

Copper speciation in vapor-phase fluid inclusions from the Mole Granite, Australia

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ABSTRACT

X-ray fluorescence elemental maps and Cu *K*-edge X-ray absorption near-edge structure (XANES) spectra were recorded for individual vapor and brine phase fluid inclusions from the Mole Granite, NSW, Australia. The maps indicate that Cu is concentrated in the vapor inclusions and, at room temperature, distributed uniformly in the condensed liquid. Opaque precipitates in these inclusions do not contain Cu. The absorption spectra identify the stable complexes as $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ at 25 °C, $[\text{CuCl}_2]^{-}$ at 200 °C, and either $[\text{CuCl}_2]^{-}$ or $[\text{CuCl}(\text{H}_2\text{O})]$ at the homogenization temperature of around 400 °C. These changes in Cu coordination and oxidation state are fully reversible. We suggest that the vapor phase partitioning of Cu as a chloride complex from a high-density brine may occur under acidic conditions. Estimates of fluid acidity at the time of boiling may potentially predict the metal distribution between epithermal and porphyry-type environments in hydrothermal systems.