

Molybdenite Crystal Polytype and Rhenium Trace Element Concentrations: A Novel Analytical Approach

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Molybdenite (MoS₂) is a common accessory or ore mineral found in copper porphyry systems worldwide. Its economic value stems not only from its molybdenum content, but also because it is the primary ore of rhenium (Re). However, Re is only present as a trace element within molybdenite, and its concentration is significantly variable even between individual crystallites within a grain.

Molybdenite samples from Bagdad, Ariz. were analyzed using electron microprobe and laser ab-lation inductively coupled plasma mass spectrometry (LA-ICP-MS), resulting in Re detections ranging from below detection limits to approximately 1400 ppm within a single polycrystalline grain. This suggests the ability of molybdenite to accommodate rhenium within its lattice may relate to its variations within its lattice structure. Molybdenite crystallizes naturally in the poly-types 2H and 3R. Molybdenite-2H is the more common polytype, which crystallizes in the hexagonal crystal system, whereas the less common Molybdenite-3R crystallizes as a trigonal mineral. Of note is the fact that reniite (ReS₂) crystallizes as a triclinic mineral.

In this study, we hypothesize that the less ordered 3R molybdenite is better able to accommodate rhenium within its lattice than the 2H molybdenite. To demonstrate whether there is indeed a correlation between the molybdenite polytype and its ability to accommodate rhenium, it is necessary to generate a two-dimensional map of the molybdenite polytype. To achieve this, we plan to map molybdenite grains using electron backscatter diffraction (EBSD), complemented with Raman spectroscopy mapping. Those maps will then be overlain with the Re concentration data from LA-ICP-MS and/or microprobe to understand the Re distribution.

Combining two-dimensional polytype mapping of polycrystalline molybdenite grains with in situ high-resolution Re measurements will allow us to qualitatively determine whether crystal poly-type controls molybdenite's ability to host Re, an insight that could significantly improve our understanding of Re distribution within a given deposit.