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Timing, duration, and causes of Late Jurassic-Early Cretaceous anoxia in the Barents Sea

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In the last ten years, Re-Os isotope geochemistry has become the standard for providing ages for organic-rich sedimentary rocks. In unprecedented detail, we use Re-Os to tease apart and correlate events within one of the world's most important source rocks [1].

New and precise Re-Os depositional ages for Upper Jurassic-Lower Cretaceous organic-rich shales from the Norwegian Arctic, accompanied by detailed Boreal biostratigraphy, document ~19 Myr of widespread anoxia-euxinia. Using ages and regression-derived initial $^{187}Os/^{188}Os$ ratios (Os_i), regional and global correlations help address the cause(s) for burial and preservation of organic matter in the Late Jurassic-Early Cretaceous.

Black shales of the Hekkingen Formation were sampled from two offshore localities that represent Late Jurassic-Early Cretaceous shale deposition in a deep shelf (Troms III) and deep basin (Nordkapp Basin) setting. Black shale deposition, constrained by precise Re-Os ages, started at ~157.7 Ma and lasted until ~138.8 Ma. Within this ~19 Myr time interval, Os_i rose from ~0.45 to ~0.65, closely mimicking published trends of increasing seawater $^{87}Sr/^{86}Sr$ during the Late Jurassic [2].

A synthesis of new and published radiometric ages suggests a shorter duration for the late Oxfordian-late Kimmeridgian stages, and longer duration for the Berriasian-Valanginian stages relative to estimates in the 2012 Geologic Time Scale [3]. Late Jurassic anoxia was likely related to a greenhouse climate sustained by high atmospheric CO_2 levels from accelerating oceanic crust production. Rising temperature enhanced weathering and nutrient supply, increased productivity, and slowed oceanic circulation. Sea-level rise brought anoxic waters onto continental shelves. The extended duration of oceanic anoxia required sustained CO_2 input from fast spreading rates and/or longer spreading ridge lengths to balance the large amount of carbon burial in black shales.

References:

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