Re-Os ages for a multi-oil petroleum system, Norwegian North Sea

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Here, we present a case study of Re-Os geochronology for a geochemically well-characterized petroleum system in the Norwegian North Sea. Hydrocarbons extracted from Triassic sandstones show systematic stratigrahic variations in asphaltene contents. Our data support models for a younger charge of lighter oil mixing with an older and heavier oil. Mixing-induced asphaltene precipitation deposited widespread tar mats. The live oil reservoir overlies this tar mat. Extracted hydrocarbons from an older oil charge below the tar mat are moderately to strongly biodegraded.

The studied crude oils and hydrocarbons extracted from host Triassic sandstones were separated into asphaltene and maltene fractions [1]. These fractions, together with splits of crude oils or bulk leached hydrocarbons, were analyzed for Re-Os contents and their isotopic compositions.

Crude oil and hydrocarbons extracted from the oil leg yield two separate Re-Os isochrons that indicate recent to ongoing (7-0 Ma) oil generation. Oil extracted from the moderately biodegraded interval yields a Miocene to recent (15-0 Ma) Re-Os age, whereas oils extracted from the strongly biodegraded intervals have older nominal Re-Os ages (15-70 Ma). Hydrocarbons extracted from the tar mat likely represent mixtures of two oil charges; the few analyzed pilot samples are less than isochronous.

The different generations of hydrocarbons have distinct Os isotopic compositions. Collectively, the present-day $^{187}Os/^{188}Os$ ratios of all analyzed materials vary between 0.56 and 0.65; calculated initial ratios are similar. These ratios are much lower than the projected $^{187}Os/^{188}Os$ ratios of Jurassic source shale at the time of recent oil generation. Similar observations in other case studies suggest that the Os isotopic signature of oils may not reflect the $^{187}Os/^{188}Os$ of source rocks at time of oil generation, but rather the initial $^{187}Os/^{188}Os$ of source rocks or, more likely, interaction with basinal fluids of variable origin.

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[1] Georgiev, S.V. et al. 2016. Re-Os dating of maltenes and asphaltenes within single samples of crude oil: GCA, **179**: 53-75.