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Use of multielement associations in till for detecting concealed Cu mineralization, south-central British Columbia, Canada

Shishi Chen*, Keiko Hattori, and Alain Plouffe

University of Ottawa, Ottawa, ON, Canada, *e-mail, schen162@uottawa.ca

The Bonaparte Lake area in south-central British Columbia lies in the Quesnel terrane of the Canadian Cordillera, which dominantly consists of Mesozoic Nicola volcanic rocks and granitic intrusions. Nearly continuous cover of thick glacial sediments poses a difficulty in mineral exploration in the area. Limited exposure of rocks reveal several showings of Au, Cu, Mo, Ag, Zn, Pb, Ni, and Cr. Large porphyry Cu-Mo and Cu-Au deposits, including the Highland Valley Copper (production plus reserves of 8.48 Mt Cu and 0.22 Mt Mo), Gibraltar (1.72 Mt Cu and 0.060 Mt Mo), and Mount Polley (0.276 Mt Cu, 27.8 tonnes Au), are proximal (<50 km) to this region. The study area experienced two phases of ice flow during the last glaciation. These include an earlier flow during ice advance directed towards the west to southwest and a second phase at glacial maximum generally to the south. Principal component analysis (PCA) was applied to the data from aqua regia leachates of the clay fraction (< 2 mm) of basal till to assess the elemental assemblages related to Cu mineralization. The PCA captures two element associations with Cu; a Cu-Au-Mo-Ag-As-Hg-Pb-Sb association accounting for 32.3% of the total Cu variance in PC2, and a Cu-Cr-V-As association accounting for 16.8% of the total Cu variance in PC3. An association of Cu-Mn-Ca-Fe-Al is also observed in PC2 and is likely related to the presence of epidote with Cu mineralization. Epidote is known to be abundant in till near propylitic alteration zones at the aforementioned porphyry deposits. The Kriging interpolation maps and hot spot analysis (Getis-Ord Gi*) of PC2 and PC3 show that the anomalies of multi-elements associated with Cu occur at the northern boundary of the Thuya batholith. This area records abundant gold grains in till, which is consistent with the potential presence of undiscovered mineralization. Multivariate analysis is effective in displaying elements associated with Cu mineralization in glacial sediments and delineating potential prospective areas.