

## **Using Biotite-Chlorite Alteration as a Fluid Tracer for Cu Mineralization in the Sanchez Porphyry Cu(-Au-Mo) Deposit, Safford District, Arizona**

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Magmatic-hydrothermal ore deposits develop via fluid circulation in the upper crust. It is crucial to create techniques for tracing fluid evolution to enhance our understanding of ore formation and to refine exploration strategies. Trace-element compositions of alteration minerals provide valuable fingerprints of these processes, and advances regarding in situ microanalytical methods enable detection of micron-scale geochemical variability.

The Sanchez Cu(-Au-Mo) porphyry, part of the world-class Safford District in SE Arizona, is hosted by Cretaceous andesitic volcanic rocks (73.3-67.6 Ma) that are cut by Paleocene quartz monzonite porphyry dikes (56-55 Ma).

This study combines macroscale and microscale observations to characterize the elemental systematics of biotite and chlorite. Lithology, alteration, and mineralization were documented through systematic logging of five drill holes along an NNW-SSE transect of the deposit. Petrographic analysis was complemented by scanning electron microscopy (SEM) to identify minerals, assess textural relationships, and examine cross-cutting vein generations. Additionally, major, minor, and trace-element compositions of biotite and chlorite were determined using electron microprobe analysis in combination with laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS).

Three main alteration assemblages are recognized: propylitic (chlorite  $\pm$  epidote  $\pm$  calcite), phyllic (sericite  $\pm$  chlorite  $\pm$  clay), and potassic (biotite  $\pm$  k-feldspar). Chloritization of biotite is widespread within the propylitic assemblage; however, we note that in unmineralized samples from the supergene zone, the interface between primary biotite and chlorite locally contains up to 21 wt.% CuO. This suggests that during propylitic alteration, Cu mobilized by fluids may precipitate at the biotite-chlorite interface, implying that Cu was present in the fluid but that the physical-chemical conditions did not allow chalcopyrite precipitation. These preliminary observations suggest that copper enrichment at the biotite-chlorite interface may serve as a useful indicator of mineralizing processes within the Safford district and potentially in Laramide porphyry copper systems more broadly.