Yukon Geological Survey

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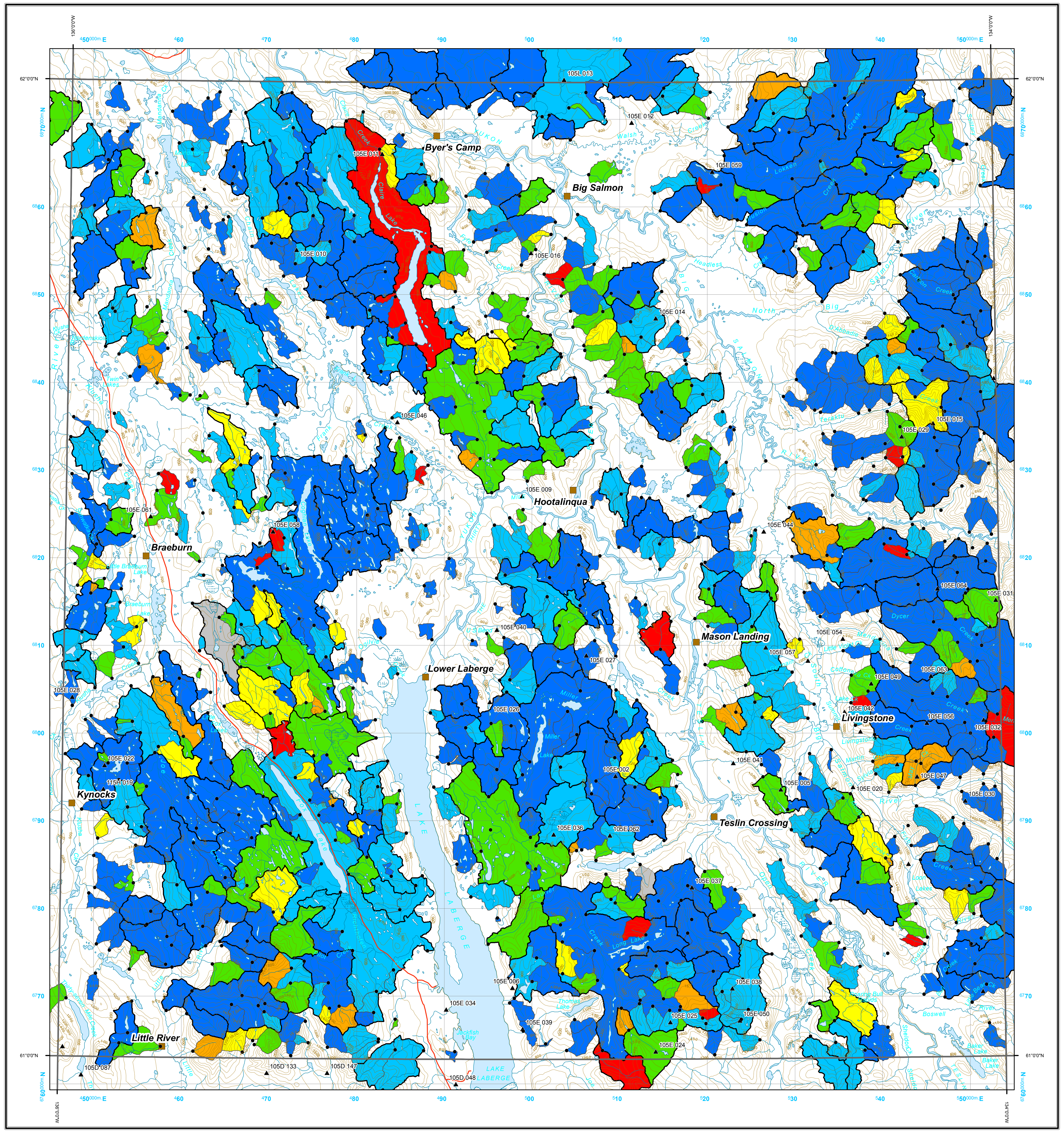
Yukon
Energy, Mines and Resources



INTRODUCTION

New geochemical data from re-analysis of archived stream sediment samples have been assessed using weighted sums modeling and catchment basin analysis, 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 portion of Yukon.

SAMPLING AND ANALYSIS PROGRAMS

Regional stream sediment and water samples from the Lake Laberge map area (NTS 105E) were collected at a reconnaissance scale in 1988 as part of the National Geochemical Reconnaissance program under the Canada-Yukon Mineral Development Agreement (Hornbrook & Friske, 1989). Field descriptions and geochemical data for 908 sites were initially released in Geological Survey of Canada ("GSC") Open File 1960 (Hornbrook & Friske, 1989). As part of the Yukon Database Upgrade Project, archived sample material was re-analyzed by Induced Coupled Plasma Mass Spectrometry following an aqua regia digestion. The new geochemical data were released in Yukon Geological Survey ("YGS") Open File 2015-7 (Jackaman, 2015). The reader is referred to these open files for details regarding sampling techniques, analytical procedures and quality control and assurance.

MINERAL OCCURRENCES

A variety of types of base and precious-metal mineralization have been documented in the map area as summarized in Table 1 (Yukon MINFILE, 2015). The most notable occurrences are classed as Cu±Ag-Pb-Zn skarn (Laberge prospect; Dycer and D'Abbadie showings), Polymetallic Ag-Pb-Zn±Au vein (Loon Prospect; RK, Deet, Livingston and Sylvia showings) and Cu-Mo porphyry (TUV Prospect). Additional deposit types include Cu-Ag vein, Mo porphyry, W skarn, Sb-As-Ni-Co and quartz vein Au. Notably, there are no occurrences that are considered 'deposits' within the map area. However, both the Red Mountain Mo porphyry and Whitehorse Cu skarn deposits occur in the adjacent map sheet area, towards the south (105D).

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. The other uses residuals calculated from regression against principal components. 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. The ability to validate the models against known occurrences is limited for this map area because it contains relatively few mineral occurrences and drainage basins for several of the more significant occurrences have not been sampled.

Exploratory data analysis of both raw element data and principal components shows that the distribution of many commodity and pathfinder elements is related to lithological variation. For example, the first principal component, accounting for ~27% of the total variation, shows high positive loadings for Sr, Ca, LOI, Se, Hg and Cu, and high negative loadings for Ce, Th, La, Li, Rb and Pb. These element groupings form spatial trends that correspond with clastic and carbonate rocks of the Lewes River Group and felsic intrusive rocks of the Cassiar Suite, respectively. The second principal component with high loadings in V, Sc, Co, Fe and Cr matches the distribution of mafic volcanic rocks. The third principal component with high loadings in Ni, As, Ag, Sb, Cd, Mo and Zn corresponds to a package of rocks in the northeastern part of the map area consisting of mafic and ultramafic intrusions, mafic volcanic rocks, graphitic phyllite, argillite and carbonate. Regression analysis of these metals against the relevant principal component effectively subdued these terrane-effects while preserving responses related to known occurrences. Levelling by dominant mapped geology has a more subdued effect on filtering the interpreted geologic control for certain elements (*e.g.*, Bi, Hg). In order to reduce the impact of this on WSM using this approach these elements were given low importance rankings, or were omitted, for certain deposit types. The models generated using the two approaches for a given deposit type show only subtle differences for this map area.

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 area, marginally high WSM scores for samples in large catchments could also be of interest.

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

Number	Name	Type	Status	Commodities
105E 001	LIVINGSTON	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Copper, Silver, Lead, Gold
105E 002	TUV	Porphyry Cu-Mo-Au	Drilled Prospect	Copper, Molybdenum, Silver, Magnetite, Fluorite, Gold, Lead
105E 003	LOON	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Copper, Gold, Lead, Silver
105E 006	LABERGE	Skarn Cu	Drilled Prospect	Copper
105E 008	RUTH	Skarn Cu	Showing	Copper, Silver, Zinc
105E 010	PACKERS	Skarn Cu	Showing	Copper
105E 011	CLAIRE	Coal	Unknown	Coal
105E 012	WALSH	Coal	Showing	Coal
105E 014	SEMENOF	Vein Cu±Ag Quartz	Showing	Copper, Gold, Silver
105E 015	ILLUSION	Ultramafic-hosted asbestos	Showing	Chrysotile
105E 016	CASSIER BAR	Vein Cu±Ag Quartz	Showing	Copper, Silver
105E 020	SYLVIA	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Copper, Gold, Zinc, Silver, Lead
105E 022	CORDUROY	Coal	Drilled Prospect	Coal
105E 024	HIG	Porphyry Alkalic Cu-Au	Showing	Copper, Molybdenum
105E 025	LORI	Porphyry Mo (Low F-Type)	Showing	Copper, Molybdenum
105E 026	MUSTARD	Vein Au-Quartz	Showing	Gold
105E 027	BACON	Porphyry Mo (Low F-Type)	Showing	Copper, Gold
105E 028	KLUSHA	Coal	Drilled Prospect	Coal
105E 030	SALMON	Skarn W	Showing	Tungsten
105E 031	HITCHENS	Skarn W	Showing	Tungsten
105E 039	AKEL	Unknown	Anomaly	Gold
105E 040	OVOAS	Unknown	Anomaly	Gold
105E 041	ENOF	Unknown	Anomaly	Gold
105E 042	LAKE	Vein Au-Quartz	Showing	Gold
105E 043	GERM	Unknown	Anomaly	Gold
105E 044	PRESTON	Unknown	Anomaly	Gold
105E 046	RANKL	Unknown	Anomaly	Gold
105E 047	MAYBE	Unknown	Anomaly	Gold, Lead
105E 053	DEET	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Antimony, Gold, Arsenic, Lead, Silver, Zinc
105E 057	MILNER	Coal	Anomaly	Coal
105E 061	BRABURN LIME	Limestone	Drilled Prospect	Limestone
105E 062	EGYPT	Unknown	Anomaly	Gold
105E 034	RICHTHOFEN	Unknown	Unknown	
105E 009	REEF	Unknown	Drilled Prospect	
105E 038	SLINE	Unknown	Anomaly	
105E 064	RK	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Bismuth, Cadmium, Silver, Lead
105E 063	NICKELINE	Ultramafic - Nickel	Showing	Antimony, Arsenic, Nickel, Cobalt
105E 065	DYCER	Skarn Cu	Showing	Copper, Tungsten, Lead
105E 054	TRERICE	Unknown	Unknown	
105E 037	CROST	Unknown	Anomaly	
105E 005	NAPUA	Unknown	Unknown	
105E 056	BRENDA	Unknown	Unknown	
105E 035	LITTLE BEAR	Unknown	Unknown	
105E 032	MENDOCINA	Unknown	Unknown	
105E 029	TERAKTU	Unknown	Unknown	
105E 059	FONE	Unknown	Anomaly	
105E 050	DEBICKI	Unknown	Unknown	
105E 049	LITTLE VIOLET	Unknown	Unknown	
105E 058	COUGHLAN	Unknown	Unknown	
105E 033	D'ABBADIE	Skarn Cu	Anomaly	
105E 036	AURIER	Unknown	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
Polymetallic Ag-Pb-Zn	SEDEX (high Ag); VMS; Pb-Zn skarn				-2			1	3	4		2				1				1	-1
VMS (Zn-rich)	SEDEX (low Ag); Pb-Zn skarn				-2	2		4	3	1			1	1				1	1		-1
Porphyry Cu-Mo	Cu skarn; Porphyry Mo; W skarn					4	4			2	1								1		
Intrusion-related Au	Epithermal Au				-1						4	3				1				2	
Epithermal Au-Ag	Intrusion-related Au; Polymetallic Ag-Pb-Zn				-1					3	4	2				1		1		-1	
W skarn	Sn skarn; Porphyry W						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.

LEGEND

- Town
- Mineral Occurrence
- Road
- Contour
- River
- NTS map sheet
- Water Body
- Wetland
- Sample Location
- 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

RECOMMENDED CITATION

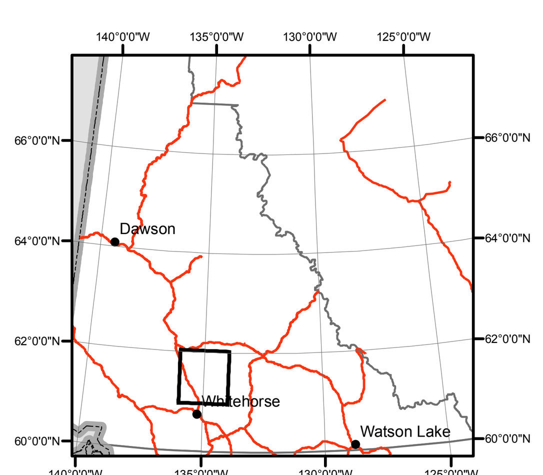
MACKIE, R., ARNE, D. AND PENNIMPEDE, C., 2016. Weighted sums model for Epithermal Au-Ag deposits using principal component residuals. In: Enhanced interpretation of stream sediment geochemical data for NTS 105E. Yukon Geological Survey, Open File 2016-9, scale 1:250 000, sheet 7 of 13.

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.

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

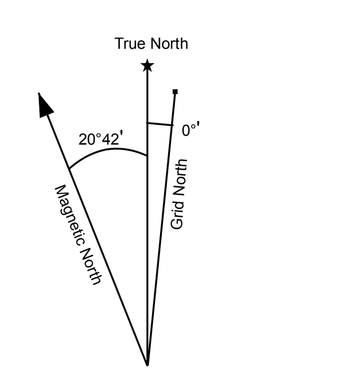
CONTOUR INTERVAL 100 FEET
Elevations in metres above Mean Sea Level

Epithermal Au-Ag
Weighted sums model
(Principal Component Residuals)
Sheet 7 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

115I CARMACKS	105L GLENLYON	105K TAY RIVER
115H AISHIHIK LAKE	105E THIS MAP	105F QUIET LAKE
105E DEZADEASH RANGE	105D WHITEHORSE	105C TESLIN

REFERENCES

Hornbrook, E.H. and Friske, P.W., 1989. National Geochemical Reconnaissance stream sediment and water geochemical data, southern central Yukon (105E). Geological Survey of Canada, Open File 1960.

Jackaman, W., 2015. Regional stream sediment geochemical data, Lake Laberge area, southern Yukon (NTS 105E). Yukon Geological Survey, Open File 2015-7.

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 2015-10.

Yukon MINFILE, 2010. Yukon MINFILE – A database of mineral occurrences. Yukon Geological Survey, www.data.geology.gov.yk.ca, accessed May 2015.

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Open File 2016-9

Weighted sums model for Epithermal Au-Ag deposits using principal component residuals (NTS 105E) Sheet 7 of 13

by

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