Yukon Geological Survey

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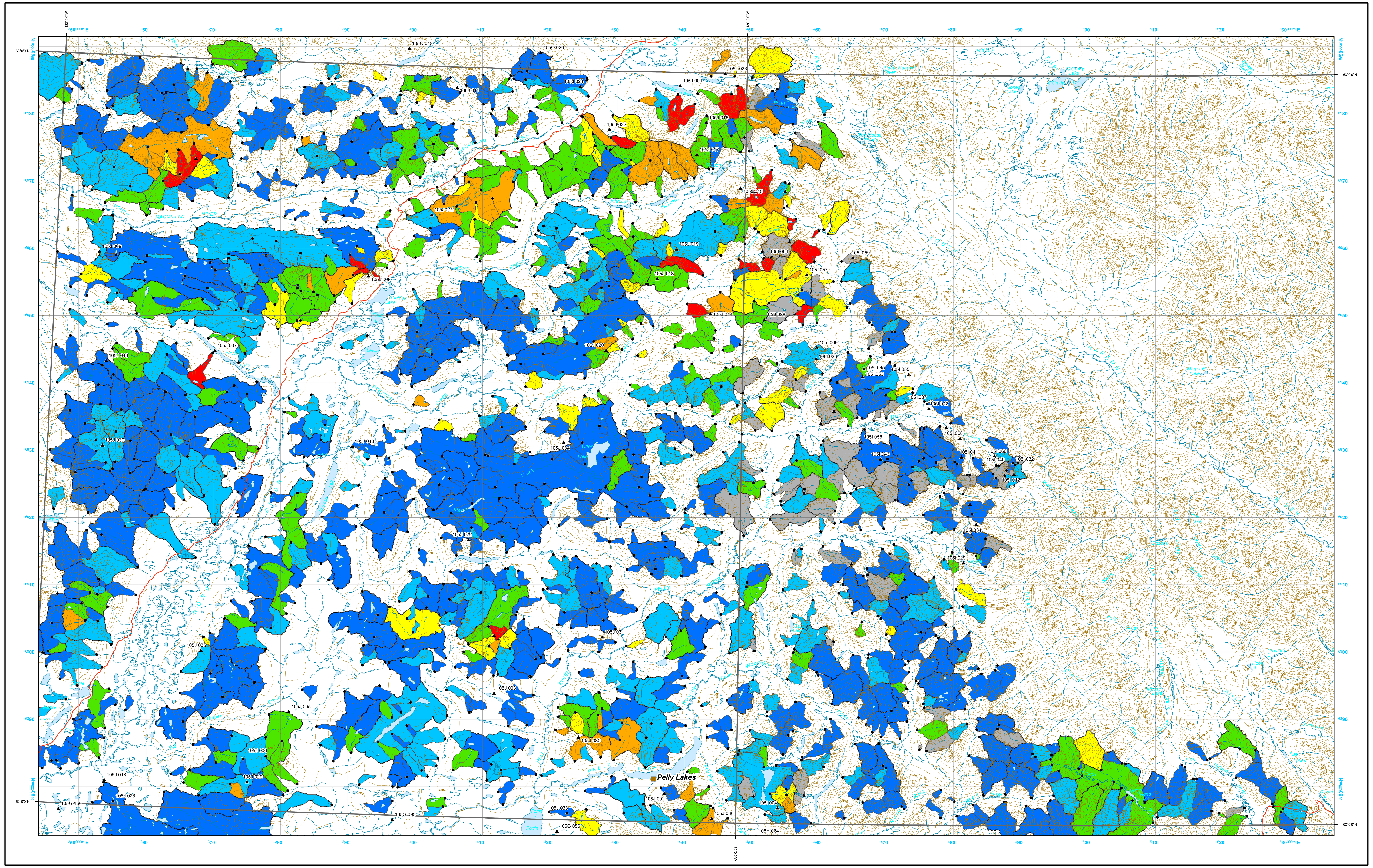

INTRODUCTION

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 Little Nahanni River (105I) and Sheldon Lake (105J) map areas were collected and analysed in several stages. The Little Nahanni River map area (105I) was sampled at reconnaissance-scale in 1981 (Goodfellow, 1982). Field descriptions and initial geochemical data for 984 sites were released by in Geological Survey of Canada ("GSC") Open File 868. Archived sample materials from this survey were re-analyzed in two subsequent projects as outlined by Friske *et al.* (1999) and McCurdy *et al.*, (2009). Only samples located within Yukon are included the current assessment. The Sheldon Lake map area (105J) was sampled in 1989 (Hornbrook *et al.*, 1990). Field descriptions and initial geochemical data for 886 samples were released in GSC Open File 2173. The re-analysis of archive sample materials is described by Friske *et al.*, (2008) in GSC Open File 5694 and Yukon Geological Survey ("YGS") Open File 2008-4. The reader is referred to these open files for detailed descriptions of sampling techniques, analytical procedures, and quality control measures.

MINERAL OCCURRENCES

A variety of base and precious-metal mineralization deposit types are known to occur in the region as shown in Table 1 (Yukon MINFILE, 2015). Five main deposit types occur within the study area including sedimentary exhalative Pb-Zn (Howards Pass and Anniv deposits), Pb-Zn skarn (Riddell, Hench and Nar prospects), W skarn (Dragon and Clea prospects), Polymetallic Ag-Pb-Zn veins (Norken and Nom prospects), and Cu-Ag veins (Pike Deposit). The Tom and Jason Pb-Zn SEDEX and Mactung W skarn deposits occur in the adjacent map area to the north, further supporting the prospectivity of the region for these types of deposits.

WEIGHTED SUMS MODELING

As described in the report accompanying this map (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. Weighted sums models (WSM) have been generated using the processed data. Importance rankings used in the WSM for a variety of deposit types are summarized in Table 2. Each model is optimized for a specific deposit type however multiple 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 shows that lithological variation has a strong influence on the distribution of many commodity and pathfinder elements. The first principal component, accounting for 30% of the total variation, shows high positive loadings for Cd, Mo, Ag, Hg, Sb, Ba, Zn and V, and matches the distribution of Road River Group sedimentary rocks that include shale horizons that are likely to be elevated in these metals. The second principal component shows high positive loadings in Ni, As, Zn, Co and Cu, and corresponds to regions of clastic sedimentary rocks of the Earn and Hyland groups. The Hyland Group rocks are also associated with elevated Mn and Fe as indicated by the element groupings in the third principal component. Regression analysis of these metals against the relevant principal component effectively filters the lithological control while preserving, and in some cases enhancing, responses related to know occurrences.

For certain pathfinder elements (*e.g.*, Cd, Mo and Ag), levelling by dominant mapped geology has a more subdued effect on filtering the interpreted lithological control. In order to reduce this effect in the WSM, these elements were given lower importance rankings, or in some cases were omitted. Strong responses for Zn and Pb related to SEDEX mineralization prevented using these elements as pathfinders for other deposit types. In fact, to subdue the contributions related to this style of mineralization, Pb and Zn were given negative importance rankings for other deposit styles. In the case of the WSM for porphyry copper using data levelled by mapped geology, a negative importance was assigned to Zn to minimize responses related to 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 (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 for samples with large catchments may also be significant.

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

Number	Names	Type	Status	Commodities
105I 004	NAR	Skarn Pb-Zn	Drilled Prospect	Copper, Silver, Tungsten
105I 006	CLEA	Skarn W	Drilled Prospect	Copper, Tungsten
105I 007	BIRR	Skarn Cu	Showing	Barite, Copper
105I 008	NOM	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Copper, Silver, Gold
105I 012	XY DEPOSITS	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Deposit	Zinc, Lead
105I 029	SUMMIT	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Anomaly	Lead
105I 032	HP DEPOSIT	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Deposit	Zinc, Lead, Silver, Vanadium, Copper, Cadmium, Nickel
105I 037	ANNIV DEPOSITS	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Deposit	Lead, Zinc, Silver
105I 038	ABBEY	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Drilled Prospect	Lead, Zinc
105I 040	WINKIE	Unknown	Drilled Prospect	Lead, Zinc
105I 041	NESS	Unknown	Anomaly	Lead, Zinc, Nickel
105I 042	GULL	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Anomaly	Copper, Zinc, Lead
105I 043	DIANNE	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Showing	Barite, Copper, Zinc
105I 044	TAM	Sediment hosted Shale-Hosted Ni-Zn-Mo-PGE (Nick)	Anomaly	Copper, Nickel, Silver, Zinc
105I 053	OP ZONES	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Deposit	Zinc, Lead
105I 064	ROOK	Skarn W	Showing	Copper, Tungsten, Zinc
105J 002	BILL	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Copper, Lead, Zinc, Silver
105J 003	PIKE	Vein Cu±Ag Quartz	Deposit	Silver, Copper, Zinc, Gold, Lead
105J 004	NORKEN	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Copper, Zinc, Lead, Silver
105J 006	TAC	Porphyry Mo (Low F-Type)	Anomaly	Copper, Molybdenum
105J 007	DRAGON	Skarn W	Drilled Prospect	Arsenic, Copper, Tungsten, Lead, Silver, Gold
105J 008	MT SHELDON	Unknown	Showing	Arsenic, Gold, Silver, Tungsten, Tin, Tellurium, Bismuth, Copper
105J 009	RIDDELL	Skarn Pb-Zn	Drilled Prospect	Copper, Gold, Silver, Zinc, Lead
105J 010	SPEARHEAD	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Copper, Gold
105J 011	IVOR	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Prospect	Copper, Gold, Silver, Zinc
105J 012	ROG	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Drilled Prospect	Zinc
105J 013	CLYDE	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Prospect	Copper, Zinc, Tungsten, Lead
105J 014	PREVOST	Skarn W	Prospect	Tungsten
105J 015	GUN	Skarn Pb-Zn	Showing	Barite, Zinc, Copper
105J 016	ITSI	Manto & Stockwork Sn	Drilled Prospect	Copper, Lead, Tin, Tungsten, Zinc, Silver, Gold
105J 017	COSTIN	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Gold, Zinc, Lead, Silver
105J 018	CAROLYN	Coal	Unknown	Coal
105J 019	VARISCITE	Skarn Cu	Showing	Copper
105J 022	RICH	Unknown	Anomaly	Barite, Zinc, Copper, Lead
105J 023	PETE	Sediment hosted Stratiform Barite	Drilled Prospect	Barite, Lead, Zinc
105J 024	COCO	Sediment hosted Stratiform Barite	Showing	Barite
105J 025	ST GODARD	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Showing	Barite
105J 029	HENCH	Skarn Pb-Zn	Drilled Prospect	Copper, Silver, Zinc, Lead
105J 030	MARYLOU	Skarn Pb-Zn	Prospect	Copper, Silver, Tungsten, Zinc, Lead, Molybdenum
105J 033	FORTIN	Unknown	Unknown	Gold
105J 035	SASK	Skarn Mo	Showing	Copper, Gold, Lead, Molybdenum, Silver, Zinc
105J 036	GULF	Skarn W	Showing	Copper, Tungsten
105J 038	FLOOD	Epithermal Au-Ag: Low Sulphidation	Anomaly	Gold, Silver
105J 039	WENDY	Vein Au-Quartz	Showing	Arsenic, Gold, Silver
105J 040	NARL	Skarn Pb-Zn	Showing	Copper, Lead, Zinc
105J 043	VG	Vein Au-Quartz	Showing	Gold, Silver
105I 058	RITZ	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Drilled Prospect	
105J 001	FULLER	Unknown	Anomaly	
105I 055	MAKOO	Unknown	Unknown	
105J 034	DYAK	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Anomaly	
105J 032	CANOL	Unknown	Anomaly	
105I 065	CANDY	Unknown	Anomaly	
105I 057	PIMA	Unknown	Unknown	
105I 066	BRODEL	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Deposit	Zinc, Lead
105I 067	HC DEPOSITS	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Deposit	Zinc, Lead
105I 068	DON DEPOSITS	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Deposit	Zinc, Lead
105I 069	PELLY NORTH	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Deposit	Zinc, Lead
105I 036	ORO	Sediment hosted Stratiform Barite	Drilled Prospect	Barite, Zinc, Lead
105I 045	DORITA	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Anomaly	Copper, Zinc, Lead
105J 031	GREGGIE	Unknown	Anomaly	
105I 035	TULLY	Unknown	Unknown	
105J 005	BIG TIMBER	Unknown	Anomaly	
105J 020	MACRAE	Unknown	Anomaly	
105J 028	BOJO	Unknown	Anomaly	
105I 059	PHEASCO	Skarn W	Anomaly	
105I 034	BLACK GIANT	Sediment hosted Sedimentary Exhalative Zn-Pb-Ag (Sedex)	Anomaly	

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[1]
Polymetallic Ag-Pb-Zn	SEDEX (high Ag); VMS					2		3	3	4		1		1		1			1		
SEDEX Pb-Zn	Pb-Zn skarn; VMS; Polymetallic Ag-Pb-Zn						-3	3	4				2	2		1	-2		1		-3
Sediment-hosted Ni-Mo-Zn					4		3	1													
Intrusion-related Au	Epithermal Au-Ag							-1	-1		4	2								2	
Epithermal Au-Ag	Intrusion-related Au							-1	-1	4	3	2				1		3			
Porphyry Cu-Mo	Cu-Au porphyry; Cu skarn; Mo porphyry					4	3	-1	-1	2	1										-2
W skarn																				2	3
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 both vein and manto styles; VMS = volcanic hosted/associated massive sulphide; SEDEX = sedimentary exhalative; Hydromorphic Anomaly = principal component 5.

[1] For heavily censored elements raw data are used, rather than residuals, following a log_{10} transformation.

LEGEND

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

Weighted sums model (PC residuals)

W Skarn deposits

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

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Friske, P.W.B., Hornbrook, E.H.W., McCurdy, M.W., Day, S.J.A., McNeil, R.J., Lynch, J.J., Durham, C.C., Gross, H. and Galletta, A.C., 2008. Regional stream sediment and water geochemical data, Sheldon Lake area, east-central Yukon (NTS 105J). Geological Survey of Canada, Open File 5694, Yukon Geological Survey, Open File 2008-4.

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RECOMMENDED CITATION

MACKIE, R., ARNE, D. AND PENNIMPEDE, C., 2015. Weighted sums model for W Skarn deposits using principal component residuals. In: Enhanced interpretation of stream sediment geochemical data for NTS map sheet 105I and 105J. Yukon Geological Survey, Open File 2015-31, scale 1:250 000, sheet 16 of 17.

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.

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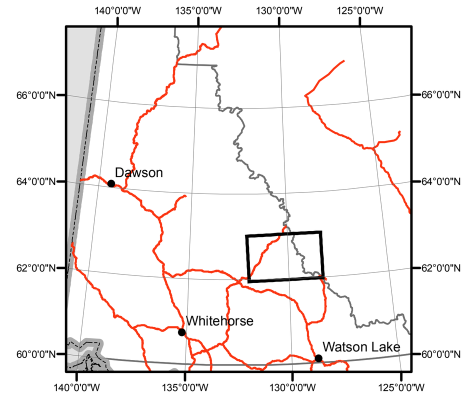

1:250 000-scale topographic base data produced by CENTRE FOR TOPOGRAPHIC INFORMATION, NATURAL RESOURCES CANADA

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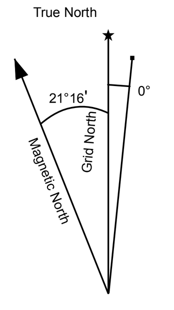
ONE THOUSAND METRE GRID
Universal Transverse Mercator Projection
North American Datum 1983
Zone 9

CONTOUR INTERVAL 100 FEET
Elevations in metres above Mean Sea Level

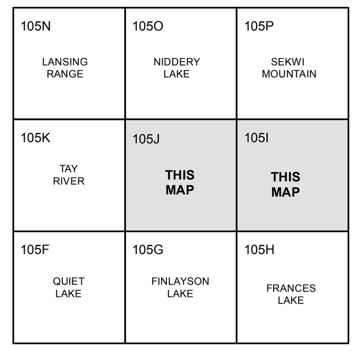
W Skarn Deposits
Weighted sums model
(Principal Component Residuals)
Sheet 16 of 17

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



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Government of Yukon

Open File 2015-31

Weighted sums model for W Skarn deposits using principal component residuals (NTS 105I and 105J) Sheet 16 of 17

by

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