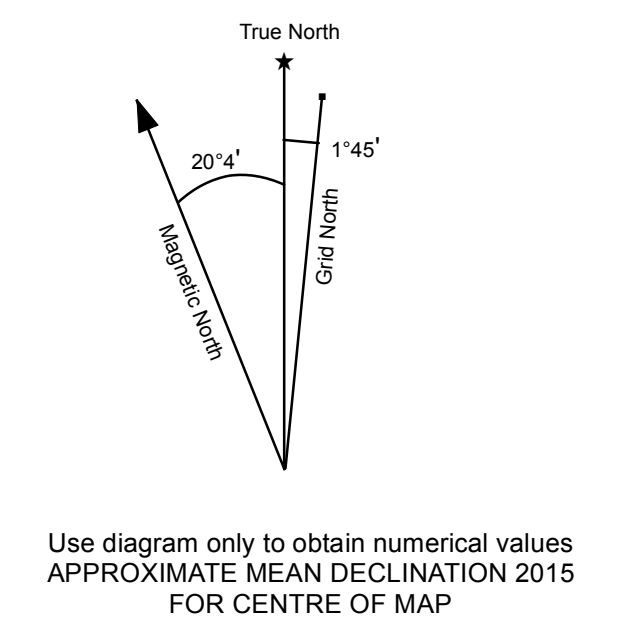
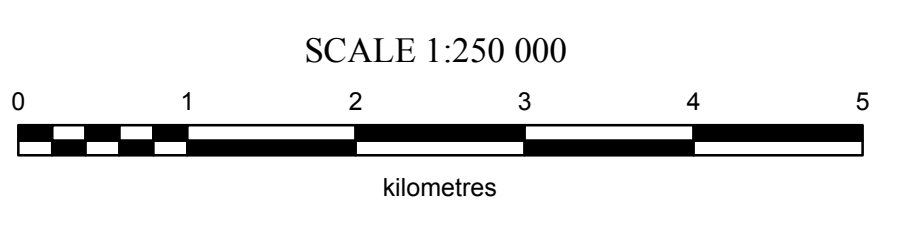


Magmatic Ni-Cu Weighted sums model (Principal Component Residuals) Sheet 9 of 13



115K PART OF 115I	115J STEVENSON RIDGE	115I CHAMACKS
115F THIS MAP	115G THIS MAP	115H AISHIK LAKE
115C PART OF 115B	115B MOUNT ST ELIAS	115A DEZADEASH RANGE

INTRODUCTION

New geochemical data from re-analysis of archived stream sediment samples have been assessed using weighted sums modeling and catchment basin analysis as described in the methodology report that accompanies this map (Mackie et al., 2015). Both commodity and pathfinder element abundances are evaluated to highlight areas that show geochemical responses consistent with a variety of base and precious-metal mineral deposit types. The results of modeling, completed using two approaches, are presented as a series of catchment maps and associated data files. This release is part of a regional assessment of stream sediment geochemistry that covers a large part of Yukon.

SAMPLING AND ANALYSIS PROGRAMS

Stream sediment and water samples from the Kluane Lake area (NTS 115F and part of 115G) were collected at a reconnaissance scale in 1986 as part of the Canada-Yukon Mineral Resource Development Cooperation Agreement (Geological Survey of Canada, 1987). Field descriptions and initial geochemical data for 1005 sites were released in Geological Survey of Canada (GSC) Open File 1362. New geochemical data from the re-analysis of archive sample material from 699 sites were released in Yukon Geological Survey (YGS) Open File 2012-15 (Jackaman, 2015). The discrepancy in number of sites between the two releases is because samples that occur within present limits of protected areas were not re-analysed. The reader is referred to these reports for detailed descriptions of sampling techniques, analytical procedures and quality control measures.

MINERAL OCCURRENCES

A variety of types of base- and precious-metal mineralization are known to occur in the Kluane Lake area as shown in Table 1 (Yukon MINFILE, 2015). The most significant deposits are classed as Cu-Ni-PGE (Wellgreen and Canlask deposits), Cu-Mo porphyry (Rockside and Raf prospects), Cu skarn (Arn and Az prospects), and quartz vein Au (Aishihik Lake) contains several quartz vein-related Au occurrences (Mom, Shut and Lid prospects) that form a trend that projects towards the southeast corner of the Kluane map area supporting the prospectivity of the region for this type of mineralization.

WEIGHTED SUMS MODELING

As described in the methodology report (Mackie et al., 2015), two approaches have been used to subdue the influence of background lithological variation and secondary absorption on the composition of stream sediments. One uses data levelled by the dominant

geology mapped within each catchment, while the other uses residuals calculated from regression against selected principal components. Weighted sums models (WSM) have been generated using the processed data. The importance rankings used in WSMs are summarized in Table 2. Each model is optimized for a target deposit type however other deposit types may be represented in a given model due to similarities in elemental abundances and associations.

Exploratory data analysis using both raw element data and principal components indicate that the distribution of many commodity and pathfinder elements is strongly influenced by lithological variation. Additionally, there is evidence of scavenging of metals ions by secondary Fe- and Mn-oxides/hydroxides, clays, and/or organic material. The first principal component accounts for ~32% of the total geochemical variation and shows high positive loadings for Co, Mg, Ni and Cr, and high negative loadings for Bi, Pb, U, La, Cd, Y, Th, Ag and Zn. Respectively, these groupings form spatial patterns that match the distribution of mafic-ultramafic intrusions and felsic intrusions. The second principal component shows negative loadings for Hg, Mo, LOI, Cd, Sb and Cu, and using LOI as a proxy for carbon, is suggestive of scavenging by organic material. This interpretation is supported by the fact that the map pattern of inverse PC2 coincides with low-lying regions where accumulation of organic material and/or clay is likely. Regression analysis of selected metals against the relevant principal component(s) effectively filters these effects while preserving responses related to known occurrences. Leveling by mapped geology has a more subdued effect on filtering the interpreted lithological control on the distribution of certain pathfinder elements. In order to reduce the impact this has on the WSM using this approach, certain elements were given low importance rankings or, in some cases, were omitted for certain deposit types.

The effectiveness of historical sampling coverage has been assessed empirically using graphs of WSMs plotted against catchment surface area to determine the ideal maximum catchment size (15 km²). Catchments that cover larger areas (shown on the map with bold outlines) are interpreted to have been under-sampled and thus require further sampling to properly evaluate the area for geochemical anomalies. Given the likelihood that a mineralization 'signal' would be progressively diluted with increasing catchment size, marginally high WSM scores in large catchments may also be of interest.

Table 2: Importance rankings for weighted sums models using residuals on principal components.

Target Deposit Type*	Other Deposit Types*	Mn	Fe	Co	Ni	Cu	Mo	Zn	Pb	Ag	Au	As	Ba	Cd	Cr	Sb	Te	Hg	Tl	Bi	W
Porphyry Cu-Mo	Cu skarn; Porphyry Mo				5	3		4	3	2	1	1	1	1	1	1	1	1	1	1	1
Polymetallic Ag-Pb-Zn	SEDEX, VMS, Pb-Zn skarn; Epithermal Au-Ag																				
Magmatic Ni-Cu-PGE			2	4	3	-2	-2														-1
Epithermal Au-Ag	Orogenic Au; Intrusion-related Au							4	4	2						2	2				
Orogenic Au	Intrusion-related Au; Epithermal Au-Ag										3	2					1				1
Hydrothermal Anomaly		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

*Polymetallic Ag-Pb-Zn type includes vein and manto styles; SEDEX = sedimentary exhalative Pb-Zn (Ag); VMS = volcanic-hosted/associated massive sulphide deposits; Hydrothermal anomaly = principal component 5

*Raw data following a log₁₀ transformation

LEGEND

- Town
- Mineral Occurrence
- Road
- Contour
- River
- Water body
- Wetland
- Sample Location
- Catchment
- Catchments > 15km²

- Weighted sums model (PC residuals)**
- Magmatic Ni-Cu deposits**
- incomplete element suite
 - 0-50th percentile
 - 50-75th percentile
 - 75-90th percentile
 - 90-95th percentile
 - 95-98th percentile
 - 98-100th percentile

Table 1: List of Mineral Occurrences for NTS map sheet 115F and 115G (Yukon MINFILE, 2015)

Number	Name	Type	Status	Commodities
115F 030	SHARPE	Porphyry Cu-Mo-Au	Showing	Copper, Gold, Molybdenum, Silver
115F 031	CALLOPINS	Porphyry Cu-Mo-Au	Showing	Molybdenum
115F 032	ICE FIELD	Porphyry Mo (Low F-Type)	Anomaly	Copper, Molybdenum
115F 034	GARLIK	Porphyry Cu-Mo-Au	Prospect	Copper, Molybdenum, Platinum, Palladium, Gold
115F 036	HAWKINS	Unknown	Unknown	
115F 037	KOBERN	Unknown	Unknown	
115F 038	LIBERTY	Vein Cu-Ag Quartz	Showing	Copper, Gold, Lead
115F 039	GLIBSCO	Unknown	Anomaly	
115F 041	CATS AND DOGS	Ultramafic Mafic Gabbro Cu-Ni-PGE	Showing	Copper, Gold, Nickel, Palladium, Platinum
115F 042	MEMCO	Skarn Cu	Showing	Copper
115F 043	PROVANDALE	Ultramafic Mafic Gabbro Cu-Ni-PGE	Drilled Prospect	Copper, Nickel
115F 044	SEVENSMA	Ultramafic Mafic Gabbro Cu-Ni-PGE	Anomaly	
115F 045	CANALASK	Ultramafic Mafic Gabbro Cu-Ni-PGE	Prospect	Cobalt, Platinum, Palladium, Nickel, Molybdenum, Copper
115F 047	EPIC	Ultramafic Mafic Gabbro Cu-Ni-PGE	Prospect	Cobalt, Molybdenum, Nickel, Palladium, Platinum, Copper
115F 048	ARN	Skarn Cu	Drilled Prospect	Copper, Gold
115F 049	SAMPETE	Skarn Cu	Prospect	Copper
115F 050	MEMDAY	Skarn Cu	Prospect	Wollastonite
115F 051	RAI	Skarn Cu	Drilled Prospect	Copper, Gold, Silver
115F 052	MEMOR	Unknown	Anomaly	
115F 054	MEMOR	Coal	Showing	Coal
115F 055	MELLELAN	Coal	Showing	Coal
115F 056	RABBIT	Vein Cu-Ag Quartz	Drilled Prospect	Copper, Silver
115F 057	LEP	Skarn Cu	Drilled Prospect	Copper, Silver, Zinc
115F 058	WHITE RIVER	Ultramafic Mafic Gabbro Cu-Ni-PGE	Drilled Prospect	Copper, Silver
115F 059	SHARE	Volcanogenic Sulfide - type not determined	Drilled Prospect	Copper
115F 061	KLETSAN	Vein Cu-Ag Quartz	Showing	Copper
115F 067	CANYON MOUNTAIN	Porphyry Cu-Mo-Au	Showing	Copper, Gold
115F 068	WYESTER	Vein Polymetallic Ag-Pb-Zn-Au	Anomaly	Arsenic, Gold, Silver, Zinc, Lead, Copper
115F 069	HAWKAY	Unknown	Anomaly	
115G 001	ME FALLS	Sediment hosted Bedded Gypsum	Anomaly	Copper, Gypsum
115G 002	STOVE	Coal	Prospect	Coal
115G 003	CONKON	Ultramafic Mafic Gabbro Cu-Ni-PGE	Prospect	Cobalt, Nickel, Platinum, Zinc, Copper, Gold
115G 004	MALLER	Porphyry Cu-Mo-Au	Anomaly	Molybdenum
115G 005	DICKSON	Ultramafic Mafic Gabbro Cu-Ni-PGE	Prospect	Copper, Nickel, Nickel, Platinum
115G 006	DESTRUCTION	Ultramafic Mafic Gabbro Cu-Ni-PGE	Prospect	Cobalt, Nickel, Platinum, Copper
115G 007	COOPER JOE	Ultramafic Mafic Gabbro Cu-Ni-PGE	Unknown	
115G 008	SQUIBBLE	Ultramafic Mafic Gabbro Cu-Ni-PGE	Unknown	
115G 009	WINDGAP	Coal	Prospect	Coal
115G 010	DUKE	Ultramafic-hosted asbestos	Showing	Asbestos, Silver, Gold
115G 011	HOGE	Coal	Prospect	Fluor Carbon
115G 012	AMPHITHEATRE	Ultramafic Mafic Gabbro Cu-Ni-PGE	Showing	Coal, Gold, Silver
115G 013	WAGE	Unknown	Anomaly	
115G 014	AMP	Porphyry Cu-Mo-Au	Anomaly	Copper
115G 015	COOK	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Molybdenum
115G 016	GLEN	Ultramafic Mafic Gabbro Cu-Ni-PGE	Drilled Prospect	Copper, Nickel, Gold
115G 017	BURWASH	Volcanogenic Massive Sulphide (VMS) Beash Cu-Zn	Drilled Prospect	Gold, Zinc, Silver
115G 018	LICHOFT	Ultramafic Mafic Gabbro Cu-Ni-PGE	Drilled Prospect	Copper, Gold, Silver
115G 020	VAG	Unknown	Unknown	
115G 021	DULE	Ultramafic Mafic Gabbro Cu-Ni-PGE	Drilled Prospect	Copper
115G 022	VERSLIJCE	Unknown	Drilled Prospect	Copper
115G 023	CALLAN	Unknown	Unknown	
115G 024	WELLGREEN	Ultramafic Mafic Gabbro Cu-Ni-PGE	Deposit	Copper, Osmium, Cobalt, Ruthenium, Rhodium, Platinum, Palladium, Nickel, Indium, Gold
115G 025	ARWAYS	Ultramafic Mafic Gabbro Cu-Ni-PGE	Drilled Prospect	Copper, Nickel, Platinum, Palladium, Gold
115G 026	MEKETEER	Ultramafic Mafic Gabbro Cu-Ni-PGE	Showing	Copper, Nickel, Platinum, Palladium, Gold
115G 027	SWIDE JOHNSON	Ultramafic Mafic Gabbro Cu-Ni-PGE	Showing	Copper, Nickel, Platinum, Palladium, Gold
115G 028	TINCLIP	Ultramafic-hosted asbestos	Drilled Prospect	Asbestos
115G 029	ST ELIAS	Vein Mo	Showing	Molybdenum
115G 030	SEXSMITH	Ultramafic Mafic Gabbro Cu-Ni-PGE	Drilled Prospect	Copper, Platinum, Gold
115G 035	NOX	Unknown	Anomaly	
115G 052	BOITARD	Unknown	Anomaly	
115G 062	DONKEL	Unknown	Anomaly	
115G 063	ELEVEN THIRTY	Skarn W	Showing	Tungsten
115G 064	KENNEDY	Skarn W	Showing	Tungsten
115G 065	TINCLIP	Ultramafic-hosted asbestos	Drilled Prospect	Asbestos
115G 066	NUNTAEA	Ultramafic-hosted asbestos	Anomaly	Asbestos
115G 067	DOOPACK	Unknown	Anomaly	
115G 068	BRIDGES	Skarn Mo	Showing	Molybdenum
115G 069	TALBOT	Porphyry Cu-Mo-Au	Showing	Copper
115G 070	RAFT	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Molybdenum, Tungsten
115G 071	ROCKSLIDE	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Molybdenum, Tungsten
115G 072	NORTH STAR	Porphyry Mo (Low F-Type)	Anomaly	
115G 073	BED	Porphyry Mo (Low F-Type)	Anomaly	
115G 074	ALASKITE	Porphyry Mo (Low F-Type)	Anomaly	Copper, Molybdenum
115G 075	TRINELLE	Porphyry Cu-Mo-Au	Anomaly	
115G 076	DWARF	Porphyry Mo (Low F-Type)	Showing	Copper, Molybdenum
115G 077	BIRCH	Skarn Cu	Showing	Copper, Molybdenum
115G 078	BRUMMER	Unknown	Showing	Copper, Zinc
115G 079	RHYOLITE	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Molybdenum
115G 080	NICK	Ultramafic Mafic Gabbro Cu-Ni-PGE	Showing	Nickel
115G 081	EASTER	Unknown	Unknown	
115G 082	ALTE	Unknown	Unknown	
115G 083	CULA	Unknown	Unknown	
115G 084	BOCK	Ultramafic Mafic Gabbro Cu-Ni-PGE	Showing	Cobalt, Gypsum, Copper, Nickel, Platinum, Palladium
115G 085	MAPLE	Sediment hosted Bedded Gypsum	Showing	Gypsum
115G 086	COPSLAR	Sediment hosted Bedded Gypsum	Showing	Gypsum
115G 088	LYNX CREEK	Unknown	Anomaly	
115G 089	FRIEBERGS	Volcanogenic Massive Sulphide (VMS) Kurat Cu-Pb-Zn	Showing	Copper
115G 090	ROBERTSON	Unknown	Anomaly	
115G 091	ELIAS	Unknown	Anomaly	
115G 092	BEZDEK	Paleosol	Anomaly	
115G 094	LINDA	Ultramafic Mafic Alaskan-type P14-Cu-Au-Rb+I	Drilled Prospect	Cobalt, Gold, Copper, Indium, Ruthenium, Rhodium, Platinum, Palladium, Osmium, Nickel
115G 095	ARBY	Unknown	Unknown	
115G 096	HUXYUK	Unknown	Unknown	
115G 097	LONTH	Unknown	Anomaly	
115G 098	TONEY	Ultramafic Mafic Alaskan-type P14-Cu-Au-Rb+I	Showing	Copper, Nickel, Platinum
115G 099	KILLANE	Unknown	Showing	Copper, Platinum, Nickel, Palladium
115G 100	WASH	Ultramafic Mafic Alaskan-type P14-Cu-Au-Rb+I	Drilled Prospect	Copper, Platinum, Palladium, Nickel
115G 101	TAL	Unknown	Unknown	
115G 102	TREMBLAY	Vein Cu-Ag Quartz	Unknown	Copper, Silver, Gold
115G 104	JURJ	Unknown	Anomaly	
115G 105	COFER	Unknown	Unknown	
115G 106	BERDASH	Vein Au-Quartz	Prospect	Gold
115G 107	LAKE	Unknown	Unknown	

RECOMMENDED CITATION

MACKIE, R., ARNE, D. AND PENNIMPEDE, C., 2016. Weighted sums model for Magmatic Ni-Cu deposits using principal component residuals. In: Enhanced interpretation of stream sediment geochemical data for NTS 115F and 115G. Yukon Geological Survey, Open File 2016-13, scale 1:250 000, sheet 9 of 13.

Catchment basin polygons generated by the Yukon Geological Survey (J. O. Bruce). Any revisions or additional geological information known to the user would be welcomed by the Yukon Geological Survey.

Paper copies of this map and the accompanying report may be obtained from the Yukon Geological Survey, Energy, Mines and Resources, Government of Yukon, Room 102-300 Main St., Whitehorse, Yukon, Y1A 2B5. Ph. 867-667-3201, Email geology@gov.yk.ca.

A digital PDF (Portable Document File) file of this map may be downloaded free of charge from the Yukon Geological Survey website: <http://www.geology.gov.yk.ca>.

Yukon Geological Survey
Energy, Mines and Resources
Government of Yukon

Open File 2016-13

Weighted sums model for Magmatic Ni-Cu deposits using principal component residuals (NTS 115F and 115G) Sheet 9 of 13

by
Rob Mackie, Dennis Arne,
and Chris Pennimpe

REFERENCES

Geological Survey of Canada, 1987. Regional Stream Sediment and Water Geochemical Reconnaissance Data. Yukon (115F & 115G). Geological Survey of Canada, Open File 1362.

Jackaman, W., 2012. Regional Stream Sediment Geochemical Data, Kluane Lake Area, southwest Yukon (NTS 115F and 115G). Yukon Geological Survey, Open File 2012-15.

Mackie, R., Arne, D. and Brown, O., 2015. Enhanced interpretation of regional stream sediment (RGS) geochemical data Yukon: catchment basin analysis and weighted sums modeling. Yukon Geological Survey, Open File Report 2015-10.

Yukon MINFILE, 2015. Yukon MINFILE – A database of mineral occurrences. Yukon Geological Survey, www.data.geology.gov.yk.ca, accessed May 2015.