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Nickel cycling in the ocean: insights from isotopes and metagenomics

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Nickel (Ni) is an essential micronutrient for phytoplankton that directly influences the biological pump, but its biogeochemical cycle is not fully understood. Recent studies have shown that photic zone Ni isotope fractionation only occurs in low latitude regions[1-5], where Ni concentrations do not decrease below 1.7 nmol/L. The cause of this heavy Ni reservoir in the surface of the low latitude ocean is still under debate: bio-limitation of Ni because of organic complexation[3], presence of a 'left-over' pool of Ni[6], or specific Ni requirements due to enzymatic needs[5]. In the modern ocean, Ni is involved in three enzymes (urease, Ni-Fe hydrogenase, Ni superoxide dismutase) controlling the nitrogen cycle, especially in the low latitude ocean where fixed nitrogen is limited.

Here, we present dissolved Ni isotope data along a transect between Tasmania and Antarctica (ACE cruise in 2017). The studied area is interesting as it traverses diverse biogeochemical and ecological zones from the subtropics to the Polar Front zone, and the regions of formation of different Southern Ocean water masses. Results from ACE show that the shift to heavier Ni isotopes (up to +1.51‰) in upper waters occurs in the Subantarctic Zone, while values in the Polar Front Zone remain close to the deep ocean (~ +1.30‰). Surprisingly, Ni isotope compositions reach +1.68‰ within the Mertz Polynya on the Antarctic Shelf. Using metagenomic data at the same stations, we will estimate the presence of the enzymes of interest, examine how their abundances correlate with Ni isotope signals and determine which organisms are responsible for the isotope fractionation.

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