Quartz-sulfosalt relationships in high-sulfidation deposits – Goldfield, Nevada, USA: Genetic implications*

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Epithermal deposits are among the most significant resources of the world’s Au and Ag production. Numerous studies are in agreement that the classic advanced argillic alteration at high-sulfidation (HS) epithermal deposits is caused by the condensation of magmatic vapors into groundwater. However, there is debate about the origin of the fluid that causes precious metal mineralization and the temperatures at which mineralization occurs at HS deposits. Several previous studies proposed that precious metal deposition occurs at <300°C from a hydrothermal liquid. However, it has been recently suggested that the metals form directly from magmatic vapors at much higher temperature.

According to the latter model, there are two main stages which occur during the formation of HS epithermal deposits. The initial vapor-dominated “sulfate stage” is characterized by formation temperatures between 100°C and 500°C, intense silicification of the wallrock, and deposition of alunite. The later “sulfide stage” is characterized by temperatures over 600°C and the formation of pyrite, sulfosalt minerals (enargite, famatinite, and tennantite) as well as gold and silver. As a part of the “sulfide stage,” euhedral quartz crystals are deposited after the formation and dissolution of early pyrite. It has been suggested that the euhedral quartz may represent beta quartz which formed at temperatures in excess of ~575°C. Based on a recent fluid inclusion study at El Indio, temperatures of 455°C were inferred for the euhedral quartz. However, those temperatures were based on homogenization of vapor-rich fluid inclusions, which is not standard practice.

The purpose of this study is to determine if euhedral quartz crystals found within sulfosalt minerals at Goldfield can provide evidence for temperature of ore formation in HS epithermal deposits. Selected samples from Goldfield, Nevada were analyzed using reflected light microscopy and scanning electron microscopy. Euhedral quartz crystals were identified in these samples primarily within famatinite, in textures similar to those observed at El Indio. Enargite, hessite and bismuthinite, were also identified at Goldfield. A paragenetic sequence was determined for the Goldfield deposit: an early phase of alunite, quartz and pyrite; and a second phase in which deposition of quartz and pyrite continued and was accompanied by enargite and famatinite. Gold
deposition occurred at the end of the second phase with hessite and bismuthinite. The textural relationships between euhedral quartz and famatinite suggest that the quartz was deposited after the formation of famatinite. On-going fluid inclusion petrography and geochemical analysis of euhedral quartz may provide additional evidence for ore formation temperatures that can help resolve this debate on the nature of mineralizing processes at high-sulfidation epithermal deposits.