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Evaluating Stable Tungsten Isotopes as a Redox Proxy: Insights from the Gulf of California Sediments

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The stable tungsten (W) isotope system has recently emerged as a promising redox indicator [e.g., 1,2], but its modern oceanic budget is not yet fully understood. Specifically, the mechanisms controlling W delivery to marine sediments, exchange processes at the water-sediment interface on the seafloor, and its behavior during early diagenesis are not well-characterized.

This study analyzed three sediment cores from diverse redox zones of the Gulf of California: a core from the oxygen minimum zone (OMZ) at intermediate depth, a core from the deep, oxygenated graben in Guaymas Basin with significant Mn enrichment, and a core from a hydrothermal vent field. Our findings indicate that the surface layers of the graben core are enriched in W with heavier isotopes linked to increased Mn, unlike the OMZ core, which shows no W enrichment but high pyrite contents. In the hydrothermally influenced core, there is a depletion of W with markedly light $\delta^{186/184}$W values, contrasting with its geochemical counterpart Mo, which shows enrichment and features heavier isotope compositions [3].

Tungsten in marginal marine sediments comprises both authigenic and detrital components. Authigenic W becomes mobilized into pore water within the Mn reduction zone. Isotopically lighter W, adsorbed onto Mn oxides are released upon reductive dissolution of Mn oxides under anoxic conditions, leading to decreasing solid phase W concentrations and W depletion relative to the terrigenous background.

This study provides insights into W behavior during early diagenesis and suggests that the W and Mo isotope systems can be jointly analyzed in sedimentary records for paleoenvironmental studies. Such an approach allows us to disentangle processes related to Fe or Mn cycling and probe various redox states, which is crucial for exploring the redox dynamics of early Earth's oceans.

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[2] Yang et al. (2023) *Geology* **51(8)**, 728-732
[3] Eroglu et al. (2020) *GCA* **273**, 51-69