Eocene hydrocarbon migration,
Green River Formation, Utah

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The renowned Eocene Green River Formation presents a spectacular field setting to study both source rock and migration of hydrocarbon. From the Uinta basin, we combine field observations with Re-Os data from pristine outcrop and drill core samples to interpret hydrocarbon migration history.

To build a meaningful Re-Os data set, we employ our sampling strategy to capture just a few mm of stratigraphic section for each analysis. Larger bulk samples risk homogenization of real variations in the initial Os ratio and any time occupied by non-depositional or erosional intervals. Re-Os data for the Mahogony Bed and the petroliferous Mahogony Zone in Hells Canyon (Utah) are combined with Re-Os data from drill core from the Parachute Creek and Douglas Creek members to provide a compelling story for hydrocarbon migration. Samples from high-TOC “Rich Zones” (local stratigraphic nomenclature; the Mahogany Zone is “Rich Zone 7”) show a narrow range of Re and Os concentrations and a narrow range in $^{187}$Re/$^{188}$Os ratios relative to low-TOC “Lean Zones”; this combination can lead to easily misinterpreted Model 1 isochron ages with low MSWDs and large age uncertainties. Such data sets do not provide accurate depositional ages. Rather, these data sets may characterize Re-Os behavior on initiation of hydrocarbon migration. In effect, we may be looking at source rock with incipient migration of its own oil (i.e., unconventional hydrocarbon), with local homogenization of organic matter and the Re and Os it carries. Samples from designated Lean Zones have nearly an order of magnitude lower Re and Os and yield Re-Os scatterchrons of 47-49 Ma. Scatterchrons and variable $^{187}$Os/$^{188}$Os ratios are attributed to local migration of oil still mixed with original kerogen.

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