Assessing the Precision and Accuracy of In Situ Re-Os Dating of Molybdenite and Considerations for Ore Systems Research

Duane Petts[1], Christopher Lawley[1], Robert Creaser[2], William Davis[1]
[1]Geological Survey of Canada, Natural Resources Canada, Ottawa, Canada, [2]Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Canada

Precisely constraining the timing of mineralization remains a key component in the development of robust ore deposit models. Recent developments in laser ablation-based, tandem inductively coupled plasma mass spectrometry (e.g., LA-ICP-MS/MS) allow for the application of in situ beta-decay geochronometry to ore deposits research, including the use of in situ Re-Os isotope analysis of molybdenite to directly date mineralization. Here we assess the precision and accuracy of the in situ Re-Os method and evaluate its applicability to ore deposit research.

In situ (LA-ICP-MS/MS) and conventional (isotope dilution – negative ion – thermal ionization mass spectrometry, ID-N-TIMS) Re-Os measurements were undertaken on three molybdenite samples for potential development as reference materials and for evaluation of the in situ technique, including samples from: 1) a mineralized ca. 2.66 Ga pegmatite in the Moly Hill/La Corne region (Quebec), 2) a Neoarchean Cu-Zn VMS deposit related to the past producing Geco mine (Ontario) and 3) a Mesoproterozoic pegmatite associated with the Grenville orogeny (Gatineau region, Quebec). Additional in situ Re-Os isotope analyses were conducted on previously ID-N-TIMS dated molybdenite samples from the ca. 154-145 Ma Endako and ca. 80 Ma MAX Mo porphyry deposits (British Columbia).

While the in situ Re-Os isotope data yields accurate age interpretations, precisions of 1 to 2% are reported for the calculated ages. The precision of the in situ technique is highly dependent on the age and Re content of molybdenite, with the latter, varying between 2 and 50 ppm in the samples studied here. With these precision and accuracy considerations in mind, the Geco data highlights potential challenges with application of the in situ Re-Os technique to ore deposits research in Archean rocks, including utilizing the in situ data to precisely distinguish between contemporaneous volcanism and mineralization at 2.72 Ga and metamorphism at 2.67 Ga.