

Enrichment of precious metals associated with chalcopyrite inclusions in sphalerite

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Of the major precious metals recovered from sulfide ore deposits, gold and silver show natural affinities with different sulfide minerals. Such phenomena involve, but not limited to evolving fluid physio-chemical conditions (e.g., temperature, pH and redox), stability of minerals and their carrying capacity for impurities (e.g., coupled substitutions of As and Au for Fe in pyrite, and Sb and Ag for Pb in galena).

In recent years, a growing attention has been drawn towards the role of submicron- to nanometer-sized mineral particles in controlling the mobility of precious metals in geological environments [1]. The disseminated chalcopyrite in sphalerite crystals has been extensively documented from natural ores of sulfide deposits in South China. Here we report the enhanced enrichment of precious metals in sphalerites by chalcopyrite micro/nano inclusions, relative to those chalcopyrite-free sphalerites from the Maluntou epithermal gold deposit. The origin of chalcopyrite inclusions involves recrystallization-driven phase separation from metastable parent chalcopyrite-sphalerite solid-solutions. The exsolution was expected to be driven by temperature-dependent structural transformation from high-temperature cubic β -phase chalcopyrite to tetragonal α -phase below 400 °C. The chalcopyrite blebs/lamellae preferentially follow sphalerite {111} planes which define a shared sulfur layer for both chalcopyrite and sphalerite. Our study indicates that mixing and boiling during evolution of ore-forming fluids for the Maluntou deposit are key processes for the abnormal enrichment of precious metals in sphalerite and pyrite. Such information can provide new insights into the controls on the enrichment of precious metals in sulfides and help further understand Au/Ag recovery and industry processing of refractory ores.

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[1] Deditius A.P. et al (2011), *Ore Geol. Rev.* 42, 32–46.