Stable tungsten (W) isotope behavior during the early diagenesis in the Gulf of California

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The stable W isotope system has recently emerged as a promising redox indicator, but its modern oceanic budget is not yet fully understood. Specifically, the mechanisms of W delivery to the sediments and its behavior during early diagenesis remain unknown.

In this study, three sediment cores in the gulf of California were thoroughly analyzed. Our findings indicate that W in marginal sediments is a combination of authigenic and detrital W components, with varying contributions at different depths. Authigenic W is likely bound to Mn oxides and released into the pore water in the Mn reduction zone. The delivery of W is primarily associated with Mn shuttling. Light W is adsorbed and released upon reductive dissolution of Mn oxides.

The sub-surface conditions in all the three cores are anoxic, leading to limited enrichment of W in sediments. Despite being geochemical twin elements, W and Mo display contrasting behaviors in sulfidic environments. Consequently, the distinctive behavior of W makes it a valuable indicator for identifying the cycling of Mn, an essential element for biological processes, and for tracing the oxidation history of the early Earth's oceans.