Overview of the 187Re-187Os radioactive isotope system applied to petroleum source rocks

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Since the first application of the Re-Os isotope system to organic-rich shales / petroleum source rocks [1], the method has benefitted from numerous analytical advancements and has matured into valuable tool for determining depositional age data directly from these sedimentary rocks. This attribute - determination of the depositional age of clastic sedimentary rocks - is unique among the commonly used radioactive isotope systems and is now proving invaluable as an alternate abolute dating method in sedimentary basins in which ash beds or other volcanic rocks are not present, and basins in which biostratigraphic age constraints are either absent (e.g., Proterozoic basins) or weak (e.g., lacustrine basins).

The primary motivation for the development of the method lies in the system's ability for geochronology. Over the past 15 years, numerous studies have shown that under ideal circumstances, petroleum source rocks can yield absolute Re-Os ages with 2s precision of close to, or in some cases better than, ± 1%. Although this level of age precision is not comparable with that attained by some other methods (e.g., CA-IDTIMS U-Pb zircon) the method can be applicable in many geologic settings where U-Pb zircon dating is not possible. Accuracy of the Re-Os method has been evaluated relative to the U-Pb zircon method via timescale boundary studies and calibration of the 187Re decay constant relative to the U-Pb system.

Initial studies of the Re-Os system focused on dating of Phanerozoic marine petroleum source rocks, but more recently the method has been expanded and successfully applied to dating of non-marine shales, dating of Precambrian shales, and in some cases dating of late Archean shales. Given the functional basis for the operation of the method, dating of late Archean shales implies mild, likely transient, oxygenation of some water masses at that time.

Limitations of the method identified so far include susceptibility to post-depositional alteration by fluid flow and surficial weathering, together with capture of variable initial Os isotope ratios over the period of deposition and in some cases invariant Re/Os ratios.

[1] Ravizza G. and Turekian K. K. (1989) GCA 53, 3257–3262