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Microtextures and their influence on molybdenite high-precision Re-Os geochronology

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Molybdenite ^{187}Re-^{187}Os geochronology is an important and widely used geochronological tool in the study of ore deposits (e.g., Stein, 2014) to directly determine the mineralisation age in a wide variety of ore deposit types. It is problematic that Re-Os dates do not always agree with other geochronological systems within their geological context. The cause of these differences is often attributed to Re and Os 'decoupling' (e.g., Stein et al., 2003), or intra-crystal open system behaviour due to different diffusion characteristics of the radiogenic Os and Re parent isotope. Other studies have attributed the heterogeneous distribution of Re and Os isotopes to Re nanophases or common Os nanoparticles (Da Silva et al., 2013; Barra et al., 2017), and alteration (e.g. powellite and illite; McCandless et al., 1993). It is still debated in literature about the exact mechanism of how mineral-scale processes may disturb Re and Os isotopic systematics.

To better constrain these issues, we have evaluated molybdenite samples which are collected from different Paleoproterozoic and Archean (~1.8, 2.8 and 3.3 Ga) magmatic-hydrothermal Mo(-Cu) deposits to capture a spectrum of post-formational geological processes. Detailed field relations can demonstrably link the timing of hydrothermal molybdenite formation to their host magmatic systems, which have been constrained by high-spatial resolution LA-ICP-MS and high-precision CA-ID-TIMS zircon U-Pb geochronology.

We develop a methodology for characterising molybdenite prior to high-precision Re-Os geochronology using imaging (SEM) and geochemical analytical (EMPA, LA-ICP-MS) techniques to gain insight into 1) The Re and Os isotope variation within molybdenite grains; and 2) the distribution of inclusions, alteration and Re- or Os-rich phases, that might influence Re-Os isotopic behaviour in bulk analyses. Comparison of high-precision molybdenite Re-Os and the zircon U-Pb dates of bracketing magmatic units provides a systematic evaluation of the open-system behaviour and the influence of intra-grain features on the Re-Os geochronology of molybdenite.

References

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