The role of Southern Ocean processes in controlling the distribution of Cd isotopes at lower latitudes in the South West Pacific

SIEBER, M.[1]*, CONWAY, T. M.[2], TAKANO, S.[3],
SOHRIN, Y.[3] AND VANCE. D.[1]

[1]Inst. Geochemisty and Petrology, ETH Zürich, Switzerland
[2]College of Marine Science & School of Geoscienes, University of South Florida, FL, United States
[3]Inst. Chem. Research, Kyoto University, Japan
*correspondence: matthias.sieber@erdw.ethz.ch

Cadmium (Cd) is a bioactive trace element, with an oceanic distribution that closely matches phosphate. However, preferential uptake of Cd by phytoplankton under Fe limiting conditions, as well as water mass mixing, result in a 'kink' in the global Cd:P relationship [1]. Biogeochemical processes in the Southern Ocean, one of the Fe-limited HNLC regions, impart distinctive dissolved Cd stable isotope ratios (δ^{114}Cd) and Cd:P signatures to southern-sourced water masses, potentially strongly influencing the distribution of Cd throughout the lower latitude oceans [2]. Previous work has shown that Antarctic Intermediate Water (AAIW) carries a depleted δ^{114}Cd signal (+0.45‰) into the far North Atlantic, but also that such a signal is apparently absent in the North Pacific, suggesting interbasinal differences in Cd cycling [3,4].

Here we present water-column profiles of dissolved δ^{114}Cd from the SW Pacific Ocean, using samples collected from a recent Japanese GEOTRACES transect along 170°W (GP19). In the Antarctic, we observe heavy δ^{114}Cd signatures (+0.7‰) in surface waters and lighter values (+0.2‰) in subsurface waters, due to biological uptake and shallow remineralization of Cd respectively. These heavy δ^{114}Cd surface signatures are then subducted and transported northwards at intermediate depths by AAIW, with values of +0.5‰ to +0.6‰ observed at intermediate depths in the southern latitudes. While the southern-sourced signal slowly fades northward along the section due to the increasing influence of Pacific Deep Water (~+0.25‰), we do observe heavier δ^{114}Cd at intermediate depths at least as far north as the Equator. Our data shows that large scale-mixing of water masses originating in the Southern Ocean seems to dominate the distribution of Cd and its isotopes and is likely causing the 'kink' in the Cd:P relationship at lower latitudes. However, this influence does not appear to extend as far north in the Pacific, as in the Atlantic.

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