

In-situ and ex-situ experimental investigation on the chalcopyrite replacement in saline solution at 310–365 °C and 15–25 MPa

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ABSTRACT

The replacement of chalcopyrite in NaCl solutions was investigated from 310 to 365 °C and 15 to 25 MPa with ex-situ surface characterization techniques and in-situ electrochemical methods. The replacement products and reactions were analyzed ex situ using Raman spectroscopy and a scanning electron microscope (SEM) with an energy-dispersive X-ray spectrometer (EDS). Chalcopyrite dissolution was monitored by open circuit potential (OCP), polarization curves, and electrochemical impedance spectroscopy (EIS). The ex-situ and in-situ measurements show that: (1) elevated temperature and pressure promote the oxidative dissolution of chalcopyrite by different pathways; (2) the altered chalcopyrite surface consists of an outer layer of hematite and an inner layer of covellite; (3) at elevated temperature, removal of more copper from chalcopyrite surface enhances chalcopyrite dissolution, and favors hematite formation over covellite in the alteration rind; and (4) at elevated pressure, more iron ions diffuse through the passive covellite layer by point defects, promoting chalcopyrite replacement by covellite over hematite. This study provides experimental evidence on the replacement of chalcopyrite by covellite, the precipitation of hematite, and the exchange of Fe/Cu ions between chalcopyrite and hydrothermal brine.

Keywords: Chalcopyrite replacement, covellite, hematite, ex-situ surface characterization, in-situ electrochemical techniques