

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 Watson Lake and Coal River areas (NTS 105A and 95D, respectively) were collected at a reconnaissance scale in 1995 as part of the Canada-Yukon Mineral Resource Development Cooperation Agreement (Friskie et al., 1999). Field descriptions and initial geochemical data for 1117 sites were released in Geological Survey of Canada (GSC) Open File 3293. New geochemical data from the re-analysis of archive sample material from 824 sites were released in Yukon Geological Survey (YGS) Open File 2012-10 (Jackaman, 2012). The reader is referred to these reports for detailed descriptions of sampling techniques, analytical procedures, and quality control measures. The current assessment includes only those samples that have been re-analyzed by inductively coupled plasma mass spectrometry (ICP-MS) and as such, the eastern half of NTS map sheet 95D is excluded.

MINERAL OCCURRENCES

A variety of types of base and precious-metal mineralization are known to occur in the Watson Lake and Coal River area as shown in Table 1 (Yukon MINFILE, 2015). The most significant deposits are classed as intrusion-related gold (Hyland Deposit), Polymetallic Ag-Pb-Zn manto (providing Mt. Hundere Mine & McMillan deposit) and W-Skarn (Bailey deposit). Other types of mineralization include various Pb-Zn deposits and prospects such as the Ritco (Skarn), Balon (SEDEX), Jeri and Jeri-North (SEDEX or MVT), and Sambo (VMS). The volcanic and sedimentary package that hosts VMS mineralization in the Finlayson Lake district extends into the Watson Lake map area indicating a high prospectivity for this style 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 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. Weighted sums models were not generated for porphyry Cu-Mo and epithermal Au-Ag deposit types because no such deposits are known to exist in the region and exploratory data analysis revealed no obvious anomalies in the expected commodity and pathfinder elements. Similarly, given a lack of evidence for scavenging of metal ions by secondary Fe or Mn-oxides a WSM for hydromorphic anomalies was also not produced.

Exploratory data analysis using both raw element data and principal components indicate that the distribution of many commodity and pathfinder elements is strongly influenced by lithological variation. The first principal component accounts for ~27% of the total geochemical variation and shows high positive loadings for Cd, Se, Sb, Ba, Hg, Zn and Ag, and negative loadings for, amongst other elements, Rb, Al, Sn, La, Ce and K. Respectively, these groupings form spatial patterns that match the distribution of chert and clastic sedimentary rocks of the Rabbitkettle Formation and intermediate intrusive rocks of the Hyland Suite. The second principal component, accounting for ~13% of the total variation, shows high positive loadings for Co, Fe and Cu, and high negative loadings for Ti, Nb, Ca, Ti, Na and Sr, and forms domains matching the mapped distribution of clastic sedimentary rocks of the Hyland Group and the carbonate rocks of the Rabbitkettle Formation, respectively. Regression analysis of selected metals against the relevant principal component(s) effectively filters these terrane-effects while preserving responses related to known occurrences. Leveling by mapped geology has a more subdued effect on filtering the interpreted lithological control on the distribution of certain pathfinder elements (e.g., Sb, Ba and Cd). In order to reduce the impact this has on the WSM using this approach, certain elements were given low importance rankings or, in some cases, were omitted for certain deposit types.

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 (15 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 anomalies. 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 105A/95D (Yukon MINFILE, 2015)

Table with columns: Number, Name, Type, Status, Commodities. Lists various mineral occurrences such as TOGBALLY, QUETRY, RA, etc., with their respective types and associated commodities like Copper, Lead, Zinc, Silver.

Table 2: Importance rankings for weighted sums models using data levelled by dominant mapped geology.

Table with columns: Target Deposit Type, Other Deposit Types, and elements (Mn, Fe, Co, Ni, Cu, Mo, Zn, Pb, Ag, Au, As, Ba, Cd, Sn, Sb, Te, Hg, Tl, Bi, W). Shows numerical importance rankings for different deposit types.

1 Polymetallic Ag-Pb-Zn type includes vein and manto styles; SEDEX = sedimentary exhalative Pb-Zn (Ag); VMS = volcanic-hosted/associated massive sulphide deposits; MVT = Mississippi Valley-type Pb-Zn deposits

LEGEND

Legend for the map, including symbols for Town, Mineral Occurrence, Road, Contour, River, Water Body, Wetland, Sample Location, Catchment, and Catchments > 15 km². Also includes the 'Weighted sums model (Geology Levelled)' legend with color-coded boxes for different percentiles (0-50th, 50-75th, 75-90th, 90-95th, 95-98th, 98-100th).

RECOMMENDED CITATION

MACKIE, R. ARNE, D. AND PENNIMPEDE, C., 2015. Weighted sums model for VMS Cu-Co deposits levelled by geology. In: Enhanced interpretation of stream sediment geochemical data for NTS 95D and 105A. Yukon Geological Survey, Open File 2015-30, scale 1:250 000, sheet 5 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 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.

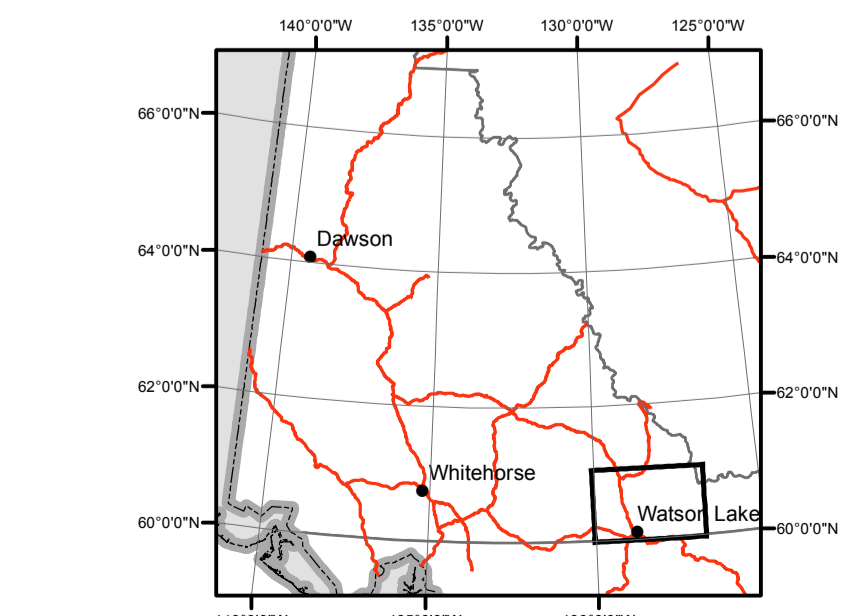
A digital PDF (Portable Document File) of this map may be downloaded free of charge from the Yukon Geological Survey website: <http://www.yukon.geology.gov.yk.ca>.

Yukon Geological Survey, Energy, Mines and Resources, Government of Yukon

Open File 2015-30

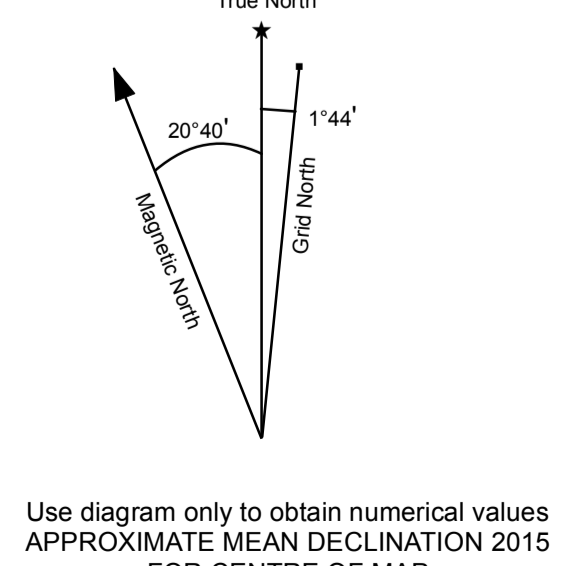
Weighted sums model for VMS Cu-Co deposits levelled by geology (NTS 95D and 105A) Sheet 5 of 13

by Rob Mackie, Dennis Arne, and Chris Pennimpede



1:250 000-scale topographic base data produced by CENTRE FOR TOPOGRAPHIC INFORMATION, NATURAL RESOURCES CANADA. Copyright Her Majesty the Queen in Right of 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.

Map title: VMS Cu-Co Deposits Weighted sums model (Geology Levelled) Sheet 5 of 13. Includes a scale bar for 1:250 000 and a north arrow diagram showing a magnetic declination of 1°44'.



Grid reference table showing coordinates for various locations: FINLAYSON LAKE, FRANCIS LAKE, FLAT RIVER, WOLF LAKE, THIS MAP, ROAD RIVER, MCCLAME, RABBIT RIVER, TOAD RIVER.

REFERENCES

Friskie P.W.B., McCurdy M.W., Balma R.G., Day S.J.A., Lynch J.J. and Durham C.C., 1996. Regional Stream Sediment and Water Geochemical Data, Southeastern Yukon (Parts of NTS 95D and 105A). Geological Survey of Canada, Open File 3293. Jackaman W., 2012. Regional Stream Sediment Geochemical Data, Watson Lake Area, Southeastern Yukon (NTS 095D and 105A). Yukon Geological Survey, Open File 2012-10, 111 p. Mackie, R., Arne, D. and Brown, O., 2015. Enhanced interpretation of regional stream sediment (RGS) geochemical data 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.