

Submicron-scale variation of metals in colloform pyrite revealed by NanoSIMS

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Colloform textures of sulfides preserved in hydrothermal ore systems can record the changing conditions of ore formation via sequential formation of the colloform layers. Although the petrographic and crystallographic features are well documented, few studies have focussed on the compositional variations within discrete layers. We present new high spatial resolution (<50nm) data for metal concentrations in fine-grained auriferous colloform pyrite collected at the Daqiao orogenic gold deposit, China. Nanoscale secondary ion mass spectrometry (NanoSIMS) elemental mapping reveals that the colloform pyrite displays thickness of the layers varies significantly. There are two zones, inner core (~10–20 μm) and outer rim (~0.5–8 μm). The rims are enriched in Au, Ag, As, and Sb compared to the cores, while ^{34}S is highly variable. As and Ag maps highlight metal-deficient sector zoning in the core. Mean metal counts of different layers reveal positive correlations between Au-Sb and As-Ag. This study demonstrates a relationship between changes in trace element composition and grain size within layers of the colloform pyrite. The outermost layer is indicative of rapid growth, which is considered to be a result of high degrees of supersaturation. This rapid growth promotes trace-element uptake in the newly formed lattice in the near-surface region. In contrast, the metal-poor, sector-zoned layers in the core may be attributed to a relatively slow growth rate and low degrees of supersaturation. Low metal concentrations in ore fluid during core formation cannot be discounted. Incorporation of Sb or As into the lattice of pyrite is thought to be related to the crystal preferred orientation. The submicron-scale correlation of Sb-Au and As-Ag may underline preferential bonding of Au and Ag on specific crystallographic surfaces of the rapid-growth colloform pyrite from hydrothermal gold systems.