

The potential importance of metal transfer from formation waters to petroleum for Re-Os dating of oils

F. MAHDAOUI¹²³, L. REISBERG^{2*}, R. MICHELS³,
E. MONTARGES-PELLETIER⁴, I. PANFILOVA⁵, M. PUJOL⁶
AND I. KIEFFER⁷

¹TOTAL Research Center, Qatar

²CRPG, UMR7358, CNRS-Univ. Lorraine, Vandoeuvre-les-Nancy, France (reisberg@crpg.cnrs-nancy.fr)

³GeoRessources, UMR7359, CNRS-UL, Nancy, France

⁴LIEC, UMR7360, CNRS-UL, Nancy, France

⁵LEMETA, UMR7563, CNRS-UL, Nancy, France

⁶TOTAL CST Jean-Féger, Pau, France

⁷ESRF & OSUG, UMS832, CNRS-UJF, Grenoble, France

During migration and residence in sedimentary reservoirs, petroleum liquids are in nearly constant contact with formation waters. We undertook an experimental study of the effects such contact might have on the Re-Os radiometric system, which is increasingly used to date oils (e.g. [1] [2]). Contact experiments were performed to study the possible transfer of Re and Os from aqueous solutions highly enriched in these elements to natural oils. Tested parameters included time, temperature, concentration and oil composition. In all cases very rapid, extensive transfer occurred of both elements from the aqueous to the organic phase. The molecular-scale mechanism by which this occurs was studied by XANES and EXAFS at Re and Os L-edges using the FAME beamline at the European Synchrotron Radiation Facility.

If the efficient Re and Os transfer seen in the laboratory occurs in nature, this process may have a major effect on the Re and Os systematics of oils. Assuming that Re and Os contents of formation waters are similar to those of groundwaters (e.g., ~4 pg/g for Re [3] and ~0.07 pg/g for Os [4]), the amounts of Re and Os found in 1 gram of our conventional oil are equivalent to those found in ~200 g of water. Reservoir flow modeling shows that oils are likely to be exposed to such quantities of water over geologically short timescales (several hundred thousand years). Thus our results suggest that many oils may have acquired much or in some cases nearly all of their Re and Os content through interaction with basin waters. It is therefore critical to consider this process when interpreting apparent Re-Os isochrons in oils.

[1] Selby & Creaser (2005), *Science* **308**, 1293-1295. [2] Lillis & Selby (2013), *Geochim. Cosmochim. Acta* **118**, 312-330. [3] Colodner et al. (1993), *Earth Planet. Sci. Lett.* **131**, 1-15. [4] Paul et al. (2010), *Geochim. Cosmochim. Acta.* **74**, 3232-3448.