



Polymetallic Ag-Pb-Zn deposits Weighted sums model (Principal Component Residuals) Sheet 11 of 15

SCALE 1:250 000



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

1150	115P	105M
STEWART RIVER	MCCUISTEN	MAYO
115J	115I	105L
STEVENSON RIVER	THIS MAP	GLENLYON
115G	115H	105E
KUJANE LAKE	AISHIRIK LAKE	LAKE LABERGE

REFERENCES

- Geological Survey of Canada, 1986. Regional stream sediment and water geochemical reconnaissance data, southern Yukon (NTS 1151). Geological Survey of Canada, Open File 1220.
- Jackaman, W., 2015. Regional stream sediment geochemical data, Carmacks area, southern Yukon (NTS 1151). Yukon Geological Survey, Open File 2015-14.
- 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.

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 map sheet 1151. Yukon Geological Survey, Open File 2016-14, scale 1:250 000, sheet 11 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. 867-687-3201, 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>.

Yukon Geological Survey
Energy, Mines and Resources
Government of Yukon

Open File 2016-14

Weighted sums model for Polymetallic Ag-Pb-Zn deposits using principal component residuals (NTS 1151) Sheet 11 of 15

by

Rob Mackie, Dennis Arne,
and Chris Pennimpede

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 Carmacks area (NTS 1151) were collected at a reconnaissance scale in 1985 under the direction of the Geological Survey of Canada (GSC) in conjunction with the Department of Indian Affairs and Northern Development and the government of Yukon (Geological Survey of Canada, 1986). Geochemical data for 951 sample sites were first released in GSC Open File 1220 (Geological Survey of Canada, 1986). As part of an ongoing database upgrade project by the Yukon Geological Survey (YGS), archived sample material has been re-analyzed by inductively coupled plasma mass spectrometry following an aqua-regia digestion as described in YGS Open File 2015-14 (Jackaman, 2015). The reader is referred to these reports for detailed descriptions of sampling techniques, analytical procedures and quality control measures.

MINERAL OCCURRENCES

The Carmacks area contains several significant base and precious-metal deposits of various types (Table 1). These include the Minto Cu-Au-Ag mine, past producing Mt. Nansen epithermal Au-Ag and Caribou Creek Au mines, Klaza and Tintina polymetallic Ag-Au-Pb-Zn deposits and the Nucleus and Revenue Cu-Mo-Au porphyry deposits. The Casino Cu-Mo porphyry deposit occurs in the adjacent map area to the west supporting the prospectivity of the region 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 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

interpreted to represent geologic horizons that exhibit strong influence on the distribution of commodity and pathfinder elements of interest. 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 shows that the much of the variability can be related to mineralization and the influence of lithological variation is of lesser importance for certain elements. This differs from some of the other map areas evaluated in this project where the lithological control was of particular importance. The first principal component, accounting for ~28% of the total variation, shows high positive loadings for Mg, Co, Cr and Sc; and high negative loadings for Ag, Cd, Sb, Pb, Bi, Ti, Mo and As. Respectively, these element groupings form spatial patterns matching distribution of Carmacks mafic-intermediate volcanic rocks and occurrences of Cu porphyry and Ag-Pb-Zn vein/manto-style mineralization. The second principal component shows high negative loadings for Cu, loss-on-ignition and Cd, and is interpreted to reflect scavenging by organic material. This interpretation is supported by the fact that most inverse PC2 responses correspond to samples collected in areas of subdued topography adjacent to rivers and lakes. Principal components 5 and 6, with high loadings of Al, LOI, Mn, Fe, As, Zn, Pb and Co, are also related to possible scavenging by clay minerals and Fe-Mn oxides/hydroxides. Regression analysis using the relevant principal component(s) effectively filters these effects resulting in enhanced responses related to known mineral occurrences. Levelling by dominant mapped geology has a more subdued effect on filtering the interpreted lithological control however given the strong mineralization signal on the map sheet the two approaches produce WSMs that are quite similar.

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 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 anomalous. Given the likelihood that a mineralization 'signal' would be progressively diluted with increase in catchment size,

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

Target Deposit Type ^a	Other Deposit Type ^b	Mn	Fe	Co	Ni	Cu	Mo	Zn	Pb	Ag	Au	As	Ba	Cd	Sn	Sb	Te	Hg	Bi	Tl	W
Polymetallic Ag-Pb-Zn	VMS (Zn-rich); SEDEX; Pb-Zn skarn					5	3	1	1	1	1	1	1	2	1	1			2		
Porphyry Cu-Mo	Cu skarn; Porphyry Mo; VMS (Cu-rich)			5		-2		1	1								2				
Porphyry Cu-Au	Cu skarn; Porphyry Mo; VMS (Cu-rich)			5		-2		1	1								2				
Epithermal Au-Ag	Intrusion-related and orogenic Au; Polymetallic Ag-Pb-Zn								4	4	2				-2	2		1			
VMS (Zn-rich)	Polymetallic Ag-Pb-Zn; SEDEX; Pb-Zn skarn			1		4	3	1				2	1								
Orogenic Au	Intrusion-related Au; Epithermal Au-Ag			-2				3	3			1	1		1			1			
Hydrothermal 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; VMS = volcanic-hosted/associated massive sulphide deposits; Hydrothermal Anomaly = principal component 6
^b For heavily censored elements and those not strongly controlled by geology as interpreted from principal component analysis, raw data are used following a log₁₀ transformation.

LEGEND

- Town
- Mineral Occurrence
- Road
- Contour
- River
- Water Body
- Wetland
- Sample Location
- Catchment > 14km²
- Catchment

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