Cadmium Isotope Fractionation in Seawater

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Cadmium displays a nutrient-like distribution akin to phosphorous in the oceans. This has been attributed to the assimilation of Cd by phytoplankton in the upper water column and re-mineralization at depth. If biological uptake is associated with kinetic isotopic fractionation, as recently suggested by Lacan et al. (2005), then the Cd-poor surface waters of the oceans should be depleted in the light isotopes of Cd, relative to the more Cd-rich bottom waters. Previous investigations were, however, unable to identify any significant Cd isotope effects for either seawater or sedimentary rocks (Wombacher et. al, 2003; Lacan et al., 2005). In this study, we have extended the search for Cd isotope variations in the oceans with analyses of almost 20 seawater samples from various locations and depths. The isotopic measurements utilized a Cd double spike in conjunction with MC-ICPMS, to achieve a precision and accuracy of about ± 1 $\varepsilon^{114/110}$Cd (2s.d.).

Most of the samples define a trend of co-variation of Cd isotope compositions and concentrations. The most Cd-rich water samples (with ~1 nmol/kg Cd) display the lightest Cd isotope compositions with $\varepsilon^{114/110}$Cd $\approx +3$, akin to results previously obtained for rocks from the crust and mantle (Wombacher et. al, 2003). In contrast, samples from the upper water column of the North Pacific (with <0.02 nmol/kg Cd) have the heaviest Cd isotope compositions with $\varepsilon^{114/110}$Cd values of up to +35. These variations are likely to reflect isotope fractionation during biological utilization of Cd because inorganic geological processes (other than evaporation & condensation) do not appear to generate isotope effects as large as those observed in the present study (Wombacher et. al, 2003). This conclusion is in accord with the observation that the correlated variation of Cd concentrations and isotope compositions can be explained by a simple, single-stage Rayleigh fractionation model. The results that were obtained for seawater samples from the ALOHA station in the vicinity of Hawaii are not in accord with such a fractionation model, however, as they display both low Cd contents and relatively unfractionated Cd isotope compositions.

References

[1] Lacan et al. (2005) *Geophys. Res. Abstr.* **7,** 07657.
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