Application of Re-Os Isotope Systematics to Basin Modeling in the Norwegian Arctic

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The Barents Sea, Northern Norwegian Sea, and East Greenland share a complex Late Paleozoic to Cenozoic sedimentary and tectonic history. Although lithostratigraphic correlations have been made, units are highly variable in thickness, time-transgressive, and disrupted by faulting. Basin-scale time lines are largely absent. Several potential source rocks underlie the region (Late Permian, Early Triassic, and Late Jurassic), but ties to migrated hydrocarbons are tenuous. Here we summarize two examples of Re-Os geochemistry for black shales, illustrating precise geochronology and corresponding variations in $^{187}Os/^{188}Os$ that fingerprint source rocks.

Permo-Triassic sections on opposite sides of the Northern Norwegian Sea are broadly similar. The Late Permian transgression mantled shallower water sandstones, evaporites, and carbonate reefs with a blanket of anoxic mud, which persisted through the end-Permian extinction. A Re-Os age of ca. 253 Ma (< 0.4% uncertainty) precisely pins the age of uppermost Permian shale on the mid-Norwegian shelf [1]. The correlative Ravnefjeld shale on East Greenland is also being dated. A low initial $^{187}Os/^{188}Os$ ratio for Changhsingian seawater suggests an increase in mantle and/or meteoritic Os relative to continental riverine input just prior to the end-Permian extinction event.

Re-Os ages for Anisian (Lower Triassic) shales from clean cliff faces on Svalbard and drill core from the Svalis Dome 600 km to the south in the Barents Sea, temporally link these two sections. Also, the ages permit time-stratigraphic correlation between the Boreal and Tethyan realms where faunal connections are lacking [2]. A sharp peak in the seawater $^{187}Os/^{188}Os$ to more than 0.8 at ca. 241 Ma, dropping back to less than 0.7 at ca. 239 Ma, correlates with a similar spike in seawater $^{87}Sr/^{86}Sr$. This shift in $^{187}Os/^{188}Os$ marks rapid changes in continental vs. mantle Os sources during the recovery following the end-Permian extinction at ca. 253 Ma.

Together, these data show the effectiveness of Re-Os geochronology for linking stratigraphic sections across poorly constrained Arctic systems, and the potential of $^{187}Os/^{188}Os$ as a tracer for characterizing source rocks and for oil-source correlations.

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1) Georgiev, S. et al. (2009) EOS Transactions (submitted, American Geophysical Union).
2) Xu, G. et al. (2009) Geochimica et Cosmochimica Acta, v. 73, no. 13, p. A1463.