Re-Os geochronology of oils and oil fractions – new advances

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Geochronology of petroleum systems is a coveted achievment for its inherent scientific and commercial value. Oils may have detectable quantities of Re and Os [1,2,3], providing potential for a radiometric clock to date different aspects of petroleum systems [e.g. 4].

Here we present Re-Os data for two oils from a common source rock (location undisclosed). Asphaltene (ASPH) and maltene (MALT) fractions of each oil were separated using n-C5, n-C6, n-C7, and n-C10 solvents. The heavier oil (26-33 wt% ASPH) has ~230 ppb Re and ~360 ppt Os, far surpassing reported values in crude oils. The lighter oil (7-12 wt% ASPH) has ~40 ppb Re and ~280 ppt Os, at the higher end of reported values. By studying Re- and Os-rich oils, we can minimize blank corrections and improve accuracy.

Mass balance based on Re and Os data for all fractions shows that most Re (~98%) and Os (~96%) in the heavy oil are hosted in the ASPH fraction, in agreement with earlier studies [2]. In the lighter oil, however, a significant portion of Re and Os (40% on average) is stored in the MALT fraction.

The Re-Os isotope composition of the two crude oils is clearly different. Within each oil, the Re-Os isotopes of the crude oil and the ASPH fraction are similar. However, for both oils, all MALT fractions have notably lower $^{187}Re/^{188}Os$ and $^{187}Os/^{188}Os$ ratios than their corresponding crude oils or ASPH counterparts. This is an important discovery, as these lower ratios provide needed spread in data points for a Re-Os isochron. Further, Re-Os data from all fractions of the heavier oil define a possible isochron with a geologically plausible age at a precision of ~1%. The maltene fractions of the lighter oil define a possible isochron with an age approaching that of the source rock, and with plausible initial Os isotopes.

This critical discovery opens a new door. It is now possible to date maturation and migration of *different oil fractions*. This possibility may fundamentally impact models of petroleum maturation.

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[1] Barré *et al* (1995) *Terra Abs*. **7**, 199 **[2]** Selby *et al* (2007) *GCA* **71**, 378-386 **[3]** Mahdaoui *et al* (2013) *CG* **358**, 90-100 **[4]** Selby and Creaser (2005), *Science* **398**, 1293-1295