Lithogeochemistry of the Quebrada Blanca porphyry copper deposit, Atacama Desert, northern Chile

Tamara Moss and Cliff Stanley
Department of Earth and Environmental Science, Acadia University, Wolfville, NS, Canada B4P 2R6

Hypogene mineralization at the Quebrada Blanca (QB) porphyry Cu deposit is not well understood because the current resource includes only supergene enrichment mineralization. Nevertheless, it is likely that the geology of the supergene enrichment zone at QB can provide clues about the underlying hypogene lithologies, mineralization, and hydrothermal alteration. This project is investigating the geology intersected by nine drill cores from a NS cross-section at 19,600 m E through the QB open pit in order to understand the nature of hypogene mineralization, hydrothermal alteration, and the principle host lithologies at QB. Pre-existing major oxide lithogeochemical data (n = 7540), and new petrological and lithogeochemical data (n = 100) were examined to provide insight into: (1) the igneous and hydrothermal processes that produced the host rocks; (2) the nature of hydrothermal alteration and how host rock composition controls the resulting mineral assemblages; and (3) how weathering processes have affected hypogene rocks.

Three principle lithologies exist within the QB open pit. They consist of diorite that was intruded by quartz monzonite, and a suite of later, irregular plagioclase porphyry dykes associated with mineralization. The petrography of hypogene samples indicates the presence of minor propylitic alteration (mostly in diorite), weak to moderate potassic alteration overprinted by strong phyllic alteration in quartz monzonite, and potassic alteration in plagioclase porphyry. Phyllic alteration consists of quartz and sericite, the latter occurring incipiently replacing both igneous feldspar and feldspar formed during potassic alteration, within veins with quartz, and as polycrystalline masses replacing the igneous matrix. Intense phyllic alteration typically obliterates original textures in quartz monzonite. Potassically altered plagioclase porphyry units generally contain plagioclase altered to potassium feldspar.

Pearce element ratio analysis was undertaken using lithogeochemical data from pre-existing supergene samples. These data indicate that most historic samples are phyllically altered and that phyllic alteration at QB exhibits a range of quartz/muscovite ratios (from 1 to 3) that exhibit spatial patterns. Within individual phyllic alteration zones, quartz/muscovite ratios gradually increase from 1 in the southeast to 3 in the northwest. These zones are rooted along muscovite-rich northeast-southwest-trending faults from which phyllic alteration flares upward and to the southeast.

Atlantic Geology, 2009, Volume 45, Number 1