1 Introduction

The Zijinshan orefield, located in the southwestern part of the Fujian Province, is a porphyry-epithermal Cu-Au-Mo-Ag mineralization system (Zhang et al., 2003). The orefield comprises the Zijinshan high-sulfidation epithermal Cu-Au deposit, the Luoboling porphyry Cu-Mo deposit, the Yueyang low-sulfidation epithermal Au-Ag-Cu deposit, and the Wuziqilong mesothermal Cu deposit. Recently, rare minerals such as kiddcreekite, hemusite, and vinciennite were identified in the Zijinshan Cu-Au epithermal deposit (Liu et al., 2012). These are considered to carry important information for understanding the physicochemical environment of formation and genetic relationships in the Zijinshan porphyry-epithermal deposit system.

2 Tin Mineralogy

2.1 Kiddcreekite

Kiddcreekite mostly occurs as subhedral to irregular grains in covellite-rich ore with mineral association of covellite, colusite, enargite, and stannoidite in the upper level of the orebody. Kiddcreekite is intimately associated with colusite and enargite. At deeper levels, kiddcreekite is associated with covellite, mawsonite, chalcopyrite, and pyrite. Kiddcreekite is determined to be homogeneous and have a composition close to ideal Cu$_{6.2}$Sn$_{0.97}$W$_{0.98}$S$_{7.85}$, with trace amounts of Fe, Bi, and Sb.

2.2 Hemusite

Hemusite was found in the deep part of the Zijinshan HS deposit, the first time the mineral has been reported in China. Hemusite is associated with kiddcreekite, colusite, mawsonite, chalcopyrite, covellite, and pyrite. This crystal grains of hemusite were determined to be homogeneous with an average chemical composition close to Cu$_{5.96}$Sn$_{0.87}$Mo$_{0.94}$S$_{8.08}$, and with trace amounts of Fe and Bi.

2.3 Vinciennite

Vinciennite, a rare mineral with the formula Cu$_{10}$Fe$_{4}$Sn($\text{As, Sb}$)$_{16}$, is found in the deepest drill hole in the Zijinshan HS deposit and in the upper level of the Longjiangting IS deposit. In Zijinshan HS deposit, vinciennite occurs as euhedral-subhedral grains in covellite-rich ore within the mineral association kiddcreekite-mawsonite-tennantite-enargite-covellite. In the Longjiangting IS deposit, vinciennite occurs in copper ores overprinted by a HS event, and is associated with tennantite, digenite, and bornite. Vinciennite in the Zijinshan HS deposit has the average composition Cu$_{10.8}$Fe$_{3.9}$Sn$_{1.1}$As$_{0.5}$S$_{10.5}$, with trace amounts of Zn. In the Longjiangting deposit, vinciennite has compositions of Cu$_{10.6}$Fe$_{3.9}$Sn$_{0.5}$As$_{0.5}$S$_{15.6}$ with higher Sb contents.

2.4 Colusite

Colusite, Cu$_{26}$V$_3$(As, Sn, Sb)$_6$S$_{32}$, is widely distributed in the Zijinshan HS deposit. In the open-pit (away from the volcanic vent), colusite occurs as rounded grains in bornite-rich Cu-ores. Some compositionally zoned grains of colusite are observed as inclusions within bornite. In mid-level of the ore body, colusite is associated with kiddcreekite and enargite, and is replaced by covellite. In the deep part of ore body, colusite is associated with kiddcreekite, hemusite, chalcopyrite, and pyrite. Grains of...
colusite are determined to be heterogeneous with zoning expressed by W and Sn, causing a complex substitution between (As+V) and (Sn+W).

2.5 Stannoidite, Mawsonite and Stannite

In the bornite-rich ore sampled from the open-pit, stannoidite associated with bornite, colusite, mawsonite, and digenite, with the structure of colusite replaced by stannoidite and later by mawsonite. In the upper digenite-rich ore close to the volcanic vent, relics of stannite are replaced by stannoidite and covellite. In the enargite-rich ore, stannoidite occurs as elongate crystals that cut through enargite. In the Wuziqilong IS deposit, stannoidite occurs as columnar crystals associated with covellite that cut through kiddcreekite and colusite. Amounts of mawsonite are observed in the deepest parts of the orebody, replacing kiddcreekite, colusite and hemusite. The average composition of stannoidite is Cu$_{8.24}$Zn$_{0.94}$Fe$_{1.92}$Sn$_{1.94}$S$_{11.91}$, with trace amounts of As; the composition of mawsonite is Cu$_{6.05}$Fe$_{1.97}$Sn$_{1.01}$S$_{7.96}$. The stannite in Zijinshan HS deposit is the Zn end-member (kesterite) with the composition Cu$_{2.15}$Zn$_{0.89}$Sn$_{0.95}$S$_{3.95}$.

3 Discussion

Kiddcreekite occurs widely in the Zijinshan minefield. It is a resistant mineral which formed at an early mineralized stage together with hemusite and colusite, implying both high temperature and sulfidation conditions. In the Zijinshan HS orefield, approaching the volcano vent, the principal copper minerals vary from bornite-rich to digenite rich to covellite-rich. Correspondingly, tin mineralogy varies from kesterite-dominated at upper levels to stannoidite-dominant at mid-to-upper levels of the copper ore body, to vinciennite- and mawsonite-dominant at depth. This zonation implies that the oxidation state and the sulfidation increase downwards. According to Kouzmanov et al. (2004), the Sn-As-Cu mineral association forms in a geological environment typical of a transitional zone between porphyry to epithermal deposit, implies potential for a subjacent porphyry deposit in the Zijinshan orefield. The occurrences of the W-Sn-Mo sulfides in Zijinshan minefield suggest that some contribution of ore metals (W, Sn, Mo) in the mineralized fluids may have come from the early granitic host rock.

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