

Tracking Hydrothermal Processes With Magnetite Composition and Texture at the Quebrada Blanca Cu-Mo Porphyry Deposit, Chile

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Quebrada Blanca (QB) is a Cu-Mo porphyry deposit within the Collahuasi District of the Eocene-Oligocene metallogenic belt of northern Chile. The deposit is hosted by several rock units: 1) Collahuasi Formation, a Paleozoic volcanic-sedimentary basement unit, 2) Paleozoic diorite that intrudes the Collahuasi Formation, 3) Paleozoic quartz monzonite-granodiorite that intrudes the Collahuasi Formation and the diorite unit (303-294 Ma), 4) early to syn-mineralization feldspar porphyry stocks (37.5-36.4 Ma), and 5) syn-mineralization hydrothermal breccias. Potassic alteration is subdivided into an assemblage of biotite and potassium feldspar, and a more pervasive phlogopite, sericite, and chlorite assemblage. Two temporally transitional alteration assemblages are identified: a magnetite-biotite alteration event, and a green-grey sericite event. Late-stage alteration includes a quartz-sericite assemblage and post-mineralization supergene argillic assemblage.

The objective of this study is to characterize the paragenesis of magnetite at QB through compositional and textural analysis of 20 samples of core. Magnetite in the potassic alteration assemblage is predominantly disseminated with rare instances of acting as breccia cement, while transitional magnetite occurs as disseminations, breccia cement, and as veins, often associated with chalcopyrite. Studies have found that magnetite incorporates specific minor and trace elements in predictable concentrations during precipitation from a hydrothermal fluid in porphyry deposits. We hypothesize that magnetite from transitional alteration assemblages will have decreasing quantities of minor and trace elements compared to potassic stage magnetite, reflecting decreasing fluid temperature, element availability, and changing oxygen fugacity conditions that control element partitioning into magnetite. Scanning electron microscopy (SEM) was used to analyze magnetite textures and reveal coupled dissolution reprecipitation textures in transitional-stage magnetite. Electron probe microanalysis (EPMA) and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) will be used to determine minor and trace element compositions of magnetite and we will perform statistical analysis to determine how magnetite chemical composition varies across alteration assemblages.