Yukon Geological Survey

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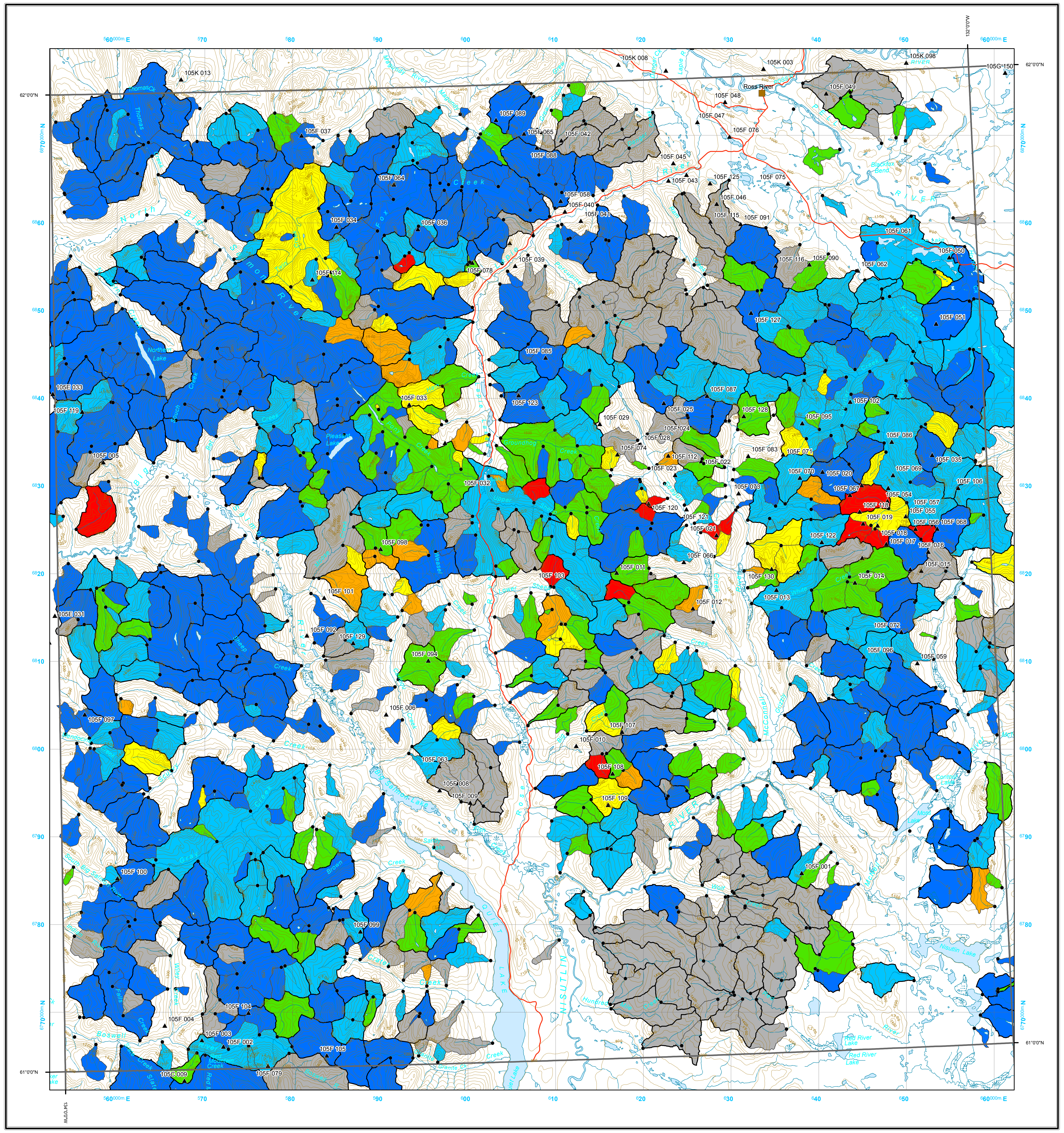
Energy, Mines and Resources



INTRODUCTION

New geochemical data from re-analysis of archived stream sediment samples have been assessed using weighted sums modeling and catchment basin analysis, as described in the accompanying open file report (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 Quiet Lake area (NTS 105F) were collected at a reconnaissance scale in 1978 as part of the Federal Uranium Reconnaissance program. The sediment samples were analysed in several stages and the geochemical data was released in Geological Survey of Canada (GSC) Open Files 564, 734, and 1290 (Goodfellow & Lynch, 1978; Coker *et al*., 1981; Hornbrook *et al*., 1985). A recent re-analysis program conducted by the Yukon Geological Survey (YGS) has generated new geochemical data from analysis of archived sample material as described in YGS Open File 2015-8 (Jackaman, 2015). The reader is referred to these reports for detailed descriptions of sampling techniques, analytical procedures, and quality control measures. Not all samples have been analysed for gold using preferred Fire-Assay or Neutron Activation methods. Given the uncertainty in quality of ICP-MS analysis of gold stream sediments, as described by Arne & MacFarlane (2014), no attempt has been made to incorporate data by this method.

MINERAL OCCURRENCES

The main mineral occurrences within the Quiet Lake area are classed as polymetallic Ag-Pb-Zn (Au) veins (Groundhog and Ketzakey deposits), replacement-/manto-style Au (Ketza River Deposit) and W skarn (Stormy and Risby deposits). Other deposit types represented in the map area include Cu-Pb-Zn volcanogenic massive sulphide (MM and Tub prospects), Mo skarn (Molly prospect), quartz-vein Au (Seagull Creek prospect), high sulphidation Au-Ag-Cu (Beautiful prospect), and sedimentary exhalative Zn-Pb-Ag (“High-grade” and Angie prospects). The Anvil SEDEX and Finlayson Lake VMS districts are located in the adjacent NTS map sheets to the north and east, respectively. Notably, the Red Mountain porphyry Mo deposit is located less than 2 km from the southern boundary of the map area.

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 principal components. Weighted sums models (WSM) have been generated using the processed data. The importance rankings used in WSMs are summarized in Table 2 for a variety of deposit types. 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. Given that not all samples have been analyzed for Au, models using Au data present results for fewer catchments.

Exploratory data analysis using both raw element data and principal components reveals that the distribution of many commodity and pathfinder elements is strongly influenced by lithological variation. The first principal component, accounting for ~39% of the total variation, shows high positive loadings for Sb, Ag, Cd, Zn, Se, Ca, Ba, Cu and Zr and high negative loadings for Rb, Li, Ti, Al, Ca and Ce. These groupings form spatially coherent trends that match, respectively, the distribution of sedimentary rocks, including shale and slate horizons, of the St. Cyr and Earn groups and Jones Lake Formation, and felsic intrusive rocks of the Cassiar Suite. The second principal component, accounting for ~14% of the total variation, shows high loadings for Co, Cr, Ni, Sc, Cu and Mg, and negative loadings for U, Mo and Y. These groupings form spatial trends matching the distribution of ultramafic rocks and some carbonate units, and felsic intrusive rocks, respectively. Regression analysis of selected metals against the relevant principal component(s) effectively filters these terrane-effects while preserving responses related to known occurrences.

Levelling by the dominant mapped geology has a more subdued effect on filtering the interpreted lithological control for certain elements (*e.g.,* Ag, As, Ba, Hg, Mo, Sb and Tl). In order to reduce this impact in the WSM these elements were given low importance rankings (or were omitted) for certain deposit types. Negative rankings were assigned to certain variables to help differentiate deposit types with similar metal associations and also to dampen remaining lithological effects.

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 (12 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 could also be of interest in large catchments.

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

Target Deposit Type [a]	Other Deposit Type [a]	Mn	Fe	Co	Ni	Cu	Mo	Zn	Pb	Ag	Au[1]	As	Ba	Cd	Sn	Sb	Te	Hg	Tl	Bi	W
Polymetallic Ag-Pb-Zn	SEDEX (high Ag); VMS; Pb-Zn skarn							1	4	3		2			1	1				1	
VMS (Zn-rich)	SEDEX (low Ag); Pb-Zn skarn					2		4	2	1				1				1			
Intrusion-related Au	Epithermal Au										3	1				1				1	
Epithermal Au-Ag	Intrusion-related Au									3	3	2				1		1		-1	
Porphyry Mo	Porphyry Cu-Mo; W skarn					1	3			1											1
Cu skarn	Porphyry Cu-Mo; VMS (mafic); Cu-Ag Vein					4	1			2										1	1
W skarn	Sn skarn; Porphyry W					1	1			-2		1			1					2	4

[a] Polymetallic Ag-Pb-Zn type includes vein and manto styles; SEDEX = sedimentary exhalative; VMS = volcanic-hosted/associated massive sulphide deposits

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

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

Number	Name	Type	Status	Commodities
105F 022	GRAYLING	Vein Polymetallic Ag-Pb-Zn+/-Au	Drilled Prospect	Gold, Lead, Silver, Zinc
105F 023	COXALL	Manto Polymetallic Ag-Pb-Zn	Drilled Prospect	Bismuth, Gold, Lead, Silver
105F 025	MUM	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Showing	Lead, Zinc
105F 029	GROUNDHOG	Vein Polymetallic Ag-Pb-Zn+/-Au	Deposit	Lead, Silver, Gold, Zinc, Copper
105F 032	PONY	Vein Au-Quartz	Showing	Antimony, Gold, Lead, Silver
105F 033	HAM	Skarn W	Prospect	Tungsten
105F 034	RISBY	Skarn W	Deposit	Tungsten, Tungsten Trioxide, Gold, Antimony, Copper
105F 035	AMBROSE	Vein Polymetallic Ag-Pb-Zn+/-Au	Prospect	Copper, Lead, Silver, Zinc, Gold
105F 036	TUB	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Drilled Prospect	Copper, Lead, Tungsten, Zinc, Silver, Gold
105F 037	EVA	Skarn W	Drilled Prospect	Copper, Lead, Tungsten, Gold
105F 038	BARITE MOUNTAIN	Vein Barite-Fluorite	Deposit	Barite, Zinc, Copper, Silver
105F 040	CANUSA	Vein Polymetallic Ag-Pb-Zn+/-Au	Prospect	Gold, Lead, Silver, Zinc
105F 042	MT. COOK	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Showing	Lead, Molybdenum, Silver, Zinc
105F 044	WATERFALL	Vein Au-Quartz	Showing	Gold
105F 046	KINDLE	Vein Au-Quartz	Showing	Copper, Gold, Silver
105F 047	TRENCH	Coal	Prospect	Coal
105F 048	WHISKEY LAKE	Coal	Producer	Coal
105F 050	BRUCE LAKE	Ultramafic Mafic Flood basalt-associated Ni-Cu	Drilled Prospect	Copper, Lead, Nickel, Silver, Gold
105F 052	MT. MISERY	Vein Polymetallic Ag-Pb-Zn+/-Au	Prospect	Gold, Silver, Lead
105F 053	KEY	Vein Polymetallic Ag-Pb-Zn+/-Au	Past Producer	Copper, Lead, Silver
105F 054	LAPRAIRIE	Vein Polymetallic Ag-Pb-Zn+/-Au	Drilled Prospect	Gold, Silver, Lead
105F 055	HOEY	Vein Polymetallic Ag-Pb-Zn+/-Au	Drilled Prospect	Gold, Lead, Zinc, Thallium, Silver
105F 056	STUMP	Vein Polymetallic Ag-Pb-Zn+/-Au	Drilled Prospect	Silver, Lead
105F 058	MAGUNDY	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	Lead, Silver
105F 059	HOGG	Vein Cu+/-Ag Quartz	Showing	Copper
105F 063	RHYORCHUK	Ultramafic-hosted asbestos	Showing	Asbestos
105F 066	CONNELL	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	Copper, Silver
105F 067	FURY	Vein Cu+/-Ag Quartz	Prospect	Copper, Gold, Silver
105F 068	REGEHR	Manto Polymetallic Ag-Pb-Zn	Showing	Copper, Zinc, Silver, Gold, Lead
105F 069	KIRWAN	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	Lead, Silver
105F 070	DROC	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	Lead, Zinc, Copper
105F 072	YOUNG	Skarn Cu	Showing	Copper
105F 073	BNOB	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Drilled Prospect	Barite, Lead, Zinc, Silver, Copper
105F 075	BEAUTIFUL	Epithermal Au-Ag-Cu: High Sulphidation	Drilled Prospect	Gold
105F 078	PIMPLE	Skarn W	Showing	Copper, Tungsten, Molybdenum
105F 079	MURPHY	Porphyry Cu-Mo-Au	Showing	Copper, Uranium, Tungsten
105F 080	NOKLUIT	Carbonatite	Prospect	Barite, Cerium, Fluorite, Gold, Lead, Niobium, Silver, Uranium, Zinc, Yttrium, Thorium, Rare Earths, Neodymium, Lanthanum, Copper
105F 081	GUANO	Carbonatite	Prospect	Fluorite, Rare Earths, Uranium, Thorium, Niobium
105F 083	FOX	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	Lead, Silver, Zinc
105F 084	LAP	Skarn W	Showing	Tungsten
105F 085	ENTRY	Sediment hosted Mississippi Valley-Type Pb-Zn (MVT)	Showing	Lead, Zinc
105F 086	IGLE	Volcanogenic Sulphide - type not determined	Unknown	Lead, Zinc
105F 087	RAMPANT	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Showing	Copper
105F 001	MOLLY	Skarn Mo	Drilled Prospect	Molybdenum, Uranium
105F 002	MOBS	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	Lead, Molybdenum, Silver
105F 003	WOPUS	Vein Polymetallic Ag-Pb-Zn+/-Au	Prospect	Lead, Silver
105F 004	GOPHER	Vein Polymetallic Ag-Pb-Zn+/-Au	Prospect	Gold, Molybdenum, Zinc, Silver, Lead
105F 005	DUNITE MOUNTAIN	Ultramafic-hosted asbestos	Showing	Asbestos
105F 008	TOWER PEAK	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	Copper, Silver
105F 009	DODY	Ultramafic-hosted asbestos	Showing	Asbestos
105F 011	STORMY	Skarn W	Deposit	Molybdenum, Tungsten
105F 012	MM	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Drilled Prospect	Barite, Copper, Zinc, Silver, Lead, Gold
105F 013	CPA	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Showing	Copper, Zinc, Lead
105F 014	SONNY	Vein Polymetallic Ag-Pb-Zn+/-Au	Prospect	Arsenic, Copper, Silver, Lead, Gold
105F 015	KAY	Sediment hosted Mississippi Valley-Type Pb-Zn (MVT)	Showing	Antimony, Silver, Zinc, Lead, Barite, Copper, Fluorite
105F 016	SHARON	Vein Polymetallic Ag-Pb-Zn+/-Au	Prospect	Copper, Lead, Silver, Zinc
105F 017	OXO	Manto Polymetallic Ag-Pb-Zn	Drilled Prospect	Copper, Zinc, Silver, Lead, Gold
105F 018	KOPINEC	Vein Cu+/-Ag Quartz	Prospect	Copper
105F 019	KETZA	Manto Au	Past Producer	Gold, Silver, Arsenic
105F 020	EROS	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Prospect	Arsenic, Mercury, Zinc, Silver, Lead, Copper, Gold
105F 021	BOX	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Drilled Prospect	Copper, Zinc, Gold, Lead, Silver
105F 088	GROWTH	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Showing	Barite
105F 089	WOODSIDE	Sediment hosted Stratiform Barite	Prospect	Barite
105F 090	SPURT	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	Barite, Copper, Zinc
105F 091	ANGIE	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Drilled Prospect	Silver, Zinc
105F 092	AYDUCK	Skarn W	Prospect	Tungsten
105F 093	HIGRADE	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Drilled Prospect	Lead, Zinc, Gold, Silver
105F 094	OBVIOUS	Skarn W	Showing	Tungsten
105F 097	KIDLARK	Skarn W	Showing	Tungsten
105F 098	FIRST	Skarn W	Showing	Copper, Silver, Zinc, Lead
105F 100	CANOXY	Unknown	Anomaly	Uranium
105F 104	ALVIN	Porphyry W	Showing	Tungsten
105F 105	CRATER	Porphyry W	Showing	Tungsten
105F 106	HOWRU	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Prospect	Copper, Silver, Lead, Zinc
105F 112	GRAHAM	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Prospect	Copper, Zinc, Silver, Lead
105F 114	BIG SAM	Skarn W	Prospect	Tungsten
105F 115	MT. ROSS	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Prospect	Barite, Lead, Zinc
105F 116	HOLLAND	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Showing	Silver, Zinc
105F 117	AMERLIN	Unknown	Showing	Arsenic, Gold, Silver, Lead, Copper
105F 118	QUILLO	Vein Au-Quartz	Showing	Arsenic, Silver, Gold
105F 119	HELO	Unknown	Anomaly	Copper, Zinc, Lead, Tungsten, Silver
105F 120	MACKENZIE	Vein Polymetallic Ag-Pb-Zn+/-Au	Drilled Prospect	Antimony, Gold, Silver, Lead, Arsenic, Bismuth
105F 121	SEAGULL CREEK	Vein Au-Quartz	Drilled Prospect	Arsenic, Silver, Lead, Bismuth, Gold, Copper
105F 125	BLACKHAWK	Epithermal Au-Ag: Low Sulphidation	Prospect	Gold
105F 128	MELT	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	Gold, Lead, Zinc, Silver
105F 129	HID	Skarn W	Drilled Prospect	Beryllium, Tungsten, Vanadium
105F 071	CHZERPNOUGH	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Drilled Prospect	Barite, Silver, Zinc, Lead, Copper, Fluorite
105F 074	PINNACLE	Vein Polymetallic Ag-Pb-Zn+/-Au	Drilled Prospect	Barite, Silver, Zinc, Lead, Copper, Gold
105F 095	TREE	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Showing	Barite, Molybdenum, Zinc, Silver, Mercury, Gold, Lead
105F 122	WHYTE	Vein Polymetallic Ag-Pb-Zn+/-Au	Prospect	Arsenic, Silver, Copper, Gold, Lead
105F 024	TYRO	Vein Polymetallic Ag-Pb-Zn+/-Au	Prospect	Copper, Zinc, Silver, Gold, Lead
105F 028	HAYDN	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Drilled Prospect	Arsenic, Bismuth, Copper, Gold, Lead, Silver, Zinc
105F 057	KETZAKEY	Vein Polymetallic Ag-Pb-Zn+/-Au	Deposit	Lead, Silver, Copper, Antimony, Gold
105F 043	LAPIE	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	
105F 123	PINKENBURG	Unknown	Unknown	
105F 099	PISA	Unknown	Anomaly	
105F 076	BICKISH	Epithermal Au-Ag-Cu: High Sulphidation	Unknown	
105F 103	AGIP	Unknown	Anomaly	
105F 041	CYR	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	
105F 107	BIG OX	Unknown	Anomaly	
105F 130	TRUE BLUE	Gemstone	Prospect	Gemstones
105F 101	ANYWAYS	Unknown	Unknown	
105F 061	CHUNG	Unknown	Drilled Prospect	
105F 051	JOE	Unknown	Unknown	
105F 102	TIER	Unknown	Drilled Prospect	
105F 010	WALLI	Ultramafic-hosted asbestos	Unknown	
105F 127	WOLF	Unknown	Unknown	
105F 039	MCNEE	Vein Polymetallic Ag-Pb-Zn+/-Au	Showing	
105F 062	HUNT	Unknown	Anomaly	
105F 109	COLD	Unknown	Unknown	
105F 045	DANGER	Vein Au-Quartz	Showing	
105F 096	CONTOUR	Unknown	Unknown	
105F 049	ROSS	Unknown	Unknown	
105F 065	DIRK	Sediment hosted Stratiform Barite	Prospect	
105F 108	OXY	Unknown	Unknown	
105F 064	ASKIN	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Showing	
105F 006	IOLA	Vein Polymetallic Ag-Pb-Zn+/-Au	Drilled Prospect	

LEGEND

- ■ Town
- ▲ Mineral Occurrence
- ▭ NTS map sheet
- — Road
- — Contour
- ~ River
- Water Body
- Wetland
- ● Sample Locations
- Catchment
- Catchments>12km²

Weighted sums model (PC residuals)

Epithermal Au-Ag deposits

- ▨ incomplete element suite
- 🟦 0-50th percentile
- 🟦 50-75th percentile
- 🟩 75-90th percentile
- 🟨 90-95th percentile
- 🟧 95-98th percentile
- 🟥 98-100th percentile

REFERENCES

Arne, D. and MacFarlane, B., 2014. Reproducibility of gold analyses in stream sediment samples from the White Gold District and Dawson Range, Yukon, Canada. Explore, No. 164, p.1-10.

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Jackaman, W., 2015. Regional stream sediment geochemical data, Quiet Lake area, southern Yukon (NTS 105F). Yukon Geological Survey, Open File 2015-8.

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

RECOMMENDED CITATION

MACKIE, R., ARNE, D. AND BROWN, O., 2015. Weighted sums model for Cu skarn deposits using principal component residuals. In: Enhanced interpretation of stream sediment geochemical data for NTS 105F. Yukon Geological Survey, Open File 2015-28, scale 1:250 000, sheet 9 of 15.

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 purchased 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.

Yukon Geological Survey
Energy, Mines and Resources
Government of Yukon

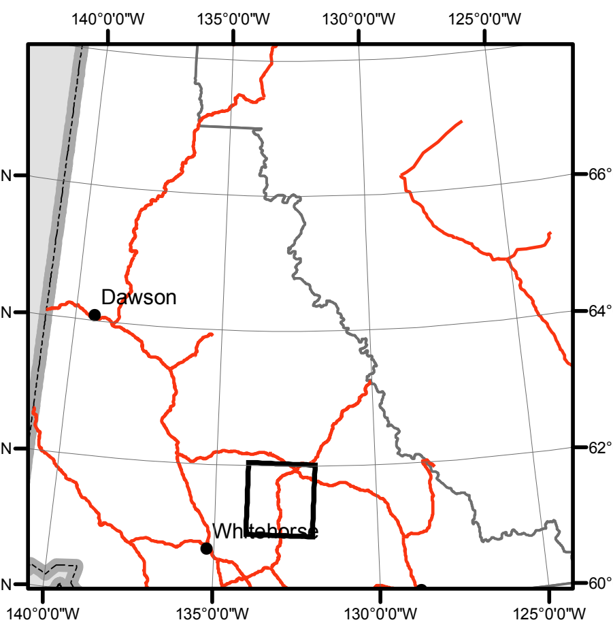
Open File 2015-28

Weighted sums model for Epithermal Au-Ag deposits using principal component residuals (NTS 105F)

Sheet 9 of 15

by

Rob Mackie, Dennis Arne,
and Chris Pennimpede



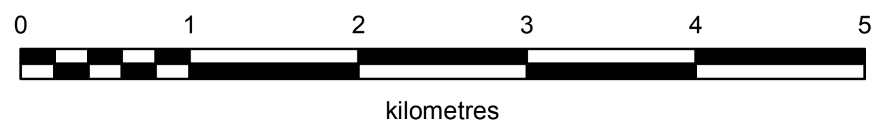
1:250 000-scale topographic base data produced
by
CENTRE FOR TOPOGRAPHIC INFORMATION,
NATURAL RESOURCES CANADA

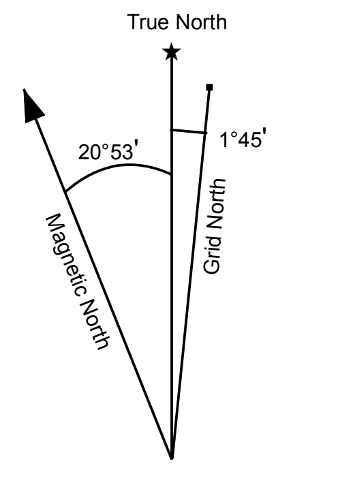
ONE THOUSAND METRE GRID
Universal Transverse Mercator Projection
North American Datum 1983
Zone 8

CONTOUR INTERVAL 100 FEET
Elevations in metres above Mean Sea Level

Epithermal Au-Ag deposits
Weighted sums model
(Principal Component Residuals)
Sheet 9 of 15

SCALE 1:250 000





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

105L GLENYON	105K TAY RIVER	105J SHELDON LAKE
105E LAKE LABERGE	105F **THIS MAP**	105G FINLAYSON LAKE
105D WHITEHORSE	105C TESLIN	105B WOLF LAKE