

Fluid evolution of the Juno porphyry Cu-Mo deposit in Gangdese tract, Tibet, China: A fluid inclusion investigation

Jie Dai*, I-Ming Chou, Yong Huang, and Jun Ding

Chengdu Center, China Geological Survey, Chengdu, China, *e-mail, daijiegirl@163.com

The Juno porphyry Cu-Mo deposit in the western part of the south Gangdese porphyry copper belt in Tibet, China is a very large porphyry system, containing an estimated 2.3 million tons of Cu and 0.0399 million tons of Mo. The Cu-Mo mineralization is mainly associated with a Miocene low-aluminous I-type granite porphyry pluton, formed in an extensional tectonic setting. Field observations and petrographic studies demonstrate that emplacement of the pluton took place in several intrusive pulses with associated hydrothermal activity. Early hydrothermal alteration produced a potassic assemblage, which was later overprinted by phyllic alteration. At least three main stages of mineralization have been identified: (1) early stage A veins containing quartz + K-feldspar + minor sulfide; (2) middle stage B veins containing quartz + molybdenite + sporadic sulfide (B1-subtype veins) and quartz + pyrite + chalcopyrite (B2-subtype veins); and (3) late stage D veins containing pyrite + quartz.

Three types of fluid inclusions (FIs) were observed in quartz in the early and middle stages; carbonic bearing-aqueous V-type and L-type, and solid bearing (S-type), where V and L represent vapor and liquid, respectively. Only aqueous L-type FIs were observed in late stage minerals. The S-type FIs contain variable daughter minerals, including halite, chalcopyrite, hematite, anhydrite (or gypsum), calcite, and an unidentified transparent crystal, and only halite was observed to dissolve during heating. Halite-bearing S-type FIs are mainly homogenized by halite dissolution at 300-470°C, corresponding to salinities of 38.9-56.3 wt.% NaCl equiv.; however, some of these homogenized to liquid at 360-520°C via vapor disappearance, with salinities of 31.9-56.7 wt.% NaCl equiv. Other FIs in minerals of A, B1, B2, and D veins homogenized at temperatures of 350-570, 303-550, 305-525, and 250-347°C with salinities of 3.4-21.1, 2.6-22.4, 5.0-22.4, and 4.7-18.2wt.% NaCl equiv., respectively. These data suggest that the ore fluids forming the Juno deposit changed from high-temperature, low-moderate salinity, CO₂-bearing magmatic fluids to low-temperature, low-salinity and CO₂-poor meteoric fluids. Boiling and cooling were the important factors causing the precipitation of the abundant chalcopyrite in the middle stage B2-subtype veins. The molybdenite mineralization was mainly caused by pressure decrease due to the escape of CO₂, but also by fluid boiling in the middle stage of B2-subtype vein formation. This hydrothermal ore-forming system is not typical of magmatic-hydrothermal porphyry Cu systems, but is similar to Cu-Mo or Mo-Cu porphyry systems characterized by high initial CO₂ environments, as indicated by the abundance of CO₂-bearing, low-moderate salinity FIs and calcite bearing S-type FIs.