Residency of Rhenium and Osmium in a Heavy Crude Oil

JENNA M. DIMARZIO[1], SVETOSLAV V. GEORGIEV[1,2], HOLLY J. STEIN[1,2], JUDITH L. HANNAH[1,2]

[1] AIRIE Program, Colorado State University, USA
[2] CEED, University of Oslo, Norway

Little is known about the residency of Re and Os within asphaltene and maltene sub-fractions of crude oil. This information is crucial if we are to successfully interpret Re-Os geochronological data for crude oil and its fractions. This permits us to pinpoint times of oil formation, migration, mixing and/or biodegradation [1, 2].

In this study, a heavy crude oil was separated into *n*-heptane soluble (maltene) and *n*-heptane insoluble (asphaltene) fractions. Asphaltenes were separated sequentially into sub-fractions using heptane-DCM and acetone-toluene mixtures; maltenes were separated into saturates, aromatics, and resins using open column chromatography. Asphaltene and maltene sub-fractions were analyzed for Re and Os; asphaltene sub-fractions and bulk samples were also analyzed for a selected suite of trace metals by ICP-MS.

Re and Os concentrations track each other, and both elements are mostly found in highly polar and aromatic sub-fractions; we also show for the first time that significant Re and Os can be present in the aromatics and resins. The asphaltene and maltene sub-fractions have distinct Re-Os isotopic ratios which are not isochronous, which suggests that separation of asphaltene into its sub-fractions undercuts the isotopic integrity of the chronometer. Re correlates strongly with Mo and Cd among the asphaltene sub-fractions; as Re and Os track each other, this suggests that Re-Os, Mo, and Cd occupy similar sites. Re, Ni, and V budgets also track each other, suggesting that some Re may form metalloporphyrins.

Finally, we suggest that progressive asphaltene precipitation during migration and/or mixing of oils can change the resultant oil's Re-Os isotopic ratios. This is key to interpretation of Re-Os data for tar mats and live oils, as precipitation of asphaltenes between source and reservoir has the possibility to alter the Re-Os systematics. By combining data from source rocks, oils, and asphaltenes, we are constructing temporal histories for whole petroleum systems.

Supported by the Norwegian petroleum industry (Lundin Petroleum, Eni Norge, Aker BP), CHRONOS Project.

[1] Georgiev, Stein, Hannah, Galimberti, Nali, Yang, Zimmerman (2016) Re-Os dating of maltenes and asphaltenes within single samples of crude oil: *GCA*, 179:53-75.
[2] DiMarzio (2017) M.S. Thesis, Colorado State University.