Re-Os and U-Pb gechronology –complementary systems

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Re-Os geochronology offers an alternative to U-Pb dating in Precambrian terrains, not as a replacement, not better or worse, but as a complement. U-Pb geochronology has the advantage of the dual decay schemes of ^{235}U and ^{238}U, providing an internal check on concordance. Geologic significance of Re-Os ages can be assessed by analysing multiple samples from the same geologic occurrence. Both U-Pb and Re-Os systems offer single-mineral chronometers: zircon, titanite, and others for U-Pb, and molybdenite for Re-Os. Molybdenite has proven highly robust in the absence of extreme oxidation producing ferrimolybdite, and surviving metamorphic conditions up to osumilite grade.

Spot analyses of zircon reveal temporal zoning, exposing multiple events in a single grain. In some cases, however, unusual age distributions suggest internal redistribution of daughter and/or parent. Spot analyses are not feasible for molybdenite chronology because the daughter Os isotope is readily mobilized within the crystal and thereby spatially decoupled from its parent Re. Still, because neither Re nor Os are soluble in reducing fluids and neither has a home in non-sulphide phases, the molybdenite crystal is a resilient time capsule. Zoning has been observed in a rare cases, but is generally recognizable in polished thin section.

Re-Os depositional ages can also be determined from syn-sedimentary sulphides or organic matter in organic-rich sedimentary rocks. This offers another geochronological method in those Precambrian systems for which U-Pb dating opportunities are sparse. The Re-Os isochron ages will inevitably appear less precise than related U-Pb ages. To the non-expert, lower precision is taken as a measure of quality, with more precise ages assumed to be 'better' and (most likely) more accurate. In part, this is because the ^{187}Re decay constant, derived from U-Pb chronology, carries an uncertainty of 0.31% that must be propagated with other errors. More importantly, the reported precisions for Re-Os and U-Pb ages are mathematically different statistics, are generated from markedly different numbers of analyses, may reflect very different culling of data, and may neglect decay constant uncertainties. These differences, and potential inaccuracies that may exceed reported uncertainties, should be communicated fully in any comparison of age results.