Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.3508

Re-assessing the role of water-column sulphide formation in the marine Cd cycle

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It has been inferred that the marine distributions of the micronutrient cadmium (Cd) and its stable isotope composition (expressed as δ^{114}Cd) bear widespread and unambiguous evidence for loss of Cd from the water column through the formation of solid cadmium sulphide (CdS) in oxygen minimum zones (OMZs) [1]. Recent research has suggested that this water-column CdS formation may represent the largest Cd sink term in its whole-ocean budget [2]. Here, by bringing together previously-published elemental and isotopic datasets from the dissolved and particulate Cd pools, we unravel the multiple, overlapping controls on the Cd and δ^{114}Cd distributions, demonstrating that the data challenge this view.

Our analysis reveals that the most important control on the marine Cd distribution is the extreme plasticity in the cadmium:phosphorus (Cd:P) stoichiometry of biological uptake, and thus particulate export. We show that the δ^{114}Cd systematics in low-latitude OMZs that have been taken to reflect Cd loss in fact mainly come about through interaction between the physical circulation and the stoichiometric plasticity of biological Cd uptake at high and low latitudes. Water-column evidence for Cd loss is thus much less widespread than has previously been inferred.

Subtle but consistent signals in particulate elemental and dissolved isotopic data from the tropical Atlantic and Pacific Oceans do allow us to identify the signal of a Cd loss associated with the oxycline of the shallow tropical subsurface, as has previously been suggested [e.g. 1-5]. However, this Cd loss appears to be ubiquitous throughout the tropics, rather than confined to oxygen-poor waters, speaking against CdS formation as the driving mechanism. Although its true identity remains unknown, this tropical Cd loss may be related to biological activity. Most generally, our analysis bears upon the contribution of water-column CdS formation to the whole-ocean mass balance of Cd, which is likely to be much smaller than recent estimates have suggested.

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