Zinc and Nickel isotope systematics in the South Atlantic Ocean

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Zinc (Zn) is an essential micronutrient and the most abundant trace metal in diatoms, phytoplankton which play a key role in carbon export from the oceanic photic zone (e.g. [1]). The strong relationship between dissolved Zn and silicon (Si) [2] in the oceans has long remained a puzzle, as Zn is not associated with Si in the diatom frustule. Nickel (Ni) also plays a role as an oceanic micronutrient, and is also correlated with Si [2] and co-located with P in phytoplankton cells. Zn and Ni isotopes in the oceans differ in one key aspect. Zn exhibits significant variation in the upper ocean, but is homogenous below the thermocline (e.g. [3,4]), whereas Ni isotopes appear to be homogenous throughout the ocean [5].

The importance of the Southern Ocean is increasingly recognised as a key control on major nutrient distributions in the global ocean (e.g. [6]). Here we present Zn and Ni data collected as part of two UK-GEOTRACES South Atlantic cruises. Zn shows the expected extreme depletion towards the surface, to sub-nM concentrations. Moreover, though surface Zn concentrations in the South Atlantic decreases by two orders of magnitude from the upwelling zone in the Southern Ocean, this drawdown is also associated with no fractionation [this study, 3], with δ^{66}Zn showing a uniform value of ~0.5‰, similar to previous estimates of average oceanic dissolved Zn [e.g. 3,4]. This suggests that the main removal process of Zn is not accompanied by an isotopic fractionation, at least in the Southern Ocean. Ni also shows a decrease in concentration towards the surface, but only by a factor of 2-3. At one station Ni has a homogeneous δ^{60}Ni value of ~1.3‰, whereas δ^{60}Ni increases to ~1.75‰ towards the surface at a second station. These differences in δ^{60}Ni occur in spite of similar concentration profiles at both stations, suggesting at least two mechanisms of Ni removal.

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