Hydrothermal alteration of porphyry dykes related to Cu-Ag porphyry and skarn mineralization in the McKenzie Gulch area, northern New Brunswick, Canada

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The McKenzie Gulch Cu–Ag skarn mineralization occurs in four zones: the Woden Brook occurrence (0.5% Cu over 6.0 m) to the northeast, the McKenzie Gulch occurrence (1.11% Cu and 10.63g/t Ag over 0.50 m) and the Legacy skarn deposit (0.87% Cu in 1 500 000t and 10.29 g/t Ag) in the middle, and the Burntland Brook occurrence (0.40% Cu over 10.2 m) to the southwest. These occurrences are localized between two northeast-trending, dextral strikeslip fault systems, the McKenzie Gulch Fault to the west and the Rocky Gulch Fault to the east. All four zones are hosted by carbonate-bearing sedimentary rocks of the Upper Ordovician through Lower Silurian Matapédia Group and spatially associated with northeast-trending Middle to Late Devonian intermediate to felsic dyke swarms.

Geochemical data indicate that the dykes are granodioritic to tonalitic in composition and have an I-type, volcanic-arc signature. Overall these data indicate a trend towards increasing SiO_2 and Zr with decreasing TiO_2 , Al_2O_3 , MgO, Sc, and V from the plagioclase-hornblende porphyry through to the quartz-plagioclase porphyry, and is consistent with evolution by fractional crystallization of plagioclase, hornblende, magnetite, and titanite. However, parallel fractionation arrays for Y, Zr, and Nb in the two suites indicate that the quartz-plagioclase porphyry fractionated from a related, but slightly different source than the hornblende-plagioclase porphyry.

Petrographic examination coupled with XRD analysis indicates that primary mineral composition (i.e., plagioclase, K-feldspar, biotite, hornblende), both phenocrysts and groundmass, have been partially or completely replaced by hydrothermal alteration assemblages dominated by calcitesericite-illite, with subordinate chlorite and kaolinite. Minor pyrite occurs as disseminations and fracture filling. Trace amounts of hematite exist in veins and replacing pyrite. Molar element ratio analyses indicate alteration styles consistent with petrographic and XRD analyses.

As a result, these hydrothermal alteration assemblages can be summarized into: (a) phyllic alteration that varies from weak to strong, and can be differentiated into two subgroups: (i) quartz-sericite-pyrite assemblage that is characterized by the complete replacement of plagioclaseK-feldspar-biotite phenocrysts and groundmass; (ii) weak sericite-pyrite ± illite assemblage that is characterized by the presence of weakly to unaltered plagioclase; (b) weak propylitic alteration, but moderate to strong along contacts with skarn, and along joint-like fractures and hydrofractures. This alteration style is characterized by partial to complete replacement of plagioclase-hornblendebiotite by chlorite-illite-calcite ± epidote. Thus, variations and distributions of these alteration assemblages reflect several important variables including degree of alteration, and nature and composition of protolith.

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