^{187}Re Decay Constant Accuracy and Black Shale Re-Os Geochronology

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The geochemical character of Re and Os is strikingly different from most other commonly used isotopic systems (e.g.. Rb-Sr, Sm-Nd, K-Ar, U-Pb). This permits chronology and isotopic tracing in geology and cosmochemistry on minerals and matrices that other isotopic systems cannot employ. Widespread application of the Re-Os geochronometer requires that the ^{187}Re decay constant be accurately and precisely known, however, the presently used ^{187}Re decay constant ($1.666 \times 10^{-11}.a^{-1}$) has been questioned. Intercalibration of the U-Pb zircon and Re-Os molybdenite chronometers from magmatic-related mineralization spanning Cenozoic to Archean time shows extraordinary agreement and indicates that the ^{187}Re decay constant of $1.666 \times 10^{-11}.a^{-1}$ (± 0.31%) remains the most accurate and precise determination for the ^{187}Re decay constant to date.

Since the early applications of the Re-Os system to dating black shales, we have shown that the Re-Os isotope system in shales remains undisturbed during hydrocarbon maturation, and in some cases, chlorite-grade metamorphism. In addition, we have shown that improved methodologies (analytical and sampling) allow precise depositional ages to be determined from a greater range of shales than previously thought possible, e.g., rocks with ≤0.5 % TOC contents. The direct dating of a overmature black shale at the Devonan-Carboniferous (DC) boundary in Western Canada gave a Re-Os age of 361.3 ± 2.4 Ma (2σ, including λ uncertainty) that is in accord with the most recent U-Pb zircon age interpolations of the DC boundary, demonstrating the application of the ^{187}Re-^{187}Os geochronometer to the determination of geologic time and for constraining the rates of geological and biological processes. Other high-precision ages for Jurassic units (Hettangian-Sinemurian, Canada; Oxfordian-Kimmeridgian, Scotland) further demonstrate that the Re-Os shale geochronometer has a role to play in timescale calibration research, especially in sections with limited potential for U-Pb zircon ashbed dating. In addition, Re-Os geochronology of Neoproterozoic black shales (precisions < ±1%; 2σ) associated with glacial deposits in Australia have provided a greater understanding of the timing of these glacial event(s), indicating that the "Sturtian" ice age was either markedly diachronous worldwide and/or there was more than one "Sturtian"-type glaciation between ca. 750 and 643 Ma. These examples show that the Re-Os black shale geochronometer has widespread application in studies of Earth evolution, regional and global stratigraphic correlation, and timescale research.