An Integrated Assessment of Regional Stream Sediment Geochemistry for Metallic Deposits in Northwest British Columbia, Canada

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Summary

Regional stream sediment geochemistry is an important data layer in mineral exploration targeting and thus provides important information to mineral exploration companies, governments, and First Nation communities. Re-analysis of archived material by ICP-MS has increased number of elements and lowered detection limits allowing for a rigorous assessment of the variation in sediment composition related to geologic terrane, lithology, and metallic mineral occurrences. The locations of over 15,000 stream sediment samples are validated against scanned images of original sampling maps and catchment basins are generated using TRIM topographic data. Geochemical variation is examined using raw element data and principal component analysis. An evaluation of element associations and spatial relations reveals a strong porphyry-epithermal signature relating to many mineral occurrences throughout the project area. Using weighted sums modeling a geochemical index is generated using the principal component data to subdue signals related to 'unprospective' terranes and enhance those related to known occurrences. This product is more effective than indices generated from raw element data. The usefulness of other multi-variate techniques such as independent component analysis, multi-dimensional scaling, and singularity analysis will be tested as part of this ongoing project.

Other Considerations

Dilution of a mineralization signal becomes more likely for large catchments. Correction factors can be applied to reveal anomalies in larger drainage basins that are likely to have been overlooked by previous explorers. Other factors that relate to catchment quality such as sample location confidence, slope aspect, surficial material type and slope gradient could be incorporated to prioritize geochemical targets. The information and interpretations presented herein are a work-in-progress and the final products will be available in Q2 of 2018. The generated geochemical products can then be integrated with other geological, structural, stratigraphic, and geochronological information to construct meaningful exploration targeting maps.

References

Arne, D.C., Mackie, R., Pennimpede, C. and Grunsky, E., 2018, An integrated assessment of regional stream sediment geochemistry for metallic deposits in northwest British Columbia; in Geoscience BC Summary of Activities 2017, Geoscience BC, Report 2018-1.

Garrett, R.G. and Grunsky, E.C., 2001, Weighted sums – knowledge based empirical indices for use in exploration geochemistry. Geochemistry: Exploration, Environment, Analysis, vol. 1 2001, p. 135–141.

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.

Mackie, R.A., Arne, D.C. and Pennimpede, C., 2017. Assessment of Yukon regional stream sediment catchment basin and geochemical data quality. Yukon Geological Survey, Open File 2017-4, 29 p. and digital files.

Project Area

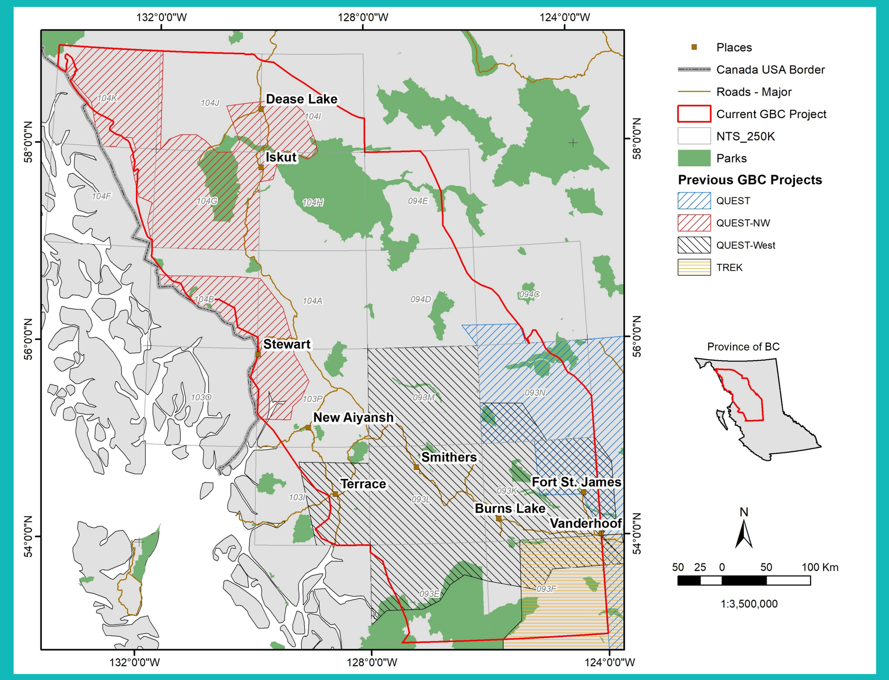

Figure 1: Location of study area in relation to major roads, communities, parks, and previous Geoscience BC projects.

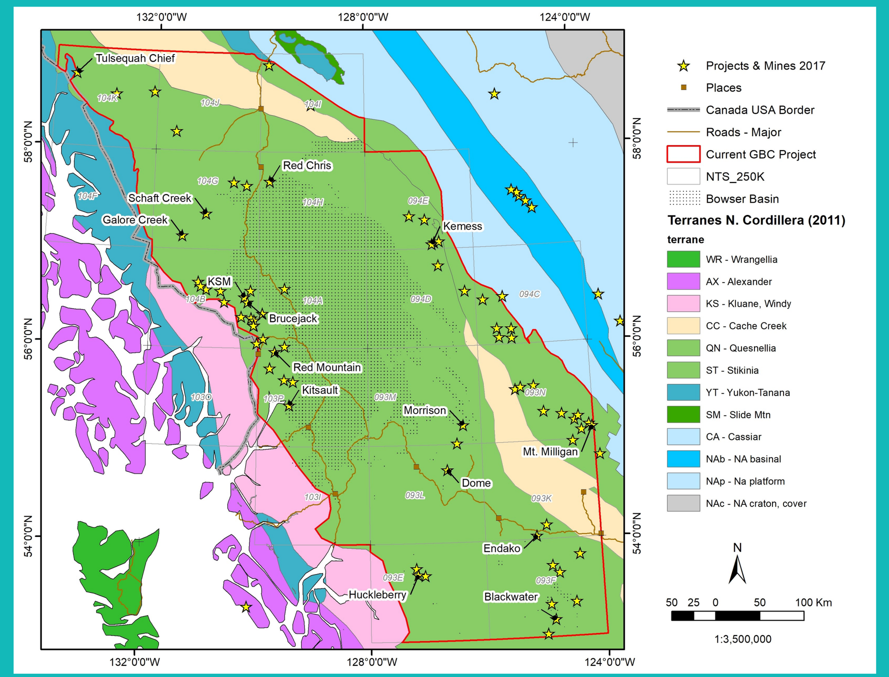

Figure 2: Location of study area in relation to geological terranes (Colpron & Nelson, 2011) and 2017 metallic exploration and mining projects (BCGS Open File 2017-01).

Catchment Basins

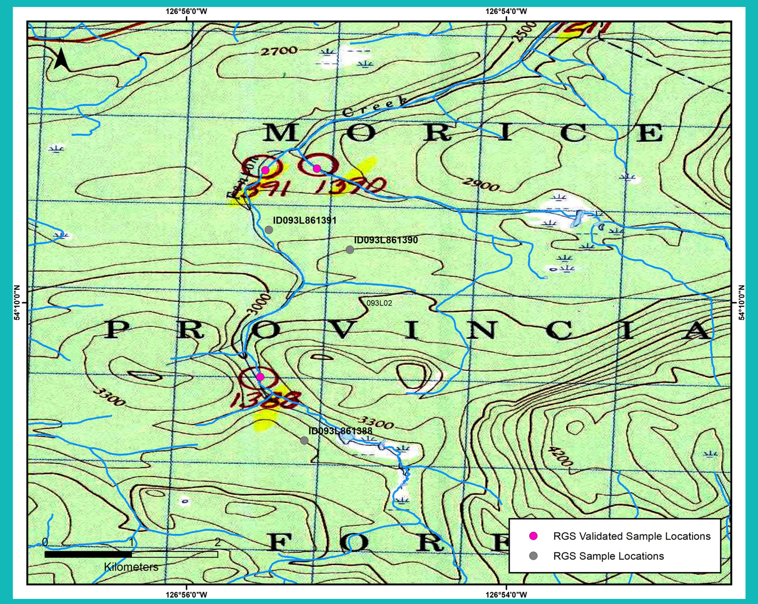

Figure 3: Stream sediment sample locations have been validated for >15,000 samples using scanned images of maps used during the sampling campaigns. As shown in the map above, sample locations in the database often plot some distance from that shown on the sampling maps and do not intersect drainage lines. For this project more than 50% of the samples require adjustment.

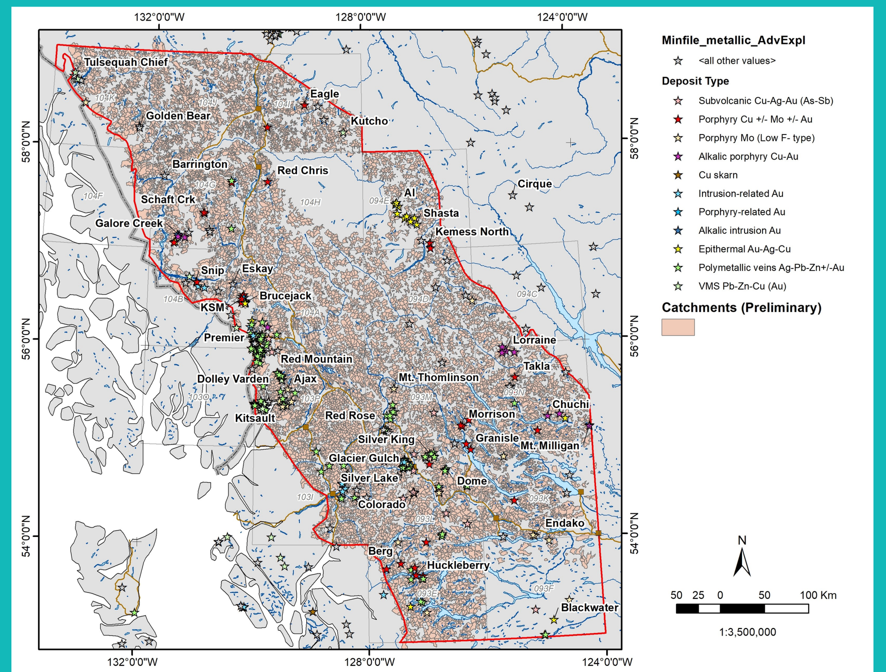

Figure 4: Catchment basins derived by BCGS using validated sample locations and TRIM topography data. This is a preliminary product missing catchments for ~200 samples where the initial location validation process was unsuccessful.

Element Concentrations

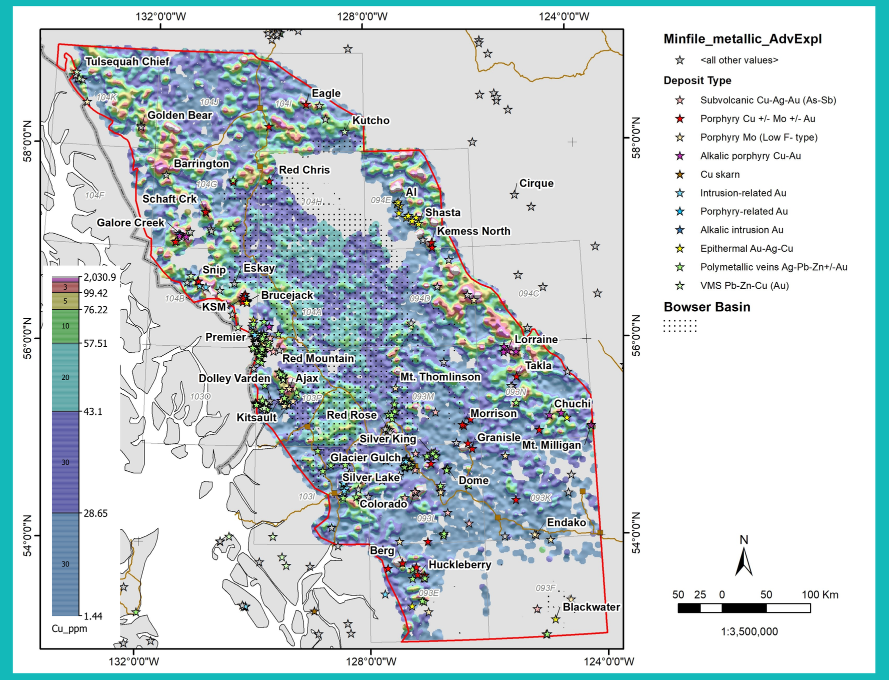

Figure 5: Plan map showing the distribution of raw copper in stream sediments in relation to active exploration projects; difficult to see clear relationship between known Cu deposits and elevated raw Cu values.

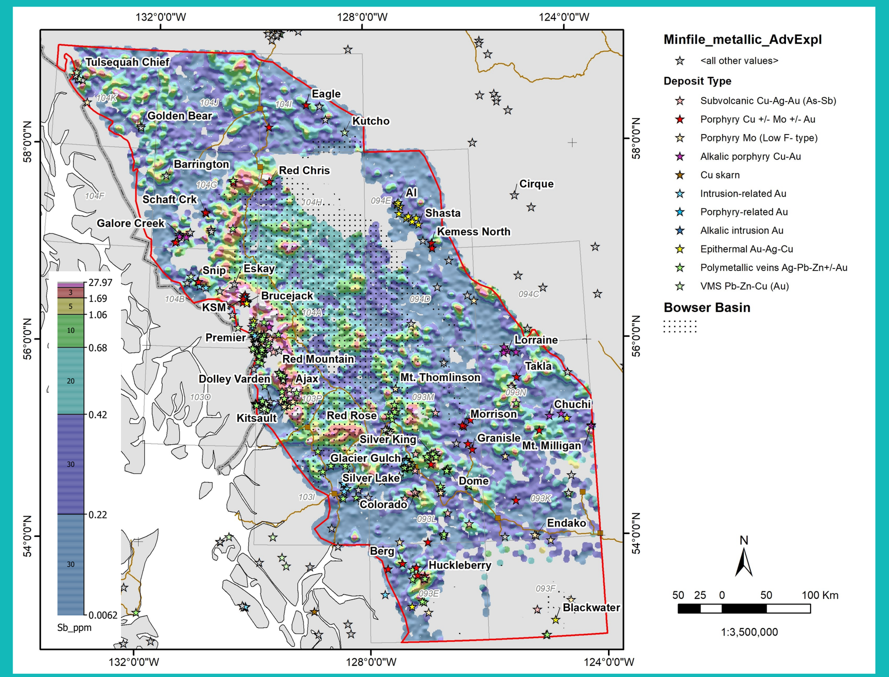

Figure 6: Plan map showing the distribution of raw antimony in stream sediments in relation to metallic mineral occurrences. Regional antimony high occurs in the Golden Triangle region of northwestern BC. Also note the elevated values within the Bower Basin.

Principal Component Analysis

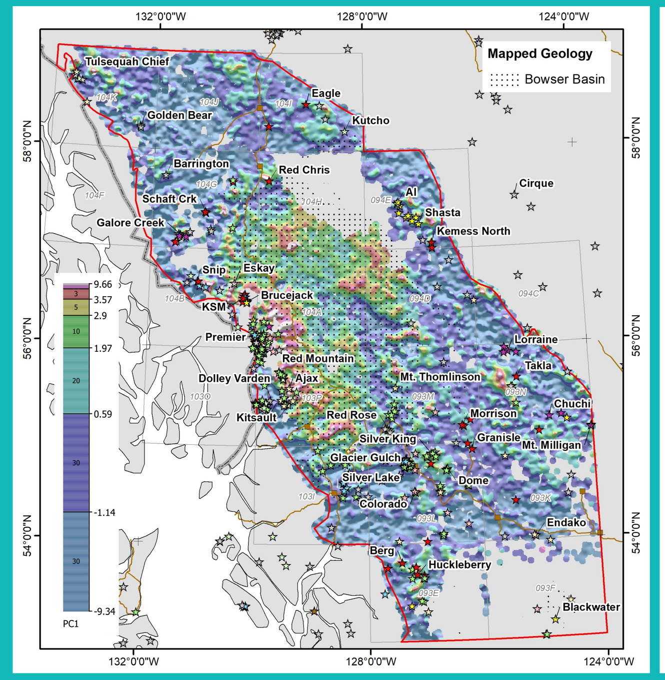

Figure 7a: Plan map showing a spatial relationship between positive PC1 and the Golden Triangle region. Note also the response related to the Bowser Basin. See Figure 4 for commodity legend.

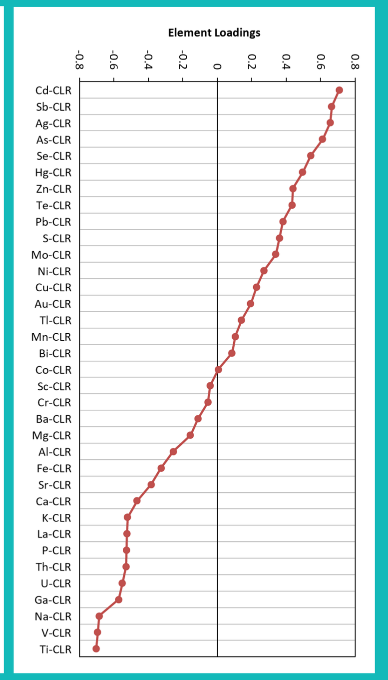

Figure 7b: Line plot of element loadings on PC1. Note the pathfinder element association for positive PC1.

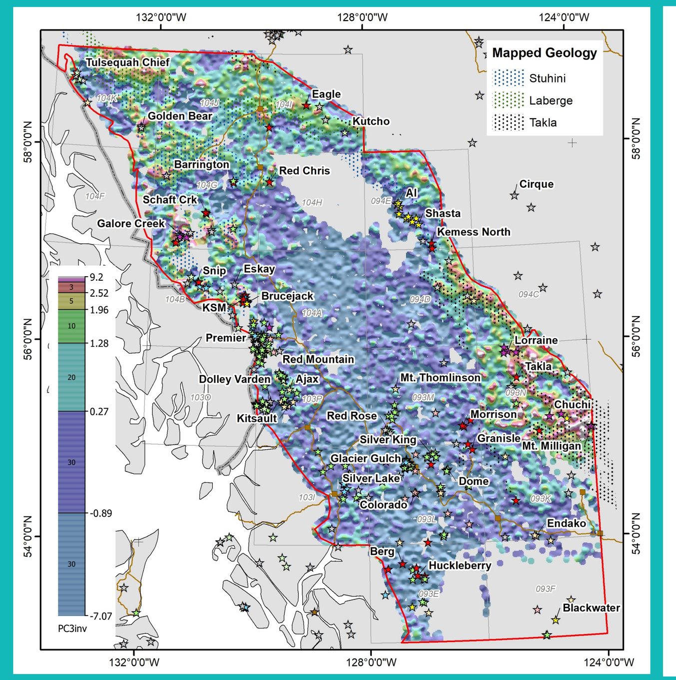

Figure 9a: Plan map showing the spatial relationship between selected stratigraphic units and negative PC3.

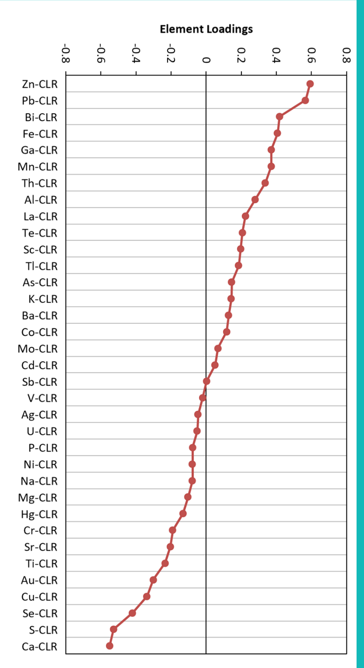

Figure 9b: Line plot of element loadings on PC3. Note the Ca-S-Se-Cu-Au association for negative PC3.

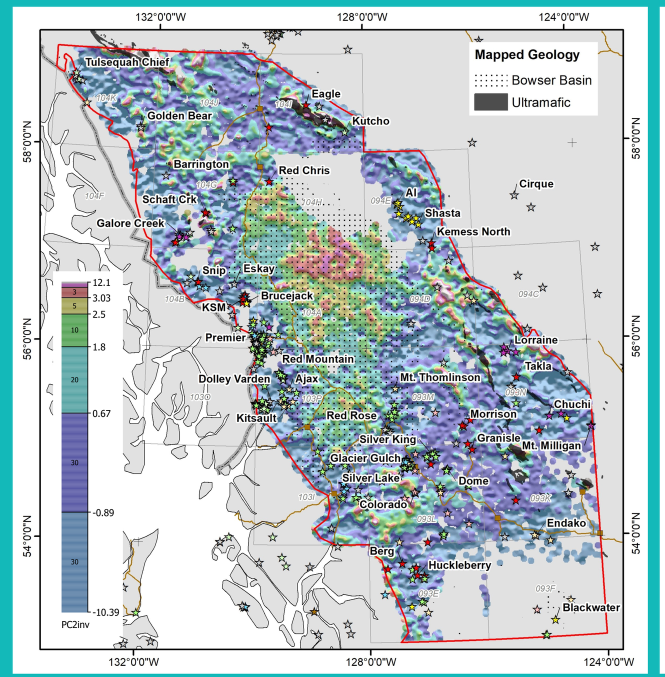

Figure 8a: Plan map showing a spatial relationship between mapped ultramafic units, Bowser Basin sedimentary rocks, and negative PC2. See Figure 4 for commodity legend.

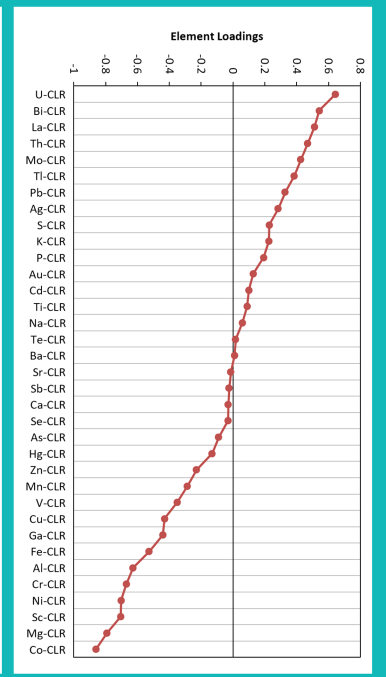

Figure 8b: Line plot of element loadings on PC2. Note the mafic Co-Mg-Sc-Ni-Cr-Al association of negative PC2 .

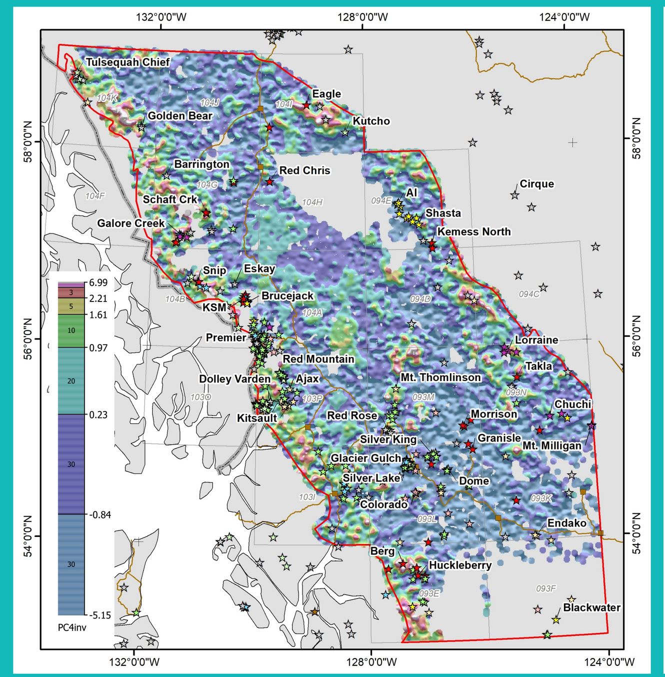

Figure 10a: Plan map showing the spatial relationship between negative PC4 and selected mineral occurrences.

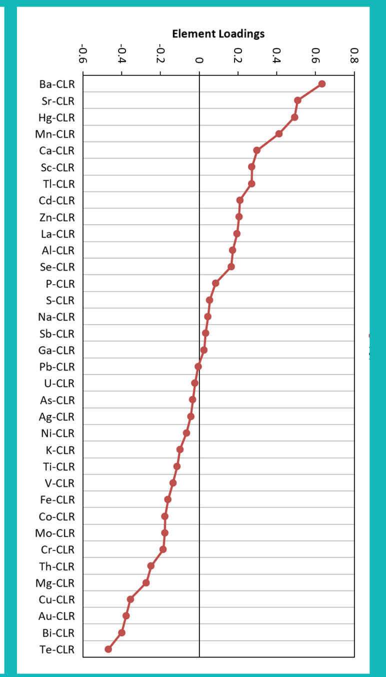

Figure 10b: Line plot of element loadings on PC4. Note the Te-Bi-Au-Cu association for negative PC4.

Preliminary Products

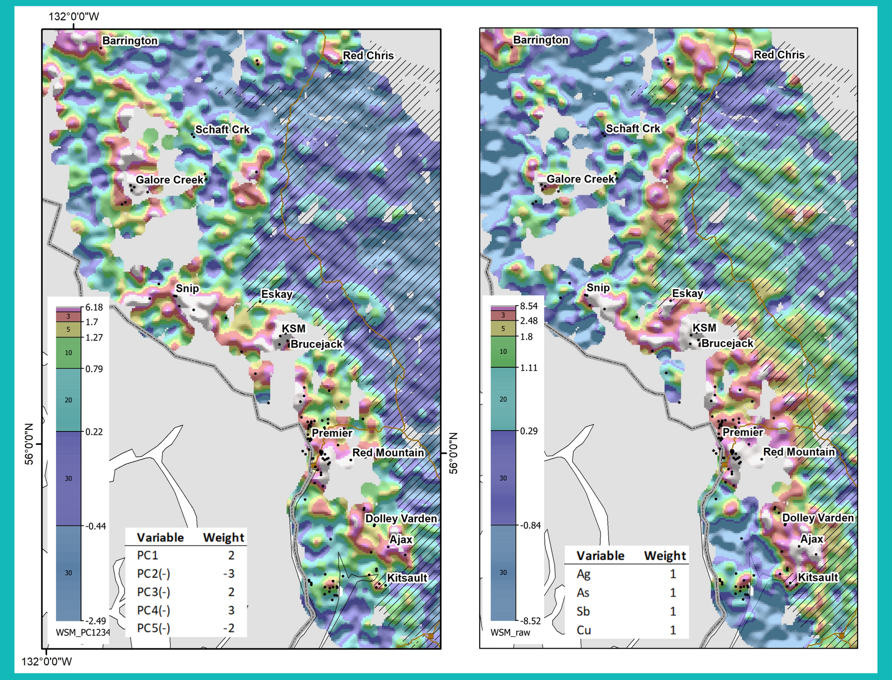

Figure 11: Comparison between weighted sums models for porphyry-epithermal deposits using principal component data (left) and raw element data (right) for the Golden Triangle region. The PC product uses negative weights for components related to Bowser Basin (hatched) and ultramafic rocks to remove lithological effects.

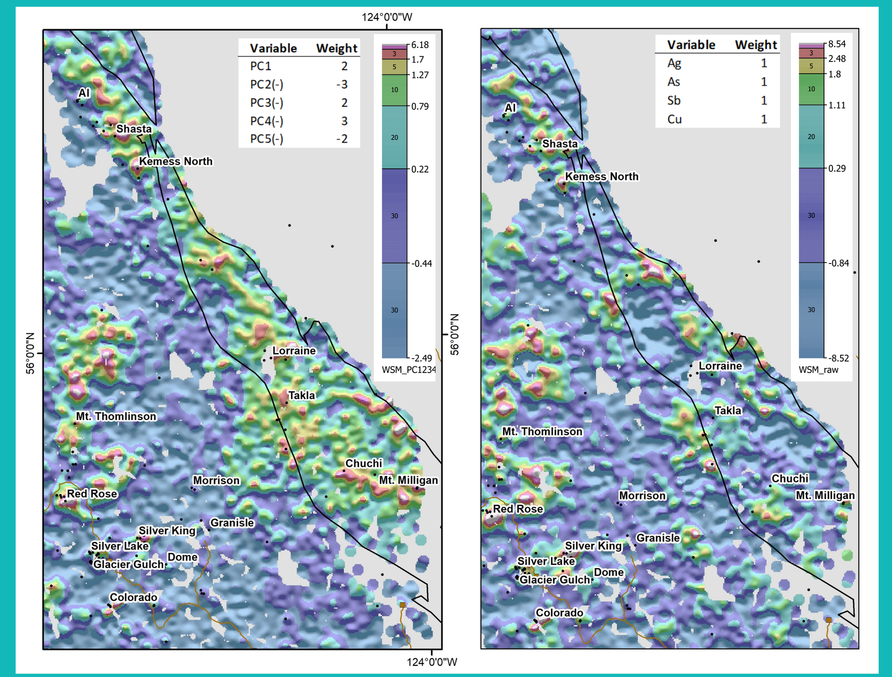

Figure 12: Comparison between weighted sums models for porphyry-epithermal deposits using principal component data (left) and raw element data (right) in the Quesnel terrane (outlined). The PC product uses negative weights for components related to Bowser Basin and ultramafic rocks.