Yukon Geological Survey

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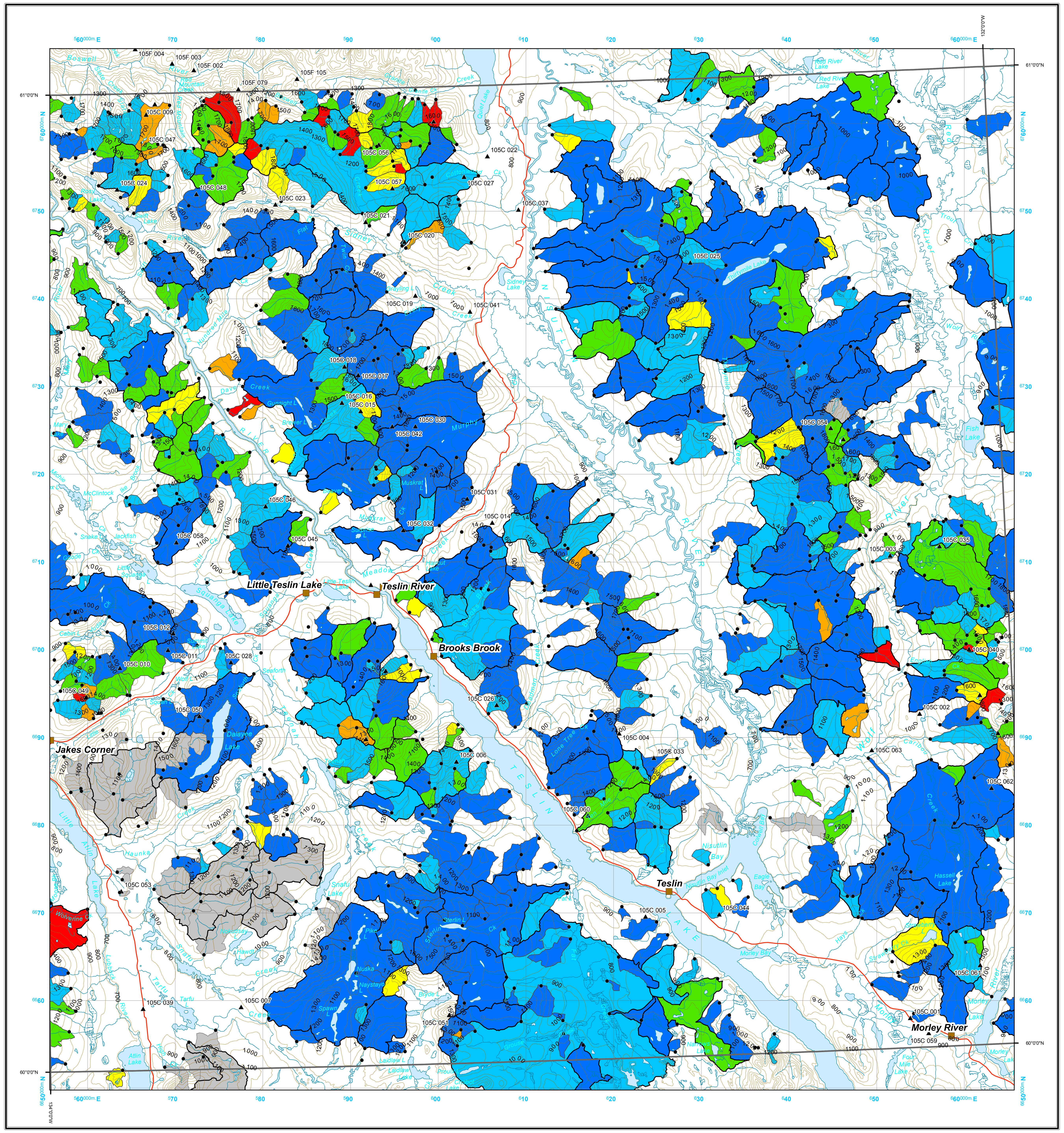
Yukon
Energy, Mines and Resources



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 part of Yukon.

SAMPLING AND ANALYSIS PROGRAMS

Stream sediment and water samples from the Teslin area (NTS 105C) were collected at a reconnaissance scale in 1985 as part of the Canada-Yukon Mineral Development Agreement (Geological Survey of Canada, 1986). Field descriptions and initial geochemical data for 865 sites were released in Geological Survey of Canada (GSC) Open File 1217. New geochemical data from the re-analysis of archive sample material were released in Yukon Geological Survey (YGS) Open File 2015-11 (Jackaman, 2015). Samples from sites located within currently protected areas were excluded from re-analysis. The current assessment examines only data for the 816 sites that are located outside of these protected areas and were selected for re-analyzed. 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 has been identified in the Teslin area as listed in Table 1 (Yukon MINFILE, 2015). Interestingly the Teslin Area contains relatively few mineral occurrences compared to surrounding map areas. The most significant deposits are classed as porphyry Mo (Red Mountain deposit), polymetallic Ag-Pb-Zn (Slate prospect and Sawas showing), unclassified quartz-vein related Au (Dalayee prospect) and volcanogenic massive sulphide (More and Iron Creek showings). Other deposit types within the area include Cu skarn (Ork and Hyder showings) and W-Sn skarn (Mindy and Mulligan prospects). While magmatic Ni-Cu-PGE mineralization has not been documented in the Teslin area, several mafic-ultramafic bodies have been mapped in the region suggesting at least some prospectivity for this deposit type.

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 selected principal components. Weighted sums models (WSM) have been generated using the processed data. 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. Importantly, the area of Cu skarn mineralization in the vicinity of Whitehorse has not been effectively sampled which limits the ability to validate the model presented for this deposit type.

Exploratory data analysis using both raw element data and principal components indicate that lithological variation and secondary scavenging affect the distribution of certain commodity and pathfinder elements. The first principal component, accounting for ~30% of the total geochemical variation, high positive loadings for Ni, Cr, Mg, Co, Cu, Sc and Ca; and high negative loadings for La, Rb, Ce, U, Th Tl, Li and Bi. Respectively, these element groupings are consistent with that expected for sediments derived from mafic and felsic rocks, and show a spatial pattern matching their mapped distribution. The second component with high positive loadings for Ag, Cd, Loss-on-ignition (LOI) and Hg. Using LOI as a proxy for organic carbon it is interpreted that this component represents scavenging by organic material. This interpretation is supported by the fact that positive component two corresponds to area of subdued topography. Similarly, the third component has high loadings in As, Sb, Fe, Pb, Co, Zn and Mn; and is interpreted to represent scavenging by hydrous Fe and/or Mn oxides.

Regression analysis of selected metals against the relevant principal component(s) effectively filters the scavenging and lithological controls while preserving responses related to known occurrences. Levelling by mapped geology has a more subdued effect on filtering the interpreted lithological control on the distribution of certain pathfinder elements. In order to reduce the impact of this effect on the WSM, certain elements were given low importance rankings for certain deposit types. Negative importance rankings are used in both approaches to help distinguish between signatures related to deposit types with 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 (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 105C (Yukon MINFILE, 2015)

Number	Name	Type	Status	Commodities
105C 002	KITCHEN	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Lead, Silver
105C 003	BAR	Sediment hosted Stratiform Barite	Drilled Prospect	Antimony, Barite, Mercury, Thallium, Zinc, Tin, Silver, Lead, Arsenic
105C 004	LINCOLN	Unknown	Anomaly	Uranium
105C 008	SLATE	Vein Polymetallic Ag-Pb-Zn±Au	Drilled Prospect	Lead, Molybdenum, Silver, Zinc
105C 009	RED MOUNTAIN	Porphyry Cu-Mo-Au	Deposit	Molybdenum Disulfide, Tungsten, Silver, Copper
105C 010	RIBA	Ultramafic-hosted asbestos	Showing	Asbestos
105C 011	SEAFORTH	Ultramafic-hosted asbestos	Showing	Asbestos
105C 012	SQUANGA	Ultramafic Mafic Podiform Chromite	Showing	Chromium, Palladium, Platinum
105C 013	HAYES PEAK	Ultramafic-hosted asbestos	Showing	Chrysotile, Lead, Copper, Silver
105C 021	IRON CREEK	Volcanogenic Sulphide - type not determined	Drilled Prospect	Copper, Silver, Zinc, Gold, Lead
105C 022	LINDSAY	Ultramafic Mafic Flood basalt-associated Ni-Cu	Drilled Prospect	Copper, Mercury, Silver, Nickel, Gold
105C 023	SIDNEY	Unknown	Anomaly	Copper
105C 024	ROSY	Vein Cu±Ag Quartz	Showing	Copper, Silver, Gold
105C 025	NISUTLIN	Unknown	Anomaly	Gold, Silver
105C 026	DEADMAN	Unknown	Anomaly	Lead, Silver
105C 028	DALAYEE	Vein Au-Quartz	Drilled Prospect	Chromium, Gold, Silver
105C 029	MCCLEERY	Skarn Cu	Showing	Cobalt, Fluorite, Tin, Silver, Copper
105C 030	MUSKRAT	Vein Polymetallic Ag-Pb-Zn±Au	Anomaly	Molybdenum
105C 031	LAMPERT	Unknown	Anomaly	Uranium
105C 035	ENGLISHMAN	Unknown	Showing	Lead, Uranium, Molybdenum
105C 036	MULLIGAN	Skarn W	Drilled Prospect	Gold, Silver, Tungsten, Tin
105C 038	MINDY	Skarn Sn	Drilled Prospect	Barite, Lead, Tin, Tungsten, Zinc, Silver
105C 040	BAS	Skarn Sn	Anomaly	Tin, Tungsten
105C 045	TES	Vein Cu±Ag Quartz	Drilled Prospect	Copper
105C 047	SAWAS	Vein Polymetallic Ag-Pb-Zn±Au	Showing	Arsenic, Gold, Silver
105C 048	TOO	Unknown	Anomaly	Arsenic, Gold
105C 055	EAGLENEST	Vein Au-Quartz	Showing	Antimony, Mercury, Silver, Barite, Gold
105C 059	HYDER	Unknown	Drilled Prospect	Copper, Silver, Zinc, Gold
105C 061	MOR	Volcanogenic Sulphide - type not determined	Showing	Copper, Lead, Zinc, Silver, Gold
105C 062	CARIBOU CREEK	Volcanogenic Sulphide - type not determined	Anomaly	Copper, Silver, Zinc, Gold, Lead
105C 063	WR	Unknown	Showing	Copper, Silver, Gold
105C 017	MARLIN	Sediment hosted Sedimentary Mn	Producer	Manganese, Rhodonite
105C 018	MT. GRANT	Vein Cu±Ag Quartz	Showing	Copper, Gold, Silver
105C 054	ORK	Skarn Cu	Prospect	Copper, Tin, Tungsten, Silver
105C 016	MOOSE HILL	Vein Polymetallic Ag-Pb-Zn±Au	Anomaly	
105C 033	EASTMAN	Unknown	Unknown	
105C 042	THOM	Vein Cu±Ag Quartz	Unknown	
105C 056	IRON	Unknown	Unknown	
105C 019	EVELYN	Unknown	Unknown	
105C 020	DRY	Unknown	Unknown	
105C 058	HOMBRE	Unknown	Unknown	
105C 052	THA	Unknown	Unknown	
105C 060	PAULA	Unknown	Unknown	
105C 001	MORLEY	Unknown	Unknown	
105C 027	QUIET	Unknown	Unknown	
105C 037	COYOTE	Unknown	Unknown	
105C 032	MEADOW	Unknown	Unknown	
105C 005	TESLIN	Unknown	Unknown	
105C 007	TARFU	Unknown	Drilled Prospect	
105C 050	TON	Unknown	Unknown	
105C 006	SIDNAW	Unknown	Unknown	
105C 034	BROPHY	Unknown	Unknown	
105C 051	BRENDON	Unknown	Unknown	
105C 053	HANNKA	Unknown	Unknown	
105C 014	HAIRCUT	Unknown	Unknown	
105C 046	BRAULT	Unknown	Unknown	
105C 057	BIG SALMON	Unknown	Unknown	
105C 044	SEARS	Unknown	Unknown	
105C 043	HENRY	Unknown	Unknown	
105C 041	PESHKE	Unknown	Unknown	
105C 049	NUF	Unknown	Anomaly	
105C 015	GUNSIGHT	Unknown	Unknown	
105C 039	LISA	Unknown	Unknown	

Table 2: Importance rankings for weighted sums models using residuals on selected 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[1]	Hg	Tl	Bi	W[1]
Porphyry Mo	Cu skarn; Porphyry Cu; W skarn				-2	2	3			1								-2			1
Cu skarn	Porphyry Cu; Porphyry Mo; W skarn				-2	4	1			1	1	2						-2		1	2
Polymetallic Ag-Pb-Zn	SEDEX, VMS, Pb-Zn skarn; Epithermal Au-Ag							2	2	4		2		1		1		-2			
Epithermal Au-Ag	Orogenic Au; Intrusion-related Au; Polymetallic Ag-Pb-Zn									4	3	3	1			2		1			-2
Orogenic Au	Intrusion-related Au, Epithermal Au-Ag							-2		1	4	3					1				1
Magmatic Ni-Cu	Cu skarn			1	4	3		-2	-2												
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 vein and manto styles; SEDEX = sedimentary exhalative Pb-Zn-(Ag); VMS = volcanic-hosted/associated massive sulphide deposits; hydromorphic anomaly = inverse principal component 3

[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> 14 km²

Weighted sums model (PC residuals)

Polymetallic Ag-Pb-Zn deposits

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

RECOMMENDED CITATION

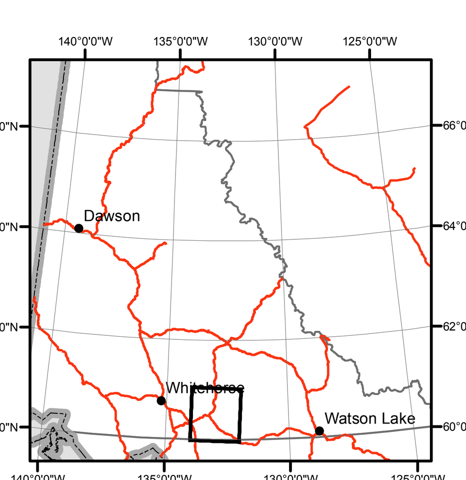
MACKIE, R., ARNE, D. AND PENNIMPEDE, C., 2016. Weighted sums model for Polymetallic Ag-Pb-Zn deposits using principal component residuals. In: Enhanced interpretation of stream sediment geochemical data for NTS 105C. Yukon Geological Survey, Open File 2016-12, scale 1:250 000, sheet 13 of 15.

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.



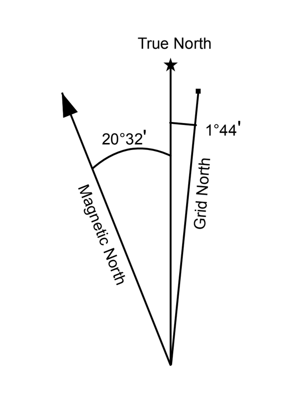
ONE THOUSAND METRE GRID
Universal Transverse Mercator Projection
North American Datum 1983
Zone 8

CONTOUR INTERVAL 100 FEET
Elevations in metres above Mean Sea Level

Polymetallic Ag-Pb-Zn
Weighted sums model
(Principal Component Residuals)
Sheet 13 of 15

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

105E LAKE LABERGE	105F QUIET LAKE	105G FINLAYSON LAKE
105D WHITEHORSE	105C THIS MAP	105B WOLF LAKE
104M SKAGWAY	104N ATLIN	104O JENNINGS RIVER

REFERENCES

Geological Survey of Canada, 1986. Regional Stream Sediment and Water Geochemical Reconnaissance Data, Yukon (105C). Geological Survey of Canada, Open File 1217.

Jackaman, W., 2015. Regional Stream Sediment Geochemical Data, Teslin Area, southern Yukon (NTS 105C). Yukon Geological Survey, Open File 2015-11.

Mackie, R., Arne, D. and Brown, O., 2015. Enhanced interpretation of regional stream sediment geochemistry 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.

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Open File 2016-12

Weighted sums model for Polymetallic Ag-Pb-Zn deposits using principal component residuals (NTS 105C) Sheet 13 of 15

by

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