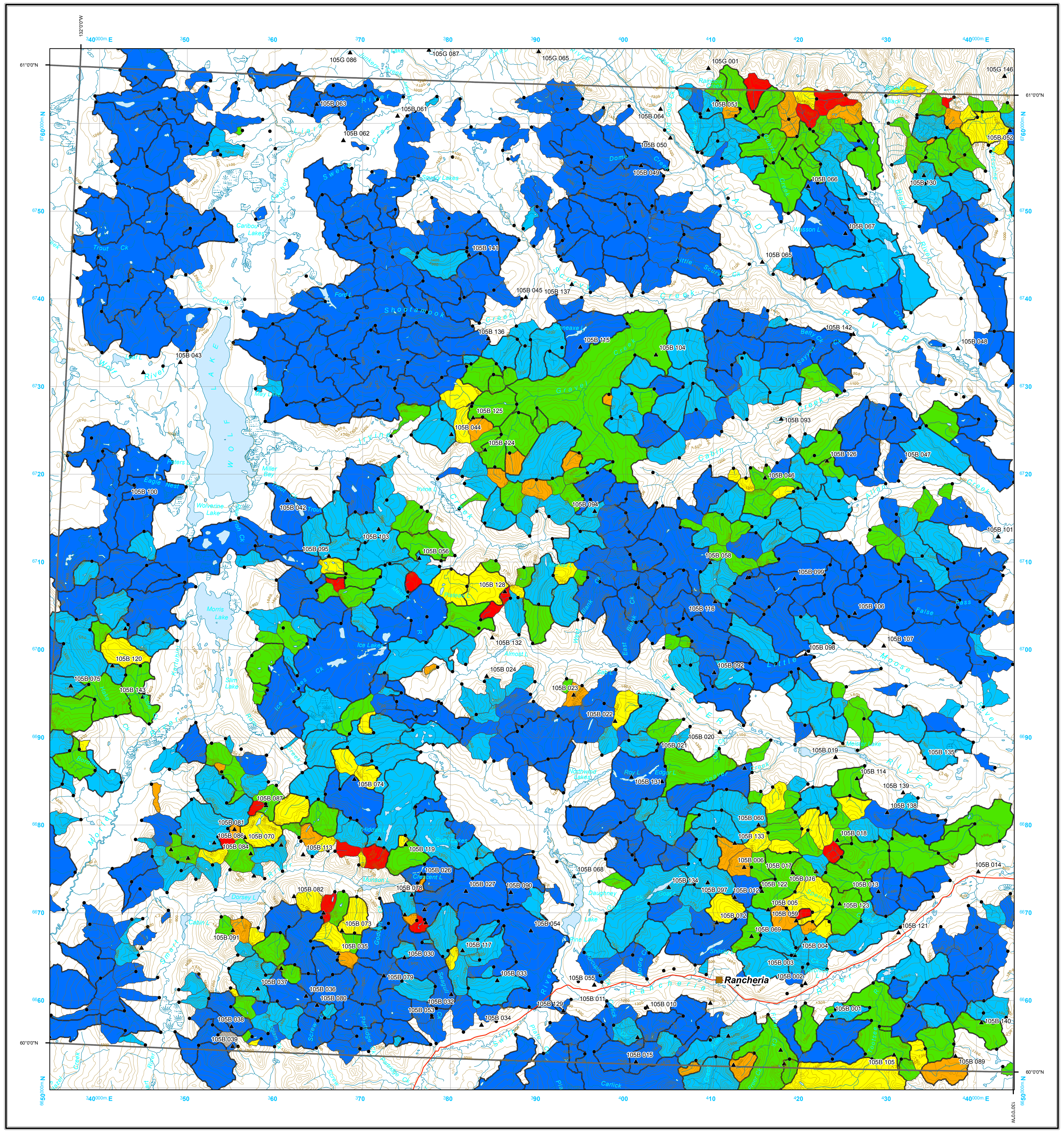
Yukon Geological Survey

CSA Global
Resource Industry Consultants

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 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 Wolf Lake area (NTS 105B) were collected at a reconnaissance scale in 1978 under the direction of the Geological Survey of Canada as part of the Federal Uranium Reconnaissance program (Geological Survey of Canada, 1986). The samples were analyzed in several stages and the geochemical data were originally released in Geological Survey of Canada (GSC) Open Files 563 and 1289 (Geological Survey of Canada, 1979 and 1986). 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 2015-6 (Jackaman, 2015). The reader is referred to these reports for detailed descriptions of sampling techniques, analytical procedures, and quality control measures.

MINERAL OCCURRENCES

The most significant mineral occurrences discovered within the Wolf Lake area have been classed as polymetallic Ag-Pb-Zn vein (*e.g.*, Dale, Logjam and Logan deposits), porphyry W (*e.g.*, Logtung deposit and Cordilleran prospect), Pb-Zn skarn (*e.g.*, Atom and Bar prospects), Sn skarn (*e.g.*, Partridge prospect) or Sn vein and greisen (*e.g.*, Cusp prospect). Other deposit types represented in the map area include epithermal Au-Ag (*e.g.*, Shootamook prospect), volcanogenic massive sulphide (*e.g.*, Convert Prospect), and porphyry Cu-Mo (*e.g.*, McPres prospect). Polymetallic Ag-Pb-Zn vein and manto-type prospects trend into the map area to the south (NTS 104O), within British Columbia, supporting the prospectivity of the region for this class 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 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.

Exploratory data analysis of both raw element data and principal components show that the distribution of many commodity and pathfinder elements is strongly controlled by lithologic variation. The first principal component, accounting for ~25% of the total variation, shows high positive loadings for Co, Ni, Mg, Cu, Fe, Ca and Sc, and negative loadings for Sn, U, Tl and Rb. Respectively, these element groupings form spatial patterns matching distribution of mafic volcanic rocks in the southwest and Kechika group sedimentary and mafic igneous rocks in the northeast part of the map area; and granite plutons throughout the map area. The second principal component, accounting for ~15% of the total variation, shows high loadings for Cd, As, Sb, Ag, Zn, Cu and Mo and forms a spatial trend matching the distribution of sedimentary rocks of the Earn, Finlayson, Klinkit groups and Snowcap assemblage that form a northwest trending package in the southwest part of the map area. Several base-metal skarn occurrences occur in this area suggesting that the second principal component may represent, in part, a mineralization signature for this deposit type. Regression analysis of these metals against the relevant principal component effectively filters these postulated terrane-effects resulting in enhanced responses elsewhere in the map area and preserving responses related to known occurrences in most instances. Levelling by dominant mapped geology has a more subdued effect on filtering the interpreted lithologic control. In order to reduce the impact this has on the WSM using this approach, certain elements were given low importance rankings or, in the case of Cd, were omitted for certain deposit types. Negative rankings were used in both approaches to help distinguish signatures of different deposit types that have similar metal associations.

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 (10 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 anomalism. Given the likelihood that a mineralization 'signal' would be progressively diluted with increasing catchment size, marginally high WSM scores in large catchments could also be of interest.

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	VMS (felsic); SEDEX (high Ag); Pb-Zn skarn							2	3	3				1	-1				-1		
Porphyry Cu-Mo	Cu skarn; Porphyry Mo; Cu-Ag vein; VMS					4	3			2											
Intrusion-related Au	Epithermal Au										4	3			-1	1				1	
Epithermal Au-Ag	Intrusion-related Au; Polymetallic Ag-Pb-Zn									3	3	2				1		1			
Pb-Zn skarn	VMS; SEDEX (low Ag)					1		2	5	1					2					1	1
Sn skarn	W skarn; Pb-Zn skarn							1	1			2			4					2	
W skarn	Sn skarn; Porphyry W																1			1	3

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

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

LEGEND

- Town
- Mineral Occurrence
- Road
- Contour
- River
- NTS map sheet
- Water Body
- Wetland
- Sample Location
- Catchment
- Catchments >10 km²

Weighted sums model (PC residuals)

Pb-Zn skarn 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 105B (Yukon MINFILE, 2015)

Number	Name	Type	Status	Commodities
105B 001	WILDCAT	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Gold, Lead, Silver, Zinc
105B 002	STERLING	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Arsenic, Gold, Silver, Zinc, Lead, Copper
105B 003	LUCK	Manto Polymetallic Ag-Pb-Zn	Prospect	Antimony, Tungsten, Zinc, Silver, Copper, Lead, Gold
105B 004	FIDDLER	Skarn W	Drilled Prospect	Copper, Silver, Zinc, Tungsten, Lead
105B 005	ANNE	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Zinc, Silver
105B 006	LENA	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver
105B 007	DALE	Vein Polymetallic Ag-Pb-Zn±Au	Past Producer	Lead, Gold, Zinc, Silver, Copper
105B 008	HOLLIDAY	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Lead, Gold, Copper, Silver, Zinc
105B 009	TIGER	Unknown	Unknown	
105B 010	TROY	Porphyry Cu-Mo-Au	Anomaly	Copper
105B 011	CARLICK	Unknown	Showing	Antimony, Zinc, Arsenic, Silver, Gold
105B 012	SHILSKY	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Silver
105B 013	KUBIAK	Skarn Pb-Zn	Drilled Prospect	Lead, Zinc
105B 014	RANCHERIA	Unknown	Unknown	
105B 015	BLACKROCK	Unknown	Unknown	Copper, Silver, Lead, Zinc
105B 016	KODIAK	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Copper, Zinc, Gold, Lead, Silver
105B 017	HARDTACK	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Lead, Silver, Zinc
105B 018	KERNS	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Copper, Lead, Silver, Tungsten, Zinc
105B 019	BRODHAGEN	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Copper
105B 020	NIGHT	Skarn W	Drilled Prospect	Gold, Lead, Silver, Zinc, Copper, Tungsten, Uranium
105B 021	SILVER HART	Vein Polymetallic Ag-Pb-Zn±Au	Deposit	Silver, Zinc, Lead
105B 022	AURORA	Skarn Pb-Zn	Prospect	Gold, Zinc, Tungsten, Silver, Molybdenum, Manganese, Lead
105B 023	SNOW	Vein Polymetallic Ag-Pb-Zn±Au	Unknown	
105B 024	ALMOST	Unknown	Prospect	Copper, Silver, Tungsten
105B 025	HIDDEN	Skarn Pb-Zn	Anomaly	Copper, Gold, Lead, Silver, Zinc, Tungsten
105B 026	ATOM	Skarn Pb-Zn	Drilled Prospect	Bismuth, Zinc, Lead, Silver
105B 027	BAR	Skarn Pb-Zn	Drilled Prospect	Copper, Zinc, Silver, Lead, Gold
105B 028	BOM	Skarn Pb-Zn	Drilled Prospect	Gold, Lead, Silver, Tin, Zinc
105B 029	MUNSON	Skarn Pb-Zn	Drilled Prospect	Lead, Silver, Tungsten, Zinc
105B 030	PARTRIDGE	Skarn Sn	Prospect	Lead, Zinc, Tin
105B 031	MOD	Skarn Pb-Zn	Showing	Lead, Zinc, Silver, Tungsten, Tin
105B 032	GEM	Gemstone Schist-hosted emerald	Anomaly	
105B 033	REGGIE	Unknown	Unknown	
105B 034	PLATE	Volcanogenic Sulphide - type not determined	Anomaly	Barium, Lead, Tin, Silver, Copper, Gold
105B 035	GODDART	Skarn Pb-Zn	Drilled Prospect	Silver, Tin, Zinc
105B 036	SCREW	Skarn Pb-Zn	Showing	Copper, Silver, Lead, Zinc, Tungsten
105B 037	SMART	Unknown	Unknown	
105B 038	LOGJAM	Vein Polymetallic Ag-Pb-Zn±Au	Deposit	Silver, Gold, Zinc, Lead
105B 039	LOGTUNG	Porphyry W	Deposit	Molybdenum, Tungsten, Tungsten Trioxide, Beryl
105B 040	JC	Skarn Sn	Drilled Prospect	Copper, Tin, Zinc, Silver
105B 041	POULIN	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Zinc, Silver
105B 042	TROUT	Vein Barite-Fluorite	Showing	
105B 043	MUNG	Unknown	Anomaly	Copper, Molybdenum
105B 044	IRVINE	Skarn Pb-Zn	Showing	Lead, Silver, Zinc
105B 045	SHOOTAMOOK	Epithermal Au-Ag-Cu: High Sulphidation	Drilled Prospect	Arsenic, Silver, Gold
105B 046	TUNG	Skarn W	Showing	Molybdenum, Tungsten
105B 047	CABIN	Skarn W	Anomaly	Tungsten
105B 048	MOOSELICK	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Cobalt, Gold, Silver, Copper
105B 049	DOME	Unknown	Unknown	Copper
105B 050	OLD GOLD	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Copper, Gold, Silver
105B 051	RAINBOW	Vein Polymetallic Ag-Pb-Zn±Au	Anomaly	Copper
105B 052	PORCUPINE	Ultramafic-hosted asbestos	Showing	Asbestos, Copper, Zinc
105B 053	HOHO	Unknown	Unknown	
105B 054	OULETTE	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Drilled Prospect	Lead, Zinc, Silver
105B 055	POGGEN	Unknown	Unknown	
105B 056	ZAK	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Copper, Zinc, Lead, Nickel
105B 057	ROY	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Antimony, Lead, Gold, Silver, Zinc
105B 058	BINGY	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver, Zinc
105B 059	FAG	Vein Polymetallic Ag-Pb-Zn±Au	Prospect	Lead, Zinc, Silver
105B 060	DEATH	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Silver
105B 061	JUNKER	Unknown	Unknown	
105B 062	SWAMP	Unknown	Unknown	
105B 063	LIARD	Unknown	Unknown	
105B 064	BOWEL	Unknown	Unknown	
105B 065	BOWER	Unknown	Unknown	
105B 066	BOWL	Unknown	Unknown	
105B 067	BOWLEG	Unknown	Unknown	
105B 068	DAUGHNEY	Unknown	Unknown	
105B 069	LOCK	Unknown	Unknown	
105B 070	CAN	Skarn Sn	Drilled Prospect	Copper, Garnet, Gemstones, Silver, Tin
105B 071	TELEVISION	Unknown	Unknown	
105B 072	NEGRO	Unknown	Unknown	
105B 073	CURRENT	Skarn Sn	Prospect	Copper, Tin, Tungsten, Zinc
105B 074	POOLE	Porphyry W	Showing	Tungsten, Uranium
105B 075	HAKE	Unknown	Anomaly	
105B 076	MORK	Unknown	Anomaly	
105B 077	PYKE	Vein Polymetallic Ag-Pb-Zn±Au	Anomaly	Copper, Lead, Zinc, Silver
105B 078	VERLEY	Porphyry W	Showing	Copper, Silver, Molybdenum, Uranium, Tungsten, Tin, Thorium
105B 079	SKIN	Vein and Greisens Sn	Showing	Tin
105B 080	SLOUCE	Skarn Sn	Showing	Copper, Tin, Zinc, Tungsten, Molybdenum
105B 081	DUVAL	Vein and Greisens Sn	Showing	Tin
105B 082	PONT	Skarn Sn	Anomaly	Tin
105B 083	SIN	Porphyry Sn	Showing	Tin
105B 084	DU	Vein and Greisens Sn	Showing	Tin
105B 085	TIN	Skarn Sn	Showing	Tin, Tungsten
105B 086	CUSP	Vein and Greisens Sn	Drilled Prospect	Beryl, Tin, Gemstones, Zinc, Tungsten
105B 087	MCPRES	Porphyry Cu-Mo-Au	Prospect	Copper, Silver, Molybdenum
105B 088	SMITH	Skarn Sn	Drilled Prospect	Gold, Zinc, Silver, Tin
105B 089	JENNINGS	Skarn W	Showing	Molybdenum, Tungsten
105B 090	SWIFT	Skarn Mo	Unknown	Molybdenum
105B 091	KLINKIT	Unknown	Unknown	
105B 092	SHERMAN	Unknown	Unknown	
105B 093	RALFS	Skarn W	Unknown	
105B 094	OLSSON	Unknown	Anomaly	
105B 095	TAT	Unknown	Showing	Uranium
105B 096	LICK	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver, Zinc, Uranium
105B 097	URP	Skarn W	Showing	Copper, Fluorite, Molybdenum, Silver, Zinc, Tungsten, Lead
105B 098	LITTLE MOOSE	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Copper, Gold, Lead, Silver, Zinc
105B 099	LOGAN	Vein Polymetallic Ag-Pb-Zn±Au	Deposit	Silver, Zinc, Tin, Lead, Copper
105B 100	PETERS	Unknown	Anomaly	Uranium
105B 101	CORDILLERAN	Porphyry W	Drilled Prospect	Copper, Zinc, Tungsten, Silver, Gold, Lead
105B 102	FREER	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Copper, Lead, Zinc, Silver, Gold
105B 103	THRALL	Porphyry Cu-Mo-Au	Showing	Copper, Silver, Molybdenum
105B 104	TEAM	Skarn W	Showing	Tungsten, Zinc
105B 105	STOLLERY	Sediment hosted Stratiform Barite	Showing	Barium
105B 106	URSUS	Skarn W	Showing	Tin, Tungsten
105B 107	MOOSE	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Zinc, Silver
105B 108	REGIONAL	Porphyry Cu-Mo-Au	Anomaly	Molybdenum, Tin, Tungsten
105B 109	OAKE	Vein Polymetallic Ag-Pb-Zn±Au	Anomaly	Copper
105B 110	LEAF	Unknown	Unknown	
105B 111	DORSEY	Unknown	Anomaly	Tin
105B 112	HOLLISTER	Skarn Sn	Anomaly	Tungsten
105B 113	STEPHENS	Skarn Pb-Zn	Showing	Lead, Zinc, Silver
105B 114	MEISTER RIVER	Manto Polymetallic Ag-Pb-Zn	Drilled Prospect	Lead, Silver, Zinc
105B 115	STONEAXE	Skarn W	Prospect	Tungsten, Zinc
105B 116	BRX	Unknown	Unknown	
105B 117	HIGHMARK	Unknown	Unknown	
105B 118	PISTOL	Unknown	Unknown	
105B 119	CRESCENT	Unknown	Anomaly	
105B 120	KARTUHINI	Skarn Pb-Zn	Showing	Lead, Silver, Tin
105B 121	RAKE	Unknown	Unknown	
105B 122	ABBOTT	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Copper, Zinc, Lead, Silver
105B 123	HEAD	Manto Polymetallic Ag-Pb-Zn	Anomaly	Gold, Lead, Silver
105B 124	SILVER CREEK	Vein Polymetallic Ag-Pb-Zn±Au	Prospect	Lead, Zinc, Silver
105B 125	KARVINEN	Unknown	Anomaly	Lead, Silver, Zinc
105B 126	ELECTRICITY	Skarn W	Showing	Lead, Rare Earths, Molybdenum, Uranium, Tungsten, Tantalum
105B 127	VERONICA	Manto Polymetallic Ag-Pb-Zn	Showing	Lead, Silver
105B 128	KR	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver, Zinc, Strontium, Manganese
105B 129	LOWEY	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Cadmium, Zinc, Silver, Gold, Lead
105B 130	TANANA	Unknown	Unknown	
105B 131	ROI	Unknown	Staked - No Work Recorded	
105B 132	STACK	Unknown	Unknown	
105B 133	SCHELLENBURG	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Germanium, Lead, Silver
105B 134	GOAT LAKE	Unknown	Staked - No Work Recorded	
105B 135	GOLDEX	Vein Polymetallic Ag-Pb-Zn±Au	Anomaly	Copper, Zinc, Molybdenum
105B 136	BREN	Unknown	Unknown	Gold
105B 137	SCURVY	Unknown	Unknown	
105B 138	HAIRSINE	Manto Polymetallic Ag-Pb-Zn	Showing	Gold, Zinc, Lead, Silver
105B 139	FAIRFIELD	Unknown	Showing	Lead, Zinc, Silver
105B 140	TIM	Unknown	Showing	Lead, Silver
105B 141	EAGLE	Unknown	Unknown	
105B 142	FOX	Unknown	Unknown	Gold
105B 143	CONVERT	Volcanogenic Massive Sulphide (VMS) Kuroko Cu-Pb-Zn	Drilled Prospect	Copper, Silver, Zinc, Lead
105B 144	CABIN LAKE	Volcanogenic Sulphide - type not determined	Showing	Copper

RECOMMENDED CITATION

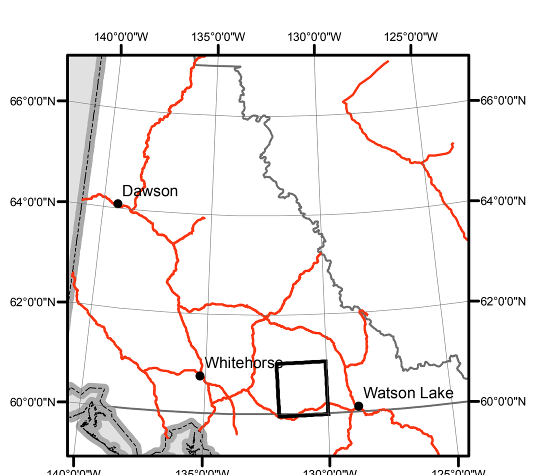
MACKIE, R., ARNE, D. AND PENNIMPEDE, C., 2016. Weighted sums model for Pb-Zn skarn deposits using principal component residuals. In: Enhanced interpretation of stream sediment geochemical data for NTS 105B . Yukon Geological Survey, Open File 2015-8, scale 1:250 000, sheet 10 of 15.

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 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 9

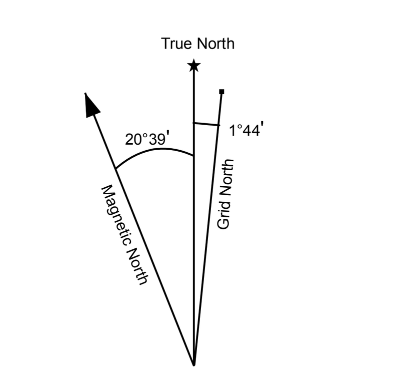
CONTOUR INTERVAL 100 FEET
Elevations in metres above Mean Sea Level

Pb-Zn skarn
Weighted sums model
(Principal Component Residuals)
Sheet 10 of15

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

105F QUIET LAKE	105G FINLAYSON LAKE	105H FRANCES LAKE
105C TESLIN	105B THIS MAP	105A WATSON LAKE
104N ATLIN	104O JENNINGS RIVER	104P MCDAME

REFERENCES

Geological Survey of Canada, 1979, Regional stream sediment and water geochemical reconnaissance data, Yukon Territory (105B). Geological Survey of Canada Open File 563, revised 1980.

Geological Survey of Canada, 1986. Regional stream sediment and water geochemical reconnaissance data, southern Yukon, NTS 105B. Geological Survey of Canada, Open File 1289.

Jackaman, W., 2015. Regional stream sediment geochemical data, Wolf Lake area, southern Yukon (NTS 105B). Yukon Geological Survey, Open File 2015-6.

Mackie, R., Arne, D. and Brown, O., 2015. Enhanced interpretation of regional stream sediment (RGS) geochemical data from 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.

Yukon Geological Survey
Energy, Mines and Resources
Government of Yukon

Open File 2016-8

Weighted sums model for Pb-Zn skarn deposits using principal component residuals (NTS 105B) Sheet 10 of 15

by

Rob Mackie, Dennis Arne,
and Chris Pennimpede