Cadmium sulfide formation in low-oxygen waters of the North Atlantic

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Recent work in the North Pacific has suggested that soft metals (e.g. Zn, Cu, and Cd) may be precipitated as sulfides within the water column in oxygen-depleted waters. We present a wide variety of dissolved and particulate data from the US GEOTRACES North Atlantic Zonal Transect suggesting that Cd precipitates as sulfides within the low-oxygen waters of the eastern tropical North Atlantic.

Dissolved seawater cadmium (Cd) and phosphate (PO_4^{2-}) concentrations show that Cd is depleted relative to PO_4^{2-} within the most oxygen-depleted (~50 μmol kg^{-1}) waters of the eastern basin. This depletion is associated with anomolously high dissolved $\delta^{114}Cd$, suggesting removal of isotopically light Cd by sulfide precipitation. Similar depletions in dissolved Cd, relative to PO_4^{2-}, are not observed in higher-oxygen waters of the central and western basin.

Particulate Cd and P concentrations and $\delta^{114}Cd$ are also consistent with a hypothesis of CdS precipitation. In the lower-oxygen eastern basin, particulate Cd has two maxima. An upper maximum within the surface fluorescence maximum correlates with high particulate P, attributed to the growth of phytoplankton. A second maximum at deeper depths where oxygen concentrations are lowest, without an associated particulate P maximum, is attributed to CdS precipitation. Particulate $\delta^{114}Cd$ in this lower maximum are between 0 to +0.2 ‰, which is lighter than the surrounding seawater and lighter than the presumed biologenic $\delta^{114}Cd$ supply from the euphotic zone. This suggests the preferential precipitation of isotopically light Cd as sulfides in low-oxygen waters. Finally, particulate Cd, P, and Ba concentrations across the entire transect show a correlation between Cd and P concentrations in the surface ocean and particulate Ba concentrations in deeper waters of the thermocline, consistent with precipitation of both barite and Cd sulfides within anoxic microenvironments surrounding sinking biological particles.

This data has implications for interpretation of Cd concentrations in the modern ocean, as well as for the interpretation of Cd/Ca as a paleoceanographic proxy.