis	==> 28.4	Azimuth ==> 203	Dip ==> -28

Second Structure -- Spherical

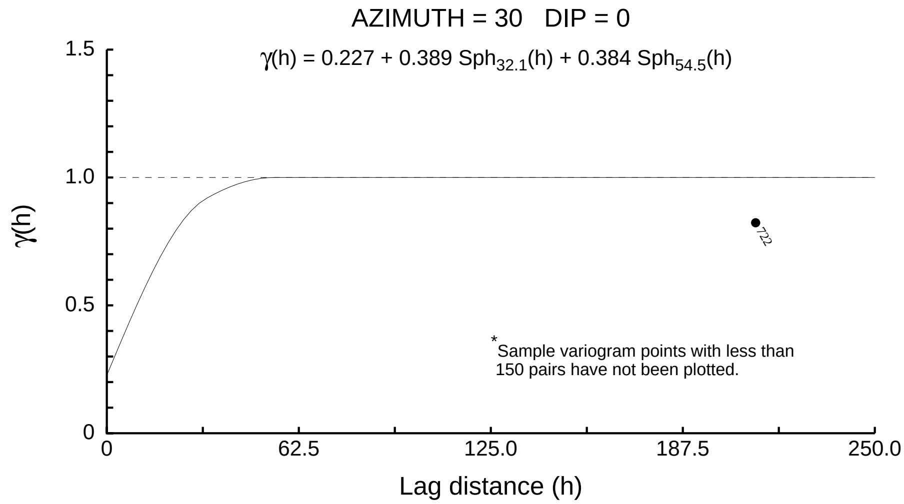
RH Rotation about the Z axis ==> 15
RH Rotation about the Y' axis ==> -0
RH Rotation about the Z' axis ==> 13

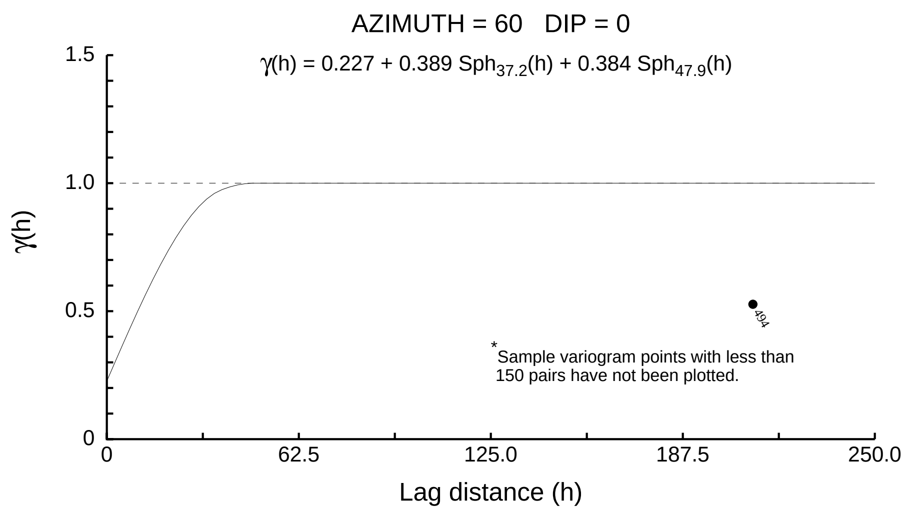
Range along the Z' axis	==> 1410.5	Azimuth ==> 255	Dip ==> 90
Range along the Y' axis	==> 105.4	Azimuth ==> 332	Dip ==> -0
Range along the X' axis	==> 47.9	Azimuth ==> 62	Dip ==> 0

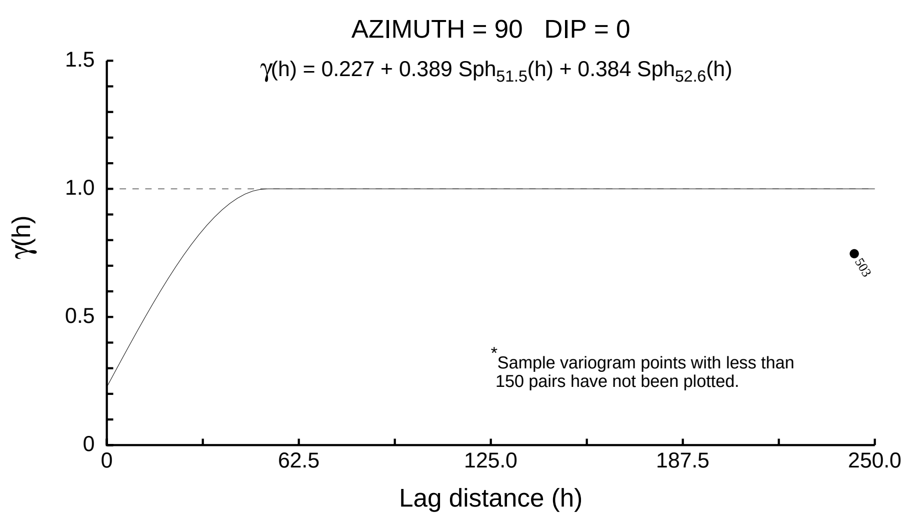
Modeling Criteria

Minimum number pairs req'd ==> 150
Sample variogram points weighted by # pairs

NorthMet U_20_Su_MDIR







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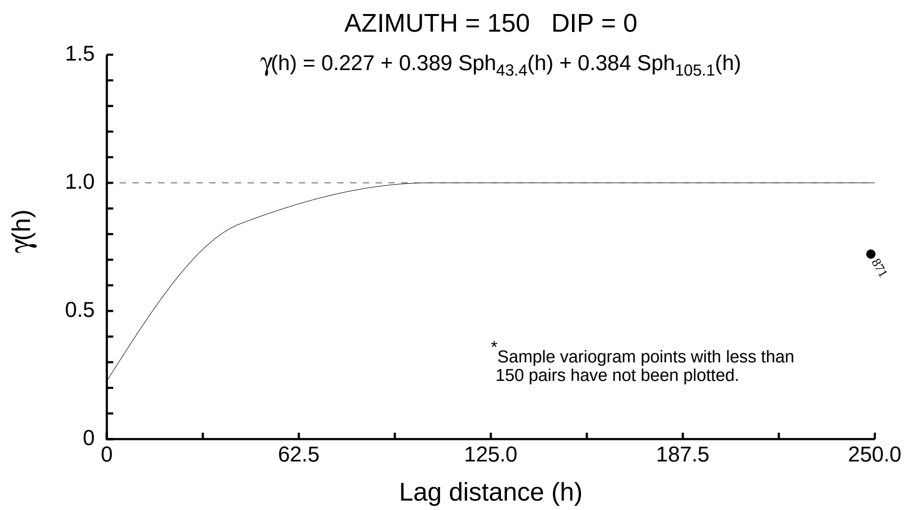
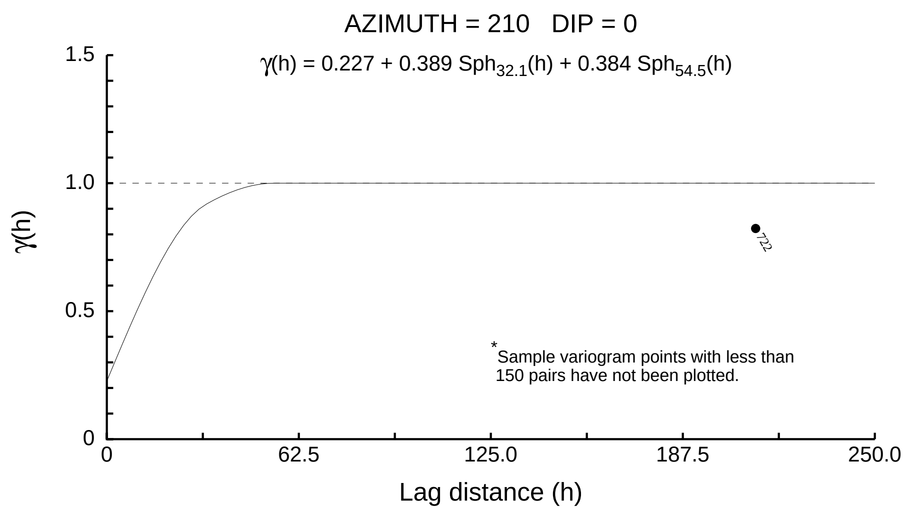
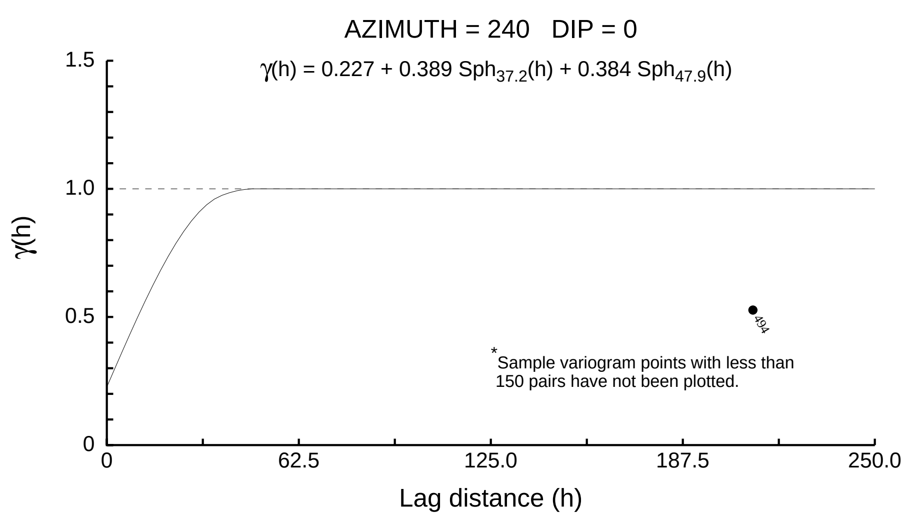
NorthMet U_20_Su_MDIR







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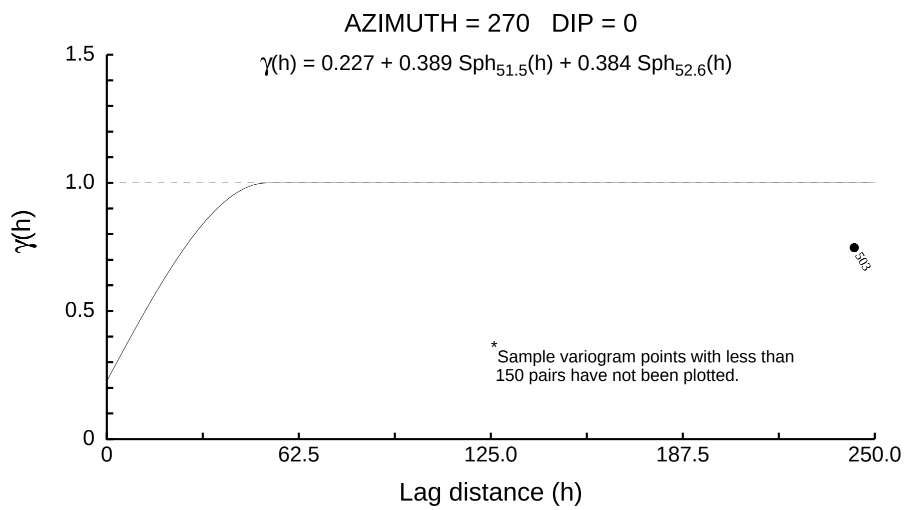
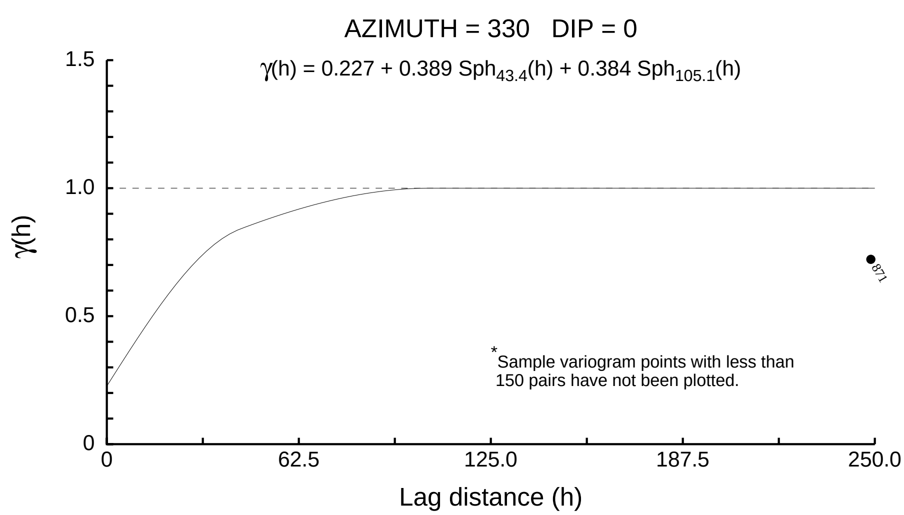
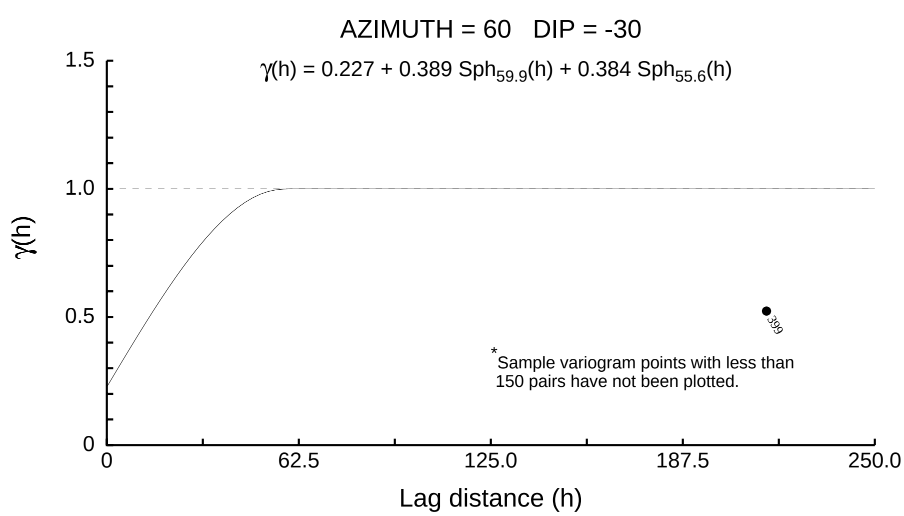
NorthMet U_20_Su_MDIR

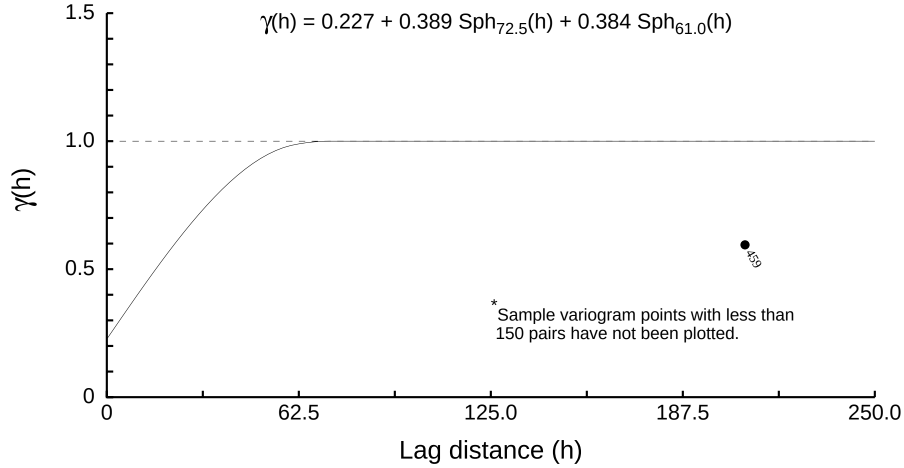




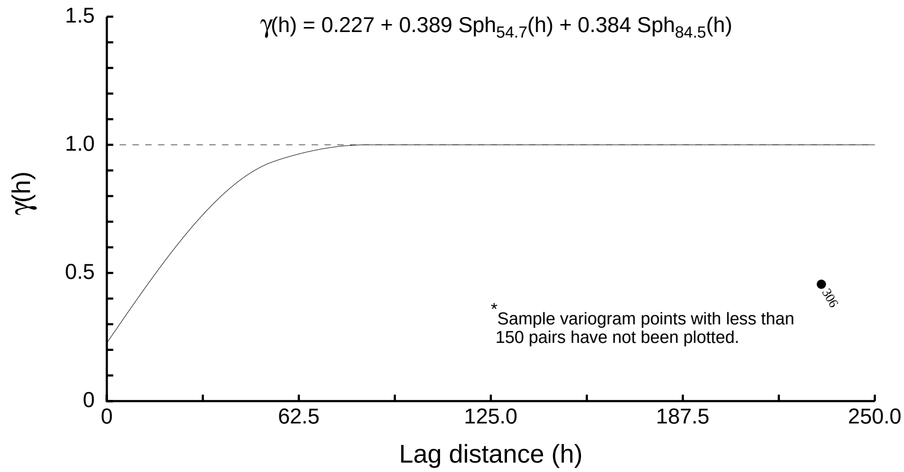


NorthMet U_20_Su_MDIR

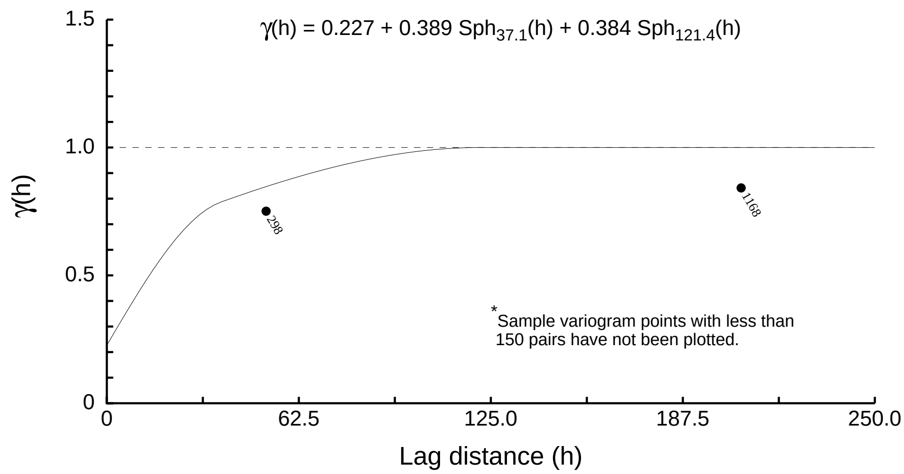
AZIMUTH = 90   DIP = -30



AZIMUTH = 120   DIP = -30

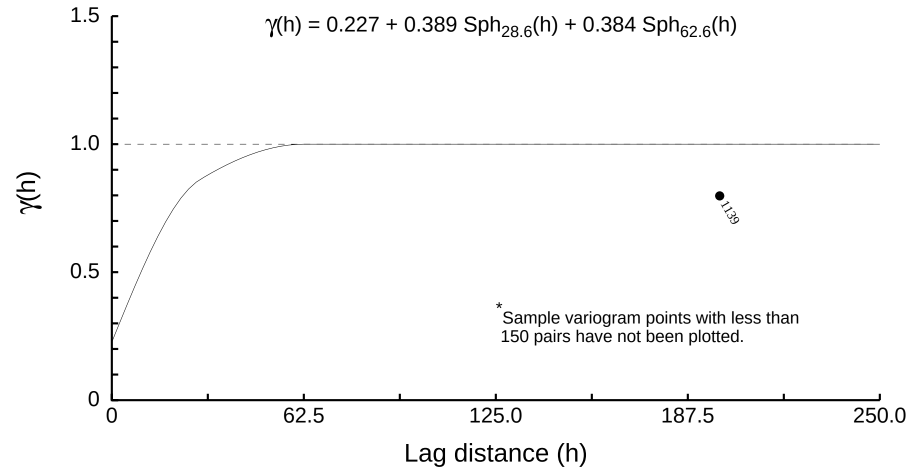


AZIMUTH = 150   DIP = -30

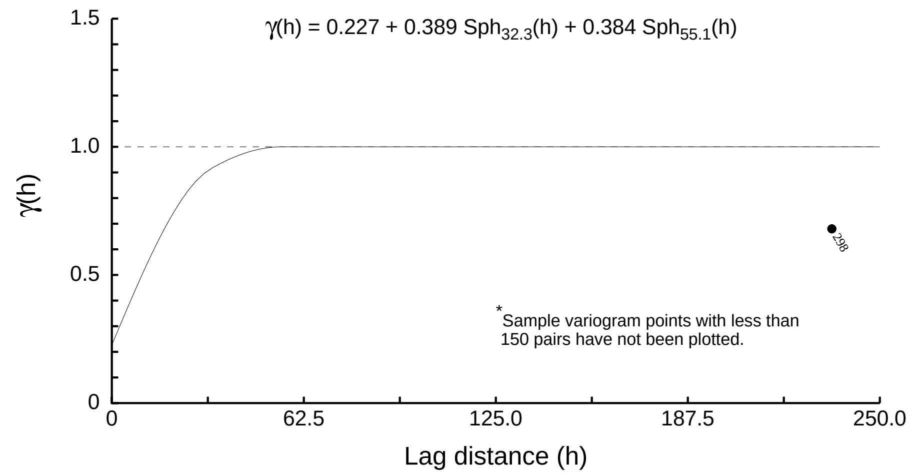


NorthMet U_20_Su_MDIR

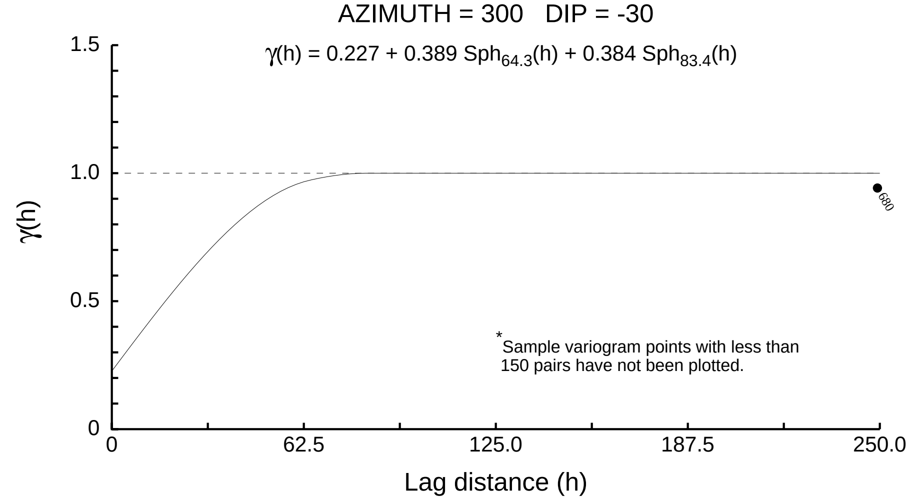
AZIMUTH = 210   DIP = -30



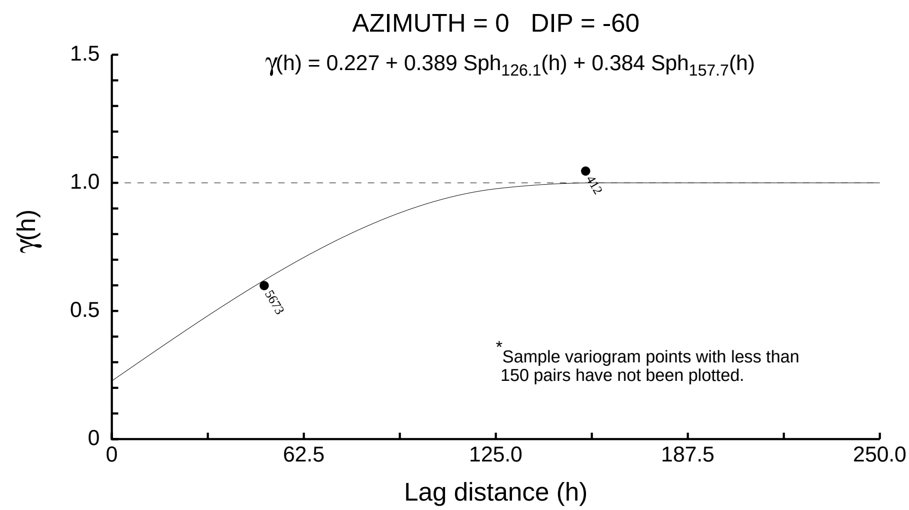
AZIMUTH = 240   DIP = -30

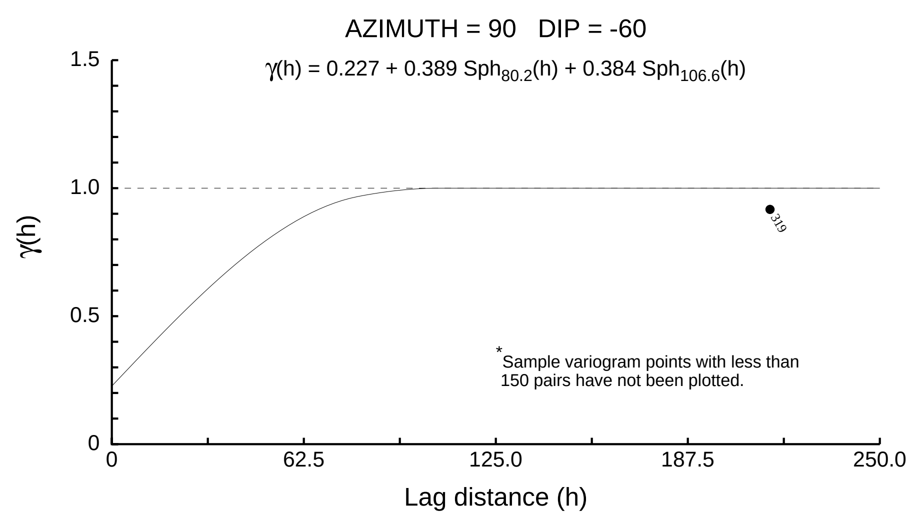


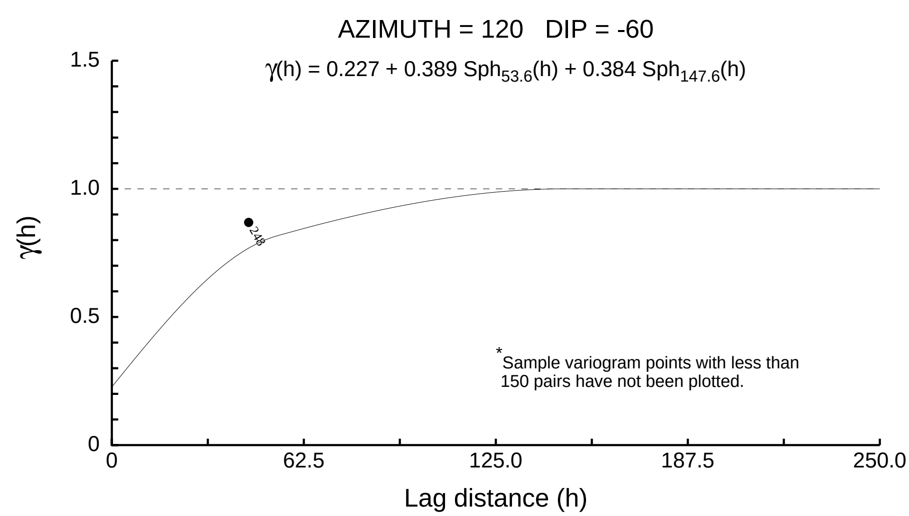
AZIMUTH = 300   DIP = -30



NorthMet U_20_Su_MDIR



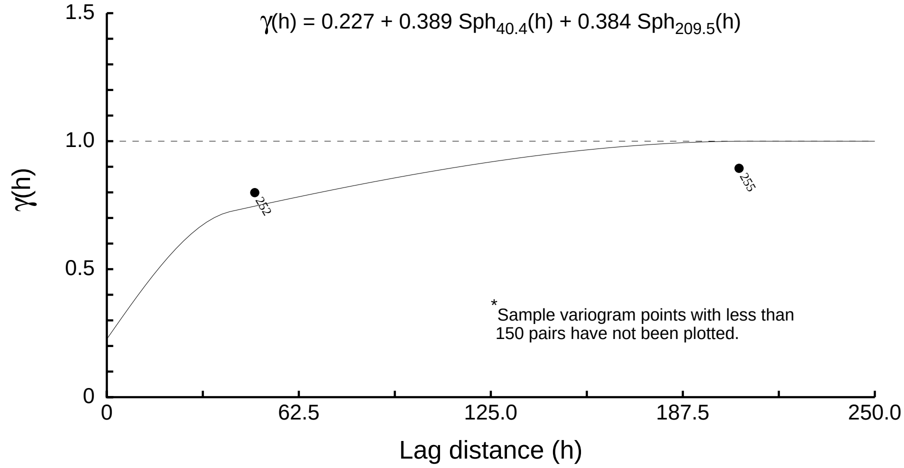




NorthMet U_20_Su_MDIR

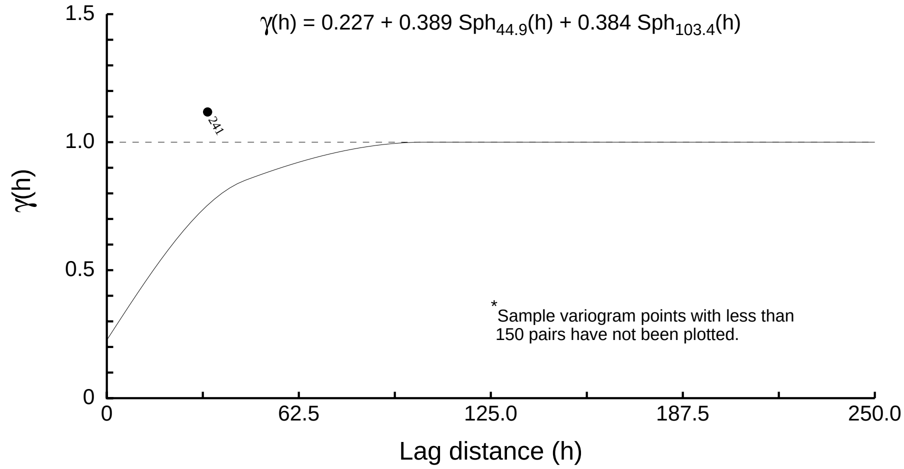
AZIMUTH = 150 DIP = -60

$\gamma(h) = 0.227 + 0.389\ Sph_{40.4}(h) + 0.384\ Sph_{209.5}(h)$



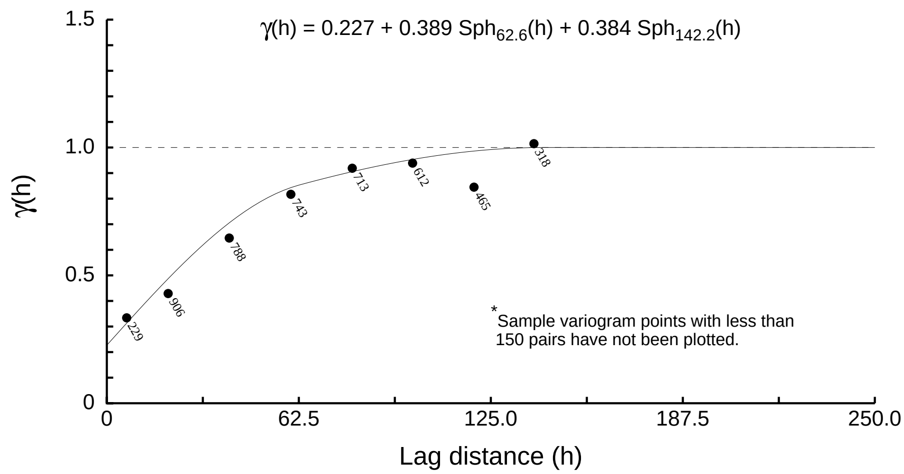
AZIMUTH = 270 DIP = -60

$\gamma(h) = 0.227 + 0.389\ Sph_{44.9}(h) + 0.384\ Sph_{103.4}(h)$



AZIMUTH = 300 DIP = -60

$\gamma(h) = 0.227 + 0.389\ Sph_{62.6}(h) + 0.384\ Sph_{142.2}(h)$



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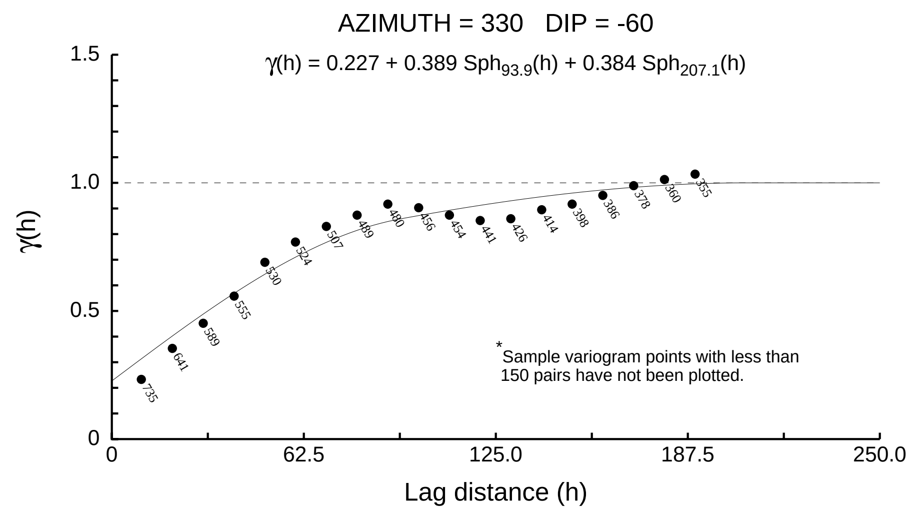
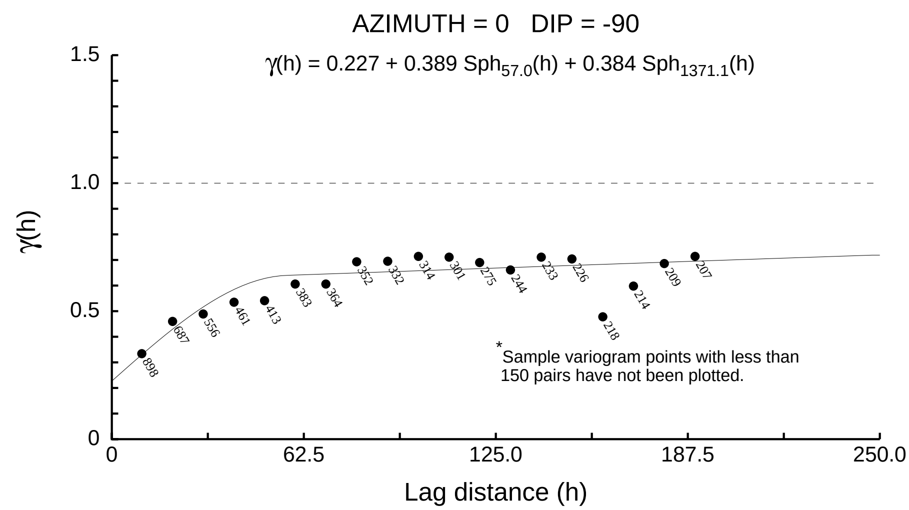
Consultants in Spatial Statistics

NorthMet U_20_Su_MDIR





APPENDIX G

MINING DETAILS

Appendix G

i) Production Schedule – 32,000 tons per day with 5 million ton stockpile limit

32,000 Ton per Day production schedule

Mill		Total	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Total
Mill Feed	Total	**TOTAL ORE TONS**	-	**8,760,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**5,158,516**	**223,978,516**
		DCu%	-	**0.31**	**0.32**	**0.31**	**0.31**	**0.30**	**0.29**	**0.28**	**0.28**	**0.31**	**0.32**	**0.29**	**0.28**	**0.27**	**0.26**	**0.24**	**0.21**	**0.23**	**0.28**	**0.28**	**0.29**	**0.28**
		DNi%	-	**0.09**	**0.10**	**0.09**	**0.09**	**0.09**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.07**	**0.07**	**0.07**	**0.08**	**0.08**	**0.08**	**0.08**
		DPt	-	**76.1**	**77.8**	**70.5**	**71.9**	**73.7**	**78.8**	**79.4**	**95.5**	**102.0**	**97.8**	**77.6**	**69.0**	**69.5**	**69.0**	**62.9**	**65.1**	**60.0**	**65.2**	**70.4**	**62.8**	**75.1**
		DPd	-	**307.7**	**314.4**	**284.7**	**296.1**	**291.9**	**290.1**	**275.2**	**281.6**	**298.7**	**282.2**	**241.7**	**229.4**	**237.1**	**227.8**	**201.9**	**242.7**	**222.3**	**257.0**	**262.0**	**246.9**	**264.5**
		DAu	-	**36.1**	**39.7**	**39.2**	**38.0**	**38.1**	**39.5**	**39.2**	**46.5**	**48.0**	**43.8**	**37.4**	**34.2**	**35.8**	**34.9**	**30.4**	**32.6**	**32.1**	**34.6**	**37.0**	**32.1**	**37.6**
		DCo	-	**68.8**	**78.4**	**78.5**	**74.0**	**71.5**	**71.4**	**70.2**	**72.0**	**74.1**	**75.6**	**78.2**	**78.4**	**75.7**	**73.3**	**73.6**	**69.2**	**67.8**	**68.3**	**73.2**	**70.6**	**73.3**
	From Mine	**H Grade ($7+)**	-	6,460,000	9,570,000	8,020,000	7,270,000	6,570,000	6,870,000	5,836,602	6,155,354	7,161,426	6,837,314	5,994,652	5,600,649	5,293,787	5,006,692	4,147,849	3,313,355	3,778,332	5,923,205	5,589,443	1,797,262	117,195,922
		DCu%	-	0.36	0.35	0.37	0.38	0.38	0.36	0.37	0.37	0.38	0.41	0.39	0.38	0.38	0.38	0.34	0.29	0.34	0.36	0.38	0.49	0.37
		DNi%	-	0.10	0.11	0.11	0.11	0.11	0.10	0.10	0.09	0.09	0.10	0.10	0.11	0.11	0.10	0.09	0.09	0.09	0.09	0.11	0.12	0.10
		DPt	-	87.70	84.96	82.94	89.54	92.58	94.26	101.20	119.70	121.80	125.44	104.77	90.74	86.72	80.33	78.21	97.64	87.65	85.99	90.10	101.82	95.41
		DPd	-	356.96	343.11	333.88	365.89	378.11	355.28	357.91	351.49	358.20	364.71	335.24	311.98	324.16	301.01	265.96	391.24	358.55	353.02	354.05	375.37	346.79
		DAu	-	41.12	43.08	45.76	46.08	47.66	46.96	49.12	57.52	56.72	54.71	48.53	43.75	46.62	44.89	38.59	51.45	48.83	44.35	46.52	49.10	47.53
		DCo	-	70.84	81.08	83.35	78.51	75.72	75.48	75.25	76.34	77.98	81.14	86.87	88.07	84.57	81.33	83.50	75.33	70.87	71.73	79.68	81.55	79.02
		L Grade($0-$7)	-	2,300,000	2,100,000	3,650,000	4,400,000	5,100,000	4,800,000	4,228,095	4,825,123	4,508,574	4,832,686	5,675,348	6,069,351	6,376,213	6,663,308	7,522,151	8,356,645	7,891,668	5,746,795	5,768,097	920,791	101,734,845
		DCu%	-	0.19	0.19	0.19	0.19	0.19	0.18	0.19	0.19	0.19	0.20	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.20	0.19	0.19	0.19
		DNi%	-	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
		DPt	-	43.5	45.2	43.1	42.7	49.4	56.7	60.4	71.0	70.4	58.6	48.8	48.9	55.2	60.4	54.4	52.3	46.7	43.8	52.5	50.6	53.2
		DPd	-	169.2	183.6	176.7	180.8	180.8	196.9	197.8	207.2	204.3	165.6	143.0	153.2	164.9	172.7	166.5	183.8	157.1	158.1	177.4	169.7	174.0
		DAu	-	21.9	24.5	24.7	24.6	25.8	28.7	30.2	35.2	34.1	28.3	25.5	25.3	26.7	27.4	25.8	25.1	24.1	24.6	28.2	28.3	26.9
		DCo	-	63.0	66.2	67.8	66.5	66.1	65.6	64.5	67.2	68.0	67.8	69.1	69.5	68.3	67.2	68.1	66.7	66.4	64.7	67.2	67.0	67.0
	From Stockpile	**H Grade ($7+)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		DCu%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		DNi%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		DPt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		DPd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		DAu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		DCo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		L Grade($0-$7)	-	-	-	-	-	-	-	1,605,303	689,523	-	-	-	-	-	-	-	-	-	-	312,460	2,440,463	5,047,749
		DCu%	-	-	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	-	-	-	-	0.19	0.19	0.19
		DNi%	-	-	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	-	-	-	-	0.06	0.06	0.06
		DPt	-	-	50.40	50.40	50.40	50.40	50.40	50.40	50.40	50.40	50.40	50.40	50.40	50.40	50.40	-	-	-	-	50.40	38.59	44.69
		DPd	-	-	178.40	178.40	178.40	178.40	178.40	178.40	178.40	178.40	178.40	178.40	178.40	178.40	178.40	-	-	-	-	178.40	181.49	179.89
		DAu	-	-	26.66	26.66	26.66	26.66	26.66	26.66	26.66	26.66	26.66	26.66	26.66	26.66	26.66	-	-	-	-	26.66	21.01	23.93
		DCo	-	-	67.21	67.21	67.21	67.21	67.21	67.21	67.21	67.21	67.21	67.21	67.21	67.21	67.21	-	-	-	-	67.21	63.84	65.58

Pit		Total	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Total
Mine Production	Open Pit Ore	**H Grade ($7+)**	-	6,460,000	9,570,000	8,020,000	7,270,000	6,570,000	6,870,000	5,836,602	6,155,354	7,161,426	6,837,314	5,994,652	5,600,649	5,293,787	5,006,692	4,147,849	3,313,355	3,778,332	5,923,205	5,589,443	1,797,262	117,195,922
		DCu%	-	0.36	0.35	0.37	0.38	0.38	0.36	0.37	0.37	0.38	0.41	0.39	0.38	0.38	0.38	0.34	0.29	0.34	0.36	0.38	0.49	0.37
		DNi%	-	0.10	0.11	0.11	0.11	0.11	0.10	0.10	0.09	0.09	0.10	0.10	0.11	0.11	0.10	0.09	0.09	0.09	0.09	0.11	0.12	0.10
		DPt	-	87.70	84.96	82.94	89.54	92.58	94.26	101.20	119.70	121.80	125.44	104.77	90.74	86.72	80.33	78.21	97.64	87.65	85.99	90.10	101.82	95.41
		DPd	-	356.96	343.11	333.88	365.89	378.11	355.28	357.91	351.49	358.20	364.71	335.24	311.98	324.16	301.01	265.96	391.24	358.55	353.02	354.05	375.37	346.79
		DAu	-	41.12	43.08	45.76	46.08	47.66	46.96	49.12	57.52	56.72	54.71	48.53	43.75	46.62	44.89	38.59	51.45	48.83	44.35	46.52	49.10	47.53
		DCo	-	70.84	81.08	83.35	78.51	75.72	75.48	75.25	76.34	77.98	81.14	86.87	88.07	84.57	81.33	83.50	75.33	70.87	71.73	79.68	81.55	79.02
		L Grade($0-$7)	-	3,433,661	5,644,941	4,004,076	4,405,682	5,108,081	4,801,308	4,228,095	4,825,123	4,508,574	4,832,686	5,675,348	6,069,351	6,376,213	6,663,308	7,522,151	8,356,645	7,891,668	5,746,795	5,768,097	920,791	106,782,593
		DCu%	-	0.19	0.19	0.19	0.19	0.19	0.18	0.19	0.19	0.19	0.20	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.20	0.19	0.19	0.19
		DNi%	-	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.06
		DPt	-	43.46	45.23	43.10	42.74	49.36	56.72	60.43	71.03	70.44	58.60	48.83	48.86	55.24	60.44	54.41	52.26	46.73	43.84	52.45	50.55	52.76
		DPd	-	169.16	183.63	176.72	180.84	180.82	196.90	197.76	207.20	204.29	165.58	142.99	153.24	164.86	172.71	166.53	183.84	157.06	158.10	177.41	169.67	174.26
		DAu	-	21.87	24.51	24.68	24.59	25.85	28.71	30.23	35.21	34.09	28.34	25.54	25.29	26.73	27.43	25.83	25.13	24.10	24.57	28.25	28.35	26.74
		DCo	-	62.98	66.18	67.84	66.54	66.11	65.57	64.46	67.22	68.03	67.85	69.10	69.55	68.32	67.24	68.08	66.74	66.40	64.67	67.20	67.00	66.97
		TOTAL ORE TONS	-	9,893,661	15,214,941	12,024,076	11,675,682	11,678,081	11,671,308	10,064,697	10,980,477	11,670,000	11,670,000	11,670,000	11,670,000	11,670,000	11,670,000	11,670,000	11,670,000	11,670,000	11,670,000	11,357,540	2,718,053	223,978,515
		DCu%	-	0.30	0.29	0.31	0.31	0.30	0.29	0.29	0.29	0.31	0.32	0.29	0.28	0.27	0.26	0.24	0.21	0.23	0.28	0.29	0.38	0.28
		DNi%	-	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.08	0.08	0.10	0.08
		DPt	-	72.35	70.22	69.67	71.88	73.67	78.82	84.07	98.31	101.96	97.76	77.57	68.96	69.52	68.97	62.87	65.14	59.98	65.24	70.98	84.45	75.07
		DPd	-	291.8	283.9	281.5	296.1	291.8	290.1	290.6	288.1	298.7	282.2	241.7	229.4	237.1	227.8	201.9	242.7	222.3	257.0	264.3	305.7	264.54
		DAu	-	34.4	36.2	38.7	38.0	38.1	39.5	41.2	47.7	48.0	43.8	37.4	34.2	35.8	34.9	30.4	32.6	32.1	34.6	37.2	42.1	37.62
		DCo	-	68.1	75.6	78.2	74.0	71.5	71.4	70.7	72.3	74.1	75.6	78.2	78.4	75.7	73.3	73.6	69.2	67.8	68.3	73.3	76.6	73.3
	Open Pit Waste	**TOTAL WASTE TONS**	7,798,390	34,358,854	30,910,536	27,392,028	21,937,999	16,026,100	10,014,780	6,235,791	10,054,180	9,780,793	11,670,914	11,155,353	8,179,466	13,642,431	15,550,639	15,108,746	18,264,427	20,476,500	8,973,988	5,948,008	329,883	303,809,808
		OB (tons)	2,396,530	1,473,705	-	2,908,459	1,651,583	3,038,767	20,963	-	-	-	2,366,308	9,583	-	2,842,982	-	1,806,369	4,640	-	-	-	-	18,519,888
		Cat 1 & 2 (tons)	4,493,022	26,311,661	24,707,822	20,190,199	16,151,299	10,997,538	7,641,739	4,431,733	8,588,225	6,954,264	5,424,435	5,908,258	4,105,120	6,466,493	11,021,962	9,236,794	13,372,926	13,198,380	6,497,062	4,397,206	54,557	210,150,693
		Cat 3 (tons)	548,285	4,566,904	3,697,213	2,432,855	2,821,250	1,456,729	1,831,048	1,543,633	1,459,435	2,823,835	3,878,497	5,237,512	3,794,456	3,869,501	4,521,311	3,939,405	4,872,282	7,274,727	2,465,072	1,480,001	275,326	64,789,278
		Cat 4 (tons)	360,553	2,006,584	2,505,500	1,860,515	1,313,868	533,067	521,030	260,426	6,521	2,694	1,674	-	279,891	463,455	7,366	126,179	14,578	3,393	11,854	70,801	-	10,349,949
		Total Tons	7,798,390	44,252,514	46,125,477	39,416,104	33,613,681	27,704,181	21,686,088	16,300,489	21,034,657	21,450,793	23,340,914	22,825,353	19,849,466	25,312,431	27,220,639	26,778,746	29,934,427	32,146,500	20,643,988	17,305,548	3,047,936	527,788,323
		S.R.	0.0	3.5	2.0	2.3	1.9	1.4	0.9	0.6	0.9	0.8	1.0	1.0	0.7	1.2	1.3	1.3	1.6	1.8	0.8	0.5	0.1	1.4

		Total	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Total
Direct to Mill	Open Pit to Mill	**H Grade ($7+)**	-	6,460,000	9,570,000	8,020,000	7,270,000	6,570,000	6,870,000	5,836,602	6,155,354	7,161,426	6,837,314	5,994,652	5,600,649	5,293,787	5,006,692	4,147,849	3,313,355	3,778,332	5,923,205	5,589,443	1,797,262	117,195,922
		DCu%	-	0.36	0.35	0.37	0.38	0.38	0.36	0.37	0.37	0.38	0.41	0.39	0.38	0.38	0.38	0.34	0.29	0.34	0.36	0.38	0.49	0.37
		DNi%	-	0.10	0.11	0.11	0.11	0.11	0.10	0.10	0.09	0.09	0.10	0.10	0.11	0.11	0.10	0.09	0.09	0.09	0.09	0.11	0.12	0.10
		DPt	-	87.70	84.96	82.94	89.54	92.58	94.26	101.20	119.70	121.80	125.44	104.77	90.74	86.72	80.33	78.21	97.64	87.65	85.99	90.10	101.82	95.41
		DPd	-	356.96	343.11	333.88	365.89	378.11	355.28	357.91	351.49	358.20	364.71	335.24	311.98	324.16	301.01	265.96	391.24	358.55	353.02	354.05	375.37	346.79
		DAu	-	41.12	43.08	45.76	46.08	47.66	46.96	49.12	57.52	56.72	54.71	48.53	43.75	46.62	44.89	38.59	51.45	48.83	44.35	46.52	49.10	47.53
		DCo	-	70.84	81.08	83.35	78.51	75.72	75.48	75.25	76.34	77.98	81.14	86.87	88.07	84.57	81.33	83.50	75.33	70.87	71.73	79.68	81.55	79.02
		L Grade($0-$7)		2,300,000	2,100,000	3,650,000	4,400,000	5,100,000	4,800,000	4,228,095	4,825,123	4,508,574	4,832,686	5,675,348	6,069,351	6,376,213	6,663,308	7,522,151	8,356,645	7,891,668	5,746,795	5,768,097	920,791	101,734,845
		DCu%	-	0.19	0.19	0.19	0.19	0.19	0.18	0.19	0.19	0.19	0.20	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.20	0.19	0.19	0.19
		DNi%	-	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.06
		DPt	-	43.5	45.2	43.1	42.7	49.4	56.7	60.4	71.0	70.4	58.6	48.8	48.9	55.2	60.4	54.4	52.3	46.7	43.8	52.5	50.6	53.16
		DPd	-	169.2	183.6	176.7	180.8	180.8	196.9	197.8	207.2	204.3	165.6	143.0	153.2	164.9	172.7	166.5	183.8	157.1	158.1	177.4	169.7	173.98
		DAu	-	21.9	24.5	24.7	24.6	25.8	28.7	30.2	35.2	34.1	28.3	25.5	25.3	26.7	27.4	25.8	25.1	24.1	24.6	28.2	28.3	26.88
		DCo	-	63.0	66.2	67.8	66.5	66.1	65.6	64.5	67.2	68.0	67.8	69.1	69.5	68.3	67.2	68.1	66.7	66.4	64.7	67.2	67.0	67.04
		TOTAL ORE TONS	-	8,760,000	11,670,000	11,670,000	11,670,000	11,670,000	11,670,000	10,064,697	10,980,477	11,670,000	11,670,000	11,670,000	11,670,000	11,670,000	11,670,000	11,670,000	11,670,000	11,670,000	11,670,000	11,357,540	2,718,053	218,930,767
		DCu%	-	0.31	0.32	0.31	0.31	0.30	0.29	0.29	0.29	0.31	0.32	0.29	0.28	0.27	0.26	0.24	0.21	0.23	0.28	0.29	0.38	0.29
		DNi%	-	0.09	0.10	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.08	0.08	0.10	0.08
		DPt	-	76.09	77.81	70.48	71.90	73.69	78.82	84.07	98.31	101.96	97.76	77.57	68.96	69.52	68.97	62.87	65.14	59.98	65.24	70.98	84.45	75.77
		DPd	-	307.7	314.4	284.7	296.1	291.9	290.1	290.6	288.1	298.7	282.2	241.7	229.4	237.1	227.8	201.9	242.7	222.3	257.0	264.3	305.7	266.49
		DAu	-	36.1	39.7	39.2	38.0	38.1	39.5	41.2	47.7	48.0	43.8	37.4	34.2	35.8	34.9	30.4	32.6	32.1	34.6	37.2	42.1	37.93
		DCo	-	68.8	78.4	78.5	74.0	71.5	71.4	70.7	72.3	74.1	75.6	78.2	78.4	75.7	73.3	73.6	69.2	67.8	68.3	73.3	76.6	73.5

		Total	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Total
To Stockpile	Pit to Stockpile	**H Grade ($7+)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		DCu%	-	0.36	0.35	0.37	0.38	0.38	0.36	0.37	0.37	0.38	0.41	0.39	0.38	0.38	0.38	0.34	0.29	0.34	0.36	0.38	0.49	-
		DNi%	-	0.10	0.11	0.11	0.11	0.11	0.10	0.10	0.09	0.09	0.10	0.10	0.11	0.11	0.10	0.09	0.09	0.09	0.09	0.11	0.12	-
		DPt	-	87.70	84.96	82.94	89.54	92.58	94.26	101.20	119.70	121.80	125.44	104.77	90.74	86.72	80.33	78.21	97.64	87.65	85.99	90.10	101.82	-
		DPd	-	356.96	343.11	333.88	365.89	378.11	355.28	357.91	351.49	358.20	364.71	335.24	311.98	324.16	301.01	265.96	391.24	358.55	353.02	354.05	375.37	-
		DAu	-	41.12	43.08	45.76	46.08	47.66	46.96	49.12	57.52	56.72	54.71	48.53	43.75	46.62	44.89	38.59	51.45	48.83	44.35	46.52	49.10	-
		DCo	-	70.84	81.08	83.35	78.51	75.72	75.48	75.25	76.34	77.98	81.14	86.87	88.07	84.57	81.33	83.50	75.33	70.87	71.73	79.68	81.55	-
		L Grade($0-$7)	-	1,133,661	3,544,941	354,076	5,682	8,081	1,308	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,047,748
		DCu%	-	0.19	0.19	0.19	0.19	0.19	0.18	0.19	0.19	0.19	0.20	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.20	0.19	0.19	0.19
		DNi%	-	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.06
		DPt	-	43.46	45.23	43.10	42.74	49.36	56.72	60.43	71.03	70.44	58.60	48.83	48.86	55.24	60.44	54.41	52.26	46.73	43.84	52.45	50.55	44.69
		DPd	-	169.16	183.63	176.72	180.84	180.82	196.90	197.76	207.20	204.29	165.58	142.99	153.24	164.86	172.71	166.53	183.84	157.06	158.10	177.41	169.67	179.89
		DAu	-	21.87	24.51	24.68	24.59	25.85	28.71	30.23	35.21	34.09	28.34	25.54	25.29	26.73	27.43	25.83	25.13	24.10	24.57	28.25	28.35	23.93
		DCo	-	62.98	66.18	67.84	66.54	66.11	65.57	64.46	67.22	68.03	67.85	69.10	69.55	68.32	67.24	68.08	66.74	66.40	64.67	67.20	67.00	65.58
		TOTAL ORE TONS	-	1,133,661	3,544,941	354,076	5,682	8,081	1,308	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,047,748
		DCu%	-	0.19	0.19	0.19	0.19	0.19	0.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.19
		DNi%	-	0.06	0.06	0.06	0.06	0.06	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06
		DPt	-	43.46	45.23	43.10	42.74	49.36	56.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44.69
		DPd	-	169.2	183.6	176.7	180.8	180.8	196.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	179.9
		DAu	-	21.9	24.5	24.7	24.6	25.8	28.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23.9
		DCo	-	63.0	66.2	67.8	66.5	66.1	65.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	65.6
	Total	**TOTAL ORE TONS**	-	1,133,661	3,544,941	354,076	5,682	8,081	1,308	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,047,748
		DCu%	-	0.19	0.19	0.19	0.19	0.19	0.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.19
		DNi%	-	0.06	0.06	0.06	0.06	0.06	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06
		DPt	-	43.46	45.23	43.10	42.74	49.36	56.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44.69
		DPd	-	169.2	183.6	176.7	180.8	180.8	196.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	179.9
		DAu	-	21.9	24.5	24.7	24.6	25.8	28.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23.9
		DCo	-	63.0	66.2	67.8	66.5	66.1	65.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	65.6

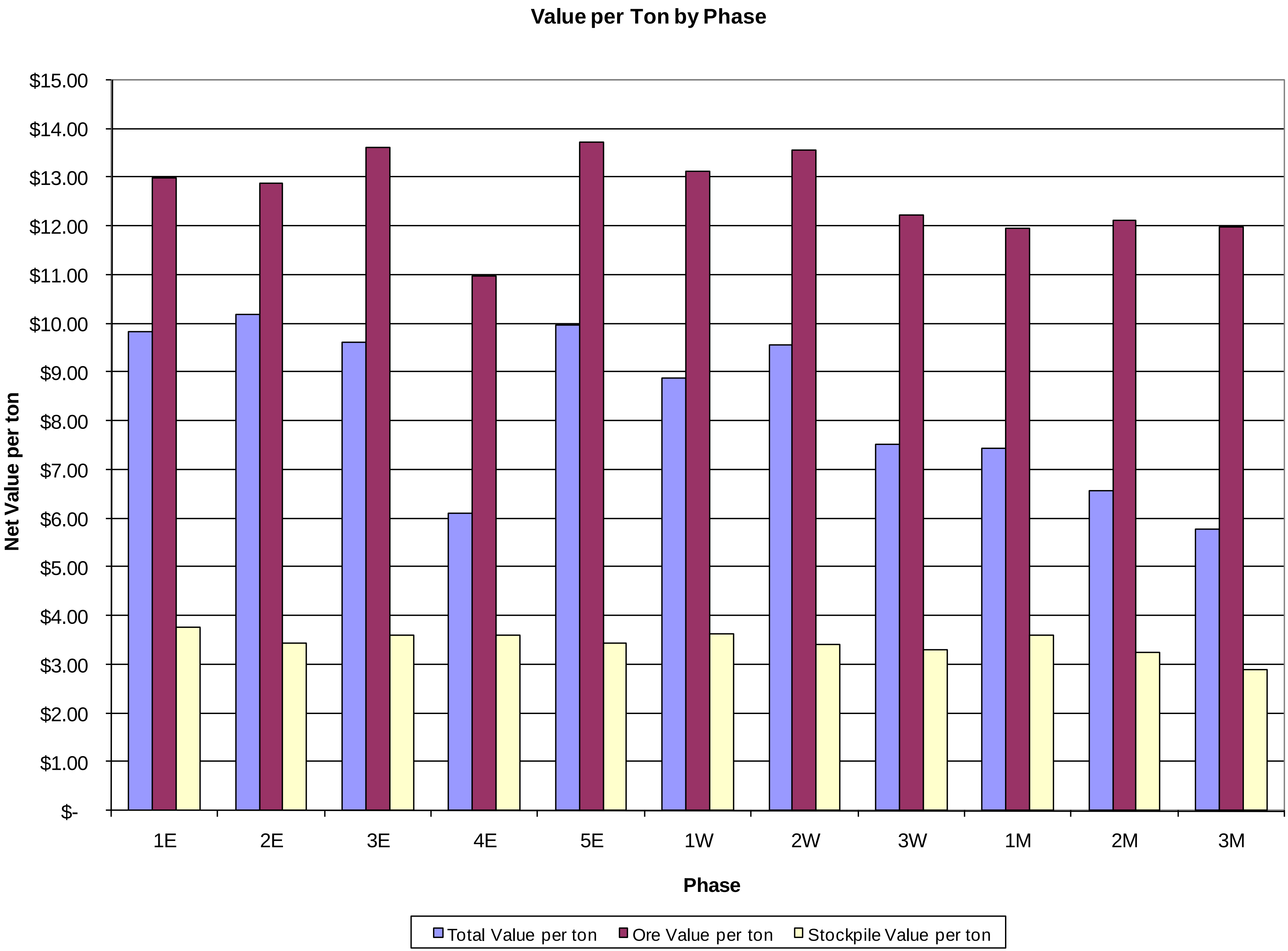
	Total	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	
From Stockpile	**TOTAL ORE TONS**	-	-	-	-	-	-	-	1,605,303	689,523	-	-	-	-	-	-	-	-	-	-	312,460	2,440,463	
	DCu%	-	-	-	-	-	-	-	0.19	0.19	-	-	-	-	-	-	-	-	-	-	0.19	0.19	
	DNi%	-	-	-	-	-	-	-	0.06	0.06	-	-	-	-	-	-	-	-	-	-	0.06	0.06	
	DPt	-	-	-	-	-	-	-	50.40	50.40	-	-	-	-	-	-	-	-	-	-	50.40	38.59	
	DPd	-	-	-	-	-	-	-	178.4	178.4	-	-	-	-	-	-	-	-	-	-	178.4	181.5	
	DAu	-	-	-	-	-	-	-	26.66	26.66	-	-	-	-	-	-	-	-	-	-	26.66	21.01	
	DCo	-	-	-	-	-	-	-	67.21	67.21	-	-	-	-	-	-	-	-	-	-	67.21	63.84	
	H Grade ($7+)																						
	DCu%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	DNi%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	DPt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	DPd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	DAu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	DCo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	L Grade($0-$7)								1,605,303	689,523											312,460	2,440,463	5,047,749
	DCu%	-	-	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	-	-	-	-	0.19	0.19	
	DNi%	-	-	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	-	-	-	-	0.06	0.06	
	DPt	-	-	50.40	50.40	50.40	50.40	50.40	50.40	50.40	50.40	50.40	50.40	50.40	50.40	50.40	-	-	-	-	50.40	38.59	
	DPd	-	-	178.40	178.40	178.40	178.40	178.40	178.40	178.40	178.40	178.40	178.40	178.40	178.40	178.40	-	-	-	-	178.40	181.49	
	DAu	-	-	26.66	26.66	26.66	26.66	26.66	26.66	26.66	26.66	26.66	26.66	26.66	26.66	26.66	-	-	-	-	26.66	21.01	
	DCo	-	-	67.21	67.21	67.21	67.21	67.21	67.21	67.21	67.21	67.21	67.21	67.21	67.21	67.21	-	-	-	-	67.21	63.84	
Stockpile Inventory	**TOTAL ORE TONS**	-	1,133,661	4,678,602	5,032,678	5,038,360	5,046,441	5,047,749	3,442,446	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,440,463	-	
	DCu%	-	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	-	
	DNi%	-	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	-	
	DPt	-	43.46	44.80	44.68	44.68	44.69	44.69	42.03	39.93	39.93	39.93	39.93	39.93	39.93	39.93	39.93	39.93	39.93	39.93	38.59	-	
	DPd	-	169.16	180.12	179.88	179.89	179.89	179.89	180.59	181.14	181.14	181.14	181.14	181.14	181.14	181.14	181.14	181.14	181.14	181.14	181.49	-	
	DAu	-	21.87	23.87	23.93	23.93	23.93	23.93	22.66	21.65	21.65	21.65	21.65	21.65	21.65	21.65	21.65	21.65	21.65	21.65	21.01	-	
	DCo	-	62.98	65.41	65.58	65.58	65.58	65.58	64.82	64.22	64.22	64.22	64.22	64.22	64.22	64.22	64.22	64.22	64.22	64.22	63.84	-	
	H Grade ($7+)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	DCu%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	DNi%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	DPt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	DPd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	DAu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	DCo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	L Grade($0-$7)	-	1,133,661	4,678,602	5,032,678	5,038,360	5,046,441	5,047,749	3,442,446	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,440,463	-	
	DCu%	-	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	-	
	DNi%	-	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	-	
	DPt	-	43.46	44.80	44.68	44.68	44.69	44.69	42.03	39.93	39.93	39.93	39.93	39.93	39.93	39.93	39.93	39.93	39.93	39.93	38.59	-	
	DPd	-	169.16	180.12	179.88	179.89	179.89	179.89	180.59	181.14	181.14	181.14	181.14	181.14	181.14	181.14	181.14	181.14	181.14	181.14	181.49	-	
	DAu	-	21.87	23.87	23.93	23.93	23.93	23.93	22.66	21.65	21.65	21.65	21.65	21.65	21.65	21.65	21.65	21.65	21.65	21.65	21.01	-	
	DCo	-	62.98	65.41	65.58	65.58	65.58	65.58	64.82	64.22	64.22	64.22	64.22	64.22	64.22	64.22	64.22	64.22	64.22	64.22	63.84	-	

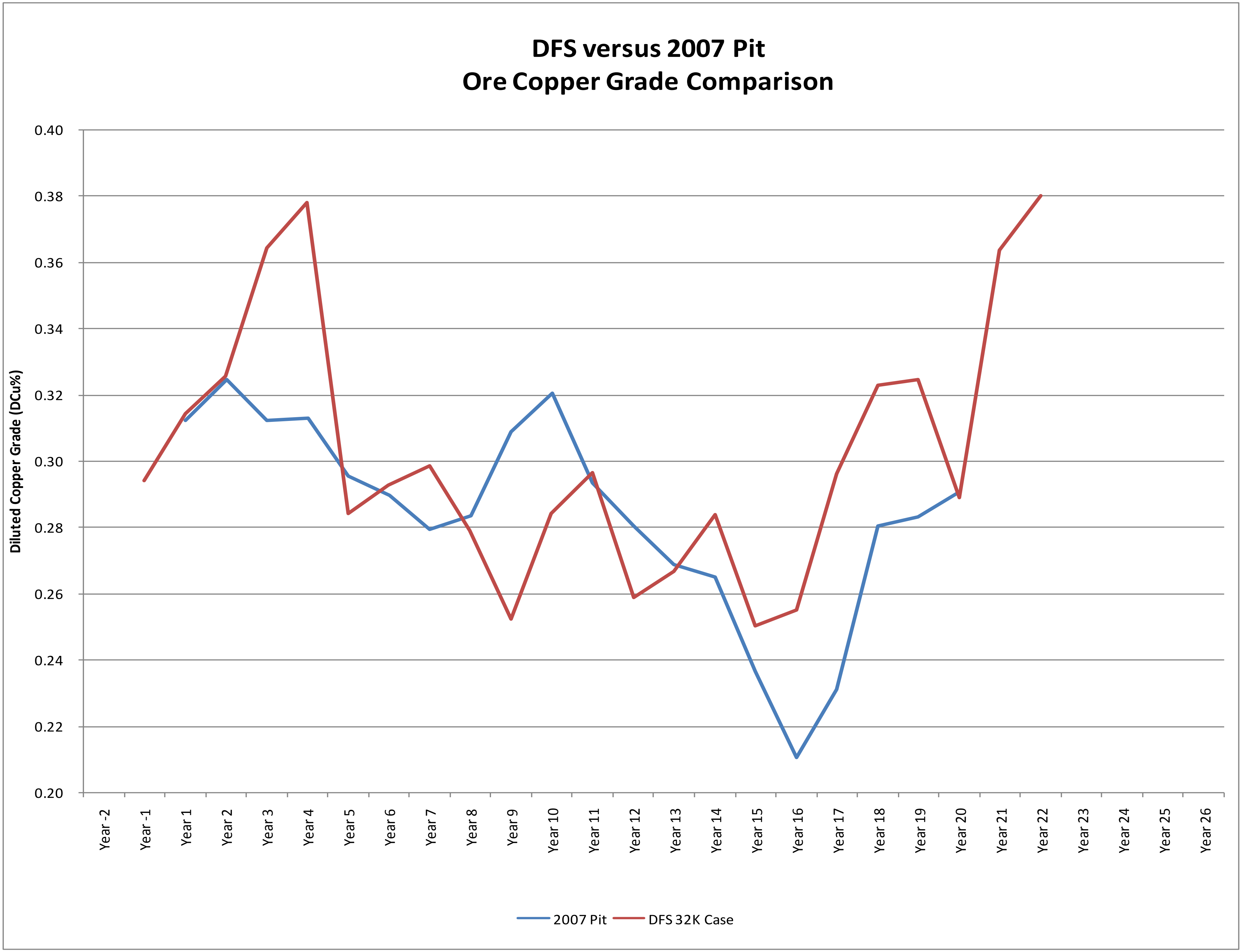
Cut Summary

	Report File	Total	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Total
Phase 1E		**H Grade ($7+)**	-	3,568,128	2,691,731	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,259,859
		DCu%	-	0.37	0.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.363
		DNi%	-	0.10	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.105
		DPt	-	84.77	87.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86.03
		DPd	-	344.46	331.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	339.08
		DAu	-	41.78	43.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42.37
		DCo	-	69.60	78.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73.42
		L Grade($0-$7)	-	1,782,677	1,451,633	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,234,310
		DCu%	-	0.19	0.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.20
		DNi%	-	0.06	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06
		DPt	-	46.88	49.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48.27
		DPd	-	175.98	201.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	187.22
		DAu	-	22.53	25.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23.86
		DCo	-	61.10	59.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60.39
		TOTAL ORE TONS	-	5,350,805	4,143,364	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,494,169
		OB (tons)	1,087,424	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,087,424
		Cat 1 & 2 (tons)	1,731,282	1,648,021	117,488	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,496,791
		Cat 3 (tons)	183,387	320,388	298,009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	801,784
		Cat 4 (tons)	340,282	1,408,397	1,282,992	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,031,671
		TOTAL WASTE TONS	3,342,375	3,376,806	1,698,489	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8,417,670
		Total Tons	3,342,375	8,727,611	5,841,853	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17,911,839
		S.R.	-	0.6	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.9
Phase 2E		**H Grade ($7+)**	-	2,571,034	4,126,222	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,697,256
		DCu%	-	0.35	0.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.354
		DNi%	-	0.10	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.105
		DPt	-	91.23	85.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	87.91
		DPd	-	380.41	365.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	371.20
		DAu	-	41.27	43.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42.59
		DCo	-	71.69	82.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	78.04
		L Grade($0-$7)	-	886,206	1,783,645	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,669,850
		DCu%	-	0.18	0.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06
		DNi%	-	0.06	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02
		DPt	-	48.02	44.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.80
		DPd	-	213.77	178.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59.12
		DAu	-	23.60	25.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.31
		DCo	-	61.73	67.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.50
		Total Ore Tonnes	-	3,457,240	5,909,867	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,367,106
		OB (tons)	1,133,259	200,447	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,333,706
		Cat 1 & 2 (tons)	1,270,506	2,653,176	1,740,459	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,664,141
		Cat 3 (tons)	110,679	469,298	834,123	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,414,100
		Cat 4 (tons)	1,029	70,768	218,603	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	290,399
		TOTAL WASTE TONS	2,515,473	3,393,689	2,793,184	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8,702,346
		Total Tonnes	2,515,473	6,850,929	8,703,051	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18,069,452
		S.R.	-	1.0	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.9
Phase 3E		**H Grade ($7+)**	-	303,798	2,749,677	7,421,916	6,229,342	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16,704,733
		DCu%	-	0.30	0.35	0.37	0.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.374
		DNi%	-	0.09	0.10	0.11	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.109
		DPt	-	95.49	80.91	79.83	86.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	82.874
		DPd	-	321.37	320.41	330.02	364.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	341.019
		DAu	-	33.36	42.53	44.78	45.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44.461
		DCo	-	76.64	82.25	84.47	79.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	82.282
		L Grade($0-$7)	-	267,275	2,289,883	3,769,694	4,064,613	701,103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,092,569
		DCu%	-	0.18	0.18	0.19	0.20	0.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.18
		DNi%	-	0.06	0.06	0.06	0.06	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06
		DPt	-	40.98	44.25	42.18	41.39	34.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36.65
		DPd	-	164.27	185.33	175.12	179.45	162.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	161.11
		DAu	-	20.91	23.95	24.13	23.93	20.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21.08
		DCo	-	72.77	68.22	67.90	66.80	69.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	63.94
		Total Ore Tonnes	-	571,073	5,039,560	11,191,611	10,293,955	701,103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27,797,302
		OB (tons)	175,847	326,572	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	502,419
		Cat 1 & 2 (tons)	1,491,234	12,463,856	11,987,219	6,680,796	575,969	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33,199,074
		Cat 3 (tons)	254,219	1,155,510	1,130,704	1,411,914	617,145	48,152	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,617,643
		Cat 4 (tons)	19,243	522,968	1,003,517	1,860,515	1,187,552	104,841	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,698,635
		TOTAL WASTE TONS	1,940,542	14,468,906	14,121,440	9,953,225	2,380,666	152,992	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43,017,771
		Total Tonnes	1,940,542	15,039,979	19,161,000	21,144,835	12,674,621	854,095	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70,815,073
		S.R.	-	25.3	2.8	0.9	0.2	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5
Phase 4E		**H Grade ($7+)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	131,256	2,028,291	686,187	-	892,868	303,921	4,042,524
		DCu%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.26	0.29	0.28	-	0.27	0.34	0.28
		DNi%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.08	0.09	0.10	-	0.10	0.12	0.09
		DPt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	96.26	99.92	99.96	-	90.58	80.60	96.29
		DPd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	441.98	470.12	484.06	-	323.30	241.56	421.96
		DAu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49.79	57.05	51.72	-	42.37	41.07	51.46
		DCo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67.54	70.62	76.43	-	88.72	124.22	79.53
		L Grade($0-$7)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	580,761	3,175,783	1,534,713	-	2,509,572	112,909	7,913,738
		DCu%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.17	0.18	0.18	-	0.18	0.18	0.18
		DNi%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	0.06	0.06	-	0.07	0.07	0.06
		DPt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55.92	52.39	55.04	-	55.14	43.42	53.91
		DPd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	236.70	232.28	200.87	-	170.26	129.19	205.37
		DAu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28.76	25.36	26.87	-	26.15	20.54	26.08
		DCo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66.28	65.41	67.13	-	70.85	89.18	67.87
		Total Ore Tonnes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	712,017	5,204,074	2,220,900	-	3,402,440	416,830	11,956,262
		OB (tons)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,806,369	4,640	-	-	-	-	1,811,009
		Cat 1 & 2 (tons)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,100,398	8,290,260	1,558,245	-	1,139,291	2,232	14,090,426
		Cat 3 (tons)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	196,315	1,699,675	511,588	-	180,858	2,156	2,590,592
		Cat 4 (tons)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		TOTAL WASTE TONS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,103,082	9,994,575	2,069,833	-	1,320,149	4,388	18,492,027
		Total Tonnes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,815,100	15,198,649	4,290,733	-	4,722,589	421,218	30,448,289
		S.R.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.2	1.9	0.9	-	0.4	0.0	1.5

	Report File	Total	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Total
Phase 5E		**H Grade ($7+)**	-	17,040	2,370	118,889	494,392	5,506,027	4,454,796	2,500,772	-	-	-	-	-	-	-	-	-	-	-	-	-	13,094,286
		DCu%	-	0.32	0.32	0.31	0.34	0.39	0.38	0.40	-	-	-	-	-	-	-	-	-	-	-	-	-	0.39
		DNi%	-	0.08	0.08	0.09	0.10	0.11	0.11	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11
		DPt	-	31.29	86.88	86.95	88.84	85.50	79.78	85.51	-	-	-	-	-	-	-	-	-	-	-	-	-	83.63
		DPd	-	71.86	412.90	378.71	385.87	377.91	350.62	382.35	-	-	-	-	-	-	-	-	-	-	-	-	-	369.39
		DAu	-	17.66	48.28	43.86	39.37	45.23	40.77	41.25	-	-	-	-	-	-	-	-	-	-	-	-	-	42.68
		DCo	-	100.37	70.31	73.96	67.81	76.80	76.44	75.51	-	-	-	-	-	-	-	-	-	-	-	-	-	76.10
		L Grade($0-$7)	-	497,503	119,780	151,799	188,856	2,938,451	2,414,871	1,175,197	-	-	-	-	-	-	-	-	-	-	-	-	-	7,486,457
		DCu%	-	0.17	0.18	0.14	0.18	0.19	0.20	0.21	-	-	-	-	-	-	-	-	-	-	-	-	-	0.19
		DNi%	-	0.05	0.06	0.06	0.06	0.06	0.06	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06
		DPt	-	24.46	15.77	48.76	48.36	41.43	41.30	39.44	-	-	-	-	-	-	-	-	-	-	-	-	-	39.86
		DPd	-	67.85	22.47	192.90	182.27	168.49	177.65	189.58	-	-	-	-	-	-	-	-	-	-	-	-	-	166.58
		DAu	-	16.97	15.19	31.07	28.69	22.10	22.68	21.51	-	-	-	-	-	-	-	-	-	-	-	-	-	22.09
		DCo	-	66.70	84.01	68.16	62.26	66.28	65.66	59.01	-	-	-	-	-	-	-	-	-	-	-	-	-	65.19
		Total Ore Tonnes	-	514,543	122,150	270,688	683,248	8,444,478	6,869,667	3,675,969	-	-	-	-	-	-	-	-	-	-	-	-	-	20,580,743
		OB (tons)	-	946,686	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	946,686
		Cat 1 & 2 (tons)	-	9,546,608	10,862,656	13,076,946	13,968,627	4,044,449	1,199,326	56,786	-	-	-	-	-	-	-	-	-	-	-	-	-	52,755,398
		Cat 3 (tons)	-	2,621,708	1,434,378	821,175	1,737,610	744,581	1,002,599	120,965	-	-	-	-	-	-	-	-	-	-	-	-	-	8,483,016
		Cat 4 (tons)	-	4,451	389	-	126,316	428,226	521,030	260,426	-	-	-	-	-	-	-	-	-	-	-	-	-	1,340,838
		TOTAL WASTE TONS	-	13,119,452	12,297,423	13,898,121	15,832,553	5,217,257	2,722,955	438,177	-	-	-	-	-	-	-	-	-	-	-	-	-	63,525,938
		Total Tonnes	-	13,633,995	12,419,573	14,168,809	16,515,801	13,661,735	9,592,622	4,114,146	-	-	-	-	-	-	-	-	-	-	-	-	-	84,106,681
		S.R.	-	25.5	100.7	51.3	23.2	0.6	0.4	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	3.1
Phase 1W		**H Grade ($7+)**	-	-	-	479,195	546,266	864,951	2,227,995	3,213,920	4,804,028	3,448,701	2,458,422	1,843,878	403,647	-	-	-	-	-	-	-	-	20,291,004
		DCu%	-	-	-	0.32	0.33	0.33	0.34	0.34	0.39	0.39	0.44	0.46	0.43	-	-	-	-	-	-	-	-	0.38
		DNi%	-	-	-	0.08	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.12	0.10	-	-	-	-	-	-	-	-	0.10
		DPt	-	-	-	130.04	122.02	118.64	116.73	112.36	116.83	105.89	94.85	94.83	68.55	-	-	-	-	-	-	-	-	109.16
		DPd	-	-	-	382.60	367.38	360.99	356.73	340.11	348.24	334.55	334.01	340.03	243.67	-	-	-	-	-	-	-	-	342.88
		DAu	-	-	-	61.39	59.04	58.10	57.72	55.11	58.32	54.01	47.57	48.82	39.70	-	-	-	-	-	-	-	-	54.56
		DCo	-	-	-	68.29	71.65	72.99	74.74	75.27	78.08	82.02	91.18	95.81	92.79	-	-	-	-	-	-	-	-	80.81
		L Grade($0-$7)	-	-	-	82,582	152,212	1,239,122	1,724,897	2,864,303	4,098,107	3,189,895	1,699,361	1,174,912	244,641	-	-	-	-	-	-	-	-	16,470,031
		DCu%	-	-	-	0.19	0.19	0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.19	-	-	-	-	-	-	-	-	0.19
		DNi%	-	-	-	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	-	-	-	-	-	-	-	-	0.06
		DPt	-	-	-	74.85	71.73	69.10	66.37	66.12	67.38	61.81	49.21	42.86	39.35	-	-	-	-	-	-	-	-	62.14
		DPd	-	-	-	220.09	216.13	207.67	199.24	196.91	196.78	176.15	137.54	124.83	95.09	-	-	-	-	-	-	-	-	181.42
		DAu	-	-	-	37.91	36.93	35.21	33.63	33.17	34.44	31.33	23.88	22.09	16.15	-	-	-	-	-	-	-	-	31.39
		DCo	-	-	-	64.52	64.92	65.64	66.38	67.16	68.08	69.34	71.12	77.68	75.84	-	-	-	-	-	-	-	-	68.87
		Total Ore Tonnes	-	-	-	561,777	698,479	2,104,073	3,952,892	6,078,223	8,902,135	6,638,596	4,157,783	3,018,790	648,288	-	-	-	-	-	-	-	-	36,761,035
		OB (tons)	-	-	-	2,908,459	1,651,583	149,103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,709,144
		Cat 1 & 2 (tons)	-	-	-	432,458	1,606,703	1,177,822	3,185,709	3,727,061	1,846,861	2,339,684	1,270,367	134,545	-	-	-	-	-	-	-	-	-	15,721,208
		Cat 3 (tons)	-	-	-	199,766	466,496	277,613	659,240	1,385,915	972,882	1,348,102	1,073,740	284,267	20,661	-	-	-	-	-	-	-	-	6,688,681
		Cat 4 (tons)	-	-	-	-	-	-	-	-	6,521	1,755	-	-	-	-	-	-	-	-	-	-	-	8,276
		TOTAL WASTE TONS	-	-	-	3,540,683	3,724,781	1,604,538	3,844,949	5,112,976	2,826,263	3,689,541	2,344,107	418,812	20,661	-	-	-	-	-	-	-	-	27,127,309
		Total Tonnes	-	-	-	4,102,459	4,423,260	3,708,610	7,797,840	11,191,199	11,728,398	10,328,136	6,501,890	3,437,602	668,949	-	-	-	-	-	-	-	-	63,888,344
		S.R.	-	-	-	6.3	5.3	0.8	1.0	0.8	0.3	0.6	0.6	0.1	0.0	-	-	-	-	-	-	-	-	0.7
Phase 2W		**H Grade ($7+)**	-	-	-	-	-	199,022	187,209	121,910	1,351,326	3,712,725	3,945,876	3,200,224	3,147,768	1,928,810	2,154,406	455,837	-	-	-	-	-	20,405,111
		DCu%	-	-	-	-	-	0.29	0.24	0.29	0.30	0.37	0.40	0.38	0.41	0.44	0.43	0.38	-	-	-	-	-	0.39
		DNi%	-	-	-	-	-	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.11	0.11	0.11	0.10	-	-	-	-	-	0.10
		DPt	-	-	-	-	-	174.95	171.61	128.70	129.90	136.59	149.47	118.93	101.17	85.79	76.86	66.92	-	-	-	-	-	118.39
		DPd	-	-	-	-	-	457.95	448.74	325.77	363.06	380.17	389.91	347.56	339.57	319.57	288.76	225.50	-	-	-	-	-	351.77
		DAu	-	-	-	-	-	69.33	66.23	52.66	54.70	59.23	60.96	51.70	47.91	44.51	43.84	42.54	-	-	-	-	-	53.07
		DCo	-	-	-	-	-	57.76	61.67	69.21	70.14	74.22	75.87	84.51	90.48	90.40	87.16	85.89	-	-	-	-	-	81.24
		L Grade($0-$7)	-	-	-	-	-	229,406	661,540	188,595	727,016	1,318,679	2,023,739	3,193,608	2,540,832	1,313,757	693,126	330,308	-	-	-	-	-	13,220,605
		DCu%	-	-	-	-	-	0.16	0.12	0.14	0.17	0.19	0.21	0.18	0.17	0.18	0.23	0.22	-	-	-	-	-	0.18
		DNi%	-	-	-	-	-	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.06	-	-	-	-	-	0.06
		DPt	-	-	-	-	-	88.33	87.88	104.94	91.61	91.31	71.12	51.56	49.37	47.78	30.25	27.46	-	-	-	-	-	61.42
		DPd	-	-	-	-	-	249.92	261.03	261.64	265.94	272.38	189.69	141.46	142.09	134.22	101.32	96.02	-	-	-	-	-	174.49
		DAu	-	-	-	-	-	40.56	37.86	39.83	39.51	40.76	33.85	27.39	27.57	23.13	19.33	18.08	-	-	-	-	-	30.26
		DCo	-	-	-	-	-	55.38	63.10	57.31	62.36	64.86	66.21	66.22	71.25	76.36	75.86	72.15	-	-	-	-	-	68.03
		Total Ore Tonnes	-	-	-	-	-	428,428	848,749	310,505	2,078,342	5,031,404	5,969,615	6,393,832	5,688,599	3,242,567	2,847,531	786,144	-	-	-	-	-	33,625,716
		OB (tons)	-	-	-	-	-	2,889,664	20,963	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,910,627
		Cat 1 & 2 (tons)	-	-	-	-	-	5,775,267	3,256,704	647,886	6,741,364	4,614,580	1,769,802	4,304,431	1,458,420	261,647	260,733	15,110	-	-	-	-	-	29,105,942
		Cat 3 (tons)	-	-	-	-	-	386,383	169,210	36,753	486,553	1,475,733	1,969,978	4,556,372	3,160,300	1,014,741	222,047	41,493	-	-	-	-	-	13,519,563
		Cat 4 (tons)	-	-	-	-	-	-	-	-	-	939	-	-	279,891	407,852	5,410	-	-	-	-	-	-	694,092
		TOTAL WASTE TONS	-	-	-	-	-	9,051,314	3,446,877	684,639	7,227,917	6,091,252	3,739,780	8,860,803	4,898,610	1,684,240	488,190	56,603	-	-	-	-	-	46,230,224
		Total Tonnes	-	-	-	-	-	9,479,741	4,295,626	995,144	9,306,259	11,122,656	9,709,395	15,254,634	10,587,210	4,926,807	3,335,721	842,747	-	-	-	-	-	79,855,940
		S.R.	-	-	-	-	-	21.1	4.1	2.2	3.5	1.2	0.6	1.4	0.9	0.5	0.2	0.1	-	-	-	-	-	1.4

Report File	Total	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Total
Phase 1M	**H Grade ($7+)**	-	-	-	-	-	-	-	-	-	-	433,016	950,550	2,049,234	3,133,842	1,899,394	1,770,459	-	-	-	-	-	10,236,495
	DCu%	-	-	-	-	-	-	-	-	-	-	0.31	0.31	0.33	0.34	0.37	0.39	-	-	-	-	-	0.24
	DNi%	-	-	-	-	-	-	-	-	-	-	0.09	0.10	0.10	0.11	0.10	0.10	-	-	-	-	-	0.07
	DPt	-	-	-	-	-	-	-	-	-	-	80.07	76.37	79.08	86.47	87.20	79.46	-	-	-	-	-	58.82
	DPd	-	-	-	-	-	-	-	-	-	-	309.39	284.48	283.06	330.26	334.34	287.69	-	-	-	-	-	221.06
	DAu	-	-	-	-	-	-	-	-	-	-	38.38	37.32	38.17	47.71	47.90	36.43	-	-	-	-	-	29.54
	DCo	-	-	-	-	-	-	-	-	-	-	72.10	77.46	83.45	81.95	76.41	80.04	-	-	-	-	-	56.57
	L Grade($0-$7)	-	-	-	-	-	-	-	-	-	-	1,109,586	1,306,828	3,283,878	3,370,942	1,906,340	1,107,807	-	-	-	-	-	12,085,382
	DCu%	-	-	-	-	-	-	-	-	-	-	0.19	0.20	0.20	0.19	0.19	0.20	-	-	-	-	-	0.15
	DNi%	-	-	-	-	-	-	-	-	-	-	0.06	0.07	0.06	0.06	0.06	0.06	-	-	-	-	-	0.05
	DPt	-	-	-	-	-	-	-	-	-	-	50.15	47.53	49.17	49.42	45.57	47.24	-	-	-	-	-	37.09
	DPd	-	-	-	-	-	-	-	-	-	-	164.56	163.05	166.20	167.84	170.43	158.85	-	-	-	-	-	126.10
	DAu	-	-	-	-	-	-	-	-	-	-	25.09	24.14	24.22	26.50	26.11	21.80	-	-	-	-	-	18.87
	DCo	-	-	-	-	-	-	-	-	-	-	65.83	68.44	67.76	66.06	64.25	68.93	-	-	-	-	-	51.29
	TOTAL ORE TONS	-	-	-	-	-	-	-	-	-	-	1,542,602	2,257,378	5,333,113	6,504,784	3,805,734	2,878,266	-	-	-	-	-	22,321,877
	OB (tons)	-	-	-	-	-	-	-	-	-	-	2,366,308	9,583	-	-	-	-	-	-	-	-	-	2,375,891
	Cat 1 & 2 (tons)	-	-	-	-	-	-	-	-	-	-	2,384,266	1,469,282	2,646,700	2,378,271	464,634	8,015	-	-	-	-	-	9,351,168
	Cat 3 (tons)	-	-	-	-	-	-	-	-	-	-	834,779	396,874	613,495	1,320,520	517,418	316,128	-	-	-	-	-	3,999,213
	Cat 4 (tons)	-	-	-	-	-	-	-	-	-	-	1,674	-	-	55,603	-	-	-	-	-	-	-	57,277
	TOTAL WASTE TONS	-	-	-	-	-	-	-	-	-	-	5,587,027	1,875,738	3,260,195	3,754,394	982,052	324,143	-	-	-	-	-	15,783,549
	Total Tonnes	-	-	-	-	-	-	-	-	-	-	7,129,629	4,133,116	8,593,308	10,259,178	4,787,786	3,202,409	-	-	-	-	-	38,105,426
	S.R.	-	-	-	-	-	-	-	-	-	-	3.6	0.8	0.6	0.6	0.3	0.1	-	-	-	-	-	0.7
Phase 2M	**H Grade ($7+)**	-	-	-	-	-	-	-	-	-	-	-	-	-	231,135	952,893	1,790,297	1,285,064	3,092,144	5,923,205	4,696,575	1,493,341	19,464,654
	DCu%	-	-	-	-	-	-	-	-	-	-	-	-	-	0.26	0.28	0.29	0.30	0.35	0.36	0.41	0.52	0.06
	DNi%	-	-	-	-	-	-	-	-	-	-	-	-	-	0.08	0.09	0.09	0.09	0.09	0.09	0.11	0.12	0.02
	DPt	-	-	-	-	-	-	-	-	-	-	-	-	-	97.90	74.48	78.52	94.03	84.91	85.99	90.01	106.14	18.87
	DPd	-	-	-	-	-	-	-	-	-	-	-	-	-	279.71	262.27	241.86	266.73	330.70	353.02	359.90	402.60	59.53
	DAu	-	-	-	-	-	-	-	-	-	-	-	-	-	49.52	41.23	38.90	42.61	48.18	44.35	47.31	50.74	9.90
	DCo	-	-	-	-	-	-	-	-	-	-	-	-	-	71.48	77.96	87.47	82.75	69.63	71.73	77.96	72.87	16.94
	L Grade($0-$7)	-	-	-	-	-	-	-	-	-	-	-	-	-	1,691,514	4,063,842	5,503,276	5,180,862	6,356,956	5,746,795	3,258,525	807,882	32,609,651
	DCu%	-	-	-	-	-	-	-	-	-	-	-	-	-	0.16	0.17	0.17	0.18	0.18	0.20	0.20	0.19	0.03
	DNi%	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.01
	DPt	-	-	-	-	-	-	-	-	-	-	-	-	-	72.65	72.56	57.30	52.18	44.73	43.84	50.39	51.55	12.46
	DPd	-	-	-	-	-	-	-	-	-	-	-	-	-	182.70	185.95	164.90	154.15	146.49	158.10	182.92	175.33	32.02
	DAu	-	-	-	-	-	-	-	-	-	-	-	-	-	29.99	29.42	26.80	25.00	23.43	24.57	29.86	29.44	5.19
	DCo	-	-	-	-	-	-	-	-	-	-	-	-	-	66.58	67.17	67.86	67.56	66.22	64.67	64.39	63.90	11.83
	TOTAL ORE TONS	-	-	-	-	-	-	-	-	-	-	-	-	-	1,922,649	5,016,735	7,293,573	6,465,926	9,449,100	11,670,000	7,955,100	2,301,223	52,074,305
	OB (tons)	-	-	-	-	-	-	-	-	-	-	-	-	-	2,842,982	-	-	-	-	-	-	-	2,842,982
	Cat 1 & 2 (tons)	-	-	-	-	-	-	-	-	-	-	-	-	-	3,826,575	10,296,595	6,113,271	5,082,666	11,640,135	6,497,062	3,257,915	52,325	46,766,545
	Cat 3 (tons)	-	-	-	-	-	-	-	-	-	-	-	-	-	1,534,240	3,781,846	3,385,468	3,172,608	6,763,139	2,465,072	1,299,143	273,170	22,674,686
	Cat 4 (tons)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,956	126,179	14,578	3,393	11,854	70,801	-	228,761
	TOTAL WASTE TONS	-	-	-	-	-	-	-	-	-	-	-	-	-	8,203,797	14,080,397	9,624,918	8,269,852	18,406,668	8,973,988	4,627,859	325,495	72,512,974
	Total Tonnes	-	-	-	-	-	-	-	-	-	-	-	-	-	10,126,446	19,097,132	16,918,491	14,735,777	27,855,767	20,643,988	12,582,959	2,626,718	124,587,279
	S.R.	-	-	-	-	-	-	-	-	-	-	-	-	-	4.3	2.8	1.3	1.3	1.9	0.8	0.6	0.1	1.4


Value per Ton by Phase
$15.00
$14.00
$13.00
$12.00
$11.00
$10.00
$9.00
$8.00
$7.00
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$-
Net Value per ton
1E
2E
3E
4E
5E
1W
2W
3W
1M
2M
3M
Phase
Total Value per ton
Ore Value per ton
Stockpile Value per ton


DFS versus 2007 Pit
Ore Copper Grade Comparison
Diluted Copper Grade (DCu%)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
Year -2
Year -1
Year 1
Year 2
Year 3
Year 4
Year 5
Year 6
Year 7
Year 8
Year 9
Year 10
Year 11
Year 12
Year 13
Year 14
Year 15
Year 16
Year 17
Year 18
Year 19
Year 20
Year 21
Year 22
Year 23
Year 24
Year 25
Year 26
2007 Pit
DFS 32K Case

Appendix G

ii) Waste Stockpile Detail

Tonnage

		Year -2	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	
Open Pit Waste	TOTAL WASTE TONS	-	7,798,390	34,358,854	30,910,536	27,392,028	21,937,999	16,026,100	10,014,780	6,235,791	10,054,180	9,780,793	11,670,914	11,155,353	8,179,466	13,642,431	15,550,639	15,108,746	18,264,427	20,476,500	8,973,988	5,948,008	329,883	303,809,808
	OB (tons)	-	2,396,530	1,473,705	-	2,908,459	1,651,583	3,038,767	20,963	-	-	-	2,366,308	9,583	-	2,842,982	-	1,806,369	4,640	-	-	-	-	18,519,888
	Cat 1 & 2 (tons)	-	4,493,022	26,311,661	24,707,822	20,190,199	16,151,299	10,997,538	7,641,739	4,431,733	8,588,225	6,954,264	5,424,435	5,908,258	4,105,120	6,466,493	11,021,962	9,236,794	13,372,926	13,198,380	6,497,062	4,397,206	54,557	210,150,693
	Cat 3 (tons)	-	548,285	4,566,904	3,697,213	2,432,855	2,821,250	1,456,729	1,831,048	1,543,633	1,459,435	2,823,835	3,878,497	5,237,512	3,794,456	3,869,501	4,521,311	3,939,405	4,872,282	7,274,727	2,465,072	1,480,001	275,326	64,789,278
	Cat 4 (tons)	-	360,553	2,006,584	2,505,500	1,860,515	1,313,868	533,067	521,030	260,426	6,521	2,694	1,674	-	279,891	463,455	7,366	126,179	14,578	3,393	11,854	70,801	-	10,349,949
Stockpile	To Stockpile (tons)	-	-	1,133,661	3,544,941	354,076	5,682	8,081	1,308	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	From Stockpile (tons)	-	-	-	-	-	-	-	-	1,605,303	689,523	-	-	-	-	-	-	-	-	-	-	312,460	2,440,463	
	Stockpile (tons)	-	-	1,133,661	4,678,602	5,032,678	5,038,360	5,046,441	5,047,749	3,442,446	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,752,923	2,440,463	-	

Bank Volume (yd3)

Tonnage Factor (ft3/ton) = 10.8559

		Year -2	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	
Open Pit Waste	TOTAL WASTE TONS	-	3,135,502	13,814,677	12,428,211	11,013,523	8,820,620	6,443,620	4,026,646	2,507,227	4,042,488	3,932,567	4,692,529	4,485,237	3,288,721	5,485,217	6,252,451	6,074,779	7,343,585	8,232,994	3,608,175	2,391,518	132,636	122,152,922
	OB	-	963,574	592,533	-	1,169,405	664,052	1,221,798	8,429	-	-	-	951,422	3,853	-	1,143,079	-	726,287	1,866	-	-	-	-	7,446,298
	Cat 1 & 2	-	1,806,511	10,579,139	9,934,283	8,117,881	6,493,959	4,421,784	3,072,517	1,781,868	3,453,071	2,796,103	2,181,005	2,375,535	1,650,547	2,599,985	4,431,604	3,713,841	5,376,857	5,306,678	2,612,276	1,767,986	21,936	84,495,367
	Cat 3	-	220,449	1,836,217	1,486,540	978,179	1,134,341	585,708	736,210	620,649	586,795	1,135,380	1,559,429	2,105,848	1,525,638	1,555,812	1,817,885	1,583,918	1,959,000	2,924,952	991,132	595,065	110,700	26,049,849
	Cat 4	-	144,968	806,788	1,007,387	748,058	528,267	214,330	209,491	104,710	2,622	1,083	673	-	112,536	186,342	2,962	50,733	5,861	1,364	4,766	28,467	-	4,161,408
Stockpile	To Stockpile	-	-	455,811	1,425,316	142,363	2,284	3,249	526	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	From Stockpile	-	-	-	-	-	-	-	-	645,445	277,237	-	-	-	-	-	-	-	-	-	-	125,631	981,238	
	Stockpile	-	-	455,811	1,881,127	2,023,491	2,025,775	2,029,024	2,029,550	1,384,106	1,106,869	1,106,869	1,106,869	1,106,869	1,106,869	1,106,869	1,106,869	1,106,869	1,106,869	1,106,869	1,106,869	981,238	-	

Loose Volume (yd3)

Swell = 30%

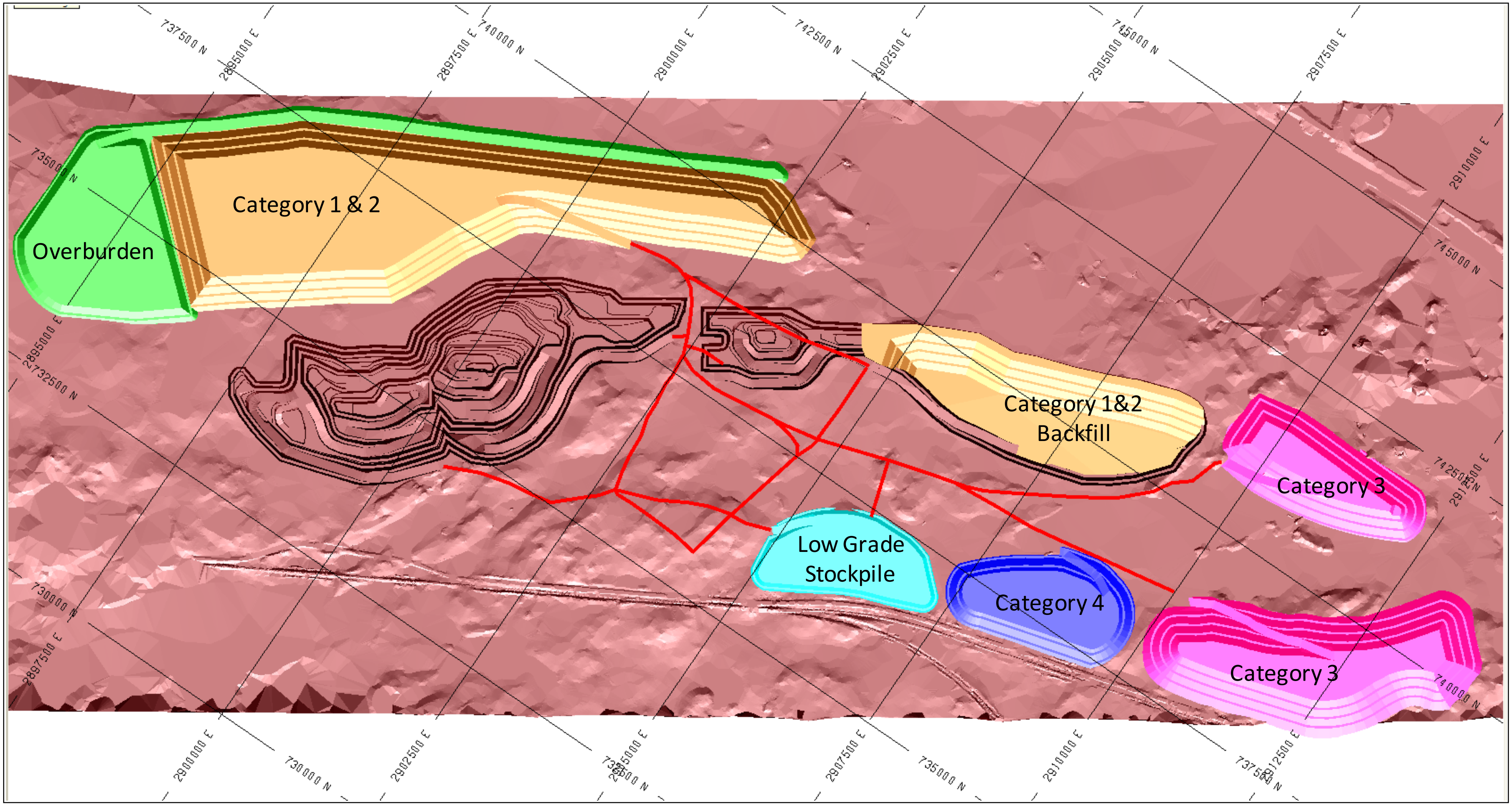
			Year -2	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	
Open Pit Waste	TOTAL WASTE TONS		-	4,076,152	17,959,080	16,156,674	14,317,580	11,466,805	8,376,706	5,234,640	3,259,395	5,255,234	5,112,337	6,100,287	5,830,808	4,275,337	7,130,782	8,128,187	7,897,213	9,546,660	10,702,892	4,690,627	3,108,973	172,427	158,798,799
	OB		-	1,252,646	770,293	-	1,520,227	863,268	1,588,337	10,957	-	-	-	1,236,849	5,009	-	1,486,002	-	944,174	2,425	-	-	-	-	9,680,188
	Cat 1 & 2		-	2,348,464	13,752,881	12,914,568	10,553,245	8,442,146	5,748,319	3,994,272	2,316,429	4,488,992	3,634,934	2,835,306	3,088,196	2,145,711	3,379,981	5,761,086	4,827,994	6,989,915	6,898,681	3,395,959	2,298,382	28,516	109,843,977
	Cat 3		-	286,584	2,387,082	1,932,502	1,271,633	1,474,643	761,420	957,073	806,844	762,834	1,475,994	2,027,257	2,737,603	1,983,330	2,022,555	2,363,251	2,059,093	2,546,700	3,802,438	1,288,472	773,584	143,911	33,864,804
	Cat 4		-	188,458	1,048,824	1,309,604	972,475	686,748	278,630	272,338	136,122	3,408	1,408	875	-	146,297	242,244	3,850	65,952	7,620	1,773	6,196	37,007	-	5,409,830
Stockpile	To Stockpile		-	-	592,555	1,852,910	185,072	2,970	4,224	684	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	From Stockpile		-	-	-	-	-	-	-	-	839,078	360,408	-	-	-	-	-	-	-	-	-	-	163,320	1,275,609	
	Stockpile		-	-	592,555	2,445,465	2,630,538	2,633,508	2,637,732	2,638,415	1,799,337	1,438,929	1,438,929	1,438,929	1,438,929	1,438,929	1,438,929	1,438,929	1,438,929	1,438,929	1,438,929	1,438,929	1,275,609	-	
OB	Finger Dyke - 1640 down	4,326,378		1,252,646	770,293	-	1,520,227	783,212				-	-	-	-	-	-	-	-	-	-	-	-	-	4,326,378
	South End - 1640 up	5,353,810		-	-	-	-	80,056	1,588,337	10,957	-	-	-	1,236,849	5,009	-	1,486,002	-	944,174	2,425	-	-	-	-	5,353,810
	Total Overburden			1,252,646	770,293	-	1,520,227	863,268	1,588,337	10,957	-	-	-	1,236,849	5,009	-	1,486,002	-	944,174	2,425	-	-	-	-	9,680,188
Cat 1 & 2	East Backfill	48,651,404										3,366,744	3,634,934	2,835,306	3,088,196	2,145,711	3,379,981	5,761,086	4,827,994	6,989,915	6,898,681	3,395,959	2,298,382	28,516	48,651,404
	Level											1060	1120	1160	1200	1220	1260	1300	1340	1400	1460	1520	1580	1580	
	North Stockpile	61,192,573		2,348,464	13,752,881	12,914,568	10,553,245	8,442,146	5,748,319	3,994,272	2,316,429	1,122,248	-	-	-	-	-	-	-	-	-	-	-	-	61,192,573
	1640 - down	14,483,310		2,348,464	12,134,846																				
	1640 - 1680	19,447,728			1,618,035	12,914,568	4,915,124																		
	1680 - 1720	15,518,437					5,638,121	8,442,146	1,438,170																
	1720 - 1760	11,743,098							4,310,149	3,994,272	2,316,429	1,122,248													
	Total Cat 1 & 2			2,348,464	13,752,881	12,914,568	10,553,245	8,442,146	5,748,319	3,994,272	2,316,429	4,488,992	3,634,934	2,835,306	3,088,196	2,145,711	3,379,981	5,761,086	4,827,994	6,989,915	6,898,681	3,395,959	2,298,382	28,516	109,843,977
Cat 3	South East Pile	25,406,743		286,584	2,387,082	1,932,502	1,271,633	1,474,643	761,420	957,073	806,844	762,834	1,475,994	2,027,257	2,737,603	1,983,330	2,022,555	2,363,251	2,059,093	97,044	-	-	-	-	
	1640 - down	10,077,613		286,584	2,387,082	1,932,502	1,271,633	1,474,643	761,420	957,073	806,844	199,832													
	1640 - 1680	7,037,894										563,002	1,475,994	2,027,257	2,737,603	234,037									
	1680 - 1720	5,057,994														1,749,292	2,022,555	1,286,146							
	1720 - 1760	3,233,242																1,077,105	2,059,093	97,044					
	North Stockpile	8,458,061		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,449,656	3,802,438	1,288,472	773,584	143,911	8,458,061
	1640 - down	4,017,617																		2,449,656	1,567,961				
	1640 - 1680	2,710,025																			2,234,477	475,548			
	1680 - 1720	1,519,422																				812,924	773,584	143,911	
	1720 - 1760																								
	Total Cat 3			286,584	2,387,082	1,932,502	1,271,633	1,474,643	761,420	957,073	806,844	762,834	1,475,994	2,027,257	2,737,603	1,983,330	2,022,555	2,363,251	2,059,093	2,546,700	3,802,438	1,288,472	773,584	143,911	8,458,061
Cat 4	South East Pile	4,757,076		188,458	1,048,824	1,309,604	972,475	686,748	278,630	272,338															
	1640 - down	4,565,591		188,458	1,048,824	1,309,604	972,475	686,748	278,630	80,853															
	1640 - 1660	1,300,060								191,485	136,122	3,408	1,408	875	-	146,297	242,244	3,850	65,952	7,620	1,773	6,196	37,007	-	
	Total Cat 4																								

East Pit Backfill Bottom up configuration

BENCH TOE	Loose (YDS)	3,366,744 Year 8	3,634,934 Year 9	2,835,306 Year 10	3,088,196 Year 11	2,145,711 Year 12	3,379,981 Year 13	5,761,086 Year 14	4,827,994 Year 15	6,989,915 Year 16	6,898,681 Year 17	3,395,959 Year 18	2,298,382 Year 19	28,516 Year 20	- Year 21
======															
1600													-		
1580	283,296												283,296		
1560	671,110												671,110		
1540	861,444												861,444		
1520	1,047,629											1,028,754	18,875		
1500	1,073,517											1,073,517			
1480	1,247,221											1,247,221			
1460	1,414,110										1,367,643	46,467			
1440	1,575,591										1,575,591				
1420	2,204,831										2,204,831				
1400	3,149,071									1,398,455	1,750,616				
1380	3,059,627									3,059,627					
1360	2,837,701								305,868	2,531,833					
1340	2,729,997								2,729,997						
1320	2,643,534							851,405	1,792,129						
1300	2,332,998							2,332,998							
1280	2,249,090							2,249,090							
1260	2,166,294						1,838,701	327,593							
1240	2,049,016					507,736	1,541,280								
1220	1,966,980				329,005	1,637,975									
1200	1,677,887				1,677,887										
1180	1,461,221			379,917	1,081,304										
1160	1,353,888			1,353,888											
1140	1,282,036		180,535	1,101,501											
1120	1,209,740		1,209,740												
1100	955,703		955,703												
1080	886,610		886,610												
1060	819,129	416,783	402,346												
1040	684,314	684,314													
1020	628,962	628,962													
1000	404,407	404,407													
980	359,648	359,648													
960	299,500	299,500													
940	259,278	259,278													
920	218,222	218,222													
900	95,630	95,630													

TOTAL	48,159,232	3,366,744	3,634,934	2,835,306	3,088,196	2,145,711	3,379,981	5,761,086	4,827,994	6,989,915	6,898,681	3,395,959	1,834,725	-	-

Note that there is a slight difference between the dump volume and the actual volume
This was only due to the detailed design and sufficient space exists to accommodate the material
In fact, there is a shortage of material to be placed in the pit.


Category 1 & 2
Overburden
Category 1&2
Backfill
Category 3
Low Grade
Stockpile
Category 4
Category 3

Appendix G

iii) Drill Bit Size Determination

PolyMet

NorthMet Mine

Blasthole Size Tradeoff

Assumptions:

Drill		Pit Viper 351			Pit Viper 271	
		Electric	Diesel		Electric	Diesel
Base Cost (less drill consumables)	$/hr	$ 152.08	$ 237.80	$/hr	$ 92.35	$ 129.50
Maximum Single Pass Depth	feet	65	65	feet	55	55
Material		Waste	Waste		Waste	Waste
Explosive Cost	$/lb	$ 0.205	$ 0.205		$ 0.205	$ 0.205
Tonnage Blasted	tons	25,000,000	25,000,000		25,000,000	25,000,000

Pit Viper - 351 (Lower Bit Size)

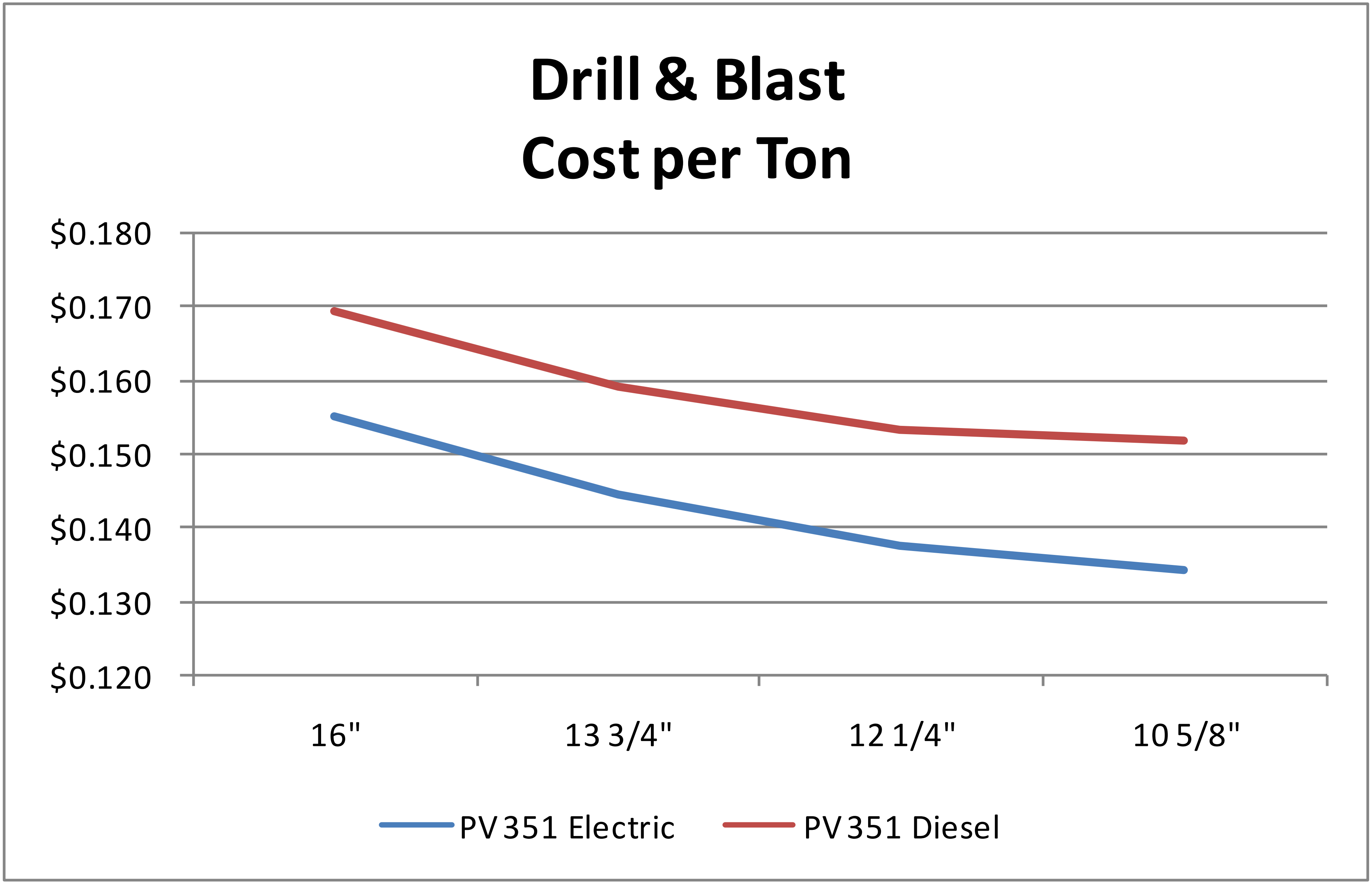
Cost Per Ton

	inches	**16"**	**13 3/4"**	**12 1/4"**	**10 5/8"**
Electric	$/ton	$ 0.155	$ 0.144	$ 0.138	$ 0.134
Diesel	$/ton	$ 0.169	$ 0.159	$ 0.153	$ 0.152

Pit Viper - 371 (Upper Bit Size)

	inches	**16"**	**13 3/4"**	**12 1/4"**	**10 5/8"**
Electric	$/ton	$ -	$ -	$ -	$ 0.122
Diesel	$/ton	$ -	$ -	$ -	$ 0.129

The Pit Viper 351 is capable of drilling a 16” diameter hole if conditions require this. The Pit Viper 271 is not able to drill that size of hole. Phelps Dodge Morenci indicated that anything smaller than the 12 ¼” hole for the PV 351 is too small. So while a cost was developed, practically it is not the correct size.


Drill & Blast
Cost per Ton
$0.180
$0.170
$0.160
$0.150
$0.140
$0.130
$0.120
16"
13 3/4"
12 1/4"
10 5/8"
PV 351 Electric
PV 351 Diesel

PolyMet
NorthMet Mine

Blasthole Size Tradeoff

Assumptions:

Drill		Pit Viper 351 - electric		Pit Viper 271 - electric
Base Cost (less drill consumables)	$/hr	$ 152.08	$/hr	$ 92.35
Maximum Single Pass Depth	feet	65	feet	55
Material		Waste		Waste
Explosive Cost	$/lb	$ 0.205		$ 0.205
Tonnage Blasted	tons	25,000,000		25,000,000

					Lower Bit Size					Upper Bit Size
Drilling										
Bit Size	inches	**16"**	**13 3/4"**	**12 1/4"**	**10 5/8"**	inches	**16"**	**13 3/4"**	**12 1/4"**	**10 5/8"**
Drill Production Rate	feet/hr	60.6	66.6	69.5	72.5	feet/hr	n/a	n/a	n/a	72.5
Drill Base Cost (less consumables)	$/foot	$ 2.51	$ 2.28	$ 2.19	$ 2.10	$/foot				$ 1.27
	$/hr	$ 152.08	$ 152.08	$ 152.08	$ 152.08	$/hr				$ 92.35
Drill Consumable Cost	$/foot	$ 1.71	$ 1.44	$ 1.24	$ 1.12	$/foot				$ 1.12
	$/hr	$ 103.41	$ 95.66	$ 86.29	$ 81.41	$/hr				$ 81.41
Total Drill Cost	$/foot	$ 4.22	$ 3.72	$ 3.43	$ 3.22	$/foot				$ 2.40
	$/hr	$ 255.49	$ 247.74	$ 238.37	$ 233.49	$/hr				$ 173.76
Blasting										
Bench Height	feet	40	40	40	40	feet	40	40	40	40
Burden	feet	33.1	30.8	29.2	26.9	feet	33.1	30.8	29.2	26.9
Spacing	feet	38.1	35.4	33.5	30.8	feet	38.1	35.4	33.5	30.8
Sub-drill	feet	6.6	6.2	5.9	5.2	feet	6.6	6.2	5.9	5.2
Total Blasthole Length	feet	46.6	46.2	45.9	45.2	feet	46.6	46.2	45.9	45.2
Tons Rock per Hole	tons/hole	4,617	4,000	3,577	3,037	tons/hole	4,617	4,000	3,577	3,037
Explosive Weight	lbs/hole	2,532	1,976	1,632	1,277	lbs/hole	2,532	1,976	1,632	1,277
Powder Factor	lbs/ton	0.55	0.49	0.46	0.42	lbs/ton	0.55	0.49	0.46	0.42
Rock Size at 95% Passing	feet	3.61	3.61	3.61	3.61	feet	3.61	3.61	3.61	3.61
Blastholes Required	holes	5,415	6,250	6,989	8,232	holes	-	-	-	8,232
Drilling Required	feet	252,328	288,750	320,800	372,078	feet	-	-	-	372,078
Drilling Hours Required	hours	4,164	4,336	4,616	5,132	hours	-	-	-	5,132
Explosives Required	lbs	13,710,201	12,350,000	11,406,206	10,512,018	lbs	-	-	-	10,512,018
Drilling Cost	$	$ 1,063,804	$ 1,074,096	$ 1,100,269	$ 1,198,275	$	$ -	$ -	$ -	$ 891,734
Explosive Cost	$	$ 2,810,591	$ 2,531,750	$ 2,338,272	$ 2,154,964	$	$ -	$ -	$ -	$ 2,154,964
Total Cost	$	$ 3,874,395	$ 3,605,846	$ 3,438,541	$ 3,353,238	$	$ -	$ -	$ -	$ 3,046,698
Cost per Ton	$/ton	$ 0.155	$ 0.144	$ 0.138	$ 0.134	$/ton	$ -	$ -	$ -	$ 0.122

PolyMet

NorthMet Mine

Blasthole Size Tradeoff

Assumptions:

Drill		Pit Viper 351 - diesel		Pit Viper 271 - diesel
Base Cost (less drill consumables)	$/hr	$ 237.80	$/hr	$ 129.50
Maximum Single Pass Depth	feet	65	feet	55
Material		Waste		Waste
Explosive Cost	$/lb	$ 0.205	$/lb	$ 0.205
Tonnage Blasted	tons	25,000,000	tons	25,000,000

					Lower Bit Size					Upper Bit Size
Drilling										
Bit Size	inches	**16"**	**13 3/4"**	**12 1/4"**	**10 5/8"**	inches	**16"**	**13 3/4"**	**12 1/4"**	**10 5/8"**
Drill Production Rate	feet/hr	60.6	66.6	69.5	72.5	feet/hr	n/a	n/a	n/a	72.5
Drill Base Cost (less consumables)	$/foot	$ 3.92	$ 3.57	$ 3.42	$ 3.28	$/foot				$ 1.79
	$/hr	$ 237.80	$ 237.80	$ 237.80	$ 237.80	$/hr				$ 129.50
Drill Consumable Cost	$/foot	$ 1.71	$ 1.44	$ 1.24	$ 1.12	$/foot				$ 1.12
	$/hr	$ 103.41	$ 95.66	$ 86.29	$ 81.41	$/hr				$ 81.41
Total Drill Cost	$/foot	$ 5.63	$ 5.01	$ 4.66	$ 4.40	$/foot				$ 2.91
	$/hr	$ 341.21	$ 333.46	$ 324.09	$ 319.21	$/hr				$ 210.91
Blasting										
Bench Height	feet	40	40	40	40	feet	40	40	40	40
Burden	feet	33.1	30.8	29.2	26.9	feet	33.1	30.8	29.2	26.9
Spacing	feet	38.1	35.4	33.5	30.8	feet	38.1	35.4	33.5	30.8
Sub-drill	feet	6.6	6.2	5.9	5.2	feet	6.6	6.2	5.9	5.2
Total Blasthole Length	feet	46.6	46.2	45.9	45.2	feet	46.6	46.2	45.9	45.2
Tons Rock per Hole	tons/hole	4,617	4,000	3,577	3,037	tons/hole	4,617	4,000	3,577	3,037
Explosive Weight	lbs/hole	2,532	1,976	1,632	1,277	lbs/hole	2,532	1,976	1,632	1,277
Powder Factor	lbs/ton	0.55	0.49	0.46	0.42	lbs/ton	0.55	0.49	0.46	0.42
Rock Size at 95% Passing	feet	3.61	3.61	3.61	3.61	feet	3.61	3.61	3.61	3.61
Blastholes Required	holes	5,415	6,250	6,989	8,232	holes	-	-	-	8,232
Drilling Required	feet	252,328	288,750	320,800	372,078	feet	-	-	-	372,078
Drilling Hours Required	hours	4,164	4,336	4,616	5,132	hours	-	-	-	5,132
Explosives Required	lbs	13,710,201	12,350,000	11,406,206	10,512,018	lbs	-	-	-	10,512,018
Drilling Cost	$	$ 1,420,728	$ 1,445,743	$ 1,495,937	$ 1,638,199	$	$ -	$ -	$ -	$ 1,082,392
Explosive Cost	$	$ 2,810,591	$ 2,531,750	$ 2,338,272	$ 2,154,964	$	$ -	$ -	$ -	$ 2,154,964
Total Cost	$	$ 4,231,319	$ 3,977,493	$ 3,834,210	$ 3,793,163	$	$ -	$ -	$ -	$ 3,237,355
Cost per Ton	$/ton	$ 0.169	$ 0.159	$ 0.153	$ 0.152	$/ton	$ -	$ -	$ -	$ 0.129

Appendix G

iv) Fragmentation Study

Polymet Mining Corporation
NorthMet Project

Project Title	PolyMet Mining Corporation NorthMet Project
Rock Type 1	Ore
Rock Type 2	Waste

	Geomechanical Properties									
	Geological Unit	**Mineralization Unit**	**UCS (MPA)**	**Young's Modulus (GPA)**	**RQD**	**FF (fractures/m)**	**FF (fractures/ft)**	**Fracture Spacing (m)**	**Fracture Spacing (ft)**	**SG**
	Unit 7	Hanging Wall	90	55	95	0.18	0.6	0.5	1.7	2.95
	Unit 6	Hanging Wall	107	80	97	0.18	0.6	0.5	1.7	2.90
	Unit 5	Hanging Wall	101	80	95	0.21	0.7	0.4	1.4	2.90
	Unit 4	Hanging Wall	120	67	89	0.64	2.1	0.2	0.5	2.91
	Unit 3	Hanging Wall	119	87	97	0.24	0.8	0.4	1.2	2.93
	Unit 2	Ore	102	88	91	0.27	0.9	0.3	1.1	2.99
	Unit 1	FW and Ore	120	84	96	0.18	0.6	0.5	1.7	2.98
	VF	Footwall	109	57	79	0.58	1.9	0.2	0.5	2.79
Average Parameters for Waste	Units 3-7	Hanging Wall	106	77	95	0.30	1.0	0.3	1.0	2.93
Average Parameters for Ore	Unit 1-2	FW and Ore	118	84	92	0.23	0.75	0.4	1.3	2.93

Design Parameters		**Meters**	**Feet**
Bench Height	Ore	12.2	40
Bench Height	Waste	12.2	40
Block Size	50x50x20 (x,y,z)		
Required Fragmentation	95% passing at 3.5 ft (1.1 m)		
Annual Production Rate	32,000 ton ore		

Explosive Parameters		
Explosive Type	70/30	
Explosive Density (g/cc)	1.25	
Target Powder Factor (kg/tonne)		
Velocity of Discharge (m/s)	4,100	
Velocity of Discharge (ft/s)	13,451	
RWS (%ANFO)	91%	RWS (AWS of Explosive / AWS ANFO)
Explosive Energy (AWS) (j/g)	3,200	
Explosive Energy (AWS) (j/g) ANFO	3,500	

Hole Diameters Anticipated	**(mm)**	**(Inches)**
Option 1	270	10 5/8
Option 2	311	12 1/4
Option 3	349	13 3/4
Option 4	406	16

	Fragmentation Target Parameters	**(Meters)**	**(Feet)**
ORE	Oversize	1.07	3.51
	Target	0.30	1.00
	Undersize	0.20	0.66
WASTE	Oversize	1.07	3.51
	Target	0.30	1.00
	Undersize	0.20	0.66

Pattern Design	
Staggered or Squared	1.1

Enter (1.1 for a Staggered Pattern or 1.0 for a Square Pattern)

PolyMet Mining Corporation NorthMet Project

			Option 1		Option 2		Option 3		Option 4	
			Waste / Ore		Waste / Ore		Waste / Ore		Waste / Ore	
Explosive Type			70/30	70/30	70/30	70/30	70/30	70/30	70/30	70/30
			Ore	Waste	Ore	Waste	Ore	Waste	Ore	Waste
Rock Density	g/cc		2.93	2.93	2.93	2.93	2.93	2.93	2.93	2.93
Bench Height	m		12	12	12	12	12	12	12	12
Explosive Diameter	mm		270	270	311	311	349	349	406	406
	inches		10 5/8	10 5/8	12 1/4	12 1/4	13 3/4	13 3/4	16	16
Explosive Density	g/cc		1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Explosive Energy AWS	j/g		3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200
Burden	m	B	6.8	8.2	7.5	8.9	8.0	9.4	8.5	10.1
Burden Stiffness (2.0<BS<3.5)			1.8	1.5	1.6	1.4	1.5	1.3	1.4	1.2
Spacing (=1.15*B)	m	S	7.8	9.4	8.6	10.2	9.2	10.8	9.8	11.6
Stemming Length (=0.7B)	m		4.8	5.7	5.3	6.2	5.6	6.6	6.0	7.1
Energy Distribution	%		61%	53%	57%	49%	54%	46%	51%	42%
Sub-Drill (Burden * 0.2)	m		1.4	1.6	1.5	1.8	1.6	1.9	1.7	2.0
Blasthole Length	m		13.6	13.8	13.7	14.0	13.8	14.1	13.9	14.2
Explosive Length	m		8.8	8.1	8.4	7.8	8.2	7.5	7.9	7.1
Explosive Loading Density	kg/m		71.53	71.53	94.91	94.91	119.52	119.52	161.75	161.75
Explosive Weight	kg/hole		629.5	579.4	797.2	740.3	980.1	896.4	1,277.8	1,148.4
Explosive Energy	kJ/hole		2,014,400	1,854,080	2,551,040	2,368,960	3,136,320	2,868,480	4,088,960	3,674,880
Volume Shot	bcm/hole		647	940	787	1,108	898	1,239	1,016	1,429
Mass Shot	t/hole		1,896	2,754	2,306	3,246	2,631	3,630	2,977	4,187
Powder Factor	kg/bcm		0.97	0.62	1.01	0.67	1.09	0.72	1.26	0.80
Powder Factor	kg/t		0.33	0.21	0.35	0.23	0.37	0.25	0.43	0.27
Energy Factor	kJ/t		1,062	673	1,106	730	1,192	790	1,374	878

Comments

Kuz Ram Model #	1	2	5	6	9	10	13	14

			Option 1		Option 2		Option 3		Option 4	
			Waste / Ore		Waste / Ore		Waste / Ore		Waste / Ore	
Explosive Type			70/30	70/30	70/30	70/30	70/30	70/30	70/30	70/30
			Ore	Waste	Ore	Waste	Ore	Waste	Ore	Waste
Rock Density	lb/ft^3		183	183	183	183	183	183	183	183
Bench Height	ft		40	40	40	40	40	40	40	40
Explosive Diameter	inches		10 5/8	10 5/8	12 1/4	12 1/4	13 3/4	13 3/4	16	16
Explosive Density	lb/ft^3		78	78	78	78	78	78	78	78
Explosive Energy AWS	BTU/lb		1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377
Burden	ft	B	22.3	26.9	24.6	29.2	26.2	30.8	27.9	33.1
Burden Stiffness (2.0<BS<3.5)			5.9	4.9	5.2	4.6	4.9	4.3	4.6	3.9
Spacing (=1.15*B)	ft	S	25.6	30.8	28.2	33.5	30.2	35.4	32.2	38.1
Stemming Length (=0.7B)	ft		15.7	18.7	17.4	20.3	18.4	21.7	19.7	23.3
Energy Distribution	%		61%	53%	57%	49%	54%	46%	51%	42%
Sub-Drill (Burden * 0.25)	ft		4.6	5.2	4.9	5.9	5.2	6.2	5.6	6.6
Blasthole Length	ft		44.6	45.3	44.9	45.9	45.3	46.3	45.6	46.6
Explosive Length	ft		28.9	26.6	27.6	25.6	26.9	24.6	25.9	23.3
Explosive Loading Density	lb/ft		48	48	64	64	80	80	109	109
Explosive Weight	lb/hole		1,388	1,277	1,758	1,632	2,161	1,976	2,817	2,532
Explosive Energy	BTU/hole		1,910,501	1,758,520	2,419,720	2,246,952	2,974,644	2,720,654	3,878,408	3,485,652
Volume Shot	bcf/hole		22,852	33,209	27,789	39,112	31,710	43,739	35,889	50,477
Mass Shot	t/hole		2,090	3,037	2,542	3,577	2,900	4,000	3,282	4,617
Powder Factor	lb/bcf		0.06	0.04	0.06	0.04	0.07	0.05	0.08	0.05
Powder Factor	lb/t		0.66	0.42	0.69	0.46	0.75	0.49	0.86	0.55
Energy Factor	BTU/ton		914	579	952	628	1,026	680	1,182	755

Comments

Kuz Ram Model #	1	2	5	6	9	10	13	14

PolyMet Mining Corporation NorthMet Project

Golder Blast Design										
Design	Type	Bench (ft)	Hole (inches)	Explosive (ANFO/Emul)	Burden (ft)	Spacing (ft)	Sub-drill (ft)	Collar (ft)	Charge Length (ft)	PF (lb/ton)
1	Ore	25	9 7/8	70/30	23	26	5	17	13	0.40
2	Ore	25	9 7/8	70/30	21	24	5	17	13	0.47
3	Ore	25	9 7/8	ANFO	19	21.4	5	17	13	0.40
4	Waste	50	9 7/8	70/30	32	34	6	19	37	0.31
5	Waste	50	10 5/8	70/30	32	36	6	20	36	0.33
6	Waste	50	12 1/4	70/30	34	38	6	23	33	0.36

Wardrop Updated											
Design	Type	Bench (m)	Hole (mm)	Explosive (ANFO/Emul)	Burden (m)	Spacing (m)	Sub-drill (m)	Collar (m)	Charge Length (m)	PF (kg/ton)	Kuz Ram #
1	Ore	12	270	70/30	6.8	7.8	1.4	4.8	8.8	0.33	1
	Waste	12	270	70/30	8.2	9.4	1.6	5.7	8.1	0.21	2
Not used	Ore	12	270	70/30	8.0	9.2	1.6	5.6	8.2	0.22	3
Not used	Waste	12	270	70/30	8.0	9.2	1.6	5.6	8.2	0.22	4
2	Ore	12	311	70/30	7.5	8.6	1.5	5.3	8.4	0.35	5
	Waste	12	311	70/30	8.9	10.2	1.8	6.2	7.8	0.23	6
Not used	Ore	12	311	70/30	9.0	10.4	1.8	6.3	7.7	0.22	7
Not used	Waste	12	311	70/30	9.0	10.4	1.8	6.3	7.7	0.22	8
3	Ore	12	349	70/30	8	9.2	1.6	5.6	8.2	0.37	9
	Waste	12	349	70/30	9.4	10.8	1.9	6.6	7.5	0.25	10
Not used	Ore	12	349	70/30	10.0	11.5	2.0	7.0	7.2	0.21	11
Not used	Waste	12	349	70/30	10.0	11.5	2.0	7.0	7.2	0.21	12
4	Ore	12	406	70/30	8.5	9.8	1.7	6.0	7.9	0.43	13
	Waste	12	406	70/30	10.1	11.6	2	7.1	7.1	0.27	14
Not used	Ore	12	406	70/30	11	12.7	2.2	7.7	6.7	0.22	15
Not used	Waste	12	406	70/30	11	12.7	2.2	7.7	6.7	0.22	16

Wardrop Updated (No Timing) Imperial										
Design	Type	Bench (ft)	Hole (inches)	Explosive (ANFO/Emul)	Burden (ft)	Spacing (ft)	Sub-drill (ft)	Collar (ft)	Charge Length (ft)	PF (lb/ton)
1	Ore	40	10 5/8	70/30	22	26	5	16	29	0.66
	Waste	40	10 5/8	70/30	27	31	5	19	27	0.42
	Ore	40	10 5/8	70/30	26	30	5	18	27	0.44
	Waste	40	10 5/8	70/30	26	30	5	18	27	0.44
2	Ore	40	12 1/4	70/30	25	28	5	17	28	0.69
	Waste	40	12 1/4	70/30	29	33	6	20	26	0.45
	Ore	40	12 1/4	70/30	30	34	6	21	25	0.43
	Waste	40	12 1/4	70/30	30	34	6	21	25	0.43
3	Ore	40	13 3/4	70/30	26	30	5	18	27	0.74
	Waste	40	13 3/4	70/30	31	35	6	22	25	0.49
	Ore	40	13 3/4	70/30	33	38	7	23	24	0.42
	Waste	40	13 3/4	70/30	33	38	7	23	24	0.42
4	Ore	40	16	70/30	28	32	6	20	26	0.86
	Waste	40	16	70/30	33	38	7	23	23	0.55
	Ore	40	16	70/30	36	42	7	25	22	0.43
	Waste	40	16	70/30	36	42	7	25	22	0.43

KUZ-RAM FRAGMENTATION ANALYSIS

Project:	PolyMet Mining Corporation NorthMet Project
Rock Type	Ore

Intact Rock Properties		
Rock Factor		
Rock Type	Ore	
Rock Specific Gravity	2.93	SG
Elastic Modulus	84	GPa
UCS	118	MPa

Jointing		
Spacing	0.40	m
Dip	0	deg
Dip Direction	0	deg
In-situ block	0.40	m

Pattern Design		
Staggered or square	1.1	
Hole Diameter	311	mm
Charge Length	8.4	m
Burden	7.5	m
Spacing	9	m
Drill Accuracy SD	0.1	m
Bench Height	12.2	m
Face Dip Direction	0	deg
Powder Factor	0.35	kg/tonne
Charge Density	1.01	kg/m^3
Charge Weight per hole	797.63	kg/hole

Blastability Index	7.51	
Average Size of Material	26	cm
Uniformity Exponent	1.46	
Characteristic Size	0.34	m

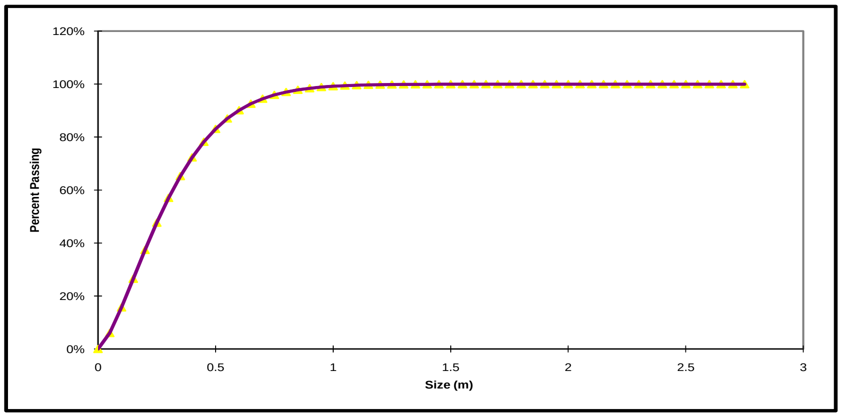
Notes

Square pattern = 1, staggered pattern = 1.1

Explosives		
Density	1.25	SG
RWS	91%	(% ANFO)
Nominal VOD	4,100	m/s
Effective VOD	4,100	m/s
Explosive Strength	0.91428571	

Fragmentation Target Parameters		
Oversize	1.07	m
Optimum	0.30	m
Undersize	0.20	m

Predicted Fragmentation		
Percent Oversize	0.5%	m
Percent In Range	62.1%	m
Percent Undersize	37.4%	m



Percent Passing	Size (m)	Size (feet)
0.0%	0	0.00
6.0%	0.05	0.16
15.7%	0.10	0.33
26.5%	0.15	0.49
37.4%	0.20	0.66
47.7%	0.25	0.82
57.1%	0.30	0.98
65.3%	0.35	1.15
72.3%	0.40	1.31
78.2%	0.45	1.48
83.1%	0.50	1.64
87.0%	0.55	1.80
90.2%	0.60	1.97
92.6%	0.65	2.13
94.5%	0.70	2.30
96.0%	0.75	2.46
97.1%	0.80	2.62
97.9%	0.85	2.79
98.5%	0.90	2.95
98.9%	0.95	3.12
99.2%	1.00	3.28
99.5%	1.05	3.44
99.6%	1.10	3.61
99.7%	1.15	3.77
99.8%	1.20	3.94
99.9%	1.25	4.10
99.9%	1.30	4.27
99.9%	1.35	4.43
100.0%	1.40	4.59
100.0%	1.45	4.76
100.0%	1.50	4.92
100.0%	1.55	5.09
100.0%	1.60	5.25
100.0%	1.65	5.41
100.0%	1.70	5.58
100.0%	1.75	5.74
100.0%	1.80	5.91
100.0%	1.85	6.07
100.0%	1.90	6.23
100.0%	1.95	6.40
100.0%	2.00	6.56
100.0%	2.05	6.73
100.0%	2.10	6.89
100.0%	2.15	7.05
100.0%	2.20	7.22
100.0%	2.25	7.38
100.0%	2.30	7.55
100.0%	2.35	7.71
100.0%	2.40	7.87
100.0%	2.45	8.04
100.0%	2.50	8.20
100.0%	2.55	8.37
100.0%	2.60	8.53
100.0%	2.65	8.69
100.0%	2.70	8.86
100.0%	2.75	9.02

KUZ-RAM FRAGMENTATION ANALYSIS

Project: PolyMet Mining Corporation NorthMet Project
Rock Type Waste

Intact Rock Properties		
Rock Factor		
Rock Type	Waste	
Rock Specific Gravity	2.93	SG
Elastic Modulus	77	GPa
UCS	106	MPa

Jointing		
Spacing	0.30	m
Dip	0	deg
Dip Direction	0	deg
In-situ block	0.30	m

Pattern Design		
Staggered or square	1.1	
Hole Diameter	311	mm
Charge Length	7.8	m
Burden	8.9	m
Spacing	10	m
Drill Accuracy SD	0.1	m
Bench Height	12	m
Face Dip Direction	0	deg
Powder Factor	0.23	kg/tonne
Charge Density	0.67	kg/m^3
Charge Weight per hole	740.65	kg/hole

Blastability Index	7.32	
Average Size of Material	35	cm
Uniformity Exponent	1.31	
Characteristic Size	0.46	m

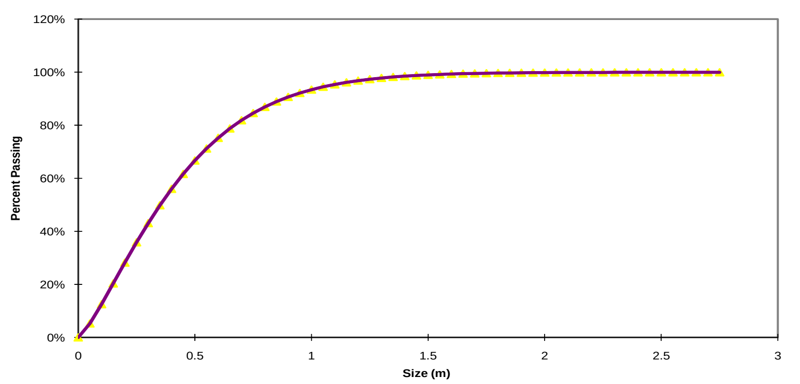
Notes

Square pattern = 1, staggered pattern = 1.1

Explosives		
Density	1.25	SG
RWS	91%	(% ANFO)
Nominal VOD	4,100	m/s
Effective VOD	4,100	m/s
Explosive Strength	0.91428571	

Fragmentation Target Parameters		
Oversize	1.07	m
Optimum	0.30	m
Undersize	0.20	m

Predicted Fragmentation		
Percent Oversize	5.1%	m
Percent In Range	66.7%	m
Percent Undersize	28.2%	m



Percent Passing	Size (m)	Size (feet)
0.0%	0	0.00
5.3%	0.05	0.16
12.5%	0.10	0.33
20.4%	0.15	0.49
28.2%	0.20	0.66
35.9%	0.25	0.82
43.1%	0.30	0.98
49.8%	0.35	1.15
56.0%	0.40	1.31
61.7%	0.45	1.48
66.7%	0.50	1.64
71.2%	0.55	1.80
75.3%	0.60	1.97
78.8%	0.65	2.13
81.9%	0.70	2.30
84.6%	0.75	2.46
86.9%	0.80	2.62
89.0%	0.85	2.79
90.7%	0.90	2.95
92.2%	0.95	3.12
93.4%	1.00	3.28
94.5%	1.05	3.44
95.4%	1.10	3.61
96.2%	1.15	3.77
96.9%	1.20	3.94
97.4%	1.25	4.10
97.9%	1.30	4.27
98.2%	1.35	4.43
98.5%	1.40	4.59
98.8%	1.45	4.76
99.0%	1.50	4.92
99.2%	1.55	5.09
99.4%	1.60	5.25
99.5%	1.65	5.41
99.6%	1.70	5.58
99.7%	1.75	5.74
99.7%	1.80	5.91
99.8%	1.85	6.07
99.8%	1.90	6.23
99.9%	1.95	6.40
99.9%	2.00	6.56
99.9%	2.05	6.73
99.9%	2.10	6.89
99.9%	2.15	7.05
100.0%	2.20	7.22
100.0%	2.25	7.38
100.0%	2.30	7.55
100.0%	2.35	7.71
100.0%	2.40	7.87
100.0%	2.45	8.04
100.0%	2.50	8.20
100.0%	2.55	8.37
100.0%	2.60	8.53
100.0%	2.65	8.69
100.0%	2.70	8.86
100.0%	2.75	9.02

Appendix G

v) Loading Production Estimate

Loading Parameters & Truck Match Calculation

NorthMet

			PC 4000	PC 4000	PC 5500	PC 5500
			3	4	3	4
	Bucket Size - m³ >		**21.0m³**	**21.0m³**	**24.0m³**	**24.0m³**
			Cat 789	**Cat 793**	**Cat 789**	**Cat 793**
	Truck Capacity - m³ >		**105.0**	**129.0**	**105.0**	**129.0**
	Truck Capacity - wmt >		**185.0**	**218.0**	**185.0**	**218.0**
Schedule Data						
	Calendar Days	days/yr	365	365	365	365
	Scheduled Shutdown	days/yr				
	Unscheduled Days Down - weather	days/yr				
	Mine Work Days	days/yr	365	365	365	365
	Work Days / Week	days/yr	7	7	7	7
	Shifts / Day	shifts/day	2	2	2	2
	Shifts / Week	shifts/week	14	14	14	14
	Scheduled Weeks / Year	weeks/yr	52	52	52	52
	Shifts / Year	shifts/yr	730	730	730	730
	Scheduled Hours / Shift	hrs/shift	12	12	12	12
	Scheduled Hours / Year	hrs/year	8,760	8,760	8,760	8,760
(T)	**Total Theoretical**	hrs/year	8,760	8,760	8,760	8,760
(SU)	Mine Scheduled & Unscheduled Shutdown	hrs/year				
Standby	Lunch Break	hrs/shift	**0.75**	**0.75**	**0.75**	**0.75**
	Shift Start / Shutdown	hrs/shift	**0.50**	**0.50**	**0.50**	**0.50**
	Miscellaneous Breaks	hrs/shift	**0.50**	**0.50**	**0.50**	**0.50**
	Misc - Clean-up	hrs/shift				
	Miscellaneous - Blasting & Moves	hrs/shift	**0.10**	**0.10**	**0.10**	**0.10**
	Total Standby	hrs/shift	1.9	1.9	1.9	1.9
(S)	**Total Standby**	hrs/year	1,351	1,351	1,351	1,351
	Available Working Hours	hrs/day	20.3	20.3	20.3	20.3
	Available Working Hours	hrs/year	7,410	7,410	7,410	7,410
Annual Hours						
(T)	Total Theoretical	hrs/year	8,760	8,760	8,760	8,760
(SU)	Mine Scheduled & Unscheduled Shutdown	hrs/year				
(S)	Total Standby	hrs/year	1,351	1,351	1,351	1,351
(W)+(R)	Work + Repair = (T-S-SU)	hrs/year	7,410	7,410	7,410	7,410
(W)	Work = MA x (T-S-SU)	hrs/year	6,289	6,289	6,289	6,289
Mechanical Availability						
	Scheduled Downtime	shifts/yr	52	52	52	52
	Scheduled Downtime	hrs/year	624	624	624	624
	Scheduled Downtime		7.1%	7.1%	7.1%	7.1%
	Unscheduled Downtime		**8.0%**	**8.0%**	**8.0%**	**8.0%**
	Total Downtime		15.1%	15.1%	15.1%	15.1%
	Shifts Available for Scheduling	shifts	678	678	678	678
(MA)	Mechanical Availability		**84.9%**	**84.9%**	**84.9%**	**84.9%**
(PA)	Physical Availability = (W+S)/T		87.2%	87.2%	87.2%	87.2%
(UA)	Use of Availability = W/(W+S)		82.3%	82.3%	82.3%	82.3%
(EU)	Effective Utilization = PA x UA		71.8%	71.8%	71.8%	71.8%
Annual Production						
(WH)	Work Hours / Year	hrs/year	6,289	6,289	6,289	6,289
	Operating Efficiency - operation based		**83.3%**	**83.3%**	**83.3%**	**83.3%**
(PH)	Production Hours / Year	hrs/year	5,239	5,239	5,239	5,239
(BC)	Bucket Capacity (heaped)	m^3	**21.00**	**21.00**	**24.00**	**24.00**
(MW)	Material Weight	kg/bcm dry	**2,940**	**2,940**	**2,940**	**2,940**
(BF)	Bulk Factor		**1.50**	**1.50**	**1.50**	**1.50**
(MW1)	Material Weight = MW / BF	kg/lcm dry	1,960.0	1,960.0	1,960.0	1,960.0
(M)	Moisture		**3.00%**	**3.00%**	**3.00%**	**3.00%**
(FF)	Fill Factor	%	**95%**	**95%**	**90%**	**90%**
(EBC)	Effective Bucket Capacity = FF x BC	m^3	19.95	19.95	21.60	21.60
(MW2)	Material Weight = MW / (1-M)	wmt/lcm	2.02	2.02	2.02	2.02
	Material Weight = MW2 x (1-M)	dmt/lcm	1.96	1.96	1.96	1.96
(TP)	Tonnes/Pass	wmt	40.31	40.31	43.65	43.65
(TC1)	Truck Size Capacity	m³ heaped	**105.0**	**129.0**	**105.0**	**129.0**
(TC2)	Truck Size Capacity	wmt	**185.0**	**218.0**	**185.0**	**218.0**
(TPV)	Theoretical Passes = TC1/ EBC by Vol	passes	5.26	6.47	4.86	5.97
(TPT)	Theoretical Passes = TC2 / TP by Wght	passes	4.59	5.41	4.24	4.99
(AP)	Actual Passes = ROUND TPT	passes	5.0	6.0	5.0	5.0
(TL)	Truck Load - Volume = AP x EBC	m^3	99.8	119.7	108.0	108.0
(TLS)	Truck Load for Simulation = AP x TP	wmt	185.0	218.0	185.0	218.0
(TLP)	Truck Load for Productivity	dmt	179.5	211.5	179.5	211.5
(TCU)	**Truck Capacity Utilized = TLS / TC2**	**by wt**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
	Truck Capacity Utilized = TL / TC1	**by vol**	**95.0%**	**92.8%**	**102.9%**	**83.7%**
	First Bucket Cycle Time	sec	**30**	**30**	**33**	**33**
(AC)	Subsequent Bucket Cycle Time	sec	**30**	**30**	**33**	**33**
(ST)	Truck Spot Time	sec	**42**	**42**	**42**	**42**
(LT)	Load Time per Truck = AP x AC + ST	sec	192.0	222.0	207.0	207.0
	ALTITUDE ADJUSTMENT		**100.0%**	**100.0%**	**100.0%**	**100.0%**
(LT)	Load Time per Truck = AP x AC + ST	min	3.20	3.70	3.45	3.45
(MP)	Maximum Productivity = 60 / LT	trks/hr	18.8	16.2	17.4	17.4
	Conversion = MP x TLP/ MW	bcm/hr	1,144.5	1,166.4	1,061.5	1,250.9
		lcm/hr	1,716.7	1,749.5	1,592.3	1,876.3
(TPHM)	Maximum Theoretical Production	dry t/hr	3,364.7	3,429.1	3,120.9	3,677.6
(SS)	Scheduled Shifts / Year (from above)	shifts/yr	678	678	678	678
(PH)	Production Hours / Year (from above)	hrs	5,239	5,239	5,239	5,239
(TA)	Truck Availability to Shovel	%	**80.0%**	**80.0%**	**80.0%**	**80.0%**
	ALTITUDE ADJUSTMENT FOR OPERATOR		**100.0%**	**100.0%**	**100.0%**	**100.0%**
(TPHA)	Production Adjusted = TPHM x TA	t/hr	2,692	2,743	2,497	2,942
(RP)	Real Production = TPHA x PH	dry t/year	14,102,078	14,371,965	13,080,189	15,413,411
	Production / Scheduled Shift = RP / SS	dry t/shift	20,800	21,198	19,292	22,734
	Production / Scheduled Work Hours = RP / WH	dry t/hr	2,242	2,285	2,080	2,451
	Production / Scheduled Production Hrs = RP / PH	dry t/hr	**2,692**	**2,743**	**2,497**	**2,942**
	Annual Wet Tonnes	wet t/year	14,525,141	14,803,124	13,472,594	15,875,814
		wet t/hour	**2,773**	**2,826**	**2,572**	**3,030**

Loading Parameters & Truck Match Calculation

			Cat 994	Cat 994
			3	4
NorthMet		Bucket Size - m^3 >	16.4m^3	16.4m^3
			Cat 793	Cat 789
		Truck Capacity - m^3 >	129.0	105.0
		Truck Capacity - wmt >	218.0	185.0
Schedule Data				
	Calendar Days	days/yr	365	365
	Scheduled Shutdown	days/yr		3
	Unscheduled Days Down - weather	days/yr		
	Mine Work Days	days/yr	365	362
	Work Days / Week	days/yr	7	7
	Shifts / Day	shifts/day	2	2
	Shifts / Week	shifts/week	14	14
	Scheduled Weeks / Year	weeks/yr	52	52
	Shifts / Year	shifts/yr	730	724
	Scheduled Hours / Shift	hrs/shift	12	12
	Scheduled Hours / Year	hrs/year	8,760	8,688
(T)	**Total Theoretical**	hrs/year	8,760	8,760
(SU)	Mine Scheduled & Unscheduled Shutdown	hrs/year	0	72
Standby	Lunch Break	hrs/shift	0.75	0.75
	Shift Start / Shutdown	hrs/shift	0.50	0.50
	Miscellaneous Breaks	hrs/shift	0.50	0.50
	Misc - Clean-up	hrs/shift	0.00	0.00
	Miscellaneous - Blasting & Moves	hrs/shift	0.10	0.10
	Total Standby	hrs/shift	1.9	1.9
(S)	**Total Standby**	hrs/year	1,351	1,339
	Available Working Hours	hrs/day	20.3	20.3
	Available Working Hours	hrs/year	7,410	7,349
Annual Hours				
(T)	Total Theoretical	hrs/year	8,760	8,760
(SU)	Mine Scheduled & Unscheduled Shutdown	hrs/year	0	72
(S)	Total Standby	hrs/year	1,351	1,339
(W)+(R)	Work + Repair = (T-S-SU)	hrs/year	7,410	7,349
(W)	Work = MA x (T-S-SU)	hrs/year	6,289	6,237
Mechanical Availability				
	Scheduled Downtime	shifts/yr	52	52
	Scheduled Downtime	hrs/year	624	624
	Scheduled Downtime		7.1%	7.1%
	Unscheduled Downtime		8.0%	8.0%
	Total Downtime		15.1%	15.1%
	Shifts Available for Scheduling	shifts	678	672
(MA)	Mechanical Availability		**84.9%**	**84.9%**
(PA)	Physical Availability = (W+S)/T		87.2%	86.5%
(UA)	Use of Availability = W/(W+S)		82.3%	82.3%
(EU)	Effective Utilization = PA x UA		71.8%	71.2%
Annual Production				
(WH)	Work Hours / Year	hrs/year	6,289	6,237
	Operating Efficiency - operation based		83.3%	83.3%
(PH)	Production Hours / Year	hrs/year	5,239	5,196
(BC)	Bucket Capacity (heaped)	m^3	16.40	16.40
(MW)	Material Weight	kg/bcm dry	2,940	2,940
(BF)	Bulk Factor		1.50	1.50
(MW1)	Material Weight = MW / BF	kg/lcm dry	1,960.0	1,960.0
(M)	Moisture		3.00%	3.00%
(FF)	Fill Factor	%	90%	90%
(EBC)	Effective Bucket Capacity = FF x BC	m^3	14.76	14.76
(MW2)	Material Weight = MW / (1-M)	wmt/lcm	2.02	2.02
	Material Weight = MW2 x (1-M)	dmt/lcm	1.96	1.96
(TP)	Tonnes/Pass	wmt	29.82	29.82
(TC1)	Truck Size Capacity	m^3 heaped	129.0	105.0
(TC2)	Truck Size Capacity	wmt	218.0	185.0
(TPV)	Theoretical Passes = TC1/ EBC by Vol	passes	8.74	7.11
(TPT)	Theoretical Passes = TC2 / TP by Wght	passes	7.31	6.20
(AP)	Actual Passes = ROUND TPT	passes	8.0	7.0
(TL)	Truck Load - Volume = AP x EBC	m^3	118.1	103.3
(TLS)	Truck Load for Simulation = AP x TP	wmt	218.0	185.0
(TLP)	Truck Load for Productivity	dmt	211.5	179.5
(TCU)	**Truck Capacity Utilized = TLS / TC2**	**by wt**	**100.0%**	**100.0%**
	Truck Capacity Utilized = TL / TC1	**by vol**	**91.5%**	**98.4%**
	First Bucket Cycle Time	sec	40	40
(AC)	Subsequent Bucket Cycle Time	sec	40	40
(ST)	Truck Spot Time	sec	42	42
(LT)	Load Time per Truck = AP x AC + ST	sec	362.0	322.0
	ALTITUDE ADJUSTMENT		100.0%	100.0%
(LT)	Load Time per Truck = AP x AC + ST	min	6.03	5.37
(MP)	Maximum Productivity = 60 / LT	trks/hr	9.9	11.2
	Conversion = MP x TLP/ MW	bcm/hr	715.3	682.4
		lcm/hr	1,072.9	1,023.6
(TPHM)	Maximum Theoretical Production	dry t/hr	2,102.9	2,006.3
(SS)	Scheduled Shifts / Year (from above)	shifts/yr	678	672
(PH)	Production Hours / Year (from above)	hrs	5,239	5,196
(TA)	Truck Availability to Shovel	%	80.0%	80.0%
	ALTITUDE ADJUSTMENT FOR OPERATOR		100.0%	100.0%
(TPHA)	Production Adjusted = TPHM x TA	t/hr	1,682	1,605
(RP)	Real Production = TPHA x PH	dry t/year	8,813,746	8,339,677
	Production / Scheduled Shift = RP / SS	dry t/shift	13,000	12,410
	Production / Scheduled Work Hours = RP / WH	dry t/hr	1,401	1,337
	Production / Scheduled Production Hrs = RP / PH	dry t/hr	**1,682**	**1,605**
	Annual Wet Tonnes	wet t/year	9,078,159	8,589,867
		wet t/hour	**1,733**	**1,653**

Appendix G

vi) Operating Cost Development

			Year -2	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Total
Mine Production	**Ore Tons Milled**	(tons x 1000)	-	-	8,760.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	5,135.9	**223,955.9**
	Ore Tons Mined	(tons x 1000)	-	-	9,893.7	15,214.9	12,024.1	11,675.7	11,678.1	11,671.3	10,064.7	10,980.5	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,670.0	11,357.5	2,695.4	**223,955.9**
	Waste Tons Mined	(tons x 1000)	-	7,798.39	34,358.85	30,910.54	27,392.03	21,938.00	16,026.10	10,014.78	6,235.79	10,054.18	9,780.79	11,670.91	11,155.35	8,179.47	13,642.43	15,550.64	15,108.75	18,264.43	20,476.50	8,973.99	5,948.01	329.88	**303,809.8**
	Total Tons Mined	(tons x 1000)	-	7,798.4	44,252.5	46,125.5	39,416.1	33,613.7	27,704.2	21,686.1	16,300.5	21,034.7	21,450.8	23,340.9	22,825.4	19,849.5	25,312.4	27,220.6	26,778.7	29,934.4	32,146.5	20,644.0	17,305.5	3,025.3	**527,765.7**
Open Pit Mining Cost	**GENERAL MINE & ENGINEERING**																								
	Salaries & Wages	Staff	0.0	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	2,694.9	1,424.8	55,323.2
	Salaries & Wages	Labour	0.0	695.3	875.2	875.2	875.2	875.2	875.2	875.2	875.2	875.2	875.2	875.2	875.2	875.2	875.2	875.2	875.2	875.2	875.2	875.2	511.3	511.3	17,471.2
	Fuel & Power	($ x 1000)																							0.0
	Dewatering	($ x 1000)		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	2,100.0
	Consumables, R&M Parts	($ x 1000)	0.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	2,415.0
	Subtotal	($ x 1000)	**0.0**	**3,605.3**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,785.1**	**3,421.2**	**2,151.1**	**77,309.4**
	DRILLING																								
	Salaries & Wages	($ x 1000)	0.0	263.1	517.4	517.4	517.4	517.4	344.9	689.8	344.9	344.9	344.9	344.9	344.9	344.9	344.9	517.4	344.9	344.9	353.1	304.0	213.4	107.0	7,966.4
	Fuel & Power	($ x 1000)	0.0	92.4	786.5	886.1	702.0	621.0	494.9	444.8	380.7	442.6	437.9	430.1	460.6	412.9	457.7	533.6	497.2	578.9	615.5	424.8	374.4	166.2	10,240.6
	Consumables, R&M Parts	($ x 1000)	0.0	213.0	1,816.1	2,046.1	1,621.0	1,433.6	1,142.3	1,026.7	878.5	1,021.5	1,010.8	992.9	1,063.3	953.1	1,056.4	1,232.1	1,147.9	1,336.6	1,421.2	980.8	864.1	383.5	23,641.4
	Subtotal	($ x 1000)	**0.0**	**568.5**	**3,119.9**	**3,449.6**	**2,840.4**	**2,571.9**	**1,982.1**	**2,161.2**	**1,604.1**	**1,809.0**	**1,793.6**	**1,767.9**	**1,868.8**	**1,711.0**	**1,859.0**	**2,283.0**	**1,990.0**	**2,260.4**	**2,389.8**	**1,709.6**	**1,451.8**	**656.7**	**41,848.4**
	BLASTING																								
	Salaries & Wages	($ x 1000)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Consumables & Direct Costs	($ x 1000)	0.0	1,156.6	5,474.7	6,150.4	4,995.5	4,495.9	3,727.7	3,426.4	3,037.3	3,406.6	3,378.7	3,332.4	3,515.8	3,232.1	3,503.6	3,955.7	3,737.4	4,227.5	3,849.9	2,703.4	2,399.8	1,062.4	74,769.7
	Subtotal	($ x 1000)	**0.0**	**1,156.6**	**5,474.7**	**6,150.4**	**4,995.5**	**4,495.9**	**3,727.7**	**3,426.4**	**3,037.3**	**3,406.6**	**3,378.7**	**3,332.4**	**3,515.8**	**3,232.1**	**3,503.6**	**3,955.7**	**3,737.4**	**4,227.5**	**3,849.9**	**2,703.4**	**2,399.8**	**1,062.4**	**74,769.7**
	LOADING																								
	Salaries & Wages	($ x 1000)	0.0	353.6	892.9	804.5	716.1	627.7	627.7	539.3	450.9	539.3	539.3	539.3	539.3	450.9	539.3	539.3	539.3	716.1	716.1	539.3	450.9	353.6	12,014.1
	Fuel & Power	($ x 1000)	0.0	233.5	1,195.4	1,254.6	1,103.8	941.9	791.3	598.7	496.6	599.8	592.3	682.5	629.5	548.9	722.2	748.2	751.8	1,054.3	1,248.8	571.1	484.2	247.7	15,497.2
	Consumables, R&M Parts	($ x 1000)	0.0	842.5	4,316.6	4,530.5	3,985.9	3,401.3	2,855.4	2,162.0	1,793.2	2,165.6	2,138.6	2,402.0	2,273.3	1,982.2	2,606.2	2,701.8	2,714.9	2,926.1	3,117.7	2,062.3	1,748.5	893.5	53,620.3
	Subtotal	($ x 1000)	**0.0**	**1,429.6**	**6,404.9**	**6,589.6**	**5,805.8**	**4,970.9**	**4,274.4**	**3,299.9**	**2,740.7**	**3,304.7**	**3,270.2**	**3,623.8**	**3,442.1**	**2,982.0**	**3,867.7**	**3,989.3**	**4,006.0**	**4,696.5**	**5,082.6**	**3,172.7**	**2,683.6**	**1,494.8**	**81,131.6**
	HAULING																								
	Salaries & Wages	($ x 1000)	0.0	423.7	2,287.8	2,542.0	2,626.7	2,457.2	2,033.6	1,440.5	1,101.5	1,440.5	1,609.9	1,694.6	1,779.4	1,440.5	1,694.6	1,779.4	1,609.9	1,694.6	2,203.0	1,525.2	1,271.0	677.9	35,333.4
	Fuel & Power	($ x 1000)	0.0	1,017.0	5,842.8	6,653.8	6,850.3	6,399.0	5,248.2	3,817.7	2,893.0	3,693.5	4,072.5	4,410.1	4,496.5	3,643.5	4,353.9	4,668.3	4,261.3	4,308.8	5,625.2	3,951.1	3,273.0	1,595.8	91,075.2
	Consumables, R&M Parts	($ x 1000)	0.0	1,175.2	6,751.7	7,688.9	7,916.0	7,394.5	6,064.7	4,411.7	3,343.1	4,268.1	4,706.0	5,096.2	5,196.0	4,210.3	5,031.2	5,394.6	4,924.2	4,979.1	6,500.3	4,565.8	3,782.2	1,844.0	105,243.9
	Subtotal	($ x 1000)	**0.0**	**2,615.9**	**14,882.3**	**16,884.7**	**17,393.1**	**16,250.7**	**13,346.5**	**9,669.8**	**7,337.6**	**9,402.0**	**10,388.4**	**11,200.9**	**11,471.8**	**9,294.2**	**11,079.7**	**11,842.3**	**10,795.3**	**10,982.6**	**14,328.5**	**10,042.1**	**8,326.3**	**4,117.7**	**231,652.5**
	SUPPORT																								
	Salaries & Wages	($ x 1000)	0.0	616.1	1,434.4	1,542.1	1,457.3	1,441.2	1,385.1	1,083.3	882.4	1,074.9	1,107.9	1,158.0	1,065.6	880.0	987.7	1,114.0	978.4	1,009.1	1,177.7	913.9	746.0	1,037.7	23,092.9
	Fuel & Power	($ x 1000)	0.0	1,058.1	1,949.4	2,001.4	2,004.9	1,968.6	1,866.3	1,497.1	1,236.9	1,465.2	1,550.0	1,652.1	1,666.6	1,430.9	1,646.7	1,733.0	1,560.9	1,602.8	1,842.7	1,447.3	1,255.8	1,492.0	33,928.8
	Consumables, R&M Parts	($ x 1000)	0.0	1,791.5	2,951.3	3,019.7	3,023.4	2,977.1	2,849.3	2,287.4	1,864.0	2,233.8	2,379.3	2,541.3	2,570.2	2,185.0	2,526.8	2,668.1	2,453.5	2,505.8	2,857.5	2,283.4	1,972.7	2,412.4	52,353.7
	Subtotal	($ x 1000)	**0.0**	**3,465.7**	**6,335.1**	**6,563.2**	**6,485.6**	**6,386.9**	**6,100.7**	**4,867.8**	**3,983.4**	**4,773.9**	**5,037.2**	**5,351.5**	**5,302.4**	**4,496.0**	**5,161.3**	**5,515.1**	**4,992.8**	**5,117.7**	**5,877.9**	**4,644.5**	**3,974.5**	**4,942.1**	**109,375.4**
	SUMMARY																								
	Salaries & Wages	($ x 1000)	0.0	5,046.8	8,702.5	8,976.0	8,887.6	8,613.6	7,961.4	7,323.0	6,349.8	6,969.6	7,172.1	7,306.9	7,299.2	6,686.3	7,136.6	7,520.1	7,042.6	7,334.8	8,020.0	6,852.4	5,887.4	4,112.3	151,201.2
	Fuel & Power	($ x 1000)	0.0	2,401.0	9,774.0	10,796.0	10,661.0	9,930.4	8,400.7	6,358.3	5,007.3	6,201.0	6,652.6	7,174.9	7,253.1	6,036.3	7,180.5	7,683.1	7,071.3	7,544.8	9,332.1	6,394.4	5,387.4	3,501.7	150,741.8
	Consumables	($ x 1000)	0.0	5,393.8	21,525.4	23,650.7	21,756.8	19,917.4	16,854.4	13,529.1	11,131.2	13,310.7	13,828.4	14,579.8	14,833.6	12,777.7	14,939.2	16,167.3	15,192.9	16,190.2	17,961.6	12,810.7	10,982.3	6,810.8	314,144.0
	Subtotal	($ x 1000)	**0.0**	**12,841.6**	**40,001.9**	**43,422.6**	**41,305.5**	**38,461.4**	**33,216.5**	**27,210.4**	**22,488.2**	**26,481.3**	**27,653.2**	**29,061.6**	**29,386.0**	**25,500.2**	**29,256.3**	**31,370.5**	**29,306.8**	**31,069.8**	**35,313.8**	**26,057.5**	**22,257.1**	**14,424.8**	**616,087.0**
Additional Mining Costs	**RAIL HAULAGE AND LOADOUT**	($ x 1000)	0.0	0.0	4,833.6	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	5,414.9	4,109.8	106,412.0
	SAMPLING	($ x 1000)	0.0	73.0	577.8	627.4	489.9	426.6	303.3	232.1	159.9	149.4	294.1	287.8	312.6	272.4	307.8	372.0	341.7	408.6	438.5	283.4	242.1	108.4	6,708.9
	AGGREGATE CRUSHING	($ x 1000)	0.0	237.7	240.2	242.9	235.4	231.9	225.2	221.4	217.4	216.9	224.7	224.4	225.7	223.6	225.5	229.0	227.3	231.0	232.6	224.2	221.9	214.6	4,773.5
																									0.0
	Subtotal	($ x 1000)	**0.0**	**310.8**	**5,651.6**	**6,285.1**	**6,140.2**	**6,073.5**	**5,943.5**	**5,868.4**	**5,792.3**	**5,781.2**	**5,933.7**	**5,927.1**	**5,953.2**	**5,910.9**	**5,948.2**	**6,015.9**	**5,984.0**	**6,054.5**	**6,086.0**	**5,922.5**	**5,879.0**	**4,432.8**	**117,894.4**
	TOTAL COST	($ x 1000)	**0.0**	**13,152.4**	**45,653.5**	**49,707.8**	**47,445.6**	**44,534.9**	**39,160.0**	**33,078.8**	**28,280.5**	**32,262.5**	**33,586.9**	**34,988.7**	**35,339.2**	**31,411.1**	**35,204.5**	**37,386.4**	**35,290.7**	**37,124.4**	**41,399.8**	**31,980.0**	**28,136.1**	**18,857.6**	**733,981.4**
UNIT COSTS ($/ton mined)	**GENERAL MINE & ENGINEERING**	$/ton mined	0.00	0.46	0.09	0.08	0.10	0.11	0.14	0.17	0.23	0.18	0.18	0.16	0.17	0.19	0.15	0.14	0.14	0.13	0.12	0.18	0.20	0.71	0.15
	DRILLING	$/ton mined	0.00	0.07	0.07	0.07	0.07	0.08	0.07	0.10	0.10	0.09	0.08	0.08	0.08	0.09	0.07	0.08	0.07	0.08	0.07	0.08	0.08	0.22	0.08
	BLASTING	$/ton mined	0.00	0.15	0.12	0.13	0.13	0.13	0.13	0.16	0.19	0.16	0.16	0.14	0.15	0.16	0.14	0.15	0.14	0.14	0.12	0.13	0.14	0.35	0.14
	LOADING	$/ton mined	0.00	0.18	0.14	0.14	0.15	0.15	0.15	0.15	0.17	0.16	0.15	0.16	0.15	0.15	0.15	0.15	0.15	0.16	0.16	0.15	0.16	0.49	0.14
	HAULING	$/ton mined	0.00	0.34	0.34	0.37	0.44	0.48	0.48	0.45	0.45	0.45	0.48	0.48	0.50	0.47	0.44	0.44	0.40	0.37	0.45	0.49	0.48	1.36	0.44
	SUPPORT	$/ton mined	0.00	0.44	0.14	0.14	0.16	0.19	0.22	0.22	0.24	0.23	0.23	0.23	0.23	0.23	0.20	0.20	0.19	0.17	0.18	0.22	0.23	1.63	0.21
	RAIL HAULAGE AND LOADOUT	$/ton mined	0.00	0.00	0.11	0.12	0.14	0.16	0.20	0.25	0.33	0.26	0.25	0.23	0.24	0.27	0.21	0.20	0.20	0.18	0.17	0.26	0.31	1.36	0.20
	SAMPLING	$/ton mined	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.01
	AGGREGATE CRUSHING	$/ton mined	0.00	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07	0.01
	Total	$/ton mined	0.00	1.69	1.03	1.08	1.20	1.32	1.41	1.53	1.73	1.53	1.57	1.50	1.55	1.58	1.39	1.37	1.32	1.24	1.29	1.55	1.63	6.23	1.39
UNIT COSTS ($/ton ore milled)	**GENERAL MINE & ENGINEERING**	$/ton ore milled	0.00	0.00	0.31	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.28	0.35
	DRILLING	$/ton ore milled	0.00	0.00	0.36	0.30	0.24	0.22	0.17	0.19	0.14	0.16	0.15	0.15	0.16	0.15	0.16	0.20	0.17	0.19	0.20	0.15	0.12	0.13	0.19
	BLASTING	$/ton ore milled	0.00	0.00	0.62	0.53	0.43	0.39	0.32	0.29	0.26	0.29	0.29	0.29	0.30	0.28	0.30	0.34	0.32	0.36	0.33	0.23	0.21	0.21	0.33
	LOADING	$/ton ore milled	0.00	0.00	0.73	0.56	0.50	0.43	0.37	0.28	0.23	0.28	0.28	0.31	0.29	0.26	0.33	0.34	0.34	0.40	0.44	0.27	0.23	0.29	0.36
	HAULING	$/ton ore milled	0.00	0.00	1.70	1.45	1.49	1.39	1.14	0.83	0.63	0.81	0.89	0.96	0.98	0.80	0.95	1.01	0.93	0.94	1.23	0.86	0.71	0.80	1.03
	SUPPORT	$/ton ore milled	0.00	0.00	0.72	0.56	0.56	0.55	0.52	0.42	0.34	0.41	0.43	0.46	0.45	0.39	0.44	0.47	0.43	0.44	0.50	0.40	0.34	0.96	0.49
	RAIL HAULAGE AND LOADOUT	$/ton ore milled	0.00	0.00	0.55	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.80	0.48
	SAMPLING	$/ton ore milled	0.00	0.00	0.07	0.05	0.04	0.04	0.03	0.02	0.01	0.01	0.03	0.02	0.03	0.02	0.03	0.03	0.03	0.04	0.04	0.02	0.02	0.02	0.03
	AGGREGATE CRUSHING	$/ton ore milled	0.00	0.00	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.02
	Total	$/ton ore milled	0.00	0.00	5.21	4.26	4.07	3.82	3.36	2.83	2.42	2.76	2.88	3.00	3.03	2.69	3.02	3.20	3.02	3.18	3.55	2.74	2.41	3.67	3.28

		Year -2	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Total
Mill Feed	**Ore Tons**	-	-	**8,760,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**11,670,000**	**5,135,883**	-	-	-	-	-	-	**223,955,884**
	DCu%	-	-	**0.31**	**0.32**	**0.31**	**0.31**	**0.30**	**0.29**	**0.28**	**0.28**	**0.31**	**0.32**	**0.29**	**0.28**	**0.27**	**0.26**	**0.24**	**0.21**	**0.23**	**0.28**	**0.28**	**0.29**	-	-	-	-	-	-	**0.28**
	DNi%	-	-	**0.09**	**0.10**	**0.09**	**0.09**	**0.09**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.07**	**0.07**	**0.07**	**0.08**	**0.08**	**0.08**	-	-	-	-	-	-	**0.08**
	DPt	-	-	**76.1**	**77.8**	**70.5**	**71.9**	**73.7**	**78.8**	**79.4**	**95.5**	**102.0**	**97.8**	**77.6**	**69.0**	**69.5**	**69.0**	**62.9**	**65.1**	**60.0**	**65.2**	**70.4**	**62.8**	-	-	-	-	-	-	**75.1**
	DPd	-	-	**307.7**	**314.4**	**284.7**	**296.1**	**291.9**	**290.1**	**275.2**	**281.6**	**298.7**	**282.2**	**241.7**	**229.4**	**237.1**	**227.8**	**201.9**	**242.7**	**222.3**	**257.0**	**262.0**	**247.2**	-	-	-	-	-	-	**264.5**
	DAu	-	-	**36.1**	**39.7**	**39.2**	**38.0**	**38.1**	**39.5**	**39.2**	**46.5**	**48.0**	**43.8**	**37.4**	**34.2**	**35.8**	**34.9**	**30.4**	**32.6**	**32.1**	**34.6**	**37.0**	**32.1**	-	-	-	-	-	-	**37.6**
	DCo	-	-	**68.8**	**78.4**	**78.5**	**74.0**	**71.5**	**71.4**	**70.2**	**72.0**	**74.1**	**75.6**	**78.2**	**78.4**	**75.7**	**73.3**	**73.6**	**69.2**	**67.8**	**68.3**	**73.2**	**70.6**	-	-	-	-	-	-	**73.3**

Railroad and Loadout

		Year -2	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Total
Unit Cost	$/ton	$ -	$ -	$ 0.55	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.46	$ 0.80	$ -	$ -	$ -	$ -	$ -	$ -	
Cost	$	$ -	$ -	$ 4,833,617	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 5,414,925	$ 4,109,778	$ -	$ -	$ -	$ -	$ -	$ -	$ 106,412,045
Train Lease Cost	$	$ -	$ -	$ 575,368	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 337,331	$ -	$ -	$ -	$ -	$ -	$ -	$ 14,709,699
Fuel Price 2.74	$/gallon																													
Fuel	$	$ -	$ -	$ 1,174,364	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 1,564,540	$ 688,562	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,024,646
Fuel	gallons	-	-	428,600	571,000	571,000	571,000	571,000	571,000	571,000	571,000	571,000	571,000	571,000	571,000	571,000	571,000	571,000	571,000	571,000	571,000	571,000	251,300	-	-	-	-	-	-	
Materials	$	$ -	$ -	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000	$ 76,000							
Track Maintenance																														
Consumables	$	$ -	$ -	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000							
Outsourced services	$	$ -	$ -	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000							
Rolling Stock																														
Maintenance parts	$	$ -	$ -	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000							
Loading Pocket																														
Maintenance parts, lubes, consumables	$	$ -	$ -	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000							
Loadout Power	$	$ -	$ -	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700	$ 141,700							
Labour																														
Supervisors @	supervisors			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2							
$ 107,680 per year	$	$ -	$ -	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360	$ 215,360							
Workers - Category 4 @	employees			25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25							
$ 98,793 per year	$	$ -	$ -	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825	$ 2,469,825							
Total Labour	$	$ -	$ -	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185	$ 2,685,185							$ 53,703,700

Labour Breakdown	per crew	
	Train Operators	1
	Loadout Operator	0
	Cleanup Loader/Truck Dump Loader	1 Runs loadout and cleanup loader after train leaves
	Mechanic	0.5
	Electrician	0.5
	Service Man	0.25
	Welders	1
	General labourer	2
	Total per shift	6.25
	Total	25

Train Lease Cost

		Year -2	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26
Lease rate $350	per day/unit																												
Number of units required 6	number			6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6						
Annual Cost	$	$ -	$ -	$ 575,368	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 766,500	$ 337,331	$ -	$ -	$ -	$ -	$ -	-

Sampling Cost		Year -2	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Total
Unit Cost	$/sample	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	$ 40.00	
Samples per blasthole	#	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Blastholes per year	#		1,826	14,446	15,684	12,247	10,666	7,583	5,803	3,998	3,734	7,352	7,194	7,814	6,810	7,695	9,300	8,543	10,216	10,962	7,086	6,053	2,710	167,722
Cost	$	$ -	$ 73,040	$ 577,840	$ 627,360	$ 489,880	$ 426,640	$ 303,320	$ 232,120	$ 159,920	$ 149,360	$ 294,080	$ 287,760	$ 312,560	$ 272,400	$ 307,800	$ 372,000	$ 341,720	$ 408,640	$ 438,480	$ 283,440	$ 242,120	$ 108,400	$ 6,708,880

Crushed Rock			Year -2	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Total
Unit Cost		$/ton	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	$ 2.50	
Mobilization Cost			$ -	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	
Road Crush																															
Tons of crush per mile	tons/mile	#	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	
Miles of road	miles		0	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20							
Tons of crush required	tons		0	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	73,000	0	0	0	0	0	0	
Blast hole stemming																															
Blast holes drilled	#		0	1,826	14,446	15,684	12,247	10,666	7,583	5,803	3,998	3,734	7,352	7,194	7,814	6,810	7,695	9,300	8,543	10,216	10,962	7,086	6,053	2,710	0	0	0	0	0	0	
Blasthole diameter	feet		1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	
Feet of stemming/hole	feet		17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	
Density of crush	tons/cubic foot		0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	
Tons of stemming/hole	tons/hole		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
Tons of crush required	tons		0	1,588	12,567	13,644	10,654	9,278	6,596	5,048	3,478	3,248	6,396	6,258	6,797	5,924	6,694	8,090	7,432	8,887	9,536	6,164	5,266	2,357	0	0	0	0	0	0	
Railroad Ballast																															
Tons of ballast required	tons		0	12,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	77,500
Total tons required			0	87,088	88,067	89,144	86,154	84,778	82,096	80,548	78,978	78,748	81,896	81,758	82,297	81,424	82,194	83,590	82,932	84,387	85,036	81,664	80,766	77,857	2,500	2,500	2,500	2,500	2,500	2,500	
Cost		$	$ -	$ 237,721	$ 240,167	$ 242,859	$ 235,384	$ 231,946	$ 225,241	$ 221,370	$ 217,445	$ 216,871	$ 224,739	$ 224,395	$ 225,744	$ 223,560	$ 225,485	$ 228,975	$ 227,329	$ 230,967	$ 232,590	$ 224,160	$ 221,914	$ 214,644	$ 26,250	$ 26,250	$ 26,250	$ 26,250	$ 26,250	$ 26,250	$ 4,931,004

Haulage Cycle Times

East 1E

(all times in min)

bench	HG		LG		Cat 4		OB		Cat 1/2		Cat 3	
	from	to	from	to	from	to	from	to	from	to	from	to
1620	3.36	2.95	4.18	3.74	4.67	4.14	5.66	5.25	5.41	4.83	5.92	5.39
1600	3.36	2.95	4.18	3.74	4.67	4.14	5.66	5.25	5.41	4.83	5.92	5.39
1580	3.36	2.95	4.18	3.74	4.67	4.14	5.66	5.25	5.41	4.83	5.92	5.39
1560	3.42	2.84	4.50	3.92	4.73	4.03	6.35	5.71	5.53	4.77	5.98	5.28
1540	3.49	2.72	4.81	4.11	4.78	3.91	7.04	6.17	5.64	4.72	6.03	5.16
1520	3.55	2.61	5.13	4.29	4.84	3.80	7.73	6.63	5.76	4.66	6.09	5.05
1500	4.04	2.94	5.41	4.35	5.40	4.18			6.31	4.91	6.58	5.35
1480	4.53	3.26	5.70	4.41	5.97	4.55			6.85	5.17	7.07	5.65
1460	5.02	3.59	5.98	4.46	6.53	4.93			7.40	5.42	7.56	5.95
1440	5.51	3.91	6.26	4.52	7.09	5.30			7.94	5.67	8.05	6.25
1420												
1400												
1380												
1360												
1340					`							

East 2E

(all times in min)

bench	HG		LG		Cat 4		OB		Cat 1/2		Cat 3	
	from	to	from	to	from	to	from	to	from	to	from	to
1620	3.36	2.95	4.18	3.74	4.67	4.14	5.66	5.25	5.41	4.83	5.92	5.39
1600	3.36	2.95	4.18	3.74	4.67	4.14	5.66	5.25	5.41	4.83	5.92	5.39
1580	3.36	2.95	4.18	3.74	4.67	4.14	5.66	5.25	5.41	4.83	5.92	5.39
1560	3.74	3.19	4.50	3.92	5.04	4.39	6.57	5.94	5.79	5.07	6.25	5.61
1540	4.11	3.43	4.81	4.11	5.42	4.64	7.49	6.63	6.16	5.31	6.59	5.82
1520	4.49	3.67	5.13	4.29	5.79	4.89	8.40	7.32	6.54	5.55	6.92	6.04
1500	4.76	3.75	5.38	4.35	6.05	4.97			6.85	5.62	7.19	6.12
1480	5.03	3.84	5.63	4.40	6.30	5.04			7.17	5.69	7.46	6.21
1460	5.30	3.92	5.89	4.46	6.56	5.12			7.48	5.76	7.73	6.29
1440	5.56	4.00	6.14	4.51	6.82	5.20			7.79	5.82	7.99	6.37
1420	5.83	4.09	6.39	4.57	7.07	5.27			8.11	5.89	8.26	6.46
1400	6.10	4.17	6.64	4.62	7.33	5.35			8.42	5.96	8.53	6.54
1380												
1360												
1340												

East 3E

(all times in min)

bench	HG		LG		Cat 4		OB		Cat 1/2		Cat 3	
	from	to	from	to	from	to	from	to	from	to	from	to
1620	3.36	2.95	4.18	3.74	4.67	4.14	5.66	5.25	5.41	4.83	5.92	5.39
1600	3.36	2.95	4.18	3.74	4.67	4.14	5.66	5.25	5.41	4.83	5.92	5.39
1580	3.36	2.95	4.18	3.74	4.67	4.14	5.66	5.25	5.41	4.83	5.92	5.39
1560	3.49	2.90	4.22	3.61	4.76	4.08	6.61	5.93	5.54	4.78	5.98	5.30
1540	3.61	2.84	4.25	3.47	4.84	4.01	7.55	6.60	5.66	4.72	6.04	5.20
1520	3.97	3.03	4.59	3.63	5.20	4.20			6.05	4.90	6.40	5.39
1500	4.32	3.22	4.93	3.80	5.55	4.39			6.45	5.07	6.75	5.58
1480	4.68	3.41	5.27	3.96	5.91	4.58			6.84	5.25	7.11	5.77
1460	5.03	3.60	5.62	4.13	6.26	4.78			7.24	5.43	7.46	5.97
1440	5.39	3.79	5.96	4.29	6.62	4.97			7.63	5.61	7.82	6.16
1420	5.74	3.98	6.30	4.46	6.97	5.16			8.03	5.78	8.17	6.35
1400	6.10	4.17	6.64	4.62	7.33	5.35			8.42	5.96	8.53	6.54
1380	6.41	4.28	6.97	4.76	7.64	5.46			8.85	6.19	8.84	6.65
1360	6.72	4.39	7.30	4.91	7.95	5.57			9.28	6.42	9.15	6.76
1340	7.02	4.51	7.62	5.05	8.25	5.69			9.70	6.64	9.46	6.87
1320	7.33	4.62	7.95	5.20	8.56	5.80			10.13	6.87	9.77	6.98
1300	7.64	4.73	8.28	5.34	8.87	5.91			10.56	7.10	10.08	7.09
1280	7.86	4.77	8.50	5.38	9.09	5.95			10.79	7.08	10.30	7.13
1260	8.08	4.81	8.73	5.42	9.31	5.99			11.02	7.07	10.52	7.17
1240	8.31	4.85	8.95	5.46	9.53	6.03			11.25	7.05	10.74	7.21
1220	8.53	4.88	9.17	5.49	9.75	6.06			11.47	7.03	10.95	7.24
1200	8.75	4.92	9.40	5.53	9.97	6.10			11.70	7.02	11.17	7.28
1180	8.97	4.96	9.62	5.57	10.19	6.14			11.93	7.00	11.39	7.32
1160												
1140												

East 4E

(all times in min)

bench	HG		LG		Cat 4		OB		Cat 1/2		Cat 3	
	from	to	from	to	from	to	from	to	from	to	from	to
1620	2.81	2.43	2.81	2.43	4.49	3.73	6.04	3.67	6.04	3.67	6.80	5.08
1600	2.81	2.43	2.81	2.43	4.49	3.73	6.04	3.67	6.04	3.67	6.80	5.08
1580	2.81	2.43	2.81	2.43	4.49	3.73	6.04	3.67	6.04	3.67	6.80	5.08
1560	3.12	2.55	3.12	2.55	4.79	3.85	6.04	3.67	6.13	3.69	7.00	5.14
1540	3.42	2.67	3.42	2.67	5.10	3.97	6.04	3.67	6.22	3.71	7.19	5.20
1520	3.73	2.78	3.73	2.78	5.40	4.09	6.04	3.67	6.31	3.73	7.39	5.26
1500	4.03	2.90	4.03	2.90	5.71	4.21			6.41	3.76	7.59	5.33
1480	4.34	3.02	4.34	3.02	6.01	4.32			6.50	3.78	7.78	5.39
1460	4.64	3.14	4.64	3.14	6.31	4.44			6.59	3.80	7.98	5.45
1440	4.95	3.25	4.95	3.25	6.62	4.56			6.68	3.82	8.17	5.51
1420	5.25	3.37	5.25	3.37	6.92	4.68			6.77	3.84	8.37	5.57
1400	5.53	3.45	5.53	3.45	7.20	4.76			6.84	3.83	8.78	5.73
1380	5.82	3.54	5.82	3.54	7.49	4.85			6.91	3.82	9.19	5.89
1360	6.10	3.62	6.10	3.62	7.77	4.93			6.98	3.80	9.60	6.05
1340	6.38	3.71	6.38	3.71	8.05	5.02			7.05	3.79	10.01	6.22
1320	6.66	3.79	6.66	3.79	8.33	5.10			7.12	3.78	10.41	6.38
1300	6.95	3.87	6.95	3.87	8.62	5.18			7.19	3.77	10.82	6.54
1280	7.23	3.96	7.23	3.96	8.90	5.27			7.26	3.75	11.23	6.70
1260	7.51	4.04	7.51	4.04	9.18	5.35			7.33	3.74	11.64	6.86
1240												
1220												
1200												
1180												
1160												
1140												

Haulage Cycle Times

	East 5E (all times in min)											
bench	HG		LG		Cat 4		OB		Cat 1/2		Cat 3	
	from	to	from	to	from	to	from	to	from	to	from	to
1620	4.11	3.34	4.75	3.97	5.34	4.51	8.05	7.10	6.16	5.22	6.62	5.74
1600	4.11	3.34	4.75	3.97	5.34	4.51	8.05	7.10	6.16	5.22	6.62	5.74
1580	4.11	3.34	4.75	3.97	5.34	4.51	8.05	7.10	6.16	5.22	6.62	5.74
1560	4.11	3.34	4.75	3.97	5.34	4.51	8.05	7.10	6.16	5.22	6.62	5.74
1540	4.11	3.34	4.75	3.97	5.34	4.51	8.05	7.10	6.16	5.22	6.62	5.74
1520	4.31	3.35	4.95	3.98	5.54	4.52			6.42	5.21	6.81	5.74
1500	4.51	3.36	5.15	3.99	5.74	4.53			6.67	5.20	6.99	5.74
1480	4.72	3.38	5.36	4.00	5.95	4.54			6.93	5.19	7.18	5.75
1460	4.92	3.39	5.56	4.01	6.15	4.55			7.18	5.18	7.36	5.75
1440	5.12	3.40	5.76	4.02	6.35	4.56			7.44	5.17	7.55	5.75
1420	5.45	3.54	6.10	4.17	6.68	4.71			7.87	5.41	7.89	5.90
1400	5.79	3.69	6.43	4.31	7.02	4.85			8.31	5.66	8.22	6.04
1380	6.12	3.83	6.77	4.46	7.35	5.00			8.74	5.90	8.56	6.19
1360	6.45	3.97	7.10	4.60	7.68	5.14			9.17	6.14	8.89	6.33
1340	6.79	4.12	7.44	4.75	8.02	5.29			9.61	6.39	9.23	6.48
1320	7.12	4.26	7.77	4.89	8.35	5.43			10.04	6.63	9.56	6.62
1300	7.48	4.42	8.12	5.05	8.71	5.59			10.41	6.71	9.91	6.78
1280	7.83	4.59	8.48	5.22	9.06	5.76			10.77	6.79	10.27	6.95
1260	8.19	4.75	8.83	5.38	9.42	5.92			11.14	6.87	10.62	7.11
1240	8.54	4.91	9.18	5.54	9.77	6.08			11.50	6.95	10.97	7.27
1220	8.78	4.98	9.44	5.61	10.03	6.15			11.76	7.02	11.23	7.34
1200	9.02	5.05	9.70	5.68	10.29	6.22			12.02	7.09	11.49	7.41
1180	9.27	5.13	9.96	5.75	10.55	6.29			12.28	7.16	11.75	7.48
1160	9.51	5.20	10.21	5.81	10.80	6.35			12.54	7.22	12.00	7.54
1140	9.75	5.27	10.47	5.88	11.06	6.42			12.80	7.29	12.26	7.61
1120	9.99	5.34	10.73	5.95	11.32	6.49			13.06	7.36	12.52	7.68
1100	10.30	5.46	11.04	6.07	11.65	6.62			13.38	7.46	12.82	7.80
1080	10.62	5.57	11.34	6.18	11.99	6.75			13.70	7.56	13.13	7.91
1060	10.93	5.69	11.65	6.30	12.32	6.88			14.02	7.66	13.43	8.03
1040	11.24	5.80	11.95	6.42	12.65	7.01			14.34	7.76	13.74	8.15
1020	11.56	5.92	12.26	6.54	12.98	7.14			14.66	7.86	14.04	8.27
1000	11.87	6.03	12.56	6.65	13.32	7.26			14.99	7.95	14.35	8.38
980	12.19	6.15	12.87	6.77	13.65	7.39			15.31	8.05	14.65	8.50
960	12.50	6.26	13.17	6.89	13.98	7.52			15.63	8.15	14.96	8.62
940	12.81	6.38	13.48	7.01	14.31	7.65			15.95	8.25	15.26	8.74
920	13.13	6.49	13.78	7.12	14.65	7.78			16.27	8.35	15.57	8.85
900	13.44	6.61	14.09	7.24	14.98	7.91			16.59	8.45	15.87	8.97

Haulage Cycle Times

East Central 1W

(all times in min)

bench	HG		LG		Cat 4		OB		Cat 1/2		Cat 3	
	from	to	from	to	from	to	from	to	from	to	from	to
1620	2.92	2.66	3.63	3.29	5.87	5.47	8.70	7.92	6.04	5.24	7.00	6.58
1600	2.92	2.66	3.63	3.29	5.87	5.47	8.70	7.92	6.04	5.24	7.00	6.58
1580	3.29	2.92	4.24	3.77	6.27	5.75	9.31	8.17	6.88	5.53	7.40	6.86
1560	3.65	3.18	4.84	4.25	6.66	6.02	9.92	8.42	7.71	5.81	7.79	7.13
1540	3.97	3.31	5.03	4.23	7.09	6.19	9.92	8.42	8.03	5.94	8.11	7.26
1520	4.29	3.44	5.23	4.21	7.51	6.36			8.35	6.07	8.43	7.39
1500	4.61	3.57	5.42	4.19	7.94	6.53			8.67	6.20	8.75	7.52
1480	4.98	3.71	5.75	4.34	8.27	6.68			10.39	6.80	9.30	7.75
1460	5.34	3.85	6.09	4.48	8.61	6.82			12.12	7.40	9.84	7.98
1440	5.71	3.99	6.42	4.63	8.94	6.97			13.84	8.00	10.39	8.21
1420	6.10	4.23	6.81	4.87	9.33	7.21			14.02	8.14	10.78	8.45
1400	6.49	4.47	7.20	5.11	9.72	7.45			14.20	8.28	11.17	8.69
1380	6.88	4.70	7.59	5.34	10.11	7.68			14.37	8.41	11.56	8.93
1360	7.27	4.94	7.98	5.58	10.50	7.92			14.55	8.55	11.95	9.17
1340	7.57	5.01	8.25	5.65	10.77	7.99			14.68	8.56	12.22	9.24
1320	7.88	5.09	8.52	5.73	11.04	8.07			14.80	8.57	12.49	9.31
1300	8.18	5.16	8.78	5.80	11.30	8.14			14.93	8.57	12.75	9.38
1280	8.48	5.23	9.05	5.87	11.57	8.21			15.05	8.58	13.02	9.45
1260	8.70	5.28	9.31	5.92	11.83	8.26			15.17	8.57	13.32	9.47
1240	8.92	5.33	9.57	5.97	12.09	8.31			15.29	8.55	13.61	9.50
1220	9.14	5.38	9.83	6.02	12.35	8.36			15.41	8.54	13.91	9.52
1200	9.36	5.43	10.09	6.06	12.60	8.40			15.52	8.53	14.20	9.54
1180	9.58	5.48	10.35	6.11	12.86	8.45			15.64	8.51	14.50	9.57
1160	9.80	5.53	10.61	6.16	13.12	8.50			15.76	8.50	14.79	9.59
1140												
1120												
1100												
1080												
1060												
1040												
1020												
1000												
980												
960												
940												
920												

East Central 2W

(all times in min)

bench	HG		LG		Cat 4		OB		Cat 1/2		Cat 3	
	from	to	from	to	from	to	from	to	from	to	from	to
1620	3.65	3.18	4.84	4.25	6.66	6.02	9.92	8.42	7.71	5.81	7.79	7.13
1600	3.65	3.18	4.84	4.25	6.66	6.02	9.92	8.42	7.71	5.81	7.79	7.13
1580	3.65	3.18	4.84	4.25	6.66	6.02	9.92	8.42	7.71	5.81	7.79	7.13
1560	3.65	3.18	4.84	4.25	6.66	6.02	9.92	8.42	7.71	5.81	7.79	7.13
1540	3.97	3.31	5.03	4.23	7.09	6.19	9.92	8.42	8.03	5.94	8.11	7.26
1520	4.29	3.44	5.23	4.21	7.51	6.36	9.92	8.42	8.35	6.07	8.43	7.39
1500	4.61	3.57	5.42	4.19	7.94	6.53			8.67	6.20	8.75	7.52
1480	4.98	3.71	5.75	4.34	8.27	6.68			10.39	6.80	9.30	7.75
1460	5.34	3.85	6.09	4.48	8.61	6.82			12.12	7.40	9.84	7.98
1440	5.71	3.99	6.42	4.63	8.94	6.97			13.84	8.00	10.39	8.21
1420	6.10	4.23	6.81	4.87	9.35	7.21			14.02	8.14	10.78	8.45
1400	6.49	4.47	7.20	5.11	9.76	7.45			14.20	8.28	11.17	8.69
1380	6.88	4.70	7.59	5.34	10.16	7.68			14.37	8.41	11.56	8.93
1360	7.27	4.94	7.98	5.58	10.57	7.92			14.55	8.55	11.95	9.17
1340	7.43	4.83	8.14	5.47	10.69	7.81			14.42	8.32	12.11	9.06
1320	7.58	4.72	8.29	5.36	10.81	7.70			14.29	8.08	12.26	8.94
1300	7.87	4.82	8.58	5.46	11.10	7.80			14.50	8.14	12.57	9.03
1280	8.16	4.92	8.87	5.56	11.39	7.90			14.70	8.21	12.88	9.11
1260	8.45	5.03	9.16	5.66	11.68	8.00			14.91	8.27	13.19	9.20
1240	8.74	5.13	9.45	5.76	11.97	8.10			15.11	8.33	13.50	9.29
1220	9.03	5.23	9.74	5.87	12.26	8.21			15.32	8.40	13.82	9.38
1200	9.32	5.33	10.03	5.97	12.54	8.31			15.52	8.46	14.13	9.46
1180	9.61	5.43	10.32	6.07	12.83	8.41			15.73	8.52	14.44	9.55
1160	9.90	5.54	10.61	6.17	13.12	8.51			15.93	8.58	14.75	9.64
1140	10.19	5.64	10.90	6.27	13.41	8.61			16.14	8.65	15.06	9.72
1120	10.48	5.74	11.19	6.37	13.70	8.71			16.34	8.71	15.37	9.81
1100	11.06	6.09	11.41	6.40	15.02	9.45			16.68	8.97	15.85	10.00
1080	11.63	6.43	11.63	6.43	16.33	10.19			17.02	9.22	16.33	10.19
1060	12.44	6.78	12.44	6.78	16.35	10.12			17.07	9.18	16.68	10.31
1040	13.25	7.13	13.25	7.13	16.37	10.04			17.13	9.13	17.03	10.43
1020	14.06	7.48	14.06	7.48	16.39	9.97			17.18	9.09	17.38	10.55
1000	14.87	7.83	14.87	7.83	16.40	9.90			17.24	9.04	17.72	10.67
980	15.68	8.18	15.68	8.18	16.42	9.83			17.29	9.00	18.07	10.79
960	16.49	8.53	16.49	8.53	16.44	9.75			17.35	8.95	18.42	10.91
940	17.30	8.88	17.30	8.88	16.46	9.68			17.40	8.91	18.77	11.03
920												

East Central 1M

(all times in min)

bench	HG		LG		Cat 4		OB		Cat 1/2		Cat 3	
	from	to	from	to	from	to	from	to	from	to	from	to
1620	3.33	2.92	3.90	3.41	5.24	4.48	7.89	6.30	9.31	5.55	6.73	5.76
1600	3.33	2.92	3.90	3.41	5.24	4.48	7.89	6.30	9.31	5.55	6.73	5.76
1580	3.33	2.92	3.90	3.41	5.24	4.48	7.89	6.30	9.31	5.55	6.73	5.76
1560	3.57	2.97	4.13	3.46	5.48	4.53	7.89	6.30	9.33	5.50	7.02	5.77
1540	3.80	3.02	4.37	3.51	5.71	4.58	7.89	6.30	9.35	5.46	7.31	5.79
1520	4.04	3.07	4.60	3.56	5.95	4.63			9.37	5.41	7.59	5.80
1500	4.27	3.12	4.83	3.61	6.18	4.68			9.39	5.36	7.88	5.81
1480	4.60	3.31	5.02	3.67	6.53	4.88			9.60	5.49	8.23	6.00
1460	4.93	3.49	5.21	3.74	6.88	5.07			9.80	5.62	8.58	6.20
1440	5.26	3.68	5.40	3.80	7.22	5.27			10.01	5.75	8.92	6.39
1420	5.59	3.86	5.59	3.86	7.57	5.46			10.21	5.88	9.27	6.58
1400	5.93	4.00	5.93	4.00	7.90	5.60			10.43	5.97	9.67	6.75
1380	6.26	4.14	6.26	4.14	8.24	5.74			10.65	6.06	10.07	6.92
1360	6.60	4.29	6.60	4.29	8.57	5.89			10.88	6.15	10.47	7.09
1340	6.93	4.43	6.93	4.43	8.91	6.03			11.10	6.24	10.87	7.26
1320	7.27	4.57	7.27	4.57	9.24	6.17			11.32	6.33	11.27	7.43
1300	7.61	4.71	7.61	4.71	9.57	6.31			11.54	6.42	11.66	7.59
1280	7.94	4.85	7.94	4.85	9.91	6.45			11.76	6.51	12.06	7.76
1260	8.28	5.00	8.28	5.00	10.24	6.60			11.99	6.60	12.46	7.93
1240	8.61	5.14	8.61	5.14	10.58	6.74			12.21	6.69	12.86	8.10
1220	8.95	5.28	8.95	5.28	10.91	6.88			12.43	6.78	13.26	8.27
1200												
1180												
1160												
1140												
1120												
1100												
1080												
1060												
1040												
1020												
1000												
980												
960												
940												
920												
900												
880												
860												
840												
820												
800												

East Central 2M

(all times in min)

bench	HG		LG		Cat 4		OB		Cat 1/2		Cat 3	
	from	to	from	to	from	to	from	to	from	to	from	to
1620	7.38	5.88	7.38	5.88	5.68	4.75	6.19	4.30	8.32	5.17	7.38	5.88
1600	7.38	5.88	7.38	5.88	5.68	4.75	6.19	4.30	8.32	5.17	7.38	5.88
1580	7.38	5.88	7.38	5.88	5.68	4.75	6.19	4.30	8.32	5.17	7.38	5.88
1560	7.38	5.88	7.38	5.88	5.68	4.75	6.19	4.30	8.32	5.17	7.38	5.88
1540	7.13	5.57	7.13	5.57	5.95	4.83	6.19	4.30	8.43	5.18	7.75	6.00
1520	6.88	5.27	6.88	5.27	6.23	4.92	6.19	4.30	8.54	5.19	8.11	6.12
1500	6.63	4.96	6.63	4.96	6.50	5.00	6.19	4.30	8.65	5.20	8.48	6.24
1480	6.37	4.66	6.37	4.66	6.77	5.08			8.77	5.21	8.84	6.36
1460	6.12	4.35	6.12	4.35	7.04	5.16			8.88	5.22	9.21	6.48
1440	5.87	4.05	5.87	4.05	7.32	5.25			8.99	5.23	9.57	6.60
1420	5.62	3.74	5.62	3.74	7.59	5.33			9.10	5.24	9.94	6.72
1400	5.94	3.86	5.94	3.86	7.91	5.46			9.25	5.29	10.21	6.84
1380	6.25	3.99	6.25	3.99	8.22	5.58			9.39	5.33	10.48	6.96
1360	6.57	4.11	6.57	4.11	8.54	5.71			9.54	5.38	10.75	7.07
1340	6.88	4.24	6.88	4.24	8.85	5.83			9.68	5.43	11.02	7.19
1320	7.20	4.36	7.20	4.36	9.17	5.96			9.83	5.48	11.29	7.31
1300	7.51	4.48	7.51	4.48	9.48	6.08			9.97	5.52	11.55	7.43
1280	7.83	4.61	7.83	4.61	9.80	6.21			10.12	5.57	11.82	7.55
1260	8.14	4.73	8.14	4.73	10.11	6.33			10.26	5.62	12.09	7.66
1240	8.46	4.86	8.46	4.86	10.43	6.46			10.41	5.66	12.36	7.78
1220	8.77	4.98	8.77	4.98	10.74	6.58			10.55	5.71	12.63	7.90
1200	9.07	5.09	9.07	5.09	11.04	6.69			10.77	5.78	12.97	8.02
1180	9.38	5.20	9.38	5.20	11.35	6.80			10.99	5.85	13.30	8.15
1160	9.68	5.31	9.68	5.31	11.65	6.91			11.20	5.92	13.64	8.27
1140	9.98	5.42	9.98	5.42	11.95	7.02			11.42	6.00	13.97	8.40
1120	10.29	5.53	10.29	5.53	12.26	7.13			11.64	6.07	14.31	8.52
1100	10.59	5.64	10.59	5.64	12.56	7.24			11.86	6.14	14.64	8.64
1080	10.89	5.75	10.89	5.75	12.86	7.35			12.08	6.21	14.98	8.77
1060	11.20	5.86	11.20	5.86	13.16	7.46			12.29	6.28	15.31	8.89
1040	11.50	5.97	11.50	5.97	13.47	7.57			12.51	6.35	15.65	9.02
1020	11.81	6.09	11.81	6.09	13.77	7.69			12.73	6.43	15.98	9.14
1000	12.11	6.20	12.11	6.20	14.07	7.80			12.95	6.50	16.32	9.26
980	12.41	6.31	12.41	6.31	14.38	7.91			13.17	6.57	16.65	9.39
960	12.72	6.42	12.72	6.42	14.68	8.02			13.38	6.64	16.99	9.51
940	13.02	6.53	13.02	6.53	14.98	8.13			13.60	6.71	17.32	9.64
920	13.32	6.64	13.32	6.64	15.29	8.24			13.82	6.78	17.66	9.76
900	13.63	6.75	13.63	6.75	15.59	8.35			14.04	6.85	17.99	9.88
880	13.93	6.86	13.93	6.86	15.89	8.46			14.26	6.93	18.33	10.01
860	14.23	6.97	14.23	6.97	16.19	8.57			14.47	7.00	18.66	10.13
840	14.54	7.08	14.54	7.08	16.50	8.68			14.69	7.07	19.00	10.26
820	14.84	7.19	14.84	7.19	16.80	8.79			14.91	7.14	19.33	10.38
800												

Major Equipment Mechanical Availability

Cat 793	
AVAILABILITY	
hours	avail
0	0.90
6,000	0.88
12,000	0.86
18,000	0.85
24,000	0.85
30,000	0.85
36,000	0.85
42,000	0.85
48,000	0.85
54,000	0.85
60,000	0.85
66,000	0.85
72,000	0.85
78,000	0.85
84,000	0.85
90,000	0.85
96,000	0.85
102,000	0.85
108,000	0.85

Komatsu 830E AC	
AVAILABILITY	
hours	avail
0	0.90
6,000	0.88
12,000	0.86
18,000	0.85
24,000	0.85
30,000	0.85
36,000	0.85
42,000	0.85
48,000	0.85
54,000	0.85
60,000	0.85
66,000	0.85
72,000	0.85
78,000	0.85
84,000	0.85
90,000	0.85
96,000	0.85
102,000	0.85
108,000	0.85

Pit Viper 351 (d)	
AVAILABILITY	
hours	avail
0	0.90
6,000	0.88
12,000	0.86
18,000	0.84
24,000	0.82
30,000	0.80
36,000	0.80
42,000	0.80
48,000	0.80
54,000	0.80
60,000	0.80
66,000	0.80
72,000	0.80
78,000	0.80
84,000	0.80
90,000	0.80
96,000	0.80
102,000	0.80
108,000	0.80

BE 59R Used (e)	
AVAILABILITY	
hours	avail
0	0.90
6,000	0.88
12,000	0.86
18,000	0.84
24,000	0.82
30,000	0.80
36,000	0.80
42,000	0.80
48,000	0.80
54,000	0.80
60,000	0.80
66,000	0.80
72,000	0.80
78,000	0.80
84,000	0.80
90,000	0.80
96,000	0.80
102,000	0.80
108,000	0.80

PC 5500E	
AVAILABILITY	
hours	avail
0	0.90
6,000	0.88
12,000	0.86
18,000	0.85
24,000	0.85
30,000	0.85
36,000	0.85
42,000	0.85
48,000	0.85
54,000	0.85
60,000	0.85
66,000	0.85
72,000	0.85
78,000	0.85
84,000	0.85
90,000	0.85
96,000	0.85
102,000	0.85
108,000	0.85

Cat 994	
AVAILABILITY	
hours	avail
0	0.90
6,000	0.88
12,000	0.86
18,000	0.84
24,000	0.84
30,000	0.84
36,000	0.84
42,000	0.84
48,000	0.84
54,000	0.84
60,000	0.84
66,000	0.84
72,000	0.84
78,000	0.84
84,000	0.84
90,000	0.84
96,000	0.84
102,000	0.84
108,000	0.84

Equipment and ManPower Calculations

Calendar Days	365
Scheduled Shutdown	
Unscheduled Days Down - weather	
Total	365
Shifts / Day	2
Scheduled Hours / Shift	12
Lunch Break	0.3
Shift Start / Shutdown	
Coffee Breaks	0.3
Miscellaneous - Blasting & Moves	
Standard Work Week	40
Weeks per year	52
number of shifts	2
Based Pay hours	2,080
Scheduled OT	9.00%
UnScheduled OT %	
OT payrate	1.5
Total Payhours	2,361
Vacation Allowance (hours)	80
Absenteeism %	1.00%
Sick time %	0.30%
Worked hours	2160

Pre-Production	months
Year -2	
Year -1	12

Equipment Cycle times	
min on dump	**1.00**
min at crusher	**1.00**

Duties and Import Taxes

Explosives Accessories	Waste		Ore		Wall Control	
	Unit Cost		Unit Cost		Unit Cost	
Boosters	$6.85	per booste	$6.85	per booste	$6.85	per booster
Downline		per metre		per metre		per metre
Trunkline	$0.51	per metre	$0.51	per metre	$0.51	per metre
Surface Delays	$3.96	per delay	$3.96	per delay	$3.96	per delay
DownHole Delays	$6.16	per delay	$6.16	per delay	$6.16	per delay
Initiation	$60.00	per blast	$60.00	per blast	$60.00	per blast
Miscellaneous including Liners	$4.00	per hole	$2.00	per hole	$2.00	per hole

Secondary Blasting & Development	
Explosives	of Primary Blast
Accessories	of Primary Blast

AN/FO to Emulsion Proportion (by volume)	Primary	Perimeter
AN/FO	0.7	0.7
Emulsion	0.3	0.3

Swell Factor	150%
Moisture	3%

General Blasting Related Costs (contract)			
Fixed Installations	number		
Explosives Magazine	1		/month
Accessories Magazine	1		/month
Pickup Trucks & Pumps & Labour	1	$49,800	/month

Explosives Type	
Ore (bulk/package)	bulk
Waste (bulk/package)	bulk

Explosives Package Costs	$/hole
Ore	$50.00
Waste	$125.00

AN/FO Fuel Calculations		
Ammonium Nitrate	$42.90	/100 kg
Fuel Price	$0.724	/litre
Fuel Density	1.25	kg/l
Fuel Price	$57.91	100 kg
Fuel Content	6.00%	by weight
Blended Price	$43.80	/100 kg
Emulsion costs	$48.40	/100 kg
Emulsion S.G.	1.25	

	year
Est Mill Operating cost ($/t)	
Est G & A Cost (x 1000 $/year)	
Mill Capital Estimate (year -1 $k)	-2
Other Capital Est (year -1 $k)	-1

Input data for Fuel/Power		
Diesel	0.724	$/litre
Gasoline		$/litre
Electricity	0.045	$/kWh

Property Drilling Parameters		
Drilling	Bit Diameter (mm)	
Ore Drilling	311.00	
Waste Drilling	311.00	20
Bench height - Ore	**12.2**	
Bench height - Waste	12.2	
Perimeter Drilling (Yes/No	**no**	
Secondary Drilling (% of p		

		Local Salaries XXX/year	US$/year	Expatriate living Allowance	Burden	Annual Salaries $US/year
STAFF						
MINE MAINTENANCE						
1	Maintenance Superintendent	100,000	100,000		26%	126,400
2	Contract Manager	85,000	85,000		29%	109,990
3	Equipment Manager	80,000	80,000		31%	104,560
4	Maintenance Planner	70,000	70,000		34%	93,660
5	Clerk/Secretary	50,000	50,000		44%	71,900
MINE OPERATIONS						
1	Mine Operations Superintendent	120,000	120,000		24%	148,200
2	Mine General Foreman	85,000	85,000		29%	109,990
3	Mine Shift Foreman	80,000	80,000		31%	104,560
4	Drill and Blast Foreman	80,000	80,000		31%	104,560
5	Services Foreman	70,000	70,000		34%	93,660
6	Clerk/Secretary	50,000	50,000		44%	71,900
7	Dispatch	70,000	70,000		34%	93,660
MINE ENGINEERING						
1	Chief Engineer	100,000	100,000		26%	126,400
2	Senior Engineer	80,000	80,000		31%	104,560
3	Open Pit Planning Engineer	70,000	70,000		34%	93,660
4	Surveyor/Mining Technician	60,000	60,000		34%	80,280
5	Clerk/Secretary	50,000	50,000		44%	71,900
6						
7						
8						
9						
10						
11						
GEOLOGY						
1	Chief Geologist	100,000	100,000		26%	126,400
2	Senior Geologist	80,000	80,000		31%	104,560
3	Grade Control Geologist	70,000	70,000		34%	93,660
4	Sampling Technician	60,000	60,000		34%	80,280
5	Clerk/Secretary	50,000	50,000		44%	71,900
6						
7						
8						

		Local Salaries XXX/hour	$ US /hour	Burden	Annual Salaries $US/year
HOURLY					
MINE MAINTENANCE					
1	Light Duty Mechanic	23.80	23.80	46%	81,808
2	Tire Man	23.80	23.80	46%	81,808
3	Lube Truck Driver	21.89	21.89	48%	76,638
4	Apprentice				
1	Heavy Duty Mechanic				
2	Welder				
3	Electrician	26.26	26.26	43%	88,404
MINE OPERATIONS					
1	Tool Crib Attendent				
2	Warehouse Attendent				
3	General Mine Labourer	20.25	20.25	51%	72,283
4	Trainee	20.25	20.25	51%	49,015
1	Drill Operator 1	23.80	23.80	46%	81,808
2	Drill Operator 2	23.80	23.80	46%	81,808
1	Blasters	23.80	23.80	46%	81,808
2	Blaster Helper	23.80	23.80	46%	81,808
1	PC 5500E	26.26	26.26	43%	88,404
2	Cat 994	26.26	26.26	43%	88,404
3					
4					
1	Cat 793	24.89	24.89	44%	84,732
2	Komatsu 830E AC	24.89	24.89		58,760
3					
4					
5					
1	Dozer Operator	24.89	24.89	44%	84,732
2	Grader / RT Operator	24.89	24.89	44%	84,732
3	Water Truck Driver	21.89	21.89	48%	76,638
4	Backhoe Operator	24.89	24.89	44%	84,732

Schedule Data			Track Dozer	Grader	Rubber Tired Dozer	Transfer Loader	Backhoe with hammer	Water/Sand Truck - 777	Tailings Dozer - D8T LGP
	Calendar Days	days/year	365	365	365	365	365	365	365
	Scheduled Shutdown	days/year	0	0	0	0	0	0	0
	Unscheduled Days Down - weather	days/year	0	0	0	0	0	0	0
	Mine Work Days	days/year	365	365	365	365	365	365	365
	Shifts / Day	shifts/day	2	2	2	2	2	2	2
	Scheduled Hours / Shift	hours/shift	12	12	12	12	12	12	12
	Scheduled Hours / Year	hours/year	8,760	8,760	8,760	8,760	8,760	8,760	8,760
(T)	**Total Theoretical**	hours/year	8,760	8,760	8,760	8,760	8,760	8,760	8,760
(SU)	Scheduled & Unscheduled Shutdown	hours/year	0	0	0	0	0	0	0
Standby									
	Lunch Break	hours/shift	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Shift Start / Shutdown	hours/shift	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coffee Breaks	hours/shift	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Miscellaneous - Blasting & Moves	hours/shift	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total Standby	hours/shift	0.6	0.6	0.6	0.6	0.6	0.6	0.6
(S)	**Total Standby**	hours/year	438	438	438	438	438	438	438
	Available Working Hours	hours/day	22.8	22.8	22.8	22.8	22.8	22.8	22.8
	Available Working Hours	hours/year	8,322	8,322	8,322	8,322	8,322	8,322	8,322
Annual Hours									
(T)	Total Theoretical	hours/year	8,760	8,760	8,760	8,760	8,760	8,760	8,760
(SU)	Scheduled & Unscheduled Shutdown	hours/year	0	0	0	0	0	0	0
(S)	Total Standby	hours/year	438	438	438	438	438	438	438
(W)+(R)	Work + Repair = (T-S-SU)	hours/year	8,322	8,322	8,322	8,322	8,322	8,322	8,322
(W)	Work = MA x (T-S-SU)	hours/year	7,077	7,077	7,077	7,077	7,077	7,077	7,077
Mechanical Availability									
	Scheduled Downtime	shifts/year	26	26	26	26	26	26	26
	Scheduled Downtime	hours/year	312	312	312	312	312	312	312
	Scheduled Downtime		3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%
	Unscheduled Downtime		11.4%	11.4%	11.4%	11.4%	11.4%	11.4%	11.4%
	Total Downtime		15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
	Shifts Available for Scheduling	shifts	704	704	704	704	704	704	704
(MA)	Mechanical Availability		85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
(PA)	Physical Availability = (W+S)/T		85.8%	85.8%	85.8%	85.8%	85.8%	85.8%	85.8%
(UA)	Use of Availability = W/(W+S)		94.2%	94.2%	94.2%	94.2%	94.2%	94.2%	94.2%
(EU)	Effective Utilization = PA x UA		80.8%	80.8%	80.8%	80.8%	80.8%	80.8%	80.8%
Annual Production									
(WH)	Work Hours / Year	hours/year	7,077	7,077	7,077	7,077	7,077	7,077	7,077
	Operating Efficiency - operation based		83.3%	83.3%	83.3%	83.3%	83.3%	83.3%	83.3%
(OH)	Operating Hours / Year	hours/year	5,895	5,895	5,895	5,895	5,895	5,895	5,895

Loading Equipment	Capital Cost	Machine Life (in hrs)	# of units	Initial year required	Fuel Type (d/g/e)	Consumption (l/hr or KW/hr)	Lube, Oil & Filters (% of	Number of tires	Size	Life	Tire Price	Under Carriage	R&M Reserve	Special Wear	Operator Eff	dipper size	Bucket Fill Factor	Average Cycle time	Truck Spot Time	Static tipping	Trk Av. To Loader
1 PC 5500E	$10,166,000	60,000	2	-1	e	1541.0	10%					$50.00	$185.00	$68.00	83.3%	24	90%	33	42	75	80%
2 Cat 994	$3,641,000	25,000	1	-1	d	170.0	10%	4	55/80 R57	4000	$84,641		$47.58	$20.20	83.3%	16.4	90%	40	42	75	80%
3					d		10%								83.3%	15	90%	33	42	75	80%
4					d		10%								83.3%	10	90%	35	42	75	80%

Trucking	Capital Cost	Machine Life (in hrs)	# of units	Initial year required	Fuel Type (d/g/e)	Consumption (l/hr or KW/hr)	Lube, Oil & Filters (% of	Number of tires	Size	Life	Tire Price	Under Carriage	R&M Reserve	Special Wear	Operator Eff	Size Capacity m3	Size Capacity (wmt)	Nominal Truck
1 Cat 793	$2,750,000	60,000		-1	d	148.0	10%	6	40.00 R57	5500	$28,000		$82.53		83%	140 m³	240 t	241 t
2 Komatsu 830E AC	$3,178,200	60,000		-1	d	159.0	10%	6	40.00 R57	4000	$26,350		$75.60		83%	147 m³	240 t	240 t
3					d		10%								83%	78 m³	144 t	150 t
4					d		10%								83%	60 m³	91 t	100 t
5					d		10%								83%	129 m³	218 t	320 t

Drilling Equipment	Capital Cost	Machine Life (in hrs)	# of units	Initial year required	Fuel Type (d/g/e)	Consumption (l/hr or KW/hr)	Lube, Oil & Filters (% of fuel)	Drill Bits Unit Costs	Drill Bit Life (metres)			Under Carriage	R&M Reserve	Special Wear Items	Operator Eff	Scheduled Downtime (in shifts)	UnScheduled Downtime (in %)	Drill Type	Bit Diameter (mm)	Down Pressure	Move, Spot and Collar hole	Level Drill (in min)	Add Steel (in min)	Pull Rods (in min)	Penetration Rate Ore (metres/min)	Penetration Rate Waste (metres/min)	RPM
1 Pit Viper 351 (d)	$3,853,100	25,000		-1	d	159.0	10%	$6,019	1,448				$86.01		83.3%	52		Rotary	311.00	100,000	3.00	0.75		0.75	0.39	0.39	70
2 BE 59R Used (e)	$3,707,000	25,000		-1	e	700.0	10%	$6,019	1,448				$97.16		83.3%	52		Rotary	311.00	100,000	3.00	0.75		0.75	0.39	0.39	70
3															83.3%											0.60	

Support	Capital Cost	Machine Life (in hrs)	# of units	Initial year required	Fuel Type (d/g/e)	Consumption (l/hr or KW/hr)	Lube, Oil & Filters (% of fuel)	Number of tires	Size	Life	Tire Price	Under Carriage	R&M Reserve	Special Wear Items	Operator Eff	Scheduled Downtime	UnScheduled Downtime
1 Track Dozer	$1,050,000	35,000	3	-1	d	91.0	10%					$34.50	$39.50	$8.10	83.3%	26	11.4%
2 Grader	$675,000	20,000	2	-1	d	32.0	10%	6	18.00-25 12 PR	3000	$1,100		$28.09	$45.00	83.3%	26	11.4%
3 Rubber Tired Dozer	$1,068,000	30,000	1	-1	d	53.0	10%	4	35/65R33	5000	$10,700		$25.76	$2.10	83.3%	26	11.4%
4 Transfer Loader	$806,000	20,000	1	-1	d	55.0	10%	4	35/65R33	5200	$13,500		$28.05	$10.60	83.3%	26	11.4%
5 Backhoe with hammer	$745,000	10	1	-1	d	26.5	10%					$3.50	$20.49	$1.50	83.3%	26	11.4%
6 Water/Sand Truck - 777	$1,284,500	10	2	-1	d	75.7	10%	6	27.00 R49	5000	$13,600		$49.00		83.3%	26	11.4%
7 Tailings Dozer - D8T LGP	$688,600	10	1	-1	d	38.0	10%					$10.05	$17.77	$2.90	83.3%	26	11.4%
8				-1													

Mine General Equipment	Capital Cost	Machine Life	# of units	Initial year required	Fuel Type	Consumption	Lube, Oil & Filters	Number of tires	Size	Life	Tire Price	Under Carriage	R&M Reserve
1 Lube/Fuel Truck	$160,000	6		-1	d	20.0	0.1	6	22.5R11	2000	$395		$5.00
2 Tire Manipulator and Loader	$503,000	4	1	-1	d	15.0	0.1	4	22.5R11	2000	$290		$5.00
3 Welding Truck	$208,000	6		-1	d		0.1	6	22.5R11	2000	$290		$5.00
4 Blasting Loader	$65,000	5		-1	d	10.0	0.1	6	12 x 16.5	2000	$250		$10.00
5 90 ton Crane	$709,500	15	1	-1	d	10.0	0.1	12	265/75 R16	2000	$450		$10.00
6 Integrated Tool Carrier	$256,000	10	1	-1	d	18.0	0.1	4	20.5R25	3000	$1,950		$16.00
7 Compactor	$170,000	10	1	-1	d	10.0	0.1						$10.00
8 Lighting Plants	$8,200	4	5	-1	d	6.0	0.1	2	265/75 R16	4000	$450		$2.00
9 Sanding Truck - Sterling	$350,000	10	2	-1	d	20.0	0.1	6	22.5R11	2000	$395		$15.00
10 Auxilary Pumps	$45,000	5	3	-1	d	10.0							$10.00
11 Pump Truck	$250,000	5	1	-1	d	15.0	0.1	6	22.5R11	2000	$395		$15.00
12 Man Bus	$80,000	5	2	-1	d	9.0	0.1	6		2000	$450		$5.00
13 Pickup Trucks	$40,000	2	8	-1	d	5.0	0.3	4	265/75 R16	2000	$450		$5.00
14 Ambulance	$100,000	10	1	-1									
15 Fire Truck	$200,000	10	1	-1									
2				-1									

Equipment Operating Costs - Hourly

Appendix - Equipment Hourly Operating Costs - Consumables

	Fuel $/hr	Power $/Ophr	Lube, Oil & Filters	Tires $/hr	Under-Carriage	R&M Reserve	Special Wear Items	Total	Drill Bits m/hr	Drill Bits $/hr	Drill Bits $/m
Drills											
Pit Viper 351 (d)	$115.09		$11.51			$86.01	$88.04	**$300.65**	21.2	$88.04	$4.16
BE 59R Used (e)		$31.50				$97.16	$88.04	**$216.70**	21.2	$88.04	$4.16
Loading Equipment									Tire unit cost	$/hr	
PC 5500E		$69.35			$50.00	$185.00	$68.00	**$372.35**			
Cat 994	$123.05		$12.31	$84.64		$47.58	$20.20	**$287.78**	$84,641	$84.64	
Hauling Equipment											
Cat 793	$107.13		$10.72	$30.55		$82.53		**$230.92**	$28,000	$30.55	
Komatsu 830E AC	$115.09		$11.51	$39.53		$75.60		**$241.72**	$26,350	$39.53	
Mine Support Equipment											
Track Dozer	$65.87		$6.59		$34.50	$39.50	$8.10	**$154.56**			
Grader	$23.16		$2.32	$2.20		$28.09	$45.00	**$100.77**	$1,100	$2.20	
Rubber Tired Dozer	$38.36		$3.84	$8.56		$25.76	$2.10	**$78.62**	$10,700	$8.56	
Transfer Loader	$39.81		$3.98	$10.38		$28.05	$10.60	**$92.83**	$13,500	$10.38	
Backhoe with hammer	$19.18		$1.92		$3.50	$20.49	$1.50	**$46.59**			
Water/Sand Truck - 777	$54.79		$5.48	$16.32		$49.00		**$125.59**	$13,600	$16.32	
Tailings Dozer - D8T LGP	$27.51		$2.75		$10.05	$17.77	$2.90	**$60.98**			
Mine General Equipment											
Lube/Fuel Truck	$14.48		$1.45	$1.19		$5.00		**$22.11**	$395	$1.19	
Tire Manipulator and Loade	$10.86		$1.09	$0.58		$5.00		**$17.52**	$290	$0.58	
Welding Truck				$0.87		$5.00		**$5.87**	$290	$0.87	
Blasting Loader	$7.24		$0.72	$0.75		$10.00		**$18.71**	$250	$0.75	
90 ton Crane	$7.24		$0.72	$2.70		$10.00		**$20.66**	$450	$2.70	
Integrated Tool Carrier	$13.03		$1.30	$2.60		$16.00		**$32.93**	$1,950	$2.60	
Compactor	$7.24		$0.72			$10.00		**$17.96**			
Lighting Plants	$4.34		$0.43	$0.23		$2.00		**$7.00**	$450	$0.23	
Auxilary Pumps	$7.24					$10.00		**$17.24**			
Man Bus	$6.51		$0.65	$1.35		$5.00		**$13.52**	$450	$1.35	
Pickup Trucks	3.619168		$0.90	$0.90		$5.00		**$10.42**	$450	$0.90	

																								17-Jan-08
Year of Operation		-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	**Total**
Operating Days	days		365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	**7,665**
Ore Mined	(t X 1000)		327.8	10,795.3	16,366.0	12,886.2	12,073.9	11,368.3	11,349.8	11,111.3	10,885.0	10,876.2	10,885.4	10,880.5	11,126.2	11,293.4	10,880.5	10,994.2	10,893.2	10,875.0	10,894.2	10,938.5	4,678.5	**222,379.4**
Waste Mined	(t X 1000)		6,747.8	29,349.3	25,769.4	23,306.1	18,853.8	14,198.9	8,756.4	5,564.8	9,257.5	9,016.2	10,730.1	10,263.9	7,310.4	12,100.1	14,246.4	13,735.8	16,698.4	18,717.0	8,285.0	5,320.8	2,599.2	**270,827.1**
Total Mined	(t X 1000)		7,075.6	40,144.6	42,135.4	36,192.3	30,927.7	25,567.2	20,106.2	16,676.1	20,142.5	19,892.4	21,615.5	21,144.4	18,436.5	23,393.5	25,126.9	24,730.0	27,591.5	29,592.0	19,179.2	16,259.3	7,277.7	**493,206.5**
Equipment Requirements																								
Drills																								
Pit Viper 351 (d)			630	5,365	6,045	4,789	4,236	3,376	3,034	2,597	3,019	2,987	2,934	3,142	2,817	3,122	3,640	3,392	3,949	4,199	2,898	2,554	1,134	**69,859**
BE 59R Used (e)			630	5,365	6,045	4,789	4,236	3,376	3,034	2,597	3,019	2,987	2,934	3,142	2,817	3,122	3,640	3,392	3,949	4,199	2,898	2,554	1,134	**69,859**
Loading Equipment																								
PC 5500E			2,521	12,925	13,565	11,934	10,185	8,546	6,474	5,369	6,484	6,403	7,081	6,807	5,935	7,800	8,090	8,129	7,207	6,880	6,175	5,236	2,674	**156,420**
Cat 994			477	2,431	2,551	2,245	1,915	1,615	1,217	1,010	1,220	1,205	1,556	1,280	1,116	1,474	1,522	1,529	4,506	6,271	1,161	984	506	**37,791**
Hauling Equipment																								
Cat 793			9,494	54,540	62,111	63,946	59,733	48,990	35,637	27,005	34,478	38,015	41,167	41,973	34,010	40,642	43,577	39,777	40,221	52,509	36,883	30,553	14,896	**850,158**
Komatsu 830E AC																								-
Mine Support Equipment																								
Track Dozer			7,120	12,000	12,000	12,000	12,000	12,000	8,909	6,751	8,619	9,504	10,292	10,493	8,503	10,160	10,894	9,944	10,055	12,000	9,221	7,638	11,172	**211,277**
Grader			5,696	8,800	8,800	8,800	8,800	8,800	7,127	5,401	6,896	7,603	8,233	8,395	6,802	8,128	8,715	7,955	8,044	8,800	7,377	6,111	8,938	**164,222**
Rubber Tired Dozer			3,148	4,400	4,400	4,400	4,235	3,556	2,692	2,233	2,696	2,663	3,023	2,830	2,468	3,246	3,364	3,380	4,100	4,400	2,568	2,177	3,339	**69,317**
Transfer Loader			665	3,818	4,348	4,400	4,181	3,429	2,495	1,890	2,413	2,661	2,882	2,938	2,381	2,845	3,050	2,784	2,815	3,676	2,582	2,139	1,043	**59,435**
Backhoe with hammer			354	2,007	2,107	1,810	1,546	1,278	1,005	834	1,007	380	432	404	353	464	481	483	586	658	367	311	159	**17,025**
Water/Sand Truck - 777			665	3,818	4,348	4,476	4,181	3,429	2,495	1,890	2,413	2,661	2,882	2,938	2,381	2,845	3,050	2,784	2,815	3,676	2,582	2,139	1,043	**59,511**
Tailings Dozer - D8T LGP			3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	**76,650**
Mine General Equipment																								
Lube/Fuel Truck																								
Tire Manipulator and Loader			730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	**15,330**
Welding Truck																								
Blasting Loader																								
90 ton Crane			91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	**1,916**
Integrated Tool Carrier			1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	**30,660**
Compactor																								
Lighting Plants			18,250	18,250	18,250	18,250	18,250	18,250	18,250	18,250	18,250	18,250	18,250	18,250	18,250	18,250	18,250	3,650	3,650	3,650	3,650	3,650	3,650	**295,650**
Sanding Truck - Sterling			2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	1,095	1,095	1,095	1,095	1,095	1,095	**39,420**
Auxilary Pumps			2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	**45,990**
Pump Truck			1,095	1,095	1,095	1,095	1,095	1,095	1,095	1,095	1,095	1,095	1,095	1,095	1,095	1,095	1,095	2,190	2,190	2,190	2,190	2,190	2,190	**29,565**
Man Bus			2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	**45,990**
Pickup Trucks			29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	**613,200**
Adjustment Factor	dozer and grader		3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	
	other support		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

Mine Equipment - Fuel Summary

	type	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
Drills																								
Pit Viper 351 (d)	d		100,170	853,035	961,155	761,451	673,524	536,784	482,406	412,923	480,021	474,933	466,506	499,578	447,903	496,398	578,760	539,328	627,891	667,641	460,782	406,086	180,306	**11,107,581**
BE 59R Used (e)	e		441,000	3,755,500	4,231,500	3,352,300	2,965,200	2,363,200	2,123,800	1,817,900	2,113,300	2,090,900	2,053,800	2,199,400	1,971,900	2,185,400	2,548,000	2,374,400	2,764,300	2,939,300	2,028,600	1,787,800	793,800	**48,901,300**
Loading Equipment																								
PC 5500E	e		3,884,874	19,916,916	20,904,322	18,390,716	15,694,428	13,169,260	9,975,801	8,273,857	9,991,988	9,867,117	10,912,333	10,489,160	9,145,641	12,019,985	12,466,283	12,526,406	11,106,577	10,602,468	9,515,629	8,068,051	4,120,741	**241,042,554**
Cat 994	d		81,122	413,265	433,673	381,633	325,510	274,490	206,888	171,684	207,398	204,847	264,541	217,602	189,796	250,510	258,673	259,949	766,071	1,066,071	197,449	167,347	85,969	**6,424,490**
	d																							
	d																							
Hauling Equipment																								
Cat 793	d		1,405,051	8,071,958	9,192,422	9,463,955	8,840,419	7,250,582	5,274,321	3,996,807	5,102,687	5,626,259	6,092,682	6,212,004	5,033,550	6,015,006	6,449,443	5,887,061	5,952,771	7,771,338	5,458,618	4,521,813	2,204,629	**125,823,376**
Komatsu 830E AC	d																							
	d																							
	d																							
	d																							
Mine Support Equipment																								
Track Dozer	d		647,938	1,092,000	1,092,000	1,092,000	1,092,000	1,092,000	810,749	614,374	784,366	864,847	936,544	954,886	773,738	924,604	991,384	904,937	915,037	1,092,000	839,078	695,076	1,016,662	**19,226,219**
Grader	d		182,277	281,600	281,600	281,600	281,600	281,600	228,079	172,835	220,657	243,298	263,467	268,627	217,667	260,108	278,895	254,576	257,417	281,600	236,048	195,538	286,006	**5,255,095**
Rubber Tired Dozer	d		166,850	233,200	233,200	233,200	224,443	188,478	142,660	118,331	142,911	141,129	160,225	150,009	130,802	172,027	178,290	179,153	217,289	233,200	136,091	115,381	176,954	**3,673,824**
Transfer Loader	d		36,550	209,980	239,127	242,000	229,970	188,613	137,204	103,971	132,739	146,359	158,492	161,596	130,940	156,471	167,773	153,143	154,852	202,160	141,998	117,628	57,350	**3,268,917**
Backhoe with hammer	d		9,375	53,192	55,829	47,955	40,979	33,877	26,641	22,096	26,689	10,081	11,445	10,715	9,343	12,288	12,735	12,797	15,521	17,425	9,721	8,241	4,213	**451,156**
Water/Sand Truck - 777	d		50,307	289,009	329,126	338,848	316,523	259,600	188,842	143,102	182,697	201,443	218,143	222,415	180,221	215,362	230,916	210,781	213,133	278,245	195,441	161,899	78,935	**4,504,987**
Tailings Dozer - D8T LGP	d		138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	**2,912,700**
Mine General Equipment																								
Lube/Fuel Truck	d																							
Tire Manipulator and Loader	d		10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	**229,950**
Welding Truck	d																							
Blasting Loader	d																							
90 ton Crane	d		913	913	913	913	913	913	913	913	913	913	913	913	913	913	913	913	913	913	913	913	913	**19,163**
Integrated Tool Carrier	d		26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	26,280	**551,880**
Compactor	d																							
Lighting Plants	d		109,500	109,500	109,500	109,500	109,500	109,500	109,500	109,500	109,500	109,500	109,500	109,500	109,500	109,500	109,500	21,900	21,900	21,900	21,900	21,900	21,900	**1,773,900**
Sanding Truck - Sterling	d		43,800	43,800	43,800	43,800	43,800	43,800	43,800	43,800	43,800	43,800	43,800	43,800	43,800	43,800	43,800	21,900	21,900	21,900	21,900	21,900	21,900	**788,400**
Auxilary Pumps	d		21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	**459,900**
Pump Truck	d		16,425	16,425	16,425	16,425	16,425	16,425	16,425	16,425	16,425	16,425	16,425	16,425	16,425	16,425	16,425	32,850	32,850	32,850	32,850	32,850	32,850	**443,475**
Man Bus	d		19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	19,710	**413,910**
Pickup Trucks	d		146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	146,000	**3,066,000**
Ambulance																								
Fire Truck																								
Dewatering																								
Other																								
Engineering																								
Fuel Summary																								
Power			4325873.95	23672416.27	25135821.7	21743016	18659628.3	15532460.2	12099601.32	10091756.54	12105288.3	11958017.35	12966133.43	12688559.66	11117540.76	14205384.99	15014283.01	14900806.06	13870877.13	13541768.49	11544228.75	9855850.72	4914541.297	
Gasoline																								
Diesal			3,213,818	12,031,417	13,352,310	13,376,819	12,559,145	10,640,201	8,031,967	6,290,300	7,814,342	8,447,372	9,106,222	9,231,610	7,648,138	9,036,953	9,681,047	8,842,826	9,561,086	12,050,784	8,116,329	6,830,112	4,532,127	**190,394,923**
Blasting Fuel			55,574	487,696	556,525	440,750	390,867	314,291	284,365	245,629	282,268	279,478	274,894	293,117	264,991	291,999	336,817	315,191	363,832	385,676	271,774	241,637	106,892	**6,484,263**
Total Fuel			3,269,392	12,519,113	13,908,835	13,817,569	12,950,012	10,954,492	8,316,331	6,535,929	8,096,610	8,726,850	9,381,116	9,524,726	7,913,129	9,328,952	10,017,864	9,158,017	9,924,918	12,436,460	8,388,103	7,071,748	4,639,018	**196,879,186**

Mine Staff Manpower Requirments

	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	ManYears
MINE MAINTENANCE																							
Maintenance Superintendent																							
Contract Manager		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		**20**
Equipment Manager		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		**20**
Maintenance Planner		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**21**
Clerk/Secretary																							
Subtotal		**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**61**
MINE OPERATIONS																							
Mine Operations Superintendent		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**21**
Mine General Foreman		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**103**
Mine Shift Foreman		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	**82**
Drill and Blast Foreman																							
Services Foreman		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		**20**
Clerk/Secretary		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**10**
Dispatch		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	
Subtotal		**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**7**	**247**
MINE ENGINEERING																							
Chief Engineer		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		**20**
Senior Engineer		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**21**
Open Pit Planning Engineer		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	**41**
Surveyor/Mining Technician		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	**82**
Clerk/Secretary		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**21**
Subtotal		**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**5**	**185**
GEOLOGY																							
Chief Geologist																							
Senior Geologist		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		**20**
Grade Control Geologist		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**21**
Sampling Technician		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	**41**
Clerk/Secretary																							
Subtotal		**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**2**	**82**
TOTAL MINE STAFF		**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**15**	**493**

Mine Manpower Requirements

	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	ManYears
MINE GENERAL																							
Operations																							
Tool Crib Attendent																							
Warehouse Attendent																							
General Mine Labourer		6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	3	3	**120**
Trainee		2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	1	1	**76**
Maintenance																							
Light Duty Mechanic																							
Tire Man		2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	**62**
Lube Truck Driver																							
Subtotal		**10**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**7**	**7**	**258**
DRILLING																							
Operations																							
Drill Operator 1		2	3	3	3	3	2	4	2	2	2	2	2	2	2	4	2	2	2	2	1.2	0.6	**48**
Drill Operator 2		1	3	3	3	3	2	4	2	2	2	2	2	2	2	2	2	2	2	2	1	1	**45**
Maintenance																							
Heavy Duty Mechanic																							
Welder																							
Electrician		0.2	0.3	0.3	0.3	0.3	0.2	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.1	0.1	
Subtotal		**3**	**6**	**6**	**6**	**6**	**4**	**8**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**6**	**4**	**4**	**4**	**4**	**3**	**1**	**93**
BLASTING																							
Operations																							
Blasters																							
Blaster Helper																							
Subtotal																							
LOADING																							
Operations																							
PC 5500E		2	7	7	6	5	5	4	3	4	4	4	4	3	4	4	4	4	4	4	3	2	**87**
Cat 994		2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	4	2	2	2	**47**
Maintenance																							
Heavy Duty Mechanic																							
Welder																							
Electrician			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		
Subtotal		**4**	**10**	**9**	**8**	**7**	**7**	**6**	**5**	**6**	**6**	**6**	**6**	**5**	**6**	**6**	**6**	**8**	**8**	**6**	**5**	**4**	**134**
HAULING																							
Operations																							
Cat 793		5	27	30	31	29	24	17	13	17	19	20	21	17	20	21	19	20	26	18	15	8	**417**
Komatsu 830E AC																							
Maintenance																							
Heavy Duty Mechanic																							
Welder																							
Subtotal		**5**	**27**	**30**	**31**	**29**	**24**	**17**	**13**	**17**	**19**	**20**	**21**	**17**	**20**	**21**	**19**	**20**	**26**	**18**	**15**	**8**	**417**
MINE OPERATIONS SUPPORT																							
Operations																							
Dozer Operator		4.0	6.0	6.0	6.0	6.0	6.0	5.0	4.0	5.0	5.0	5.0	6.0	5.0	5.0	6.0	5.0	5.0	6.0	5.0	4.0	6.0	**111.0**
Grader / RT Operator		2.7	6.3	6.3	6.3	6.2	5.9	4.7	3.6	4.6	4.9	5.4	4.0	3.2	3.9	4.2	3.8	3.8	4.2	3.5	2.9	4.3	**94.7**
Water Truck Driver		0.3	1.8	2.1	2.1	2.0	1.6	1.2	0.9	1.2	1.3	1.4	1.3	1.2	1.5	1.6	1.6	2.0	2.1	1.2	1.0	1.6	**31.0**
Backhoe Operator		0.3	3.0	4.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	1.4	1.1	1.4	1.5	1.3	1.3	1.8	1.2	1.0	0.5	**38.8**
Maintenance																							
Heavy Duty Mechanic																							
Welder																							
Apprentice																							
Subtotal		**7.3**	**17.1**	**18.4**	**17.4**	**17.2**	**16.5**	**12.9**	**10.5**	**12.8**	**13.2**	**13.8**	**12.7**	**10.5**	**11.8**	**13.3**	**11.7**	**12.1**	**14.1**	**10.9**	**8.9**	**12.4**	**276**
MINE SUMMARY																							
Operations Subtotal		25	66	69	68	65	58	50	39	46	48	50	50	43	48	52	47	50	58	44	34	29	1,039
Maintenance Subtotal		2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	62
Total		**27**	**69**	**72**	**71**	**68**	**61**	**53**	**42**	**49**	**51**	**53**	**53**	**46**	**51**	**55**	**50**	**53**	**61**	**47**	**37**	**32**	**1,101**

Staff Mine Employee Salaries

17-Jan-08

		-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	**Total**
			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	**252**
MINE MAINTENANCE																								
Maintenance Superintendent	($ x 1000)																							
Contract Manager	($ x 1000)		110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	$110	$110	$110		2199.8
Equipment Manager	($ x 1000)		104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	$105	$105	$105		2091.2
Maintenance Planner	($ x 1000)		93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	$94	$94	$94	$94	1966.9
Clerk/Secretary	($ x 1000)																							
Subtotal	($ x 1000)		**308.2**	**308.2**	**308.2**	**308.2**	**308.2**	**308.2**	**308.2**	**308.2**	**308.2**	**308.2**	**308.2**	**308.2**	**308.2**	**308.2**	**308.2**	**308.2**	**308.2**	**$308**	**$308**	**$308**	**$94**	**6257.9**
MINE OPERATIONS																								
Mine Operations Superintendent	($ x 1000)		148.2	148.2	148.2	148.2	148.2	148.2	148.2	148.2	148.2	148.2	148.2	148.2	148.2	148.2	148.2	148.2	148.2	$148	$148	$148	$148	3112.2
Mine General Foreman	($ x 1000)		110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	$110	$110	$110	$110	2309.8
Mine Shift Foreman	($ x 1000)		418.2	418.2	418.2	418.2	418.2	418.2	418.2	418.2	418.2	418.2	418.2	418.2	418.2	418.2	418.2	418.2	418.2	$418	$418	$418	$209	8573.9
Drill and Blast Foreman	($ x 1000)																							
Services Foreman	($ x 1000)		93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	$94	$94	$94		1873.2
Clerk/Secretary	($ x 1000)		71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	$71.90	$71.90	$71.90	$71.90	1509.9
Subtotal	($ x 1000)		**1216.6**	**1216.6**	**1216.6**	**1216.6**	**1216.6**	**1216.6**	**1216.6**	**1216.6**	**1216.6**	**1216.6**	**1216.6**	**1216.6**	**1216.6**	**1216.6**	**1216.6**	**1216.6**	**1216.6**	**$1,217**	**$1,217**	**$1,217**	**$727**	**25059.1**
MINE ENGINEERING																								
Chief Engineer	($ x 1000)		126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	$126	$126	$126		2528.0
Senior Engineer	($ x 1000)		104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	$105	$105	$105	$105	2195.8
Open Pit Planning Engineer	($ x 1000)		187.3	187.3	187.3	187.3	187.3	187.3	187.3	187.3	187.3	187.3	187.3	187.3	187.3	187.3	187.3	187.3	187.3	$187	$187	$187	$94	3840.1
Surveyor/Mining Technician	($ x 1000)		321.1	321.1	321.1	321.1	321.1	321.1	321.1	321.1	321.1	321.1	321.1	321.1	321.1	321.1	321.1	321.1	321.1	$321	$321	$321	$161	6583.0
Clerk/Secretary	($ x 1000)		71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	$72	$72	$72	$72	1509.9
Subtotal	($ x 1000)		**811.3**	**811.3**	**811.3**	**811.3**	**811.3**	**811.3**	**811.3**	**811.3**	**811.3**	**811.3**	**811.3**	**811.3**	**811.3**	**811.3**	**811.3**	**811.3**	**811.3**	**$811**	**$811**	**$811**	**$431**	**16656.7**
GEOLOGY																								
Chief Geologist	($ x 1000)																							
Senior Geologist	($ x 1000)		104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	$105	$105	$105		2091.2
Grade Control Geologist	($ x 1000)		93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	93.7	$94	$94	$94	$94	1966.9
Sampling Technician	($ x 1000)		160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	$161	$161	$161	$80	3291.5
Clerk/Secretary	($ x 1000)																							
Subtotal	($ x 1000)		358.8	358.8	358.8	358.8	358.8	358.8	358.8	358.8	358.8	358.8	358.8	358.8	358.8	358.8	358.8	358.8	358.8	$359	$359	$359	$174	**7349.5**
TOTAL MINE STAFF	($ x 1000)		**2694.9**	**2694.9**	**2694.9**	**2694.9**	**2694.9**	**2694.9**	**2694.9**	**2694.9**	**2694.9**	**2694.9**	**2694.9**	**2694.9**	**2694.9**	**2694.9**	**2694.9**	**2694.9**	**2694.9**	**$2,695**	**$2,695**	**$2,695**	**$1,425**	**55323.2**

Hourly Wages

17-Jan-08

		-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
General Mine Services																								
Operations																								
Tool Crib Attendent	($ x 1000)																							
Warehouse Attendent	($ x 1000)																							
General Mine Labourer	($ x 1000)		433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7	216.8	216.8	8,674.0
Trainee	($ x 1000)		98.0	196.1	196.1	196.1	196.1	196.1	196.1	196.1	196.1	196.1	196.1	196.1	196.1	196.1	196.1	196.1	196.1	196.1	196.1	49.0	49.0	
Maintenance																								
Light Duty Mechanic	($ x 1000)																							
Tire Man	($ x 1000)		163.6	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	5,072.1
Lube Truck Driver	($ x 1000)																							
Subtotal	($ x 1000)		**695.3**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**875.2**	**511.3**	**511.3**	**17,471.2**
Drilling																								
Operations																								
Drill Operator 1	($ x 1000)		163.6	245.4	245.4	245.4	245.4	163.6	327.2	163.6	163.6	163.6	163.6	163.6	163.6	163.6	327.2	163.6	163.6	163.6	163.6	98.2	49.1	3,910.4
Drill Operator 2	($ x 1000)		81.8	245.4	245.4	245.4	245.4	163.6	327.2	163.6	163.6	163.6	163.6	163.6	163.6	163.6	163.6	163.6	163.6	171.8	122.7	106.4	49.1	3,640.5
Maintenance																								
Heavy Duty Mechanic	($ x 1000)																							
Welder	($ x 1000)																							
Electrician	($ x 1000)		17.7	26.5	26.5	26.5	26.5	17.7	35.4	17.7	17.7	17.7	17.7	17.7	17.7	17.7	26.5	17.7	17.7	17.7	17.7	8.8	8.8	**415.5**
Subtotal	($ x 1000)		**263.1**	**517.4**	**517.4**	**517.4**	**517.4**	**344.9**	**689.8**	**344.9**	**344.9**	**344.9**	**344.9**	**344.9**	**344.9**	**344.9**	**517.4**	**344.9**	**344.9**	**353.1**	**304.0**	**213.4**	**107.0**	**7,966.4**
Blasting																								
Operations																								
Blasters	($ x 1000)																							
Blaster Helper	($ x 1000)																							
Subtotal	($ x 1000)																							
Loading																								
Operations																								
PC 5500E	($ x 1000)		176.8	618.8	618.8	530.4	442.0	442.0	353.6	265.2	353.6	353.6	353.6	353.6	265.2	353.6	353.6	353.6	353.6	353.6	353.6	265.2	176.8	7,691.2
Cat 994	($ x 1000)		176.8	265.2	176.8	176.8	176.8	176.8	176.8	176.8	176.8	176.8	176.8	176.8	176.8	176.8	176.8	176.8	353.6	353.6	176.8	176.8	176.8	4,155.0
Maintenance																								
Heavy Duty Mechanic	($ x 1000)																							
Welder	($ x 1000)																							
Electrician	($ x 1000)			8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8		**168.0**
Subtotal	($ x 1000)		**353.6**	**892.9**	**804.5**	**716.1**	**627.7**	**627.7**	**539.3**	**450.9**	**539.3**	**539.3**	**539.3**	**539.3**	**450.9**	**539.3**	**539.3**	**539.3**	**716.1**	**716.1**	**539.3**	**450.9**	**353.6**	**12,014.1**
Hauling																								
Operations																								
Cat 793	($ x 1000)		423.7	2,287.8	2,542.0	2,626.7	2,457.2	2,033.6	1,440.5	1,101.5	1,440.5	1,609.9	1,694.6	1,779.4	1,440.5	1,694.6	1,779.4	1,609.9	1,694.6	2,203.0	1,525.2	1,271.0	677.9	35,333.4
Komatsu 830E AC	($ x 1000)																							
Maintenance	($ x 1000)																							
Heavy Duty Mechanic	($ x 1000)																							
Welder	($ x 1000)																							
Subtotal	($ x 1000)		**423.7**	**2,287.8**	**2,542.0**	**2,626.7**	**2,457.2**	**2,033.6**	**1,440.5**	**1,101.5**	**1,440.5**	**1,609.9**	**1,694.6**	**1,779.4**	**1,440.5**	**1,694.6**	**1,779.4**	**1,609.9**	**1,694.6**	**2,203.0**	**1,525.2**	**1,271.0**	**677.9**	**35,333.4**
Mine Operations Support																								
Operations																								
Dozer Operator	($ x 1000)		338.9	508.4	508.4	508.4	508.4	508.4	423.7	338.9	423.7	423.7	423.7	508.4	423.7	423.7	508.4	423.7	423.7	508.4	423.7	338.9	508.4	9,405.3
Grader / RT Operator	($ x 1000)		228.8	533.8	533.8	533.8	525.3	499.9	398.2	305.0	389.8	415.2	457.6	338.9	271.1	330.5	355.9	322.0	322.0	355.9	296.6	245.7	364.3	8,024.2
Water Truck Driver	($ x 1000)		23.0	137.9	160.9	160.9	153.3	122.6	92.0	69.0	92.0	99.6	107.3	99.6	92.0	115.0	122.6	122.6	153.3	160.9	92.0	76.6	122.6	2,375.8
Backhoe Operator	($ x 1000)		25.4	254.2	338.9	254.2	254.2	254.2	169.5	169.5	169.5	169.5	169.5	118.6	93.2	118.6	127.1	110.2	110.2	152.5	101.7	84.7	42.4	3,287.6
Maintenance																								
Heavy Duty Mechanic	($ x 1000)																							
Welder	($ x 1000)																							
Apprentice	($ x 1000)																							
Subtotal	($ x 1000)		**616.1**	**1,434.4**	**1,542.1**	**1,457.3**	**1,441.2**	**1,385.1**	**1,083.3**	**882.4**	**1,074.9**	**1,107.9**	**1,158.0**	**1,065.6**	**880.0**	**987.7**	**1,114.0**	**978.4**	**1,009.1**	**1,177.7**	**913.9**	**746.0**	**1,037.7**	**23,092.9**
Summary																								
Subtotal Operations	($ x 1000)		2,170.5	5,726.8	6,000.3	5,911.9	5,637.9	4,994.5	4,338.4	3,382.9	4,002.7	4,205.3	4,340.0	4,332.4	3,719.4	4,169.8	4,544.4	4,075.8	4,367.9	5,053.2	3,885.6	2,929.4	2,433.2	90,222.4
Subtotal Maintenance	($ x 1000)		163.6	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	245.4	1,516.4	923.3	7,021.0
Total	($ x 1000)		**2,334.2**	**5,972.2**	**6,245.7**	**6,157.3**	**5,883.3**	**5,240.0**	**4,583.9**	**3,628.4**	**4,248.2**	**4,450.7**	**4,585.5**	**4,577.8**	**3,964.9**	**4,415.2**	**4,789.8**	**4,321.2**	**4,613.4**	**5,298.6**	**4,131.0**	**4,445.8**	**3,356.5**	**97,243.4**

Annual Blasting Schedule

		-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
Scheduled Quantities - tonnes																								
Ore	(kt)		327.8	10,795.3	16,366.0	12,886.2	12,073.9	11,368.3	11,349.8	11,111.3	10,885.0	10,876.2	10,885.4	10,880.5	11,126.2	11,293.4	10,880.5	10,994.2	10,893.2	10,875.0	10,894.2	10,938.5	4,678.5	222,379.4
Waste	(kt)		4,573.7	28,012.4	25,769.4	20,523.6	17,211.4	11,298.1	8,593.4	5,420.8	9,113.5	8,872.2	8,439.4	10,111.2	7,166.4	9,377.0	14,102.4	11,953.1	16,550.2	18,573.0	8,141.0	5,320.8	2,599.2	251,722.0
Overburden	(kt)		2,174.1	1,336.9		2,782.6	1,642.4	2,900.8	163.0	144.0	144.0	144.0	2,290.7	152.7	144.0	2,723.1	144.0	1,782.7	148.2	144.0	144.0			19,105.1
Total	(kt)		**7,075.6**	**40,144.6**	**42,135.4**	**36,192.3**	**30,927.7**	**25,567.2**	**20,106.2**	**16,676.1**	**20,142.5**	**19,892.4**	**21,615.5**	**21,144.4**	**18,436.5**	**23,393.5**	**25,126.9**	**24,730.0**	**27,591.5**	**29,592.0**	**19,179.2**	**16,259.3**	**7,277.7**	**493,206.5**
Blasted Quantities - Total bcms																								
Ore	(kbcm)		112.3	3,697.0	5,604.8	4,413.1	4,134.9	3,893.3	3,886.9	3,805.2	3,727.7	3,724.7	3,727.9	3,726.2	3,810.3	3,867.6	3,726.2	3,765.1	3,730.5	3,724.3	3,730.9	3,746.1	1,602.2	76,157.3
Waste	(kbcm)		1,566.3	9,593.3	8,825.1	7,028.6	5,894.3	3,869.2	2,942.9	1,856.5	3,121.1	3,038.4	2,890.2	3,462.7	2,454.2	3,211.3	4,829.6	4,093.5	5,667.9	6,360.6	2,788.0	1,822.2	890.1	86,206.2
Total	(kbcm)		1,678.6	13,290.3	14,429.9	11,441.7	10,029.2	7,762.5	6,829.9	5,661.7	6,848.8	6,763.1	6,618.1	7,188.9	6,264.6	7,078.9	8,555.8	7,858.7	9,398.4	10,084.9	6,518.9	5,568.3	2,492.4	**162,363.5**
Primary Production Blasting Quantity																								
Ore	(kbcm)		112.3	3,697.0	5,604.8	4,413.1	4,134.9	3,893.3	3,886.9	3,805.2	3,727.7	3,724.7	3,727.9	3,726.2	3,810.3	3,867.6	3,726.2	3,765.1	3,730.5	3,724.3	3,730.9	3,746.1	1,602.2	76,157
Waste	(kbcm)		1,566.3	9,593.3	8,825.1	7,028.6	5,894.3	3,869.2	2,942.9	1,856.5	3,121.1	3,038.4	2,890.2	3,462.7	2,454.2	3,211.3	4,829.6	4,093.5	5,667.9	6,360.6	2,788.0	1,822.2	890.1	86,206
Total	(kbcm)		**1,678.6**	**13,290.3**	**14,429.9**	**11,441.7**	**10,029.2**	**7,762.5**	**6,829.9**	**5,661.7**	**6,848.8**	**6,763.1**	**6,618.1**	**7,188.9**	**6,264.6**	**7,078.9**	**8,555.8**	**7,858.7**	**9,398.4**	**10,084.9**	**6,518.9**	**5,568.3**	**2,492.4**	**162,364**
Perimeter Blasting Quantity																								
Ore	(kbcm)																							
Waste	(kbcm)																							
Total	(kbcm)																							
Perimeter Length for Wall Control Blasting	metres																							
Perimeter Blast Material Allocation	(kbcm)																							
Required Primary Blasting - Blastholes per Year																								
Ore	holes		123.0	4,019.0	6,092.0	4,797.0	4,495.0	4,232.0	4,225.0	4,136.0	4,052.0	4,049.0	4,052.0	4,050.0	4,142.0	4,204.0	4,050.0	4,093.0	4,055.0	4,048.0	4,055.0	4,072.0	1,742.0	82,783
Waste	holes		1,703.0	10,427.0	9,592.0	7,640.0	6,407.0	4,206.0	3,199.0	2,018.0	3,393.0	3,303.0	3,142.0	3,764.0	2,668.0	3,491.0	5,250.0	4,450.0	6,161.0	6,914.0	3,031.0	1,981.0	968.0	93,708
Total	holes		**1,826**	**14,446**	**15,684**	**12,437**	**10,902**	**8,438**	**7,424**	**6,154**	**7,445.0**	**7,352.0**	**7,194.0**	**7,814.0**	**6,810.0**	**7,695.0**	**9,300.0**	**8,543.0**	**10,216.0**	**10,962.0**	**7,086.0**	**6,053.0**	**2,710.0**	**176,491**
Wall Control Blastholes per Year																								
Pit Viper 351 (Buffer	holes																							
Pre-shear	holes																							
total	holes																							
BE 59R Used Buffer	holes																							
Pre-shear	holes																							
total	holes																							
Explosives Consumption Primary Holes - BULK																								
Ore	tonnes		114.5	3,770.3	5,715.9	4,500.6	4,216.9	3,970.5	3,964.0	3,880.7	3,801.7	3,798.6	3,801.8	3,800.1	3,885.9	3,944.3	3,800.1	3,839.8	3,804.5	3,798.2	3,804.9	3,820.4	1,634.0	77,667.7
Waste	tonnes		1,043.3	6,390.0	5,878.3	4,681.7	3,926.1	2,577.2	1,960.3	1,236.6	2,078.9	2,023.9	1,925.1	2,306.5	1,634.7	2,139.0	3,216.9	2,726.7	3,775.3	4,236.7	1,857.1	1,213.7	592.9	57,421.1
Total	tonnes		**1,157.8**	**10,160.3**	**11,594.3**	**9,182.3**	**8,143.1**	**6,547.7**	**5,924.3**	**5,117.3**	**5,880.6**	**5,822.5**	**5,727.0**	**6,106.6**	**5,520.7**	**6,083.3**	**7,017.0**	**6,566.5**	**7,579.8**	**8,034.9**	**5,662.0**	**5,034.1**	**2,226.9**	**135,088.8**
Explosives Consumption Wall control - BULK																								
Buffer	tonnes																							
Pre-shear	tonnes																							
Total	tonnes																							
Explosives Consumption Primary Holes - PACKAGE																								
Ore	# of units																							
Waste	# of units																							
Total	# of units																							
Explosives Consumption Wall control - PACKAGE																								
Buffer	# of units																							
Pre-shear	# of units																							
Total	# of units																							
Explosives - Bulk total																								
AN/FO	tonnes		810.5	7,112.2	8,116.0	6,427.6	5,700.1	4,583.4	4,147.0	3,582.1	4,116.4	4,075.7	4,008.9	4,274.6	3,864.5	4,258.3	4,911.9	4,596.5	5,305.9	5,624.4	3,963.4	3,523.9	1,558.8	**94,562.2**
Emulsion	tonnes		347.3	3,048.1	3,478.3	2,754.7	2,442.9	1,964.3	1,777.3	1,535.2	1,764.2	1,746.7	1,718.1	1,832.0	1,656.2	1,825.0	2,105.1	1,969.9	2,274.0	2,410.5	1,698.6	1,510.2	668.1	**40,526.6**
Explosives - Bulk Annual Costs																								
AN/FO Annual Cost	($ X 1000)		$355.0	$3,115.2	$3,554.8	$2,815.3	$2,496.7	$2,007.6	$1,816.4	$1,569.0	$1,803.0	$1,785.2	$1,755.9	$1,872.3	$1,692.6	$1,865.2	$2,151.4	$2,013.3	$2,324.0	$2,463.5	$1,736.0	$1,543.5	$682.8	$41,418.6
Emulsion	($ X 1000)		$168.1	$1,475.3	$1,683.5	$1,333.3	$1,182.4	$950.7	$860.2	$743.0	$853.9	$845.4	$831.6	$886.7	$801.6	$883.3	$1,018.9	$953.5	$1,100.6	$1,166.7	$822.1	$731.0	$323.3	$19,614.9
Total	($ X 1000)		**$523.1**	**$4,590.5**	**$5,238.3**	**$4,148.6**	**$3,679.1**	**$2,958.3**	**$2,676.6**	**$2,312.0**	**$2,656.9**	**$2,630.6**	**$2,587.5**	**$2,759.0**	**$2,494.2**	**$2,748.5**	**$3,170.3**	**$2,966.8**	**$3,424.6**	**$3,630.2**	**$2,558.1**	**$2,274.4**	**$1,006.1**	**$61,033.5**
Explosives - Package Annual Costs																								
Ore	($ X 1000)																							
Waste	($ X 1000)																							
Wall Control	($ X 1000)																							
Total	($ X 1000)																							
Patterns																								
Number of Ore Patterns			2	41	61	48	45	43	43	42	41	41	41	41	42	43	41	41	41	41	41	41	18	**838**
Number of Waste Patterns			18	105	96	77	65	43	32	21	34	34	32	38	27	35	53	45	62	70	31	20	10	**948**
Number of HighWall Patterns																								
Blasting Accessories - Annual Cost																								
Ore																								
Boosters			$0.8	$27.5	$41.7	$32.9	$30.8	$29.0	$28.9	$28.3	$27.8	$27.7	$27.8	$27.7	$28.4	$28.8	$27.7	$28.0	$27.8	$27.7	$27.8	$27.9	$11.9	$567.1
Downline																								
Trunkline			$1.0	$20.5	$30.5	$24.0	$22.5	$21.5	$21.5	$21.0	$20.5	$20.5	$20.5	$20.5	$21.0	$21.5	$20.5	$20.5	$20.5	$20.5	$20.5	$20.5	$9.0	$419.6
Surface Delays			$0.1	$3.2	$4.8	$3.8	$3.6	$3.4	$3.3	$3.3	$3.2	$3.2	$3.2	$3.2	$3.3	$3.3	$3.2	$3.2	$3.2	$3.2	$3.2	$3.2	$1.4	$65.6
DownHole Delays			$0.8	$24.8	$37.5	$29.5	$27.7	$26.1	$26.0	$25.5	$25.0	$24.9	$25.0	$24.9	$25.5	$25.9	$24.9	$25.2	$25.0	$24.9	$25.0	$25.1	$10.7	$509.9
Initiation			$0.1	$2.5	$3.7	$2.9	$2.7	$2.6	$2.6	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5	$2.6	$2.5	$2.5	$2.5	$2.5	$2.5	$2.5	$1.1	$50.3
Miscellaneous including Liners			$0.2	$8.0	$12.2	$9.6	$9.0	$8.5	$8.5	$8.3	$8.1	$8.1	$8.1	$8.1	$8.3	$8.4	$8.1	$8.2	$8.1	$8.1	$8.1	$8.1	$3.5	$165.6
Total			$3.1	$86.5	$130.5	$102.7	$96.3	$91.0	$90.9	$88.9	$87.0	$87.0	$87.0	$87.0	$89.0	$90.5	$87.0	$87.7	$87.1	$87.0	$87.1	$87.3	$37.6	**$1,778.0**
Waste																								
Boosters			$11.7	$71.4	$65.7	$52.3	$43.9	$28.8	$21.9	$13.8	$23.2	$22.6	$21.5	$25.8	$18.3	$23.9	$36.0	$30.5	$42.2	$47.4	$20.8	$13.6	$6.6	$641.9
Downline																								
Trunkline			$1.4	$8.2	$7.5	$6.0	$5.1	$3.4	$2.5	$1.6	$2.7	$2.7	$2.5	$3.0	$2.1	$2.7	$4.1	$3.5	$4.8	$5.5	$2.4	$1.6	$0.8	$73.9
Surface Delays			$1.3	$8.3	$7.6	$6.1	$5.1	$3.3	$2.5	$1.6	$2.7	$2.6	$2.5	$3.0	$2.1	$2.8	$4.2	$3.5	$4.9	$5.5	$2.4	$1.6	$0.8	$74.2
DownHole Delays			$10.5	$64.2	$59.1	$47.1	$39.5	$25.9	$19.7	$12.4	$20.9	$20.3	$19.4	$23.2	$16.4	$21.5	$32.3	$27.4	$38.0	$42.6	$18.7	$12.2	$6.0	$577.2
Initiation			$1.1	$6.3	$5.8	$4.6	$3.9	$2.6	$1.9	$1.3	$2.0	$2.0	$1.9	$2.3	$1.6	$2.1	$3.2	$2.7	$3.7	$4.2	$1.9	$1.2	$0.6	$56.9
Miscellaneous including Liners			$6.8	$41.7	$38.4	$30.6	$25.6	$16.8	$12.8	$8.1	$13.6	$13.2	$12.6	$15.1	$10.7	$14.0	$21.0	$17.8	$24.6	$27.7	$12.1	$7.9	$3.9	$374.8
Total			$32.8	$200.1	$184.0	$146.6	$123.0	$80.8	$61.4	$38.8	$65.1	$63.5	$60.3	$72.2	$51.2	$67.0	$100.8	$85.4	$118.2	$132.7	$58.2	$38.0	$18.6	**$1,799.0**
Wall Control																								
Boosters																								
Downline																								
Trunkline																								
Surface Delays																								
DownHole Delays																								
Initiation																								
Miscellaneous including Liners																								
Total																								
Secondary Blasting & Development																								
Explosives	($ X 1000)																							
Accessories	($ X 1000)																							
Total	($ X 1000)																							
Total Blasting Consumables																								
tonnes Anfo	tonnes		810.5	7,112.2	8,116.0	6,427.6	5,700.1	4,583.4	4,147.0	3,582.1	4,116.4	4,075.7	4,008.9	4,274.6	3,864.5	4,258.3	4,911.9	4,596.5	5,305.9	5,624.4	3,963.4	3,523.9	1,558.8	
tonnes Emulsion	tonnes		347.3	3,048.1	3,478.3	2,754.7	2,442.9	1,964.3	1,777.3	1,535.2	1,764.2	1,746.7	1,718.1	1,832.0	1,656.2	1,825.0	2,105.1	1,969.9	2,274.0	2,410.5	1,698.6	1,510.2	668.1	
packages	# of units																							
Primary and Control Blasting	($ X 1000)		$559.0	$4,877.1	$5,552.8	$4,397.9	$3,898.3	$3,130.1	$2,828.8	$2,439.7	$2,809.0	$2,781.1	$2,734.8	$2,918.2	$2,634.5	$2,906.0	$3,358.1	$3,139.8	$3,629.9	$3,849.9	$2,703.4	$2,399.8	$1,062.4	$64,610.5
Secondary Blasting	($ X 1000)																							
Total	($ X 1000)		**$559.0**	**$4,877.1**	**$5,552.8**	**$4,397.9**	**$3,898.3**	**$3,130.1**	**$2,828.8**	**$2,439.7**	**$2,809.0**	**$2,781.1**	**$2,734.8**	**$2,918.2**	**$2,634.5**	**$2,906.0**	**$3,358.1**	**$3,139.8**	**$3,629.9**	**$3,849.9**	**$2,703.4**	**$2,399.8**	**$1,062.4**	**$64,610.5**
Total Unit Cost - Total including Overburden																								
Primary and Control Blasting	$/t		$0.079	$0.121	$0.132	$0.122	$0.126	$0.122	$0.141	$0.146	$0.139	$0.140	$0.127	$0.138	$0.143	$0.124	$0.134	$0.127	$0.132	$0.130	$0.141	$0.148	$0.146	$0.131
Secondary Blasting	$/t																							
Total	$/t		**$0.079**	**$0.121**	**$0.132**	**$0.122**	**$0.126**	**$0.122**	**$0.141**	**$0.146**	**$0.139**	**$0.140**	**$0.127**	**$0.138**	**$0.143**	**$0.124**	**$0.134**	**$0.127**	**$0.132**	**$0.130**	**$0.141**	**$0.148**	**$0.146**	**$0.131**
Total - Rock Quantity Only	$/t		$0.079	$0.121	$0.132	$0.122	$0.126	$0.122	$0.141	$0.146	$0.139	$0.140	$0.127	$0.138	$0.143	$0.124	$0.134	$0.127	$0.132	$0.130	$0.141	$0.148	$0.146	**$0.131**
General Blasting Related Costs																								
Fixed Installations			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12					
Explosives Magazine	($ X 1000)																							
Accessories Magazine	($ X 1000)																							
Pickup Trucks & Pumps	($ X 1000)		$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6					$10,159.2
Total	($ X 1000)		**$597.6**	**$597.6**	**$597.6**	**$597.6**	**$597.6**	**$597.6**	**$597.6**	**$597.6**	**$597.6**	**$597.6**	**$597.6**	**$597.6**	**$597.6**	**$597.6**	**$597.6**	**$597.6**	**$597.6**					**$10,159.2**
Summary of Blasting Costs																								
Blasting Consumables	($ X 1000)		$559.0	$4,877.1	$5,552.8	$4,397.9	$3,898.3	$3,130.1	$2,828.8	$2,439.7	$2,809.0	$2,781.1	$2,734.8	$2,918.2	$2,634.5	$2,906.0	$3,358.1	$3,139.8	$3,629.9	$3,849.9	$2,703.4	$2,399.8	$1,062.4	$64,610.5
Blasting General	($ X 1000)		$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6	$597.6					$10,159.2
Total	($ X 1000)		$1,156.6	$5,474.7	$6,150.4	$4,995.5	$4,495.9	$3,727.7	$3,426.4	$3,037.3	$3,406.6	$3,378.7	$3,332.4	$3,515.8	$3,232.1	$3,503.6	$3,955.7	$3,737.4	$4,227.5	$3,849.9	$2,703.4	$2,399.8	$1,062.4	**$74,769.7**
Blasting Consumables	$/t		$0.079	$0.121	$0.132	$0.122	$0.126	$0.122	$0.141	$0.146	$0.139	$0.140	$0.127	$0.138	$0.143	$0.124	$0.134	$0.127	$0.132	$0.130	$0.141	$0.148	$0.146	$0.131
Blasting General	$/t		$0.084	$0.015	$0.014	$0.017	$0.019	$0.023	$0.030	$0.036	$0.030	$0.030	$0.028	$0.028	$0.032	$0.026	$0.024	$0.024	$0.022					$0.021
Total	$/t		**$0.163**	**$0.136**	**$0.146**	**$0.138**	**$0.145**	**$0.146**	**$0.170**	**$0.182**	**$0.169**	**$0.170**	**$0.154**	**$0.166**	**$0.175**	**$0.150**	**$0.157**	**$0.151**	**$0.153**	**$0.130**	**$0.141**	**$0.148**	**$0.146**	**$0.152**
Total - Not including Overburden - I	$/t		**$0.236**	**$0.141**	**$0.146**	**$0.150**	**$0.154**	**$0.164**	**$0.172**	**$0.184**	**$0.170**	**$0.171**	**$0.172**	**$0.167**	**$0.177**	**$0.169**	**$0.158**	**$0.163**	**$0.154**	**$0.131**	**$0.142**	**$0.148**	**$0.146**	**$0.158**

Annual Drilling Schedule - Diesel Drills

		-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
Total Quantity Scheduled																								
Ore	(kt)		327.8	10,795.3	16,366.0	12,886.2	12,073.9	11,368.3	11,349.8	11,111.3	10,885.0	10,876.2	10,885.4	10,880.5	11,126.2	11,293.4	10,880.5	10,994.2	10,893.2	10,875.0	10,894.2	10,938.5	4,678.5	222,379.4
Waste	(kt)		4,573.7	28,012.4	25,769.4	20,523.6	17,211.4	11,298.1	8,593.4	5,420.8	9,113.5	8,872.2	8,439.4	10,111.2	7,166.4	9,377.0	14,102.4	11,953.1	16,550.2	18,573.0	8,141.0	5,320.8	2,599.2	251,722.0
Total	(kt)		4,901.5	38,807.7	42,135.4	33,409.7	29,285.3	22,666.4	19,943.2	16,532.1	19,998.5	19,748.4	19,324.8	20,991.7	18,292.5	20,670.4	24,982.9	22,947.3	27,443.3	29,448.0	19,035.2	16,259.3	7,277.7	474,101.4
Ore	(kbcms)		112.3	3,697.0	5,604.8	4,413.1	4,134.9	3,893.3	3,886.9	3,805.2	3,727.7	3,724.7	3,727.9	3,726.2	3,810.3	3,867.6	3,726.2	3,765.1	3,730.5	3,724.3	3,730.9	3,746.1	1,602.2	76,157.3
Waste	(kbcms)		1,566.3	9,593.3	8,825.1	7,028.6	5,894.3	3,869.2	2,942.9	1,856.5	3,121.1	3,038.4	2,890.2	3,462.7	2,454.2	3,211.3	4,829.6	4,093.5	5,667.9	6,360.6	2,788.0	1,822.2	890.1	86,206.2
Total	(kbcms)		1,678.6	13,290.3	14,429.9	11,441.7	10,029.2	7,762.5	6,829.9	5,661.7	6,848.8	6,763.1	6,618.1	7,188.9	6,264.6	7,078.9	8,555.8	7,858.7	9,398.4	10,084.9	6,518.9	5,568.3	2,492.4	162,363.5
Ore Drill Allocation																								
Pit Viper 351 (d)	%		50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	
BE 59R Used (e)	%		50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	
Waste Drill Allocation	total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
BE 59R Used (e)	%		50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	
Pit Viper 351 (d)	%		50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	
	total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Required drills																								
Pit Viper 351 (d)			1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	
BE 59R Used (e)			1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	
Pit Viper 351 (d)																								
Production Drilling																								
Ore	holes		71	2,349	3,561	2,804	2,627	2,474	2,470	2,418	2,369	2,367	2,369	2,368	2,421	2,457	2,368	2,392	2,370	2,366	2,371	2,380	1,018	48,390
Waste	holes		707	4,331	3,984	3,173	2,661	1,747	1,329	838	1,409	1,372	1,305	1,563	1,108	1,450	2,180	1,848	2,559	2,872	1,259	823	402	38,920
Total	holes		778	6,680	7,545	5,977	5,288	4,221	3,799	3,256	3,778	3,739	3,674	3,931	3,529	3,907	4,548	4,240	4,929	5,238	3,630	3,203	1,420	87,310
Wall Control Drilling																								
Buffer	holes																							
Pre-shear	holes																							
Total	holes																							
BE 59R Used (e)																								
Production Drilling																								
Ore	holes		71	2,349	3,561	2,804	2,627	2,474	2,470	2,418	2,369	2,367	2,369	2,368	2,421	2,457	2,368	2,392	2,370	2,366	2,371	2,380	1,018	48,390
Waste	holes		707	4,331	3,984	3,173	2,661	1,747	1,329	838	1,409	1,372	1,305	1,563	1,108	1,450	2,180	1,848	2,559	2,872	1,259	823	402	38,920
Total	holes		778	6,680	7,545	5,977	5,288	4,221	3,799	3,256	3,778	3,739	3,674	3,931	3,529	3,907	4,548	4,240	4,929	5,238	3,630	3,203	1,420	87,310
Wall Control Drilling																								
Buffer	holes																							
Pre-shear	holes																							
Total	holes																							
Drilling (metres drilled per year)																								
Pit Viper 351 (d)																								
Ore	metres		973	32,181	48,786	38,415	35,990	33,894	33,839	33,127	32,455	32,428	32,455	32,442	33,168	33,661	32,442	32,770	32,469	32,414	32,483	32,606	13,947	662,943
Waste	metres		9,898	60,634	55,776	44,422	37,254	24,458	18,606	11,732	19,726	19,208	18,270	21,882	15,512	20,300	30,520	25,872	35,826	40,208	17,626	11,522	5,628	544,880
Buffer	metres																							
Pre-shear	metres																							
Total	metres		10,871	92,815	104,562	82,837	73,244	58,352	52,445	44,859	52,181	51,636	50,725	54,324	48,680	53,961	62,962	58,642	68,295	72,622	50,109	44,128	19,575	1,207,823
BE 59R Used (e)																								
Ore	metres		973	32,181	48,786	38,415	35,990	33,894	33,839	33,127	32,455	32,428	32,455	32,442	33,168	33,661	32,442	32,770	32,469	32,414	32,483	32,606	13,947	662,943
Waste	metres		9,898	60,634	55,776	44,422	37,254	24,458	18,606	11,732	19,726	19,208	18,270	21,882	15,512	20,300	30,520	25,872	35,826	40,208	17,626	11,522	5,628	544,880
Buffer	metres																							
Pre-shear	metres																							
Total	metres		10,871	92,815	104,562	82,837	73,244	58,352	52,445	44,859	52,181	51,636	50,725	54,324	48,680	53,961	62,962	58,642	68,295	72,622	50,109	44,128	19,575	1,207,823
Drill Hours Required																								
Pit Viper 351 (d)																								
Ore	op hours		47	1552	2352	1852	1736	1635	1632	1598	1565	1564	1565	1564	1599	1623	1564	1580	1566	1563	1566	1572	673	31,968
Waste	op hours		477	2917	2683	2137	1792	1177	895	565	949	924	879	1053	747	977	1468	1245	1723	1934	848	555	271	26,216
Buffer	op hours																							
Pre-shear	op hours																							
Total	op hours		524	4469	5035	3989	3528	2812	2527	2163	2514	2488	2444	2617	2346	2600	3032	2825	3289	3497	2414	2127	944	58,184
Total Cost Hours	cst hours		630	5365	6045	4789	4236	3376	3034	2597	3019	2987	2934	3142	2817	3122	3640	3392	3949	4199	2898	2554	1134	69,859
Total Scheduled Hours	Sch hours		664	5648	6364	5042	4459	3554	3194	2734	3178	3145	3089	3308	2966	3287	3832	3571	4157	4420	3051	2689	1194	73,546
Drill Requirements	number		1	1	1	1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	
Operators Required	1		2.00	3.00	3.00	3.00	3.00	2.00	4.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	4.00	2.00	2.00	2.00	2.00	1.20	0.60	
BE 59R Used (e)																								
Ore	op hours		47	1552	2352	1852	1736	1635	1632	1598	1565	1564	1565	1564	1599	1623	1564	1580	1566	1563	1566	1572	673	31,968
Waste	op hours		477	2917	2683	2137	1792	1177	895	565	949	924	879	1053	747	977	1468	1245	1723	1934	848	555	271	26,216
Buffer	op hours																							
Pre-shear	op hours																							
Total	op hours		524	4469	5035	3989	3528	2812	2527	2163	2514	2488	2444	2617	2346	2600	3032	2825	3289	3497	2414	2127	944	58,184
Total Cost Hours	cst hours		630	5365	6045	4789	4236	3376	3034	2597	3019	2987	2934	3142	2817	3122	3640	3392	3949	4199	2898	2554	1134	69,859
Total Scheduled Hours	Sch hours		664	5648	6364	5042	4459	3554	3194	2734	3178	3145	3089	3308	2966	3287	3832	3571	4157	4420	3051	2689	1194	73,546
Drill Requirements	number		1	1	1	1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	
Operators Required	1		1.00	3.00	3.00	3.00	3.00	2.00	4.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.10	1.50	1.30	0.60	
Secondary Drilling																								
	op hours																							
	cst hours																							
	Sch hours																							
Operators Required	1																							
Operating Cost - By Drill Type - $ x 1000																								
Pit Viper 351 (d)	cst hours		630	5365	6045	4789	4236	3376	3034	2597	3019	2987	2934	3142	2817	3122	3640	3392	3949	4199	2898	2554	1134	69,859
Fuel	$115.09		$72.5	$617.5	$695.7	$551.2	$487.5	$388.5	$349.2	$298.9	$347.5	$343.8	$337.7	$361.6	$324.2	$359.3	$418.9	$390.4	$454.5	$483.3	$333.5	$293.9	$130.5	8,040
Repair & Maintenance	$169.4		$106.6	$909.0	$1,024.1	$811.4	$717.5	$571.8	$513.9	$439.7	$511.3	$505.9	$497.0	$532.2	$477.1	$528.8	$616.7	$574.5	$669.0	$711.4	$490.9	$432.5	$192.0	11,833
Wages - Operating	$56.0		$163.6	$245.4	$245.4	$245.4	$245.4	$163.6	$327.2	$163.6	$163.6	$163.6	$163.6	$163.6	$163.6	$163.6	$327.2	$163.6	$163.6	$163.6	$163.6	$98.2	$49.1	3,910
Wages Maintenance	$3.0		$8.8	$13.3	$13.3	$13.3	$13.3	$8.8	$17.7	$8.8	$8.8	$8.8	$8.8	$8.8	$8.8	$8.8	$13.3	$8.8	$8.8	$8.8	$8.8	$4.4	$4.4	208
Total	$343.43		$351.6	$1,785.1	$1,978.5	$1,621.2	$1,463.8	$1,132.8	$1,208.0	$911.1	$1,031.2	$1,022.2	$1,007.1	$1,066.3	$973.7	$1,060.5	$1,376.1	$1,137.4	$1,295.9	$1,367.1	$996.9	$829.0	$376.0	23,991
BE 59R Used (e)	cst hours		630	5365	6045	4789	4236	3376	3034	2597	3019	2987	2934	3142	2817	3122	3640	3392	3949	4199	2898	2554	1134	69,859
Fuel	$31.50		$19.8	$169.0	$190.4	$150.9	$133.4	$106.3	$95.6	$81.8	$95.1	$94.1	$92.4	$99.0	$88.7	$98.3	$114.7	$106.8	$124.4	$132.3	$91.3	$80.5	$35.7	2,201
Repair & Maintenance	$169.0		$106.4	$907.1	$1,022.0	$809.6	$716.0	$570.6	$512.8	$438.8	$510.2	$504.9	$495.9	$531.1	$476.0	$527.6	$615.4	$573.3	$667.6	$709.8	$489.9	$431.6	$191.5	11,808
Wages - Operating	$52.1		$81.8	$245.4	$245.4	$245.4	$245.4	$163.6	$327.2	$163.6	$163.6	$163.6	$163.6	$163.6	$163.6	$163.6	$163.6	$163.6	$163.6	$171.8	$122.7	$106.4	$49.1	3,640
Wages Maintenance	$3.0		$8.8	$13.3	$13.3	$13.3	$13.3	$8.8	$17.7	$8.8	$8.8	$8.8	$8.8	$8.8	$8.8	$8.8	$13.3	$8.8	$8.8	$8.8	$8.8	$4.4	$4.4	208
Total	$255.61		$216.9	$1,334.8	$1,471.1	$1,219.2	$1,108.1	$849.4	$953.3	$693.1	$777.8	$771.4	$760.8	$802.5	$737.2	$798.4	$906.9	$852.6	$964.4	$1,022.8	$712.7	$622.8	$280.8	17,857
Secondary Drilling	cst hours																							
Fuel																								
Repair & Maintenance																								
Wages - Operating (in first drill)																								
Wages Maintenance																								
Total																								
Combined	cst hours		1,260	10,730	12,090	9,578	8,472	6,752	6,068	5,194	6,038	5,974	5,868	6,284	5,634	6,244	7,280	6,784	7,898	8,398	5,796	5,108	2,268	139,718
Fuel	$73.3		$92.4	$786.5	$886.1	$702.0	$621.0	$494.9	$444.8	$380.7	$442.6	$437.9	$430.1	$460.6	$412.9	$457.7	$533.6	$497.2	$578.9	$615.5	$424.8	$374.4	$166.2	10,241
Repair & Maintenance	$169.2		$213.0	$1,816.1	$2,046.1	$1,621.0	$1,433.6	$1,142.3	$1,026.7	$878.5	$1,021.5	$1,010.8	$992.9	$1,063.3	$953.1	$1,056.4	$1,232.1	$1,147.9	$1,336.6	$1,421.2	$980.8	$864.1	$383.5	23,641
Wages - Operating	$54.0		$245.4	$490.8	$490.8	$490.8	$490.8	$327.2	$654.5	$327.2	$327.2	$327.2	$327.2	$327.2	$327.2	$327.2	$490.8	$327.2	$327.2	$335.4	$286.3	$204.5	$98.2	7,551
Wages Maintenance	$3.0		$17.7	$26.5	$26.5	$26.5	$26.5	$17.7	$35.4	$17.7	$17.7	$17.7	$17.7	$17.7	$17.7	$17.7	$26.5	$17.7	$17.7	$17.7	$17.7	$8.8	$8.8	416
Total	$299.52		$568.5	$3,119.9	$3,449.6	$2,840.4	$2,571.9	$1,982.1	$2,161.2	$1,604.1	$1,809.0	$1,793.6	$1,767.9	$1,868.8	$1,711.0	$1,859.0	$2,283.0	$1,990.0	$2,260.4	$2,389.8	$1,709.6	$1,451.8	$656.7	41,848

Loading Schedule

17-Jan-08

			-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
Quantities																									
Ore		(t X 1000)		328	10,795	16,366	12,886	12,074	11,368	11,350	11,111	10,885	10,876	10,885	10,881	11,126	11,293	10,880	10,994	10,893	10,875	10,894	10,939	4,679	222,379
Waste (including Overburden)		(t X 1000)		6,748	29,349	25,769	23,306	18,854	14,199	8,756	5,565	9,258	9,016	10,730	10,264	7,310	12,100	14,246	13,736	16,698	18,717	8,285	5,321	2,599	270,827
Total		(t X 1000)		**7,076**	**40,145**	**42,135**	**36,192**	**30,928**	**25,567**	**20,106**	**16,676**	**20,143**	**19,892**	**21,616**	**21,144**	**18,437**	**23,393**	**25,127**	**24,730**	**27,592**	**29,592**	**19,179**	**16,259**	**7,278**	**493,206**
Rehandle at the mill																									
Quantity Allocation for Productivity Calculations																									
Ore																									
PC 5500E				90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	87.0%	90.0%	90.0%	90.0%	90.0%	90.0%	70.0%	65.0%	90.0%	90.0%	90.0%	
Cat 994				10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	13.0%	10.0%	10.0%	10.0%	10.0%	10.0%	30.0%	35.0%	10.0%	10.0%	10.0%	
Total				100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Ore																									
PC 5500E		(t X 1000)		295.0	9,715.8	14,729.4	11,597.6	10,866.5	10,231.5	10,214.8	10,000.1	9,796.5	9,788.6	9,470.3	9,792.5	10,013.6	10,164.1	9,792.4	9,894.8	7,625.2	7,068.8	9,804.8	9,844.7	4,210.7	194,917.5
Cat 994		(t X 1000)		32.8	1,079.5	1,636.6	1,288.6	1,207.4	1,136.8	1,135.0	1,111.1	1,088.5	1,087.6	1,415.1	1,088.1	1,112.6	1,129.3	1,088.0	1,099.4	3,268.0	3,806.3	1,089.4	1,093.9	467.9	27,461.9
		(t X 1000)																							
		(t X 1000)																							
Total		(t X 1000)		**327.8**	**10,795.3**	**16,366.0**	**12,886.2**	**12,073.9**	**11,368.3**	**11,349.8**	**11,111.3**	**10,885.0**	**10,876.2**	**10,885.4**	**10,880.5**	**11,126.2**	**11,293.4**	**10,880.5**	**10,994.2**	**10,893.2**	**10,875.0**	**10,894.2**	**10,938.5**	**4,678.5**	222,379.4
Waste																									
PC 5500E				90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	75.0%	65.0%	90.0%	90.0%	90.0%	57.8%
Cat 994				10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	25.0%	35.0%	10.0%	10.0%	10.0%	7.8%
Total				100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Waste																									
PC 5500E		(t X 1000)		6,073.0	26,414.4	23,192.4	20,975.5	16,968.4	12,779.0	7,880.8	5,008.4	8,331.8	8,114.6	9,657.1	9,237.5	6,579.3	10,890.0	12,821.8	12,362.2	12,523.8	12,166.0	7,456.5	4,788.7	2,339.3	236,560.4
Cat 994		(t X 1000)		674.8	2,934.9	2,576.9	2,330.6	1,885.4	1,419.9	875.6	556.5	925.8	901.6	1,073.0	1,026.4	731.0	1,210.0	1,424.6	1,373.6	4,174.6	6,550.9	828.5	532.1	259.9	34,266.7
		(t X 1000)																							
		(t X 1000)																							
Total		(t X 1000)		**6,747.8**	**29,349.3**	**25,769.4**	**23,306.1**	**18,853.8**	**14,198.9**	**8,756.4**	**5,564.8**	**9,257.5**	**9,016.2**	**10,730.1**	**10,263.9**	**7,310.4**	**12,100.1**	**14,246.4**	**13,735.8**	**16,698.4**	**18,717.0**	**8,285.0**	**5,320.8**	**2,599.2**	270,827.1
Production Calculations by loading Unit																									
PC 5500E																									
Ore		tph		4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	4,195	
Waste		tph		3,772	4,195	4,195	4,043	4,043	3,925	4,195	4,195	4,195	4,195	3,925	4,195	4,195	3,925	4,195	4,043	4,195	4,195	4,195	4,195	3,005	
Ore		op hours		70	2,316	3,511	2,765	2,590	2,439	2,435	2,384	2,335	2,333	2,258	2,334	2,387	2,423	2,334	2,359	1,818	1,685	2,337	2,347	1,004	46,464.0
Waste		op hours		1,610	6,297	5,529	5,188	4,197	3,256	1,879	1,194	1,986	1,934	2,461	2,202	1,568	2,775	3,057	3,058	2,985	2,900	1,778	1,142	778	57,774.0
Total Operating hours		op hours		1,680	8,613	9,040	7,953	6,787	5,695	4,314	3,578	4,321	4,267	4,719	4,536	3,955	5,198	5,391	5,417	4,803	4,585	4,115	3,489	1,782	104,238.0
Total hours for costing		cst hours		2,521	12,925	13,565	11,934	10,185	8,546	6,474	5,369	6,484	6,403	7,081	6,807	5,935	7,800	8,090	8,129	7,207	6,880	6,175	5,236	2,674	156,419.6
Total hours for Scheduling	by loader	sch hours		2,654	13,605	14,279	12,562	10,721	8,996	6,814	5,652	6,825	6,740	7,454	7,165	6,247	8,211	8,516	8,557	7,587	7,242	6,500	5,511	2,815	164,652.2
Total hours for Scheduling	by truck	sch hours		3,937	5,111	5,174	5,327	4,976	5,247	4,453	5,061	4,308	3,563	4,350	5,245	4,250	5,078	4,667	4,970	3,512	3,554	4,608	3,818	3,723	
Loader Requirements				1.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	
Operators		1		2	7	7	6	5	5	4	3	4	4	4	4	3	4	4	4	4	4	4	3	2	
Cat 994																									
Ore		tph		2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	
Waste		tph		2,211	2,478	2,478	2,389	2,389	2,300	2,478	2,478	2,478	2,478	2,300	2,478	2,478	2,300	2,478	2,389	2,478	2,478	2,478	2,478	1,761	
Ore		op hours		13	436	660	520	487	459	458	448	439	439	571	439	449	456	439	444	1,319	1,536	440	441	189	11,082.0
Waste		op hours		305	1,184	1,040	976	789	617	353	225	374	364	466	414	295	526	575	575	1,684	2,643	334	215	148	14,102.0
Rehandle		op hours																							
Total Operating hours		op hours		318	1,620	1,700	1,496	1,276	1,076	811	673	813	803	1,037	853	744	982	1,014	1,019	3,003	4,179	774	656	337	25,184.0
Total hours for costing		cst hours		477	2,431	2,551	2,245	1,915	1,615	1,217	1,010	1,220	1,205	1,556	1,280	1,116	1,474	1,522	1,529	4,506	6,271	1,161	984	506	37,791.1
Total hours for Scheduling	by loader	sch hours		502	2,559	2,685	2,363	2,016	1,700	1,281	1,063	1,284	1,268	1,638	1,347	1,175	1,551	1,602	1,610	4,743	6,601	1,223	1,036	532	39,780.1
Total hours for Scheduling	by truck	sch hours		3,804	4,563	575	592	553	583	495	562	479	396	549	583	472	564	519	552	1,274	1,914	512	424	414	
Loader Requirements				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	
Operators		1		2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	4	2	2	2	
Operating Cost																									
PC 5500E																									
		Hours		2,521	12,925	13,565	11,934	10,185	8,546	6,474	5,369	6,484	6,403	7,081	6,807	5,935	7,800	8,090	8,129	7,207	6,880	6,175	5,236	2,674	156,420
Fuel & Power	$69.35	($ x 1000)		$174.8	$896.3	$940.7	$827.6	$706.2	$592.6	$448.9	$372.3	$449.6	$444.0	$491.1	$472.0	$411.6	$540.9	$561.0	$563.7	$499.8	$477.1	$428.2	$363.1	$185.4	$10,846.9
Repair & Maintenance	$303.00	($ x 1000)		$763.9	$3,916.2	$4,110.3	$3,616.1	$3,085.9	$2,589.4	$1,961.5	$1,626.9	$1,964.7	$1,940.1	$2,145.6	$2,062.4	$1,798.3	$2,363.4	$2,451.2	$2,463.0	$2,183.8	$2,084.7	$1,871.0	$1,586.4	$810.2	$47,395.1
Wages Operations	$49.17	($ x 1000)		$176.8	$618.8	$618.8	$530.4	$442.0	$442.0	$353.6	$265.2	$353.6	$353.6	$353.6	$353.6	$265.2	$353.6	$353.6	$353.6	$353.6	$353.6	$353.6	$265.2	$176.8	$7,691.2
Wages Maintenance		($ x 1000)																							
Total	$421.52	($ x 1000)		**$1,115.5**	**$5,431.3**	**$5,669.8**	**$4,974.1**	**$4,234.2**	**$3,624.1**	**$2,764.0**	**$2,264.4**	**$2,767.9**	**$2,737.8**	**$2,990.3**	**$2,888.1**	**$2,475.0**	**$3,258.0**	**$3,365.8**	**$3,380.3**	**$3,037.3**	**$2,915.4**	**$2,652.8**	**$2,214.7**	**$1,172.5**	**$65,933.2**
Cat 994																									
		Hours		477	2,431	2,551	2,245	1,915	1,615	1,217	1,010	1,220	1,205	1,556	1,280	1,116	1,474	1,522	1,529	4,506	6,271	1,161	984	506	37,791
Fuel & Power	$123.05	($ x 1000)		$58.7	$299.1	$313.9	$276.2	$235.6	$198.7	$149.8	$124.3	$150.1	$148.3	$191.5	$157.5	$137.4	$181.3	$187.2	$188.2	$554.5	$771.7	$142.9	$121.1	$62.2	$4,650.3
Repair & Maintenance	$164.73	($ x 1000)		$78.6	$400.4	$420.2	$369.8	$315.4	$266.0	$200.5	$166.4	$201.0	$198.5	$256.3	$210.9	$183.9	$242.7	$250.6	$251.9	$742.3	$1,033.0	$191.3	$162.2	$83.3	$6,225.2
Wages Operations	$109.95	($ x 1000)		$176.8	$265.2	$176.8	$176.8	$176.8	$176.8	$176.8	$176.8	$176.8	$176.8	$176.8	$176.8	$176.8	$176.8	$176.8	$176.8	$353.6	$353.6	$176.8	$176.8	$176.8	$4,155.0
Wages Maintenance		($ x 1000)																							
Total	$397.72	($ x 1000)		**$314.1**	**$964.8**	**$910.9**	**$822.8**	**$727.8**	**$641.5**	**$527.0**	**$467.4**	**$527.9**	**$523.6**	**$624.6**	**$545.2**	**$498.1**	**$600.9**	**$614.7**	**$616.9**	**$1,650.4**	**$2,158.3**	**$511.1**	**$460.1**	**$322.3**	**$15,030.5**
total		($ x 1000)																							
Total Loading Cost																									
Repair & Maintenance		($ x 1000)		$842.5	$4,316.6	$4,530.5	$3,985.9	$3,401.3	$2,855.4	$2,162.0	$1,793.2	$2,165.6	$2,138.6	$2,402.0	$2,273.3	$1,982.2	$2,606.2	$2,701.8	$2,714.9	$2,926.1	$3,117.7	$2,062.3	$1,748.5	$893.5	$53,620.3
Fuel & Power		($ x 1000)		$233.5	$1,195.4	$1,254.6	$1,103.8	$941.9	$791.3	$598.7	$496.6	$599.8	$592.3	$682.5	$629.5	$548.9	$722.2	$748.2	$751.8	$1,054.3	$1,248.8	$571.1	$484.2	$247.7	$15,497.2
Labour		($ x 1000)		$353.6	$884.0	$795.6	$707.2	$618.8	$618.8	$530.4	$442.0	$530.4	$530.4	$530.4	$530.4	$442.0	$530.4	$530.4	$530.4	$707.2	$707.2	$530.4	$442.0	$353.6	$11,846.2
Total		($ x 1000)		$1,429.6	$6,396.1	$6,580.8	$5,796.9	$4,962.0	$4,265.5	$3,291.1	$2,731.8	$3,295.8	$3,261.3	$3,614.9	$3,433.2	$2,973.1	$3,858.8	$3,980.5	$3,997.2	$4,687.7	$5,073.7	$3,163.9	$2,674.8	$1,494.8	**$80,963.7**
Total Material Loaded		(t x 1000)		7,075.6	40,144.6	42,135.4	36,192.3	30,927.7	25,567.2	20,106.2	16,676.1	20,142.5	19,892.4	21,615.5	21,144.4	18,436.5	23,393.5	25,126.9	24,730.0	27,591.5	29,592.0	19,179.2	16,259.3	7,277.7	493,206.5
Unit Operating Cost		$/tonne		$0.202	$0.159	$0.156	$0.160	$0.160	$0.167	$0.164	$0.164	$0.164	$0.164	$0.167	$0.162	$0.161	$0.165	$0.158	$0.162	$0.170	$0.171	$0.165	$0.165	$0.205	$0.164
Check Total Tonnes																									
PC 5500E		(t x 1000)		6,368.0	36,130.1	37,921.8	32,573.0	27,834.9	23,010.5	18,095.6	15,008.5	18,128.3	17,903.2	19,127.4	19,029.9	16,592.9	21,054.1	22,614.2	22,257.0	20,149.0	19,234.8	17,261.3	14,633.4	6,549.9	431,477.9
Cat 994		(t x 1000)		707.6	4,014.5	4,213.5	3,619.2	3,092.8	2,556.7	2,010.6	1,667.6	2,014.3	1,989.2	2,488.1	2,114.4	1,843.7	2,339.3	2,512.7	2,473.0	7,442.5	10,357.2	1,917.9	1,625.9	727.8	61,728.6
		(t x 1000)																							
		(t x 1000)																							
Check tonnes		(t x 1000)																							

Haulage Operating Cost

Haulage Allocation Table

Production Year		-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
Quantities																								
Ore	(t X 1000)		327.8	10,795.3	16,366.0	12,886.2	12,073.9	11,368.3	11,349.8	11,111.3	10,885.0	10,876.2	10,885.4	10,880.5	11,126.2	11,293.4	10,880.5	10,994.2	10,893.2	10,875.0	10,894.2	10,938.5	4,678.5	**222,379.4**
Waste	(t X 1000)		6,747.8	29,349.3	25,769.4	23,306.1	18,853.8	14,198.9	8,756.4	5,564.8	9,257.5	9,016.2	10,730.1	10,263.9	7,310.4	12,100.1	14,246.4	13,735.8	16,698.4	18,717.0	8,285.0	5,320.8	2,599.2	**270,827.1**
Total	(t X 1000)		**7,075.6**	**40,144.6**	**42,135.4**	**36,192.3**	**30,927.7**	**25,567.2**	**20,106.2**	**16,676.1**	**20,142.5**	**19,892.4**	**21,615.5**	**21,144.4**	**18,436.5**	**23,393.5**	**25,126.9**	**24,730.0**	**27,591.5**	**29,592.0**	**19,179.2**	**16,259.3**	**7,277.7**	**493,206.5**
Loading Distribution																								
Ore																								
PC 5500E	(t X 1000)		295.0	9,715.8	14,729.4	11,597.6	10,866.5	10,231.5	10,214.8	10,000.1	9,796.5	9,788.6	9,470.3	9,792.5	10,013.6	10,164.1	9,792.4	9,894.8	7,625.2	7,068.8	9,804.8	9,844.7	4,210.7	**194,917.5**
Cat 994	(t X 1000)		32.8	1,079.5	1,636.6	1,288.6	1,207.4	1,136.8	1,135.0	1,111.1	1,088.5	1,087.6	1,415.1	1,088.1	1,112.6	1,129.3	1,088.0	1,099.4	3,268.0	3,806.3	1,089.4	1,093.9	467.9	**27,461.9**
	(t X 1000)																							
	(t X 1000)																							
Waste																								
PC 5500E	(t X 1000)		6,073.0	26,414.4	23,192.4	20,975.5	16,968.4	12,779.0	7,880.8	5,008.4	8,331.8	8,114.6	9,657.1	9,237.5	6,579.3	10,890.0	12,821.8	12,362.2	12,523.8	12,166.0	7,456.5	4,788.7	2,339.3	**236,560.4**
Cat 994	(t X 1000)		674.8	2,934.9	2,576.9	2,330.6	1,885.4	1,419.9	875.6	556.5	925.8	901.6	1,073.0	1,026.4	731.0	1,210.0	1,424.6	1,373.6	4,174.6	6,550.9	828.5	532.1	259.9	**34,266.7**
	(t X 1000)																							
	(t X 1000)																							
Haulage Unit - Code According to Capacity in Tonnes																								
Ore																								
PC 5500E	truck type		241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	
Cat 994	truck type		241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	
	truck type																							
	truck type																							
Waste																								
PC 5500E	truck type		241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	
Cat 994	truck type		241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	
	truck type																							
	truck type																							
Weighted Haulage times (includes fixed times)																								
WEIGHTED TIME - Ore (including fixed times)	minutes		9.81	8.56	10.55	12.57	14.08	14.50	14.45	12.33	10.30	12.31	12.99	13.63	13.20	13.33	14.67	12.43	9.33	12.20	15.55	15.50	12.46	
WEIGHTED TIME - Waste (including fixed times)	minutes		11.53	12.27	13.73	16.55	18.63	17.75	17.22	17.44	20.56	22.94	19.44	22.45	21.33	15.68	15.70	14.46	13.99	17.43	19.49	19.43	24.36	
Adjusted Cycle Times - Including Loading																								
Ore																								
PC 5500E	minutes		12.71	11.46	13.45	15.47	16.98	17.40	17.35	15.23	13.20	15.21	15.89	16.53	16.10	16.23	17.57	15.33	12.23	15.10	18.45	18.40	15.36	
Cat 994	minutes		15.18	13.93	15.92	17.93	19.45	19.86	19.82	17.70	15.66	17.67	18.36	19.00	18.56	18.70	20.03	17.80	14.70	17.56	20.92	20.87	17.82	
	minutes																							
	minutes																							
Waste																								
PC 5500E	minutes		14.98	15.17	16.63	19.45	21.53	20.65	20.12	20.34	23.46	25.84	22.34	25.35	24.23	18.58	18.60	17.36	16.89	20.33	22.39	22.33	27.81	
Cat 994	minutes		17.57	17.63	19.09	21.91	23.99	23.11	22.59	22.81	25.93	28.31	24.81	27.82	26.70	21.05	21.07	19.82	19.36	22.79	24.86	24.80	30.40	
	minutes																							
	minutes																							
Truck Load Factors																								
Ore																								
PC 5500E	tonnes/load		210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	210.24	
Cat 994	tonnes/load		229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	229.86	
	tonnes/load																							
	tonnes/load																							
Waste																								
PC 5500E	tonnes/load		225.68	210.24	210.24	202.75	202.75	195.41	210.24	210.24	210.24	210.24	195.41	210.24	210.24	195.41	210.24	202.75	210.24	210.24	210.24	210.24	181.61	
Cat 994	tonnes/load		231.32	229.86	229.86	221.68	221.68	213.65	229.86	229.86	229.86	229.86	213.65	229.86	229.86	213.65	229.86	221.68	229.86	229.86	229.86	229.86	186.15	
	tonnes/load																							
	tonnes/load																							
Production Hours by Truck Type																								
Cat 793	241 t																							
Ore	hours		333	9,919	17,599	15,895	16,329	15,747	15,682	13,500	11,484	13,195	13,815	14,330	14,276	14,611	15,217	13,448	10,874	13,307	15,994	16,016	5,730	277,302
Waste	hours		7,575	35,513	34,139	37,372	33,428	25,062	14,003	8,996	17,236	18,472	20,477	20,633	14,055	19,243	21,083	19,687	22,630	30,433	14,730	9,435	6,678	430,880
Total operating hours	op hours		7908	45432	51738	53267	49757	40809	29686	22496	28720	31667	34292	34964	28331	33855	36300	33135	33504	43740	30723	25450	12408	708,182
Total hours for costing	cst hours		9494	54540	62111	63946	59733	48990	35637	27005	34478	38015	41167	41973	34010	40642	43577	39777	40221	52509	36883	30553	14896	850,158
Total hours for Scheduling	sch hours		9778	56176	63974	65864	61525	50460	36706	27816	35512	39156	42402	43232	35031	41861	44885	40971	41428	54084	37989	31469	15343	875,663
Truck Requirements			2.00	8.00	9.00	9.00	9.00	7.00	6.00	4.00	6.00	8.00	7.00	6.00	6.00	6.00	7.00	6.00	7.00	8.00	6.00	6.00	3.00	
Operators Required	1		5	27	30	31	29	24	17	13	17	19	20	21	17	20	21	19	20	26	18	15	8	
Operating Cost - By Truck Type - $ x 1000																								
Cat 793	**241 t**																							
	hours		9,493.6	54,540.3	62,111.0	63,945.6	59,732.6	48,990.4	35,637.3	27,005.5	34,477.6	38,015.3	41,166.8	41,973.0	34,010.5	40,641.9	43,577.3	39,777.4	40,221.4	52,509.0	36,882.6	30,552.8	14,896.1	850,157.9
Fuel	$107.1		$1,017.0	$5,842.8	$6,653.8	$6,850.3	$6,399.0	$5,248.2	$3,817.7	$2,893.0	$3,693.5	$4,072.5	$4,410.1	$4,496.5	$3,643.5	$4,353.9	$4,668.3	$4,261.3	$4,308.8	$5,625.2	$3,951.1	$3,273.0	$1,595.8	$91,075.2
Repair & Maintenance	$123.8		$1,175.2	$6,751.7	$7,688.9	$7,916.0	$7,394.5	$6,064.7	$4,411.7	$3,343.1	$4,268.1	$4,706.0	$5,096.2	$5,196.0	$4,210.3	$5,031.2	$5,394.6	$4,924.2	$4,979.1	$6,500.3	$4,565.8	$3,782.2	$1,844.0	$105,243.9
Wages - Operating	$41.6		$423.7	$2,287.8	$2,542.0	$2,626.7	$2,457.2	$2,033.6	$1,440.5	$1,101.5	$1,440.5	$1,609.9	$1,694.6	$1,779.4	$1,440.5	$1,694.6	$1,779.4	$1,609.9	$1,694.6	$2,203.0	$1,525.2	$1,271.0	$677.9	$35,333.4
Wages Maintenance																								
Total	$272.5		$2,615.9	$14,882.3	$16,884.7	$17,393.1	$16,250.7	$13,346.5	$9,669.8	$7,337.6	$9,402.0	$10,388.4	$11,200.9	$11,471.8	$9,294.2	$11,079.7	$11,842.3	$10,795.3	$10,982.6	$14,328.5	$10,042.1	$8,326.3	$4,117.7	$231,652.5
Total Fuel	($ x 1000)		$1,017.0	$5,842.8	$6,653.8	$6,850.3	$6,399.0	$5,248.2	$3,817.7	$2,893.0	$3,693.5	$4,072.5	$4,410.1	$4,496.5	$3,643.5	$4,353.9	$4,668.3	$4,261.3	$4,308.8	$5,625.2	$3,951.1	$3,273.0	$1,595.8	$91,075
Total Repair & Maintenance	($ x 1000)		$1,175.2	$6,751.7	$7,688.9	$7,916.0	$7,394.5	$6,064.7	$4,411.7	$3,343.1	$4,268.1	$4,706.0	$5,096.2	$5,196.0	$4,210.3	$5,031.2	$5,394.6	$4,924.2	$4,979.1	$6,500.3	$4,565.8	$3,782.2	$1,844.0	$105,243.9
Check Fuel	($ x 1000)		$1,017.0	$5,842.8	$6,653.8	$6,850.3	$6,399.0	$5,248.2	$3,817.7	$2,893.0	$3,693.5	$4,072.5	$4,410.1	$4,496.5	$3,643.5	$4,353.9	$4,668.3	$4,261.3	$4,308.8	$5,625.2	$3,951.1	$3,273.0	$1,595.8	$91,075
Check R&M	($ x 1000)		$1,175.2	$6,751.7	$7,688.9	$7,916.0	$7,394.5	$6,064.7	$4,411.7	$3,343.1	$4,268.1	$4,706.0	$5,096.2	$5,196.0	$4,210.3	$5,031.2	$5,394.6	$4,924.2	$4,979.1	$6,500.3	$4,565.8	$3,782.2	$1,844.0	$105,243.9

Appendix G

vii) Capital Cost Development

					Options									
	Total Price	Base Price	Freight	Erection	Spare Bucket	Spare Box	Spare Blade	Tires	Chains	Accessories	Power Cable	Substation	Switchhouse	Comments
Primary Drill - PV351 (d)	$ 4,199,679	$ 3,722,679	$ 95,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 182,000	$ 200,000	$ -	$ -	Accessories are first drill string, assumed 5,000 feet of cable, GPS drill positioning ($100k)
Primary Drill - BE59R (e)	$ 4,089,000	$ 3,707,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 182,000	$ 200,000	$ -	$ -	Accessories are first drill string, assumed 5,000 feet of cable, GPS drill positioning ($100k)
PC 5500 Front Shovel (e)	$ 10,566,000	$ 9,322,500	$ -	$ -	$ 843,500	$ -	$ -	$ -	$ -	$ 100,000	$ 200,000	$ -	$ 100,000	Accessories are GPS, one spare bucket per shovel, assume one switchouse per shovel
Production Loader - Cat 994	$ 4,127,392	$ 3,350,000			$ 291,000			$ 338,564	$ 97,828	$ 50,000				Accessories are GPS, one spare bucket per loader
Breaker Loader - Cat 988	$ 894,655	$ 750,000			$ 55,655			$ 54,000		$ 35,000				One spare bucket, GPS (basic)
Haulage Trucks (Cat 793 - 240 ton)	$ 3,050,500	$ 2,750,000				$ 82,500		$ 168,000		$ 50,000				Six tires per truck and 1 spare box per 3 trucks ($247,600/3=82,500 per truck), dispatch at $50,000 per truck
Tracked Dozer (Cat D11T)	$ 2,015,277	$ 1,825,000			$ 140,277					$ 50,000				Assume one spare blade for the 2 dozers
Tracked Dozer (Cat D8T LGP)	$ 738,610	$ 688,610								$ 50,000				
Grader (Cat 16M)	$ 716,600	$ 675,000						$ 6,600		$ 35,000				
Grader (Komatsu GD675)	$ 271,500	$ 229,900						$ 6,600		$ 35,000				
Rubber Tired Dozer (Cat 854G)	$ 1,990,840	$ 1,656,240			$ 175,000			$ 109,600		$ 50,000				
Rubber Tired Dozer (Cat 834H)	$ 1,127,800	$ 950,000						$ 42,800		$ 135,000				Accessories are basic GPS and $100K for a cable reel attachment
Utility Backhoe with hammer(Cat 345CL)	$ 780,000	$ 625,000								$ 155,000				Includes basic GPS and $120K hammer
Water/Sand Truck (Cat 777F)	$ 1,551,112	$ 1,284,512				$ 150,000		$ 81,600		$ 35,000				Considers the cost of a spare box for each truck to use in the winter
Sand Truck -Sterling/Kenworth	$ 350,000	$ 350,000												Assume comes with spreader box
Tool Carrier	$ 375,000	$ 325,000								$ 50,000				Accessories include quick coupler with forks, bucket and snow plow
Blasting Skid Steer Loader	$ 39,900	$ 39,900												Provided to the blasting contractor
Light Plants	$ 8,200	$ 8,200												
Lowbed and International tractor	$ 331,500	$ 331,500												Based on new price but used one likely is cheaper
Tire Manipulator and WA500 loader	$ 535,000	$ 389,500						$ 32,000		$ 113,500				WA500 with tire manipulator
Crewcab Pickups	$ 40,000	$ 40,000												
90 ton Crane	$ 709,500	$ 709,500												
Pumps	$ 45,000	$ 45,000												
Pump Truck	$ 250,000	$ 250,000												
Pickup Truck	$ 35,000	$ 35,000												
Manbus	$ 30,000	$ 30,000												
Ambulance	$ 100,000	$ 100,000												
Fire Truck	$ 290,000	$ 290,000												Includes the cost of a used truck, air tanks, pads, etc. required
Compactor	$ 170,000	$ 170,000												Sheepsfoot packer for roads, liners, tailings, etc.
Mine Dewatering System	$ 500,000	$ 500,000												Pipelines, settling ponds, ditching
Mine Powerline System	$ 158,400	$ 158,400												Price per Mile - Based on $30 per foot and 40,000 feet required
Mine Access Roads	$ 100,000	$ 100,000												Based on $100,000 per mile and 5.7 miles (30,200 feet)
Site Shop Building at mine	$ 100,000	$ 100,000												30'x40' building with concrete slab, heat, etc.

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Production Rate **32,000 tpd**

	Unit Cost $ US	Unit Life	Total Capital Cost $US
Total Capital Cost			
Mining Capital			$ 154,092,828
Processing Capital			$ -
Infrastructure Capital			$ 2,900,000
Indirect Costs			$ -
Total			$ 156,992,828
Mining Capital			
Primary Drill - PV351 (d)	$ 4,199,679	25,000 hrs	$ 12,599,037
Primary Drill - BE59R (e)	$ 4,089,000	25,000 hrs	$ 12,267,000
PC 5500 Front Shovel (e)	$ 10,566,000	60,000 hrs	$ 31,698,000
Production Loader - Cat 994	$ 4,127,392	25,000 hrs	$ 8,254,784
Breaker Loader - Cat 988	$ 894,655	25,000 hrs	$ 2,683,965
Haulage Trucks (Cat 793 - 240 ton)	$ 3,050,500	60,000 hrs	$ 48,808,000
Tracked Dozer (Cat D11T)	$ 2,015,277	35,000 hrs	$ 8,061,108
Tracked Dozer (Cat D8T LGP)	$ 738,610	35,000 hrs	$ 2,215,830
Grader (Cat 16M)	$ 716,600	20,000 hrs	$ 2,866,400
Grader (Komatsu GD675)	$ 271,500	20,000 hrs	$ 1,086,000
Rubber Tired Dozer (Cat 854G)	$ 1,990,840	30,000 hrs	$ 3,981,680
Rubber Tired Dozer (Cat 834H)	$ 1,127,800	30,000 hrs	$ 3,383,400
Utility Backhoe with hammer(Cat 345CL)	$ 780,000	20,000 hrs	$ 1,560,000
Water/Sand Truck (Cat 777F)	$ 1,551,112	20 years	$ 3,102,224
Sand Truck -Sterling/Kenworth	$ 350,000	10 years	$ 1,400,000
Tool Carrier	$ 375,000	10 years	$ 750,000
Blasting Skid Steer Loader	$ 39,900	6 years	$ 239,400
Light Plants	$ 8,200	4 years	$ 205,000
Lowbed and International tractor	$ 331,500	mine life	$ 331,500
Tire Manipulator and WA500 loader	$ 535,000	mine life	$ 535,000
Crewcab Pickups	$ 40,000	2 years	$ 1,200,000
90 ton Crane	$ 709,500	mine life	$ 709,500
Pumps	$ 45,000	4 years	$ 675,000
Pump Truck	$ 250,000	10 years	$ 500,000
Pickup Truck	$ 35,000	2 years	$ 1,750,000
Manbus	$ 30,000	7 years	$ 180,000
Ambulance	$ 100,000	10 years	$ 200,000
Fire Truck	$ 290,000	10 years	$ 580,000
Compactor	$ 170,000	10 years	$ -
Mine Dewatering System	$ 500,000	10 years	$ 500,000
Mine Powerline System	$ 158,400	per mile	$ 1,200,000
Mine Access Roads	$ 100,000	per mile	$ 570,000
Subtotal Mining Capital			$ 154,092,828
Processing Capital			
Plant			$ -
Sustaining Capital (@1% of initial capital)	$ -		$ -
Subtotal Processing Capital			$ -
Infrastructure Capital			
Dunka Road Upgrade			$ -
Train Loadout			$ -
Railway Upgrades			$ -
Railcar Repairs			$ -
Shop Supplies			$ -
Shop Tools - Tire Bay	$ 300,000		$ 300,000
Power Transformer			$ -
Powerline			$ -
Fuel Station			$ -
Dispatch System	$ 2,500,000		$ 2,500,000
Miscellaneous Buildings	$ 100,000		$ 100,000
Communications			$ -
Pit Access Road			$ -
Site Ditching			$ -
Dewatering System			$ -
			$ -
Stockpile Liners			$ -
			$ -
Subtotal Infrastructure Capital	$ 2,900,000		$ 2,900,000
Indirect Costs			
Contractor's Overhead			$ -
Operation's Overhead			$ -
Head Office Overhead			$ -
Design and Engineering			$ -
First Fills, Commisssions, Vendor Reps			$ -
Spare Parts			$ -
Contingency			$ -
			$ -
Total Indirect Costs	$ -		$ -

Units Required

	Year -2	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22
Primary Drill - PV351 (d)	1						1								1									
Primary Drill - BE59R (e)	1						1								1									
PC 5500 Front Shovel (e)	1	1													1									
Production Loader - Cat 994	1																1							
Breaker Loader - Cat 988		1					1								1									
Haulage Trucks (Cat 793 - 240 ton)	4	4	1										3	3	1									
Tracked Dozer (Cat D11T)	2										1	1												
Tracked Dozer (Cat D8T LGP)		1								1								1						
Grader (Cat 16M)	1					1					1					1								
Grader (Komatsu GD675)	1					1						1					1							
Rubber Tired Dozer (Cat 854G)	1									1														
Rubber Tired Dozer (Cat 834H)	1								1									1						
Utility Backhoe with hammer(Cat 345CL)	1										1													
Water/Sand Truck (Cat 777F)	1	1																						
Sand Truck -Sterling/Kenworth		1	1									1	1											
Tool Carrier		1										1												
Blasting Skid Steer Loader		2						2						2										
Light Plants		5				5				5				5				5						
Lowbed and International tractor		1																						
Tire Manipulator and WA500 loader		1																						
Crewcab Pickups		3		3		3		3		3		3		3		3		3		3				
90 ton Crane		1																						
Pumps		3				3				3				3				3						
Pump Truck		1										1												
Pickup Truck		5		5		5		5		5		5		5		5		5		5				
Manbus		2							2							2								
Ambulance		1										1												
Fire Truck		1										1												
Mine Dewatering System	1																							
Mine Powerline System	4	3.58																						
Mine Access Roads	3	2.7																						
Shop Tools - Tire Bay		1																						
Dispatch System		1																						
Miscellaneous Buildings		1																						

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Production Rate 32,000 tpd

	Unit Cost		Total Capital	Capital Cost																							
	$ US	Unit Life	Cost $US	Year -2	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22
Total Capital Cost																											
Mining Capital			$ 154,092,828	$ 47,086,077	$ 30,340,577	$ 3,400,500	$ 295,000	$ -	$ 1,459,100	$ 9,183,334	$ 374,800	$ 1,187,800	$ 3,200,450	$ 3,511,877	$ 3,946,777	$ 9,501,500	$ 9,702,300	$ 22,799,834	$ 1,071,600	$ 4,398,892	$ 2,337,410	$ -	$ 295,000	$ -	$ -	$ -	$ -
Processing Capital			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Infrastructure Capital			$ 2,900,000	$ -	$ 2,900,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Indirect Costs			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total			$ 156,992,828	$ 47,086,077	$ 33,240,577	$ 3,400,500	$ 295,000	$ -	$ 1,459,100	$ 9,183,334	$ 374,800	$ 1,187,800	$ 3,200,450	$ 3,511,877	$ 3,946,777	$ 9,501,500	$ 9,702,300	$ 22,799,834	$ 1,071,600	$ 4,398,892	$ 2,337,410	$ -	$ 295,000	$ -	$ -	$ -	$ -
Mining Capital																											
Primary Drill - PV351 (d)	$ 4,199,679	25,000 hrs	$ 12,599,037	$ 4,199,679	$ -	$ -	$ -	$ -	$ -	$ 4,199,679	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,199,679	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Drill - BE59R (e)	$ 4,089,000	25,000 hrs	$ 12,267,000	$ 4,089,000	$ -	$ -	$ -	$ -	$ -	$ 4,089,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,089,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
PC 5500 Front Shovel (e)	$ 10,566,000	60,000 hrs	$ 31,698,000	$ 10,566,000	$ 10,566,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 10,566,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Production Loader - Cat 994	$ 4,127,392	25,000 hrs	$ 8,254,784	$ 4,127,392	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,127,392	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Breaker Loader - Cat 988	$ 894,655	25,000 hrs	$ 2,683,965	$ -	$ 894,655	$ -	$ -	$ -	$ -	$ 894,655	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 894,655	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Haulage Trucks (Cat 793 - 240 ton)	$ 3,050,500	60,000 hrs	$ 48,808,000	$ 12,202,000	$ 12,202,000	$ 3,050,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,151,500	$ 9,151,500	$ 3,050,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Tracked Dozer (Cat D11T)	$ 2,015,277	35,000 hrs	$ 8,061,108	$ 4,030,554	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,015,277	$ 2,015,277	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Tracked Dozer (Cat D8T LGP)	$ 738,610	35,000 hrs	$ 2,215,830	$ -	$ 738,610	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 738,610	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 738,610	$ -	$ -	$ -	$ -	$ -	$ -
Grader (Cat 16M)	$ 716,600	20,000 hrs	$ 2,866,400	$ 716,600	$ -	$ -	$ -	$ -	$ 716,600	$ -	$ -	$ -	$ -	$ 716,600	$ -	$ -	$ -	$ -	$ 716,600	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Grader (Komatsu GD675)	$ 271,500	20,000 hrs	$ 1,086,000	$ 271,500	$ -	$ -	$ -	$ -	$ 271,500	$ -	$ -	$ -	$ -	$ -	$ 271,500	$ -	$ -	$ -	$ -	$ 271,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rubber Tired Dozer (Cat 854G)	$ 1,990,840	30,000 hrs	$ 3,981,680	$ 1,990,840	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,990,840	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rubber Tired Dozer (Cat 834H)	$ 1,127,800	30,000 hrs	$ 3,383,400	$ 1,127,800	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,127,800	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,127,800	$ -	$ -	$ -	$ -	$ -	$ -
Utility Backhoe with hammer(Cat 345CL)	$ 780,000	20,000 hrs	$ 1,560,000	$ 780,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 780,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Water/Sand Truck (Cat 777F)	$ 1,551,112	20 years	$ 3,102,224	$ 1,551,112	$ 1,551,112	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sand Truck -Sterling/Kenworth	$ 350,000	10 years	$ 1,400,000	$ -	$ 350,000	$ 350,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 350,000	$ 350,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Tool Carrier	$ 375,000	10 years	$ 750,000	$ -	$ 375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Blasting Skid Steer Loader	$ 39,900	6 years	$ 239,400	$ -	$ 79,800	$ -	$ -	$ -	$ -	$ -	$ 79,800	$ -	$ -	$ -	$ -	$ -	$ 79,800	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Light Plants	$ 8,200	4 years	$ 205,000	$ -	$ 41,000	$ -	$ -	$ -	$ 41,000	$ -	$ -	$ -	$ 41,000	$ -	$ -	$ -	$ 41,000	$ -	$ -	$ -	$ 41,000	$ -	$ -	$ -	$ -	$ -	$ -
Lowbed and International tractor	$ 331,500	mine life	$ 331,500	$ -	$ 331,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Tire Manipulator and WA500 loader	$ 535,000	mine life	$ 535,000	$ -	$ 535,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Crewcab Pickups	$ 40,000	2 years	$ 1,200,000	$ -	$ 120,000	$ -	$ 120,000	$ -	$ 120,000	$ -	$ 120,000	$ -	$ 120,000	$ -	$ 120,000	$ -	$ 120,000	$ -	$ 120,000	$ -	$ 120,000	$ -	$ 120,000	$ -	$ -	$ -	$ -
90 ton Crane	$ 709,500	mine life	$ 709,500	$ -	$ 709,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pumps	$ 45,000	4 years	$ 675,000	$ -	$ 135,000	$ -	$ -	$ -	$ 135,000	$ -	$ -	$ -	$ 135,000	$ -	$ -	$ -	$ 135,000	$ -	$ -	$ -	$ 135,000	$ -	$ -	$ -	$ -	$ -	$ -
Pump Truck	$ 250,000	10 years	$ 500,000	$ -	$ 250,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 250,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pickup Truck	$ 35,000	2 years	$ 1,750,000	$ -	$ 175,000	$ -	$ 175,000	$ -	$ 175,000	$ -	$ 175,000	$ -	$ 175,000	$ -	$ 175,000	$ -	$ 175,000	$ -	$ 175,000	$ -	$ 175,000	$ -	$ 175,000	$ -	$ -	$ -	$ -
Manbus	$ 30,000	7 years	$ 180,000	$ -	$ 60,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 60,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 60,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ambulance	$ 100,000	10 years	$ 200,000	$ -	$ 100,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 100,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fire Truck	$ 290,000	10 years	$ 580,000	$ -	$ 290,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 290,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Compactor	$ 170,000	10 years	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Mine Dewatering System	$ 500,000	10 years	$ 500,000	$ 500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Mine Powerline System	$ 158,400	per mile	$ 1,200,000	$ 633,600	$ 566,400	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Mine Access Roads	$ 100,000	per mile	$ 570,000	$ 300,000	$ 270,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Subtotal Mining Capital			$ 154,092,828	$ 47,086,077	$ 30,340,577	$ 3,400,500	$ 295,000	$ -	$ 1,459,100	$ 9,183,334	$ 374,800	$ 1,187,800	$ 3,200,450	$ 3,511,877	$ 3,946,777	$ 9,501,500	$ 9,702,300	$ 22,799,834	$ 1,071,600	$ 4,398,892	$ 2,337,410	$ -	$ 295,000	$ -	$ -	$ -	$ -
Processing Capital																											
Plant			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sustaining Capital (@1% of initial capital)	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Subtotal Processing Capital			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Infrastructure Capital																											
Dunka Road Upgrade			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Train Loadout			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Railway Upgrades			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Railcar Repairs			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Shop Supplies			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Shop Tools - Tire Bay	$ 300,000		$ 300,000	$ -	$ 300,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Power Transformer			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Powerline			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fuel Station			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dispatch System	$ 2,500,000		$ 2,500,000	$ -	$ 2,500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous Buildings	$ 100,000		$ 100,000	$ -	$ 100,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Communications			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pit Access Road			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Site Ditching			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dewatering System			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Stockpile Liners			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Subtotal Infrastructure Capital	$ 2,900,000		$ 2,900,000	$ -	$ 2,900,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Indirect Costs																											
Contractor's Overhead			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Operation's Overhead			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Head Office Overhead			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Design and Engineering			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
First Fills, Commisssions, Vendor Reps			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Spare Parts			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Contingency			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Indirect Costs	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -