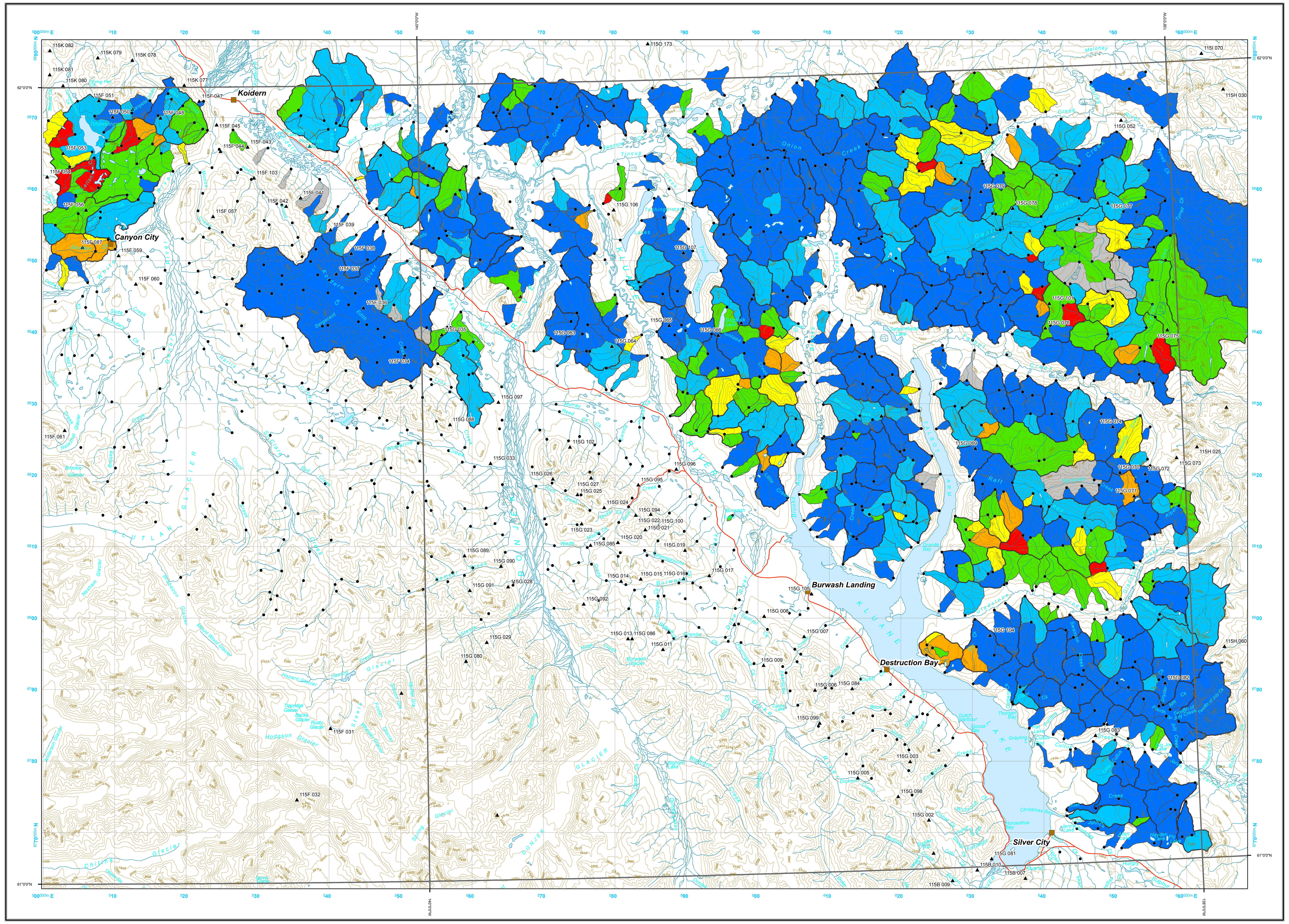

INTRODUCTION

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 Canalask deposits), Cu-Mo porphyry (Rockslide and Raft prospects), Cu skarn (Arn and Az prospects), and quartz vein Au (Berdahl prospect). The adjacent map area to the east (Aishihik Lake) contains several quartz vein-related Au occurrences (Mom, Shut and Lib 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. Levelling 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 km^2). 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 anomalism. 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[a]	Other Deposit Types[a]	Mn	Fe	Co	Ni	Cu	Mo	Zn	Pb	Ag	Au[1]	As	Ba	Cd	Sn	Sb	Te	Hg	Tl	Bi	W
Porphyry Cu-Mo	Cu skarn; Porphyry Mo					5	3			1	1	1							1	1	
Polymetallic Ag-Pb-Zn	SEDEX, VMS, Pb-Zn skarn; Epithermal Au-Ag							4	3	2		1		1		1					
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	1
Hydromorphic Anomaly		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

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

[1]Raw data following a $\log_{10}$ transformation

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	GALLOPING	Porphyry Cu-Mo-Au	Showing	Molybdenum
115F 032	ICE FIELD	Porphyry Mo (Low F-Type)	Anomaly	Copper, Molybdenum
115F 034	GARLIC	Porphyry Cu-Mo-Au	Prospect	Copper, Molybdenum, Platinum, Palladium, Gold
115F 036	HANKINS	Unknown	Unknown	
115F 037	KOIDERN	Unknown	Unknown	
115F 038	LIBERTY	Vein Cu+/-Ag Quartz	Showing	Copper, Gold, Lead
115F 039	QUEBEC	Unknown	Anomaly	
115F 041	CATS AND DOGS	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Showing	Copper, Gold, Nickel, Palladium, Platinum
115F 042	MEXICO	Skarn Cu	Showing	Copper
115F 043	PICKHANDLE	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Drilled Prospect	Copper, Nickel
115F 044	SEVENSMA	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Anomaly	
115F 045	CANALASK	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Deposit	Cobalt, Platinum, Palladium, Nickel, Molybdenum, Copper
115F 047	EPIC	Ultramafic Mafic Gabbroid 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	MONDAY	Skarn Cu	Prospect	Wollastonite
115F 051	AZ	Skarn Cu	Drilled Prospect	Copper, Gold, Silver
115F 053	RAIL	Unknown	Anomaly	
115F 054	MEMOIR	Coal	Showing	Coal
115F 055	MCLELLAN	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 059	WHITE RIVER	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Drilled Prospect	Copper, Silver
115F 060	SHARE	Volcanogenic Sulphide - type not determined	Drilled Prospect	Copper
115F 061	KLETSAN	Vein Cu+/-Ag Quartz	Showing	Copper
115F 087	CANYON MOUNTAIN	Porphyry Cu-Mo-Au	Showing	Copper, Gold
115F 093	WEBSTER	Vein Polymetallic Ag-Pb-Zn+/-Au	Anomaly	Arsenic, Gold, Silver, Zinc, Lead, Copper
115F 103	HARJAY	Unknown	Anomaly	Gold
115G 001	METALLINE	Sediment hosted Bedded Gypsum	Anomaly	Copper, Gypsum
115G 002	STOVE	Coal	Prospect	Coal
115G 003	CONGDON	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Showing	Cobalt, Nickel, Platinum, Zinc, Copper, Gold
115G 004	MULLER	Porphyry Cu-Mo-Au	Anomaly	Molybdenum
115G 005	DICKSON	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Prospect	Cobalt, Copper, Nickel, Platinum
115G 006	DESTRUCTION	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Prospect	Cobalt, Nickel, Platinum, Copper
115G 007	COPPER JOE	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Unknown	
115G 008	SQUIRREL	Ultramafic Mafic Gabbroid 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	Fixed Carbon
115G 012	AMPHITHEATRE	Coal	Showing	Coal
115G 013	WADE	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Showing	Copper, Gold, Silver
115G 014	AMP	Porphyry Cu-Mo-Au	Anomaly	Copper
115G 015	CORK	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Molybdenum
115G 016	GLEN	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Drilled Prospect	Copper, Nickel, Gold
115G 017	BURWASH	Volcanogenic Massive Sulphide (VMS) Besshi Cu-Zn	Drilled Prospect	Gold, Zinc, Silver
115G 019	JAQUOT	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Drilled Prospect	Copper, Gold, Silver
115G 020	VUG	Unknown	Unknown	
115G 021	QUILL	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Drilled Prospect	Copper
115G 022	VERSLUCE	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Drilled Prospect	Copper
115G 023	CALLINAN	Unknown	Unknown	
115G 024	WELLGREEN	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Deposit	Copper, Osmium, Cobalt, Ruthenium, Rhodium, Platinum, Palladium, Nickel, Iridium, Gold
115G 025	AIRWAYS	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Drilled Prospect	Copper, Nickel, Platinum, Palladium, Gold
115G 026	MUSKETEER	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Showing	Copper, Nickel, Platinum, Palladium, Gold
115G 027	SWEDE JOHNSON	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Showing	Copper, Nickel, Platinum, Palladium, Gold
115G 028	CEMENT	Coal	Showing	Coal
115G 029	ST. ELIAS	Vein Mo	Showing	Molybdenum
115G 033	SEXSMITH	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Drilled Prospect	Copper, Platinum, Gold
115G 035	NOX	Unknown	Anomaly	
115G 052	BOITARD	Unknown	Anomaly	
115G 062	DONJEK	Unknown	Anomaly	
115G 063	ELEVEN-THIRTY	Skarn W	Showing	Tungsten
115G 064	KENNEDY	Skarn W	Showing	Tungsten
115G 065	TINCUP	Ultramafic-hosted asbestos	Drilled Prospect	Asbestos
115G 066	NUNTAEA	Ultramafic-hosted asbestos	Anomaly	Asbestos
115G 067	DOGPACK	Unknown	Anomaly	
115G 068	BROOKS	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	TYRRELL	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 Gabbroid Cu-Ni-PGE	Showing	Nickel
115G 081	EASTER	Unknown	Unknown	
115G 082	ALTE	Unknown	Unknown	
115G 083	CULTUS	Unknown	Unknown	
115G 084	BOCK	Ultramafic Mafic Gabbroid Cu-Ni-PGE	Showing	Cobalt, Gypsum, Copper, Nickel, Platinum, Palladium
115G 085	MAPLE	Sediment hosted Bedded Gypsum	Showing	Gypsum
115G 086	GYPSUM	Sediment hosted Bedded Gypsum	Showing	Gypsum
115G 088	LYNX CREEK	Unknown	Anomaly	
115G 089	FRIEBERGS	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Showing	Copper
115G 090	ROBERTSON	Unknown	Anomaly	
115G 091	ELIAS	Unknown	Anomaly	
115G 092	BICZOK	Paleoplacer	Anomaly	
115G 094	LINDA	Ultramafic Mafic Alaskan-type Pt+/-Os+/-Rh+/-Ir	Drilled Prospect	Cobalt, Gold, Copper, Iridium, Ruthenium, Rhodium, Platinum, Palladium, Osmium, Nickel
115G 095	ARBY	Unknown	Unknown	
115G 096	HUDYUK	Unknown	Unknown	
115G 097	LONTH	Unknown	Anomaly	
115G 098	TONY	Ultramafic Mafic Alaskan-type Pt+/-Os+/-Rh+/-Ir	Showing	Copper, Nickel, Platinum
115G 099	KLUANE	Unknown	Showing	Copper, Platinum, Nickel, Palladium
115G 100	WASH	Ultramafic Mafic Alaskan-type Pt+/-Os+/-Rh+/-Ir	Drilled Prospect	Copper, Platinum, Palladium, Nickel
115G 101	TAL	Unknown	Unknown	
115G 102	TREMBLAY	Vein Cu+/-Ag Quartz	Unknown	Copper, Silver, Gold
115G 104	AUBI	Unknown	Anomaly	
115G 105	COFER	Unknown	Unknown	
115G 106	BERDAHL	Vein Au-Quartz	Prospect	Gold
115G 107	LAKE	Unknown	Unknown	

LEGEND

- Town
- Mineral Occurrence
- Road
- Contour
- River
- NTS map sheet
- Water Body
- Wetland
- Sample Location
- Catchment
- Catchments > 15km²

Weighted sums model (PC residuals)

Polymetallic Ag-Pb-Zn deposits

- incomplete element suite
- 0-50th percentile
- 50-75th percentile
- 75-90th percentile
- 90-95th percentile
- 95-98th percentile
- 98-100th percentile

RECOMMENDED CITATION

MACKIE, R., ARNE, D. AND PENNIMPEDE, C., 2016. Weighted sums model for Polymetallic Ag-Pb-Zn 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 11 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.

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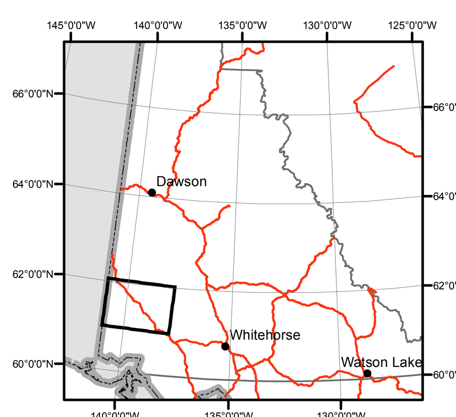

1:250 000-scale topographic base data produced by CENTRE FOR TOPOGRAPHIC INFORMATION, NATURAL RESOURCES CANADA

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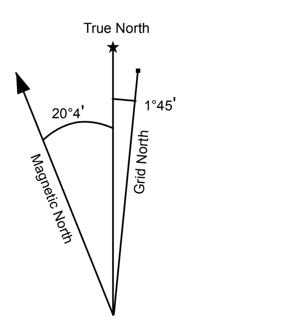
ONE THOUSAND METRE GRID
Universal Transverse Mercator Projection
North American Datum 1983
Zone 7

CONTOUR INTERVAL 100 FEET
Elevations in metres above Mean Sea Level

Polymetallic Ag-Pb-Zn
Weighted sums model
(Principal Component Residuals)
Sheet 11 of 13

SCALE 1:250 000

0 1 2 3 4 5
kilometres



Use diagram only to obtain numerical values
APPROXIMATE MEAN DECLINATION 2015
FOR CENTRE OF MAP

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

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Yukon Geological Survey
Energy, Mines and Resources
Government of Yukon

Open File 2016-13

Weighted sums model for Polymetallic Ag-Pb-Zn deposits using principal component residuals (NTS 115F and 115G) Sheet 11 of 13

by

Rob Mackie, Dennis Arne, and Chris Pennimpede