Rhenium and Os spatial distribution in molybdenite grains: Implications for Re-Os geochronology

FERNANDO BARRA[1*], ARTUR P. DEDITIUS[2], MARTIN REICH[1], MATT KILBURN[3]

[1] Department of Geology and Andean Geothermal Center of Excellence (CEGA), University of Chile, Santiago, Chile
[2] School of Engineering and Information Technology, Murdoch University, Murdoch, Australia
[3] Centre for Microscopy, Characterisation and Analysis, The University of Western Australia, Crawley, Australia
e-mail: fbarrapantoja@ing.uchile.cl

Application of the Re-Os isotopic system in mineral deposits has evolved on two fronts: as a single mineral geochronometer and as a tracer of the source of metals by direct determination of the initial Os ratio in the ore (sulfide) minerals. Molybdenite (MoS_2), the main source of molybdeunum and rhenium metal, constitutes a particular case within sulfide minerals because it contains high Re (in the ppm range) and Os (at ppb levels) concentrations, and almost no initial or common Os, hence it has developed as a single mineral geochronometer widely used to date mineral deposits. The molybdenite crystallization age can be obtained by determination of the concentration of rhenium-187 and osmium-187 isotopes. However controversy still remains regarding the possible disturbance of this isotopic system in molybdenite. Some researchers argue that post-crystallization alteration by hydrothermal fluids or metamorphism can remobilized Re and/or Os, whereas others advocate that the system remains impervious to these superimposed events. Additionally, it has been suggested by some authors that ^{187}Re and ^{187}Os are not spatially linked on a micron scale and that both elements are decoupled within molybdenite grains. In order to provide some insights on the distribution of both Re and Os and its possible implication for geochronology, high resolution elemental mapping of molybdenite grains using electron microprobe and SIMS were performed. Our results show that Re is heterogeneously distributed in molybdenite, showing in some cases oscillatory zoning and overgrowths. In some occasions Re is concentrated within the molybdenite structure forming micron-sized particles of rheniite (ReS_2). This heterogeneous distribution of Re (i.e., overgrowth and oscillatory zoning), as well as the presence of Re-rich micro-, and possibly nano-particles indicates a complex formation history that could affect the determination of accurate Re-Os molybdenite mineralization ages by microbeam techniques and bulk methods.