Isotopically light Cd in sediments underlying oxygen deficient zones

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The ocean's dissolved distribution of Cd is similar to that of phosphate, and Cd concentrations in marine microfossils have been used as a proxy for past ocean phosphate distributions. However, deviations from the global dissolved Cd/P relationship are present in oxygen deficient zones (ODZs), with Cd being depleted relative to phosphate [1]. This decoupling has been suggested to result from Cd sulphide precipitation in reducing microenvironments surrounding sinking organic matter [e.g., 1].

We analysed Cd isotopes in organic-rich sediments deposited at several sites along the northeast Pacific continental margin. We calculate a net accumulation rate of Cd of between 2.5 and 6.3 × 10^7 mol/yr, which is high compared to previous estimates for the Cd input to the ocean, at 0.6 to 2.5 × 10^7 mol/yr [2]. We find that Cd in organic-rich sediments is isotopically light relative to the deep seawater value (at ~0.3‰), with $\delta^{114}Cd_{NIST\text{-}3108}$ = 0.02 ± 0.14‰ (2 SD).

The effective isotope fractionation during diagenesis is expected to be small, because Cd is quantitatively trapped as CdS or scavenged by Fe oxide phases in suboxic or anoxic conditions in sediment [3]. CdS precipitation is predicted to preferentially remove light Cd isotopes from the water column [4] thus providing one possible source of light Cd to sediment. Uptake of light Cd by phytoplankton is another possible means to supply light Cd to the sediment. Finally, a correlation between δ^{114}Cd and total Fe suggests that scavenging of Cd by Fe oxide phases may contribute to the light Cd isotope composition of sediments.

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