First Cadmium and Zinc measurements from the Indian sector of the Southern Ocean

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Winter distributions of dissolved cadmium (Cd) and zinc (Zn) were measured for the first time in the Indian sector of the Southern Ocean thereby contributing a unique spatial and temporal dataset. Cd and Zn are geochemically alike yet divergent in the ocean, a phenomenon which has received much attention of late. Seven depth profiles, between 41°S and 58°S, were collected along the 30°E longitude in July 2017 aboard the SA Agulhas II and compared to profiles of major nutrients (PO_4, NO_3, Si) as well as physical parameters (temperature, salinity) in order to investigate the biogeochemical cycling of these metals.

The upper surface layer (25-50m) was characterised by strong latitudinal gradients, 20 – 700pmol kg^{-1} for Cd and 0.2 - 3.9nmol kg^{-1} for Zn, associated with the frontal positions, a reflection of nutrient rich watermasses upwelling south of the Antarctic Polar front (APF). Further, the upwelling regime overprinted the biological signal in the euphotic zone which was dominated by a low winter abundance of iron-limited diatoms with high metal:PO_4 uptake stoichiometries. Vertically, Cd showed intermediate depth maxima at each station, between values of 700 and 1150 pmol kg^{-1}, consistent with the tight correlation between Cd and PO_4 in the rapidly remineralised organic material of diatoms. Deeper, Cd and PO_4 plotted on multiple regression lines, an indication that mixing of watermass end-members was responsible for observed deep Cd distributions. Despite being co-located with PO_4 (and Cd) within internal diatom organics, Zn increased to bottom water maxima, in excess of 10 nmol kg^{-1} at the southern stations, and was tightly correlated with Si. The high Zn signature here may reflect reversible scavenging of Zn onto particulate organic matter enhancing Zn flux to the deep ocean. The biogeochemistry of Zn therefore reflects dominant biological processes while Cd cycling is driven by watermass characteristics, factors which likely underpin their divergent behaviour in marine environments. Understanding these complexities are particularly important in the Southern Ocean given that waters of Antarctic origin set the biogeochemical signature of the low latitude oceans.