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Fluid Inclusion Study of the Yejiwei Cu-Sn Porphyry Deposit in Hunan Province

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1 Research Topic and Significance

The ore concentration area of southern Hunan Province is a typical district at home and abroad which is mainly rich in W and Sn (Mao et al., 2007). The regional large-scale ore-forming incident which occurred within relatively short time in middle-late Jurassic caused extensive attention. Many studies used to discuss the formation mechanism of W-Sn polymetallic deposits among greisen, skarn and lode types (Yuan et al., 2012). However, the tin polymetallic porphyry deposit which is also important in the region is ignored. The Yejiwei Sn-Cu polymetallic deposit is a typical and large porphyry deposit in southern Hunan Province, even rare in China. It's the largest tin porphyry deposit in the region which has tin metal reserves of more than 110,000 t and Cu 66,000 t (Li et al., 2013). It has not been well understood that the kind of ore-forming elements in the deposit which mainly contains copper and tin is much different from the other deposits mainly rich in W and Sn in Dongpo orefield and even the region.

The characteristics of the ore-forming fluid is a clue to find out the genetic relationship between W-Sn mineralization and Sn-Cu mineralization. The aim of this paper is to discuss the evolution of ore-forming process in Yejiwei using fluid inclusion from quartz porphyry and ore samples by the methods of inclusion petrography, microthermometry and laser Raman spectrometry.

2 Detailed Study of Fluid Inclusion

This experiment of fluid inclusion microthermometry and laser Raman spectrometry analysis conducted at MLR Key Laboratory of Metallogeny and Mineral Assessment. The fluid inclusions from quartz phenocryst of altered quartz porphyry and fluorite coexisting with ore mineral in ore samples were carried out for measurement.

Detailed fluid inclusion petrography of quartz porphyry samples revealed three types of inclusion: aqueous two-phase inclusions, gas-rich inclusions, and H_2O-CO_2 inclusions. Some melt inclusions can be seen around fluid inclusions, especially coexisting with aqueous two-phase inclusions which has the more propotion among all three types. Basically, the fluid inclusions present isolated in round and oval shape. They range from 3 to 30 μm in diameter with an average of 5 to 20μm. Microthermometric results indicate that total homogenization temperatures have a wide and similar range from 200 °C to 445 °C for three types of inclusions, mostly from 260 °C to 420 °C. Estimates of fluid salinity for H_2O-CO_2 inclusions are quite restricted (1.2-4.3 wt% NaCl), whereas aqueous two-phase inclusions and gas-rich inclusions show much wider salinity ranging from 1.2 to 16.1 wt% NaCl. Besides H_2O detected in most inclusions, CO_2 has also been found in the aqueous and gas inclusions by Laser Raman Spectroscopy.

Much bigger (5-30 μm), aqueous two-phase inclusions, gas-rich inclusions, H_2O-CO_2 inclusions, and a few daughter mineral-bearing inclusions have been found isolated present in fluorite of ores. The daughter mineral-bearing inclusions in irregular shape are always coexisting with the aqueous inclusions, and the daughter minerals were hard to melt even heated above 450 °C that would burst the inclusions. This phenomenon may be inferred that the salinity would be over 50 wt% NaCl, or the minerals were some carbonates which hardly to be melted. Microthermometric results indicate that total homogenization temperatures of the other types range from 148 °C to 392 °C evenly which have a holistic lower temperature section than those from same types in quartz phenocryst of quartz porphyry. And the salinity of these inclusions totally has a wider range from 1.6 to 20.1 wt% NaCl.

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3 Summary

This study shows that the composition of ore-forming fluid in Yejiwei Cu-Sn porphyry deposit mainly belongs to NaCl-H_2O-CO_2 system. It would be likely that it evolved from the magmatic-hydrothermal fluid of middle to high temperature and middle to low salinity, and in the process of its evolution the temperature decreased and salinity range widened. It is maybe interpreted to reflect fluid boiling that the low-salinity inclusions coexist with daughter mineral-bearing inclusions and the aqueous inclusions are present with H_2O-CO_2 inclusions, which, in turn, may account for the large size of the Yejiwei Cu-Sn deposit.

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