Sericite and Chlorite Type and Composition within and around Porphyry Deposits: Tools to Vector Towards K-Silicate Alteration at Depth

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Porphyry copper deposits have a large (>25 km2) alteration footprint hosting a smaller (<0.5 km2), typically sub-vertical, body of copper mineralization. Sericite and chlorite are the most common alteration minerals that occur in shallow levels of porphyry deposits and can provide vectors for exploration and drilling.

During this study, samples from Camp Creek calc-alkalic Cu-Mo-Au porphyry deposit were selected and compared with samples from Gibraltar calc-alkalic Cu-Mo and Mount Milligan alkalic Cu-Au porphyry deposits. Alteration at the near-surface at Camp Creek is characterized by advanced-argillic assemblage, which transitions laterally to sericite, sericite-chlorite, and distal chlorite. K-silicate alteration occurs at depth, which hosts the mineralization. At Gibraltar, mineralization is hosted by sericite-chlorite alteration, but no K-silicate alteration is recognized at depth. K-silicate alteration hosts mineralization at Mount Milligan, and it is locally overprinted by sericite-chlorite, with intense sericite alteration occurring along structures.

A total of 44 samples were selected from these deposits. Samples were studied using petrography, SWIR, and sericite, chlorite mineral chemistry by EPMA and LA-ICP-MS. Sericite composition varies from muscovite (white sericite) to phengite (green sericite) at depth, with K-deficient sericite occurring at shallow levels with pyropyllite.

Sericite is alkali-deficient, Al- and Na-rich above Camp Creek and becomes alkali-rich, Fe-Mg-rich, and Na-poor at depth. Trace elements Zr, Rb, Tl, Zn, and Ti of sericite provide vectors. Remnants of K-rich muscovite with a higher Rb:Ti ratio suggest K-silicate alteration at depth. Chlorite composition is influenced by the hostrock. Fe-Mg in chlorite provides vectors in mafic host rocks, and Al-in-chlorite provides vectors in intermediate/felsic rocks. Several trace elements in chlorite, such as Ti, As, Co, Li, provide vectors. The sericite and chlorite compositional data can identify mineralization signatures typically not recognized by SWIR and whole rock geochemistry and provide vectors for K-silicate alteration at depth in areas with known shallow-level alteration.