Causes for Cu and Mo segregation in porphyry deposits: fluid and melt inclusion study

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The relative proportions of Cu and Mo (Cu/Mo ratio) in porphyry deposits are variable, however, the factors controlling the temporal and spatial Cu and Mo segregation are still unclear. Our goal is to develop a better understanding of the causes for Cu and Mo separation in porphyry-type deposits. This information may be applied in exploration for Cu and Mo mineralization.

The porphryry Mo (Cu) deposit at Bangpu is located in east section of Gangdese porphyry copper belt, one of the largest copper belts in China. The deposit shows a distinct metal zonation, with shallow molybdenum mineralization (Mo stage) following the early monzogranite porphyry intrusion and spatially deeper copper mineralization (Cu stage) occurring in the late diorite porphyrite intrusions.

We distinguish three types of fluid inclusions at Bangpu, classified as types I(moderate density), II(vapor rich), III(halite saturated). The coexistence of type I inclusions and H_2O saturated silicate melt inclusion suggests that type I inclusions trapped a single phase aqueous fluid of magmatic origin. Type III inclusions trapped mineralizing fluids for precipitating Cu-Fe sulfides. The daughter minerals in halite saturated inclusions studied by laser Raman spectroscopy and EDS-SEM are sylvite, fluorite, anhydrite, hematite, chalcopyrite, pyrite and magnetite. Synchrotron X-ray fluorescence analysis indicates that type III inclusions are dominated by Na, K, Ca, Fe, Mn, Zn and Pb and the brine contains more Cu and S than vapor. Coexisting of type II and type III fluid inclusion assemblages provide evidence for boiling (phase separation). It is unclear whether the halite saturated fluids are the result of fluid unmixing or directly exsolved from the crystallizing magma. Without petrographic evidence, the relationship of fluids and Mo stage mineralization in the shallow part remains ambiguous.