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Trace element distributions in (Cu)-Pb-Sb sulfosalts from the Gutaishan Au-Sb deposit, South China: Implications for formation of high fineness native gold

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Abstract

Compositional data, comprising electron probe microanalysis and laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) trace-element data, are presented for common (Cu)-Pb-Sb sulfosalts (bournonite, jamesonite, tetrahedrite, and boulangerite), subordinate semseyite, heteromorphite, robinsonite, and (Cu)-Pb-Bi-Sb sulfosalts, as well as for accompanying base metal sulfides (BMS) in auriferous gold veins from the Gutaishan Au-Sb deposit, southern China. The objectives of the study were to identify whether these sulfosalts represent overlooked hosts for precious metals and other trace elements of petrogenetic or economic interest, establish partitioning trends among coexisting sulfosalt species and between sulfosalts and BMS, and to seek evidence for a genetic link between the abundance of (Cu)-Pb-Sb sulfosalts and the high-fineness of native gold in the deposit. All (Cu)-Pb-Sb sulfosalts analyzed were found to be remarkably poor hosts for gold and thus do not contribute to the overall mineralogical balance for gold. Trace yet measurable concentrations of Au are, however, noted in the (Cu)-Pb-Bi-Sb sulfosalts, in agreement with published data indicating that (Cu)-Pb-Bi-Sb sulfosalts may be minor Au-hosts in some ore systems. Silver is preferentially partitioned into tetrahedrite at the expense of other sulfosalt phases, and tetrahedrite is thus the major host for Ag in the Gutaishan deposit. LA-ICP-MS trace element mapping allows partitioning relationships among different sulfosalt and BMS phases to be determined for several trace elements. Jamesonite concentrates Fe, Zn, Bi, Cd, Ag, Ni, and In over coexisting bournonite, yet boulangerite is the better host for As, Ag, Sn, Se, and Te than jamesonite. Cd and Co are typically enriched in sphalerite relative to any sulfosalt, and when present, pyrite is always enriched in Au and Co relative to all other phases. A high Au/Ag ratio in the ore-forming fluid, the presence of abundant tetrahedrite that has sequestered silver during mineral precipitation, and a lack of evidence for cooling-driven precipitation may be significant reasons for the formation of high-fineness gold throughout the deposit. Two generations of native gold are documented whereby the first is coarse-grained, Ag- and Bi-bearing, and is associated with the main (Cu)-Pb-Sb sulfosalts (bournonite, jamesonite, tetrahedrite, and boulangerite). The second generation is fine-grained and has the highest fineness. Increase in the complexity of sulfosalt assemblages, re-distribution of Ag within coarse native gold and dissolution-reprecipitation reactions among the sulfosalt-gold association increase the gold fineness. The present study shows that linking petrographic aspects at the micrometer-scale with minor/trace element distributions in complex sulfide-sulfosalt assemblages can track a complex history of Au deposition and enrichment.

Keywords: Sulfosalts, trace elements, high-fineness native gold, gold deposits, Gutaishan