Composition and Evolution of Ore Fluids in the Hongniu-Hongshan Cu Skarn Deposit, Yunnan Province, China

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The Hongniu-Hongshan Cu skarn deposit (77.8 Mt at 1.8% Cu) is located in the central part of the Zhongdian porphyry and skarn Cu belt in southwestern China. Skarn and orebodies occur mainly between the different units of the Upper Triassic Qugasi Formation or within altered limestone adjacent to Late Cretaceous intrusions (78–76 Ma). Based on detailed geological mapping, drill core record compiling and mineralogical investigation, we distinguished fluid inclusions of different mineralization stages, carried out the microscopic petrographic study, temperature measurement and in-situ LA-ICP-MS analysis on the fluid inclusions. A comprehensive evolution process of the fluid from deep magma chamber, dissolve of metallogenetic fluid and precipitation of metals was established. Phase separation were recognized in the fluid inclusions of the earlier stage and syn-ore stage of the mineralization. The phase separation of the earlier stage took place at a high temperature of 566 to 650℃ and lithostatic pressure 680 to 940 bar, at depth of 2.5 to 3.5 km, whereas the phase separation of the syn-ore stage took place at a relatively lower temperature of 300 to 400℃ and lithostatic pressure 100 to 400 bar, at depth of ~1.5 km. Different elements show different partition symptoms in the different P-T circumstances. Metallogenetic elements such as Ag, Pb, Zn, Na, K, Fe, Mn, Rb, Cs are enriched within the high-salinity aqueous fluid, possibly complexing with chlorine. Copper tend to partite into the high-salinity aqueous fluid at the earlier high P-T circumstance, and partite into vapor phase at the syn-ore lower P-T condition, respectively. It's worth noticing that although sulfur is abundant in the high-salinity aqueous fluid both in the earlier stage and the syn-ore stage (37872ppm, 37339ppm), it increased obviously from 1419 ppm to 24139 ppm from earlier stage to the syn-ore stage in the vapor phase. Significant enrichment of copper in the syn-ore stage vapor phase can be attributed to the large amount of sulfur, which is in accordance with Seo et al. 2013 's research.

In other word, in a medium P-T condition (300 to 400℃, 100 to 400 bar), copper is more likely to be transported as a sulfur complex in the vapor phase during the phase separation, if there is abundant sulfur in the vapor phase. The increase of pH and decrease of the oxygen fugacity of the fluid during the rock-fluid reaction, is the main origin for the precipitation of metal.

Key words: Fluid inclusion, Phase separation, Sulfur complex, Hongniu-Hongshan, Ore genesis