Early diagenesis of Mo: Oxic versus anoxic sediments in the Gulf of California

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Oxygen minimum zones (OMZs) along productive continental margins feature strong redox gradients in the water column and surface sediment. Reconstructing the temporal and spatial dynamics of these redox gradients is important to evaluate the impact of ocean deoxygenation on marine biogeochemical cycles. The sedimentary record of redox sensitive elements like molybdenum (Mo) and their isotope composition can provide valuable information about past changes in redox conditions, provided that element behavior and isotope fractionation have been calibrated in modern environments.

In this study, we present Mo isotope and concentration data of surface sediments from the Gulf of California. These sediments cover different redox regimes including anoxic sediments from within the OMZ, oxic sediments from deeper within the basin, as well as metalliferrous sediments from close to a hydrothermal vent field. Previous studies argued that in principle, Mo concentrations and isotope ratios increase with the extent of reducing conditions in the bottom water [e.g. 1]. However, both parameters can be modified by early diagenetic processes in the sediment including interactions with organic matter as well as diffusive transport within the pore waters. Deciphering these processes is crucial for a realistic interpretation of the Mo data.

Oxic samples of this study show a wide range in δ^{98}Mo from -1.56 to +1.89 ‰, accompanied by Mo concentrations of up to 20 µg/g. Anoxic sediments from within the OMZ show Mo concentrations of up to 15 µg/g and their δ^{98}Mo ranges from +1.56 to +2.02 ‰. These observed variations are at least partly inconsistent with the common interpretation of Mo systematics outlined above. Samples from close to the hydrothermal vent field are characterized by Mo concentrations of up to 31 µg/g and isotope signatures ranging from close to seawater to up to +2.46 ‰. The latter is indicative of an isotopically distinct sink of seawater Mo close to hydrothermal vent systems. Additional analyses of the Mo isotope signature of pore waters will be combined with elemental and mineralogical data to comprehensively constrain Mo behavior during early diagenesis.

[1] Poulson et al. (2009) Geochem. Geophy. Geosys. **10,** 1-25