YUKON GEOLOGICAL SURVEY

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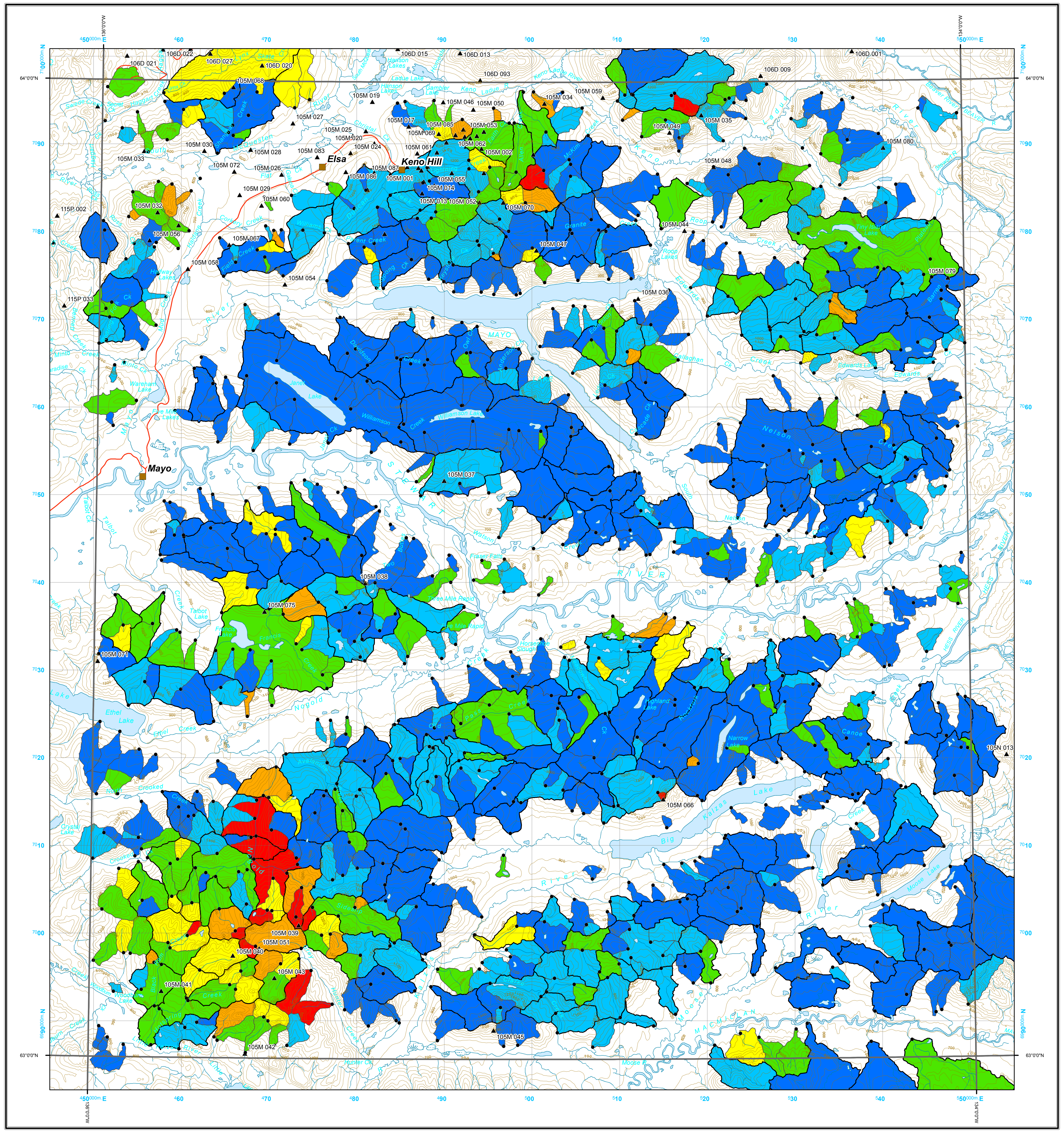
Yukon
Energy, Mines and Resources



INTRODUCTION

New geochemical data from re-analysis of archived stream sediment samples have been assessed using weighted sums modeling and catchment basin analysis (Mackie *et al.*, 2015 and Heberlein, 2013). 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 Mayo area (NTS 105M) were collected at a reconnaissance scale in 1987 and 1988 as part of the Canada-Yukon Mineral Development Agreement (Friske & Hornbrook, 1989). Field descriptions and initial geochemical data for 861 sites were released in Geological Survey of Canada (GSC) Open File 1962. New geochemical data from the re-analysis of archive sample material were subsequently released in Yukon Geological Survey (YGS) Open File 2012-8 (Jackaman, 2012). 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 Mayo area as shown in Table 1 (Yukon MINFILE, 2015). The most significant are those of the Keno Hill silver district which are classed as polymetallic Ag-Pb-Zn±Au vein deposits. Other deposit types in the area include intrusion-related Au (McQuesten deposit) and W skarn (Newry, Two Buttes and Friesen prospects). The Marg volcanogenic massive sulphide and Dublin Gulch intrusion-related gold deposits occur in the in the adjacent NTS map area to the north (106D) supporting the prospectivity of the region for these types of deposits. The area may also be prospective for sedimentary exhalative Pb-Zn±Ag deposits given the presence of Road River and Earn Group and Rabbitkettle Formation sedimentary rocks which host this type of mineralization elsewhere in Yukon.

WEIGHTED SUMS MODELING

As described in the methodology report accompanying this map (Mackie *et al.*, 2015) and a previously completed pilot study (Heberlien, 2013), 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 (Heberlein, 2013), while the other uses residuals calculated from regression against selected principal components (Mackie *et al.*, 2015). Using the processed data, weighted sums models (WSM) have been generated for different deposit types based on selected commodity and pathfinder elements. 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 indicates that the distribution of many commodity and pathfinder elements is strongly influenced by lithological variation. However, for certain elements it appears that mineralization is an important controlling factor. The principal component (PC1) accounts for ~30% of the total geochemical variation. Negative PC1, with high loadings in Cd, Ba, Ag, Se, Mo, Hg, Tl and Zn, forms a spatial pattern that matches the distribution Earn and Road River group sedimentary rocks and is thus interpreted to represent lithologic control. Similarly positive PC1, with high loadings in Ce, La, Th, Fe, Al, Mg and Co, appears to relate to Hyland Group sedimentary rocks. This element grouping is similar to that linked with Hyland Group rocks in other map areas. The second component (PC2) has high negative loadings for Sb, Pb, As, Zr, Cu, Mo and Bi and can be linked to polymetallic Ag-Pb-Zn occurrences indicating this component most likely represents a mineralization signal. Conversely positive PC2, with high loadings in Rb, Cr, Sc, V, K and Tl, can be linked to areas mapped as felsic intrusion. Regression analysis of selected metals against the relevant principal component(s) effectively subdues the influence of lithological variation while preserving responses related to known occurrences. In filtering the lithological control, responses in these elements are enhanced elsewhere in the map area and represent new exploration targets.

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 (14 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 1: List of Mineral Occurrences for NTS map sheet 105M (Yukon MINFILE, 2015)

Number	Name	Type	Status	Commodities
105M 071	DRILL	Vein W	Showing	Tungsten
105M 072	BELEY	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Lead, Zinc, Silver
105M 073	BEMA	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Gold, Silver
105M 080	GORDEY	Sediment hosted Stratiform Barite	Prospect	Barite
105M 002	FAITH	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Gold, Silver, Zinc, Lead
105M 003	DUNCAN	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Lead, Silver
105M 004	GOLDEN QUEEN	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Antimony, Lead, Silver
105M 005	SILVER BASIN	Vein Polymetallic Ag-Pb-Zn±Au	Prospect	Silver, Gold, Lead
105M 006	NABOB	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Gold, Lead, Silver
105M 007	MONUMENT	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver
105M 008	COMSTOCK	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Lead, Zinc, Silver
105M 009	APEX	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver, Zinc
105M 010	VANGUARD	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Lead, Silver
105M 011	HOMESTAKE	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Gold, Lead, Silver, Zinc
105M 012	CHRISTINE	Vein Polymetallic Ag-Pb-Zn±Au	Prospect	Lead, Silver
105M 013	MO	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Gold, Lead, Silver
105M 014	MAYBRUN	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Silver, Lead
105M 015	HOGAN	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver
105M 016	RUNER	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Lead, Gold, Zinc, Silver
105M 017	WERNECKE	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Gold, Silver, Zinc, Lead
105M 018	FORMO	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Lead, Zinc, Silver
105M 020	PADDY	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Lead, Silver, Zinc, Gold
105M 021	EAGLE	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Lead, Silver, Zinc
105M 022	FISHER	Vein Polymetallic Ag-Pb-Zn±Au	Anomaly	Gold, Silver, Zinc, Lead
105M 024	CREAM AND JEAN	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Lead, Zinc, Silver, Copper
105M 025	NORD	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Arsenic, Silver, Zinc, Gold, Lead
105M 026	GERLITZKI	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Lead, Zinc, Silver
105M 027	TITAN	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Lead, Zinc, Silver
105M 028	SHANGHAI	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Copper, Silver, Zinc, Lead
105M 029	MCQUESTEN	Plutonic Related Au	Past Producer	Gold, Zinc, Bismuth, Lead, Silver
105M 030	ARGENT	Unknown	Anomaly	Zinc
105M 031	STREBCHUK	Porphyry Sn	Prospect	Arsenic, Copper, Lead, Silver, Tin, Tungsten, Zinc
105M 032	MT HALDANE	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Lead, Arsenic, Zinc, Gold, Silver
105M 033	LAYSIER	Vein Polymetallic Ag-Pb-Zn±Au	Anomaly	Lead, Silver, Zinc
105M 034	COBALT	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Lead, Silver, Antimony, Copper, Zinc
105M 035	PATTERSON	Unknown	Anomaly	Arsenic, Lead, Silver, Zinc, Copper, Gold
105M 037	GORDON	Vein & Disseminations Stibnite	Prospect	Antimony, Bismuth, Mercury, Silver, Gold, Arsenic
105M 038	TWO BUTTES	Skarn W	Drilled Prospect	Tungsten
105M 039	SIDE SLIP	Skarn Cu	Showing	Copper
105M 040	GREAT HORN	Skarn W	Prospect	Copper, Zinc, Tungsten
105M 042	HOTSPRING	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver
105M 043	LOST WERNECKE COPPER	Unknown	Unknown	Copper
105M 046	MOON	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Gold, Silver, Zinc, Lead
105M 047	MT. ALBERT	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver
105M 048	MCKIM	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Silver
105M 050	NERO	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver
105M 051	FRIESEN	Skarn W	Prospect	Copper, Gold, Lead, Molybdenum, Silver, Tungsten
105M 052	MT HINTON	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Gold, Silver
105M 054	CHANCE	Vein & Disseminations Stibnite	Showing	Antimony
105M 055	YONO	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver
105M 056	SUNDOWN	Plutonic Related Au	Showing	Arsenic, Lead, Silver, Tin, Tungsten, Bismuth, Gold
105M 057	GUSTAVUS	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver
105M 058	HALFWAY	Unknown	Drilled Prospect	Gold, Tungsten, Mercury
105M 060	NEWRY	Skarn W	Drilled Prospect	Arsenic, Copper, Lead, Tungsten, Zinc, Gold, Bismuth
105M 061	CHRISTAL	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver, Zinc
105M 062	SEGSWORTH	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Lead, Silver
105M 066	KALZAS	Vein W	Drilled Prospect	Beryllium, Lead, Molybdenum, Silver, Tin, Tungsten
105M 069	GAMBLER	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Lead, Silver, Zinc
105M 070	HAVRENAK	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Gold, Silver, Lead
105M 001	KENO HILL - HISTORIC	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Lead, Silver, Zinc, Cadmium, Gold, Tin
105M 049	VACA	Unknown	Anomaly	
105M 044	ROOP	Skarn W	Showing	
105M 036	ETTA	Unknown	Anomaly	
105M 068	WEASEL	Unknown	Unknown	
105M 075	WHITEMAN	Unknown	Unknown	
105M 082	BELLEKENO	Vein Polymetallic Ag-Pb-Zn±Au	Producer	Lead, Silver, Zinc, Gold, Tin, Cadmium
105M 083	ELSA TAILINGS	Tailings Reprocessing	Deposit	Gold, Zinc, Silver, Lead
105M 063	IRON CLAD	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	
105M 045	ABLE	Unknown	Anomaly	
105M 041	RAM	Unknown	Unknown	
105M 084	ONEK	Vein Polymetallic Ag-Pb-Zn±Au	Deposit	Silver, Lead, Gold, Zinc, Indium
105M 086	BERMINGHAM	Vein Polymetallic Ag-Pb-Zn±Au	Deposit	Lead, Zinc, Silver, Gold
105M 085	LUCKY QUEEN	Vein Polymetallic Ag-Pb-Zn±Au	Deposit	Silver, Lead, Zinc, Gold
105M 087	FLAME & MOTH	Vein Polymetallic Ag-Pb-Zn±Au	Deposit	Gold, Silver, Lead, Zinc
105M 059	RANKIN	Unknown	Anomaly	
105M 067	CORKERY	Unknown	Unknown	
105M 019	NOMAD	Porphyry W	Anomaly	
105M 053	AVENUE	Vein Polymetallic Ag-Pb-Zn±Au	Showing	
105M 079	TINY ISLAND	Unknown	Prospect	
105M 023	PARENT	Unknown	Anomaly	

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

Target deposit type	Other deposit types	Mn	Fe	Co	Ni	Cu	Mo	Zn	Pb	Ag	Au[1]	As	Ba	Cd	Sn[1]	Sb	Te	Hg	Tl	Bi	W[1]
Polymetallic Ag-Pb-Zn	SEDEX; MVT; VMS; Pb-Zn skarn; Au-Ag epithermal							1	3	4		2				4					-2
SEDEX Zn-Pb-Ag	MVT; VMS; Pb-Zn skarn; Polymetallic Ag-Pb-Zn							4	4	1			2	1				2	1		-2
Intrusion-related Au	Carlin-style Au							-2	-2		4	4				2				2	
Carlin-style Au	Intrusion-related Au								-2		3	4			-2	2		2	1		
Cu skarn	Porphyry Mo; Porphyry Cu					5	2			1		1								1	
W skarn	Intrusion-related Au						1					2			1					2	4

[a]Polymetallic Ag-Pb-Zn type includes vein and manto styles; SEDEX = sedimentary exhalative; MVT = Mississippi Valley-Type Zn-Pb; VMS = volcanogenic massive sulphide

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

LEGEND

- Town
- Mineral Occurrence
- Road
- Contour
- River
- NTS map sheet
- Water Body
- Wetland
- Sample_Location
- Catchment > 14km²

Weighted sums model (PC residuals)

Cu skarn deposits

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

RECOMMENDED CITATION

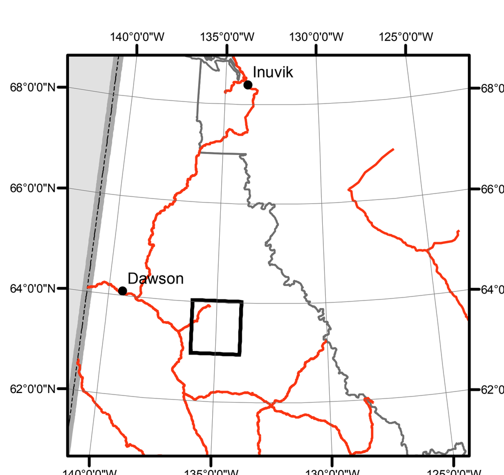
MACKIE, R., ARNE, D. AND PENNIMPEDE, C., 2016. Weighted sums model for Cu skarn deposits using principal component residuals. In: Enhanced interpretation of stream sediment geochemical data for NTS map sheet 105M. Yukon Geological Survey, Open File 2016-27, scale 1:250 000, sheet 2 of 6.

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.



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

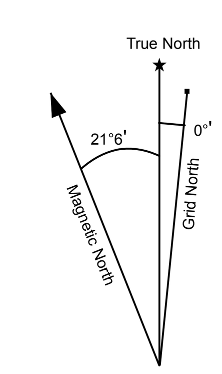
ONE THOUSAND METRE GRID
Universal Transverse Mercator Projection
North American Datum 1983
Zone 8

CONTOUR INTERVAL 100 FEET
Elevations in metres above Mean Sea Level

Cu skarn
Weighted sums model
(Principal Component Residuals)
Sheet 2 of 6

SCALE 1:250 000

0 1 2 3 4 5
kilometres



Use diagram only to obtain numerical values
APPROXIMATE MEAN DECLINATION 2016
FOR CENTRE OF MAP

116A LARSEN CREEK	106D NASH CREEK	106C NADALEEN RIVER
115P MCQUESTEN	105M THIS MAP	105N LANSING RANGE
115I Carmacks	105L Glenlyon	105K Tay River

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Government of Yukon

Open File 2016-27

Weighted sums model for Cu skarn deposits using principal component residuals (NTS 105M)
Sheet 2 of 6

by

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