Characterization of primary sulphide assemblages at the Chuquicamata porphyry copper deposit, Chile, section 4500N

Meghan Lewis
Department of Earth Sciences, Dalhousie University, Halifax, Nova Scotia B3H 3J5, Canada

The Chuquicamata porphyry copper deposit has been mined continuously in one form or another for over a century. Oxide and supergene ores with copper grades from 2 to 10 times higher than the hypogene (primary) grades have been mined for most of the first seventy-five years of this century. Hypogene ore has only recently started to be mined. Published detailed descriptions of Chuquicamata sulphide assemblages date from 1939, years before hypogene sulphides became a significant part of the mined ores. In order to aid in the formulation of a genetic model of the deposit, mineralogical data from a sequence of internal reports by the mine staff must be re-evaluated and synthesized with current studies at Dalhousie University.

Working from three deep drill holes in the representative 4500N cross section, a detailed petrographic study is being conducted to determine whether the different zones of alteration (quartz-sericite, potassic and propylitic) contain characteristic ore assemblages, and how these assemblages change with depth, with respect to mineral paragenesis and compositional variations of phases. Those of particular interest so far, include the copper-rich assemblage digenite + covellite, found dominantly in zones of quartz-sericite alteration, while the equilibrium assemblage chalcopyrite + bornite is localised deep in zones of potassic alteration. Covellite (CuS) is found throughout the system: in zones of quartz-sericite alteration, acicular covellite occurs in equilibrium with high-temperature digenite, while in intermediate levels of zones of potassic alteration, covellite is often found in thin lamellar crystals replacing other Cu-sulphides, most frequently chalcopyrite, where it forms an arrangement of loose lattices. Veins of hypogene pyrite + enargite + sulphate run through the intermediate level of the system. Using experimentally-determined phase equilibria in the Cu-Fe-S system, an attempt is made to impose limits on the temperature of formation of various hypogene ore assemblages.