Mo redox proxy reflects different depositional conditions in Pacific Oxygen Minimum Zones

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Ocean deoxygenation is a global phenomenon tightly coupled to changes in ocean ventilation and biogeochemical feedbacks, i.e. biological productivity, controlling extent and intensity of oxygen miminum zones (OMZs) along productive western continental margins. The underlying sediments provide a record of the mechanisms driving marine redox conditions on geological time scales. Concentrations of molydenum (Mo) and its stable isotope composition have been used as proxies for ocean anoxia due to their contrasting behavior under oxic and sulfidic conditions. However, the mechanisms by which Mo is delivered to and sequestered by sediments in OMZs are poorly constrained.

We compare Mo concentrations and isotope compositions of shallow sediments from the OMZs in the Gulf of California and the Peruvian continental margin [1]. The investigated sites differ in sedimentation rate, export production and ocean circulation. This allows new insights into the control of environmental conditions on the Mo redox-proxy.

Sediments from the Gulf of California OMZ have δ^{98}Mo signatures ranging from +1.64 to +2.13 ‰ and Mo concentrations between 3 and 17 µg g^{-1}. In contrast, sediments from the Peruvian OMZ are isotopically lighter (+1.16 to +1.55 ‰) at higher Mo concentrations ranging from 11 to 101 µg g^{-1} [1]. These differences in the Mo content and isotopic composition can be explained by different transport mechanisms of Mo to the sediments. The OMZ off Peru is characterized by high organic carbon rain rates and intense water column denitrification. The sedimentary Mo inventory is dominated by particulate supply via Fe-oxides [1] and organic matter. In contrast, the OMZ in the Gulf of California has a lower organic carbon rain rate and denitrification does not occur in the bottom waters. The Mo flux is dominated by diffusion into the sediments. These findings demonstrate the importance of particulate vs. diffusive Mo delivery in controlling the isotope composition of sediments, which has important implications for the use of Mo as paleo-proxy.

[1] Scholz et al. (2017) GCA 213, 400-417