The hunt for molybdenite: Imaging techniques for Low-Level Highly Radiogenic (LLHR) As, Cu, and Fe sulfides

S Bowman[a], and RA Creaser[a]

[a] Earth and Atmospheric Sciences, University of Alberta, AB, Canada

The correlation between Mo and Re is significant. Both elements behave similarly in fluids and have nearly identical ionic radii (0.70, and 0.72 Å respectably) and a 4+ valence. The geochronological implication is that Re is able to substitute for Mo in the molybdenite crystal lattice. Molybdenite (MoS_2) is capable concentrating Re in excess of 1000 ppm, and high $^{187}Os/^{188}Os$ >100. The term low-level highly radiogenic (LLHR) has been applied to molybdenite with respect to Re/Os geochronology due to the exclusion of common osmium in the crystal lattice and very high levels of radiogenic osmium. For As, Cu, and Fe sulfides with an average crustal (1 ppb) Re concentration, any molybdenite inclusions will overwhelm the Re-Os signal from the host mineral. As, Cu, and Fe sulfides from the Kamoa, and Kipushi mines in the Democratic Republic of the Congo are highly radiogenic ($^{187}Os/^{188}Os$ up to 200) and have yielded anomalously young model ages compared to published Pb-Pb, Re-Os, and Rb-Sr data. It is possible that these young ages are the result of submicron-sized molybdenite crystals, which mineralized after the As, Cu, and Fe sulfides. Preliminary electron probe microanalysis (EPMA) Mo maps indicate that at least one, one-micron diameter molybdenite crystal is present in pyrite. Due to the detection limits of the EPMA, the small size of the molybdenite crystal and time constraints; elemental mapping via laser ablation provides a lower resolution but much larger lateral area that can be mapped, as well as an increase in signal strength. Mo maps produced using a laser ablation inductively coupled plasma quadrupole mass spectrometer (LA-ICPQMS) of whole-rock areas at mm-scale provide increased petrological context, as well as lower detection limits. Mapping Mo in these LLHR sulfides, uncertainties with the Re/Os ages may be elucidated.

Corresponding author: sbowman1@ualberta.ca