

Timing, Mineralogy, and Paragenesis of Quartz-Sericite-Pyrite Veins at the Morenci Porphyry Cu-Mo Deposit, Arizona

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The Morenci deposit in southeastern Arizona is a Laramide porphyry Cu-Mo system characterized by widespread supergene and hypogene alteration and multiple-stage veining. The Quartz-Sericite-Pyrite (QSP) veins document the evolution of fluids and metal transport, but at Morenci, their internal zoning is complex, therefore the timing of the veins and the evolution of the fluids is poorly constrained.

This study explores the timing relationships, mineralogical variability, and alteration zoning of QSP veins to constrain their paragenesis within the broader context of the hypogene evolution of Morenci. It is an integrated multi-scale analytical workflow which involves core photography, LIBS and SWIR data, high-resolution petrography, electron microprobe analysis, SEM imaging, and laser ablation ICP-MS analysis. Representative core intervals are selected for spectral and geochemical analyses to characterize vein textures, cross-cutting relationships, quartz growth stages, the distribution of alteration minerals, sulfide assemblages, and replacement features.

We aim to explore whether the internal complexity in QSP veins manifests through differences in texture, distribution of alteration minerals, and white mica composition. It has been shown that diversity in white mica chemistry implies varying fluid compositions and the possibility that temperature and fluid sources varied over time during vein formation [1]. Furthermore, integrating spectral data with mineral chemistry provides new insights into the spatial and temporal relationships between vein-controlled and pervasive alteration.

The findings from this study will help refine the paragenetic conceptualization of QSP veining at Morenci and demonstrate how combined spectral, petrographic, and microanalytical methods can enhance the reconstruction of hypogene processes within porphyry systems. The results will also inform vectoring of alteration systems and the redistribution of metals during late-stage fluid evolution.

[1] Codeço et al. (2021) Miner Deposita 56, 481.