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.

Our Re-Os data and an interpretation that accommodates the full data set bring new understanding to hydrocarbon systems in lacustrine rocks. In some cases, Re-Os results inform us not just about the shale, but about hydrocarbon generation and incomplete expulsion. Field relationships are used to support this interpretation.

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Dust transport over the late Quaternary Red Sea - Dead Sea regions from Nd-Sr isotopes in deep-sea cores and lake sediments

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The Red and Dead Seas situated along the African – Syrian Rift valley between the Sahara and Arabia deserts and the subtropical Mediterranean received during the late Quaternary dust particles that were transported from the Sahara-Arabia deserts, Ethiopian Highlands and the Nile delta. Nd and Sr isotope ratios, chemical and mineralogical compositions of fine-detritus particles, that were recovered from the deep-sea cores: KL15, KL11 and KL23 and from Dead Sea and east Mediterranean sedimentary archives were used to determine the particle sources and reconstruct the synoptic conditions responsible for their transport.

The data indicate that during glacials dust was blown to the northern Red Sea and the east Mediterranean- Dead Sea area from the Sahara deserts by winds associated with the strong-glacial Mediterranean winter cyclones. At the same time dust was blown from Sahelian sources by southern winds associated with monsoonal circulation. During the last interglacial and the African Humid Period, monsoonal rains caused erosion and flooding at the ANS margins of the Red Sea, increasing the contribution of granitic ANS material to the Red Sea floor. During the Heinrich events (e.g. H11 and 1), mixed basaltic-granitic dust was blown from all sources reflecting severe regional aridity, when both monsoonal and Mediterranean cyclone activity were weak.

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