

Re-Os systematics during water-oil interaction

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Single crude oils have been dated using the Re-Os geochronometer, which is based on the radioactive decay of ¹⁸⁷Re to ¹⁸⁷Os [1]. An isochron age can be derived from a single crude oil sample if the crude oil and its maltene (n-heptane soluble) and asphaltene (n-heptane insoluble) fractions are well correlated on a ¹⁸⁷Re/¹⁸⁸Os-¹⁸⁷Os/¹⁸⁸Os plot [2]. Oil-water interaction is a key process for transferring Re and Os into oil [3,4], whereas Re-Os partitioning during maturation may be minimal [5]. However, Re-Os chemistry controlling these processes remains poorly understood. Here we present results from experimental interaction of aqueous fluids with three different crude oils.

The three different crude oils had distinct Re-Os isotopic signatures before water-oil interaction. These were overprinted by the aqueous fluid during interaction, with the ¹⁸⁷Os/¹⁸⁸Os isotopic composition of the oil rapidly approaching that of the fluid. The ¹⁸⁷Re/¹⁸⁸Os ratios varied during the experiments as a function of oil chemistry, water to oil ratios and interaction time. This indicates that the Re-Os geochronometer was reset during water-oil interaction. In contrast, partial isotopic overprint experiments show that the crude oil and its fractions remain isochronous during interaction with a non-radiogenic aqueous fluid, thereby preserving age information. The Os isotopic composition of the crude oil and its fractions changed systematically and formed a mixing line between the unreacted oil and the aqueous fluid. In natural systems, therefore, the Re-Os systematics obtained from crude oil and its fractions remains intact after water-oil interaction, retaining the age.

[1] Stein & Hannah (2014), *Springer Encyclopedia of Dating Methods*, 2nd Ed., 87-118. [2] Georgiev et al. (2016), *GCA* **179**, 53–75. [3] Mahdaoui et al. (2015), *GCA* **158**, 1-21. [4] Finlay et al. (2010), *Geology* **38**, 979–982. [5] Rooney et al. (2012), *GCA* **77**, 275–291.