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Stable W isotope insights towards its burial behavior in the global ocean

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The accumulation of W in marine sediments preserves valuable information on the paleo-redox evolution of the oceans through the Earth's history [1]. However, the sedimentary processes controlling the ocean's W budget and its stable isotope composition ($\delta^{186/184}W$) are presently still ambiguous [2]. In this study, we determined the W isotope compositions and the abundances of major/ trace elements of modern sediments from globally distributed open ocean basin sites, also including continental margin settings and the anoxic Black Sea.

We demonstrate that in modern marine sediments, the detrital inputs and authigenic enrichment of W during diagenesis control the sink of seawater-derived W. For sediments from the Southern Ocean, continental margins, and the Black Sea, the detrital components dominate, with $\delta^{186/184}W$ values around ~+0.09‰. Among the investigated sites from other major ocean basins, the Pacific sediments have the most variable and highest authigenic W proportions and, equally, the highest $\delta^{186/184}W$ compositions. In contrast, the $\delta^{186/184}W$ of the Atlantic sediments are lower and less variable, due to the presence of less authigenic W.

Authigenic W is dominantly hosted by Mn oxides with lighter W isotopes compared to ambient seawater (with a fractionation offset of ~+0.58 ± 0.14‰ for δ-MnO_2 [3]). Though, higher Mn in marine sediments is associated with elevated $\delta^{186/184}W$ when compared to the detrital background because the Mn-adsorbed W is inherited from seawater with an initially extremely high $\delta^{186/184}W$ [1]. Clay minerals might be an additional sink for seawater W, as indicated by the correlation of $\delta^{186/184}W$ with K/W and Mg/W ratios. With a seawater origin, the $\delta^{186/184}W$ values of authigenic W related to clay minerals are also higher than the detrital phase.

References

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