^{187}Re-^{187}Os geochronometry in molybdenite – 20 years fast forward

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Re-Os dating of molybdenite has taken its place as a consistently reliable, broadly applicable geochronometer. While testing of this mineral was carried out by only a few groups [1, 2], in the last couple of years the number of labs set up for molybdenite dating has doubled. So, nearly 20 years on, what have we learned about the Re-Os isotope systematics in this mineral with the unpronouncable name?

The molybdenite container is both simple and elegant [3]. Molybdenite is the only naturally occurring mineral with high affinity for parent Re coupled with a distaste for daughter Os on crystallization, thus creating a single-mineral ^{187}Re-^{187}Os radiometric clock. It is difficult to disturb this clock, even during metamorphism, because hosting silicate minerals and reducing fluids do not take in Re and Os. It is possible, however, for accumulated radiogenic ^{187}Os in molybdenite to diffuse into other adjacent sulfides in some circumstances [4].

We summarize four important advances in molybdenite geochronometry. *First*, the integrity of molybdenite ages bears no relation to milligrams of sample analyzed. It is critically dependent on strategic sampling at the outcrop scale and during separation of molybdenite for dating. *Second*, some molybdenites, in fact, have significant common Os; use of a double Os spike [5] allows precise measurement of common Os, avoiding potentially inaccurate (older) ages. *Third*, the assumption that molybdenite and zircon ages should be in agreement (used to argue the newcomer has issues) is incorrect logic; while in some magmatic systems Re-Os and U-Pb ages are concordant, this assumption may encourage cherry-picking of "correct" molybdenite ages to match U-Pb ages. Molybdenite ages provide an independent record of fluid flow in the crust. Variability in Re-Os ages for molybdenite should signal us to examine our geologic interpretation in more detail, and to incorporate thinking on process. *Fourth*, when ^{187}Re-^{187}Os decoupling is encountered (two samples from a single molybdenite grain with different to wildly varying ages), it is possible to reconstruct the original crystallization age for that molybdenite. We will explore advances in molybdenite dating with case studies.

[1] Markey *et al* (2007) *Chem Geol* **244,** 74-87. [2] Zimmerman *et al* (in press) *GCA*. [3] Stein *et al* (2001) *Terra Nova* **13**, 479-486. [4] Stein *et al* (2003) *GCA* **67,** 3673-3686. [5] Markey *et al* (2003) *Chem Geol* **200,** 395-406.