Variations of zinc and nickel isotopes in a natural iron fertilized region around Kerguelen Island, Southern Ocean

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The Southern Ocean is the site of 30% of global ocean carbon export, and is the origin of water masses that significantly impact the chemistry of the entire ocean. Over much of the Southern Ocean iron is the limiting nutrient for phytoplankton growth, which may be an important control on the biogoechemistry of the water masses emanating from it. Here we investigate the response of Zn and Ni and their isotopes to natural Fe fertilization from islands, using samples collected during KEOPS2 (Oct-Nov 2011) near Kerguelen Island, Indian Sector, Southern Ocean.

Surface Zn concentrations are drawn down to 1 nM at a background station (R2) outside the fertilized area, but to 0.44 nM at a station (FL) that is in the path of Fe dervied from Kerguelen. No significant differences are seen in surface Ni concentrations, but there is a slight enrichment beneath 1000 m at Station FL. Dissolved Zn and Si concentrations are well correlated, with a Zn/Si ratio identical to the global correlation. Zn and PO_4 are well correlated for most samples, with a ratio of around 5 mmol/mol, but PO_4 is drawn down preferentially at station FL.

The isotopic variations of Zn and Ni are very subtle, despite large variations in concentration with depth. The Zn isotopic ratios are most variable in the upper 200 m ($\delta^{66}Zn$ = 0.33‰ - 0.48‰), with a very slight minimum at 100-200m and a very slight maximum at the surface. Deeper in the water column they reach a value (0.45‰ for the deepest sample at 1500m) close to the deep ocean average (~0.47‰). The Ni isotope data show a slightly more systematic pattern with depth compared to Zn isotopes, displaying a maximum value of $\delta^{60}Ni$ at the surface minimum in Ni concentration (1.4‰), decreasing to 1.1‰ at 400 m.

Overall, natural island iron fertilization is associated with only very subtle variations in Zn, Ni and their isotopes.