Pairing Re-Os systematics with geochemical proxies – environmental conditions and seawater chemistry

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Re-Os systematics of black shales provide depositional ages and syndepositional seawater $^{187}Os/^{188}Os$ ratios. The seawater Os-isotope record is a proxy for short-term changes in continental weathering rates. Additionally, both Re and Os are redox sensitive elements, and can be used with other redox sensitive trace metals to infer depositional conditions and seawater chemistry. Here we report Re-Os data, trace metal concentrations and sizes of pyrite framboids for Triassic black shale from Svalbard, Svalis Dome and Kong Karls Land across the Barents Shelf, spanning the Olenekian to early Carnian stages. Using these data, we discuss the evolution of Triassic environmental conditions.

Seawater $^{187}Os/^{188}Os$ ratios in the Barents Sea region decrease from ca 0.85 in the Olenekian to 0.65 in the late Ladinian and then increase to 0.73 in the early Carnian. These variations are synchronous with the decrease of $^{87}Sr/^{86}Sr$ ratios through the middle Triassic and a subsequent increase in the Carnian [1]. Decreasing Os and Sr isotope ratios reflect decreasing global continental weathering rates from Olenekian to late Ladinian.

Olenekian black shales from Svalbard and Svalis Dome have higher Mo contents for a given TOC content than younger late Anisian black shales. The decrease in [Mo]/TOC ratios suggests increasing restriction as the Panthalassa ocean retreated from Svalbard and Svalis Dome [2]. Olenekian black shales from Svalbard and Svalis Dome also have low Re/Mo and V/Mo ratios and small pyrite framboids, indicating euxinic conditions, whereas early Carnian shales from Kong Karls Land have low Mo contents and high Re/Mo and V/Mo ratios suggesting suboxic – oxic conditions.

In summary, from the Olenekian to the latest Ladinian in the Barents Sea region, continental input to the oceans decreased, and the depositional environment on the Barents shelf changed progressively from euxinic, deep, open marine to a shallow, water-restricted anoxic embayment.

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[1] Korte et al. (2003) *GCA* **177**, 47-62.
[2] Xu et al. (2009) *EPSL* **288**, 581-587.

Sweet Spot for the Formation of Sedimentary Dolomite

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8i. Interactions at the interface between organic components and minerals

The roles of organic matters in dolomitization were considered important, although their precise functions remain unclear. There are four proposed mechanisms for explaining the roles of organics and microbes in dolomitization: (1) Organic bounded Mg was released during decay of the organics; (2) extracellular polymeric substance may serve as nucleation sites; (3) Removal of sulphate (believed to be an inhibitor) through sulphate-reducing bacteria promotes dolomite crystallization, and (4) Oxidation of organics and proteins increases pH and alkalinity. However, laboratory experiments based on the proposed mechanisms failed to synthesize dolomite inorganically at room temperature. Mg^{2+} ions, which form one of the strongest bonds with water molecules among the divalent ions may only be partially dehydrated when incorporated into a growing nucleus of calcite or dolomite. The residual hydration sphere of the incorporated Mg^{2+} ions would then inhibit the further growth of the crystal. Dolomite crystals preferentially associated with organic rich layers / lamina in some partially dolomitized limestone and stromatolites. Early formed Mg-calcite or calcite crystals served nucleation sites for the dolomite. Synthesis experiments indicate polysaccharides in extracellular polymeric substance (EPS) of certain anaerobic bacteria can promote dolomite nucleation and growth. The polysaccharides adsorbed on surfaces of calcite or dolomite through hydrogen bonding with surface carbonate anions will lower the kinetic energy barrier for dehydration of metal complexes between H_2O and surface Mg^{2+}. Author acknowledges supports from NSF and NASA Astrobiology Institute.