Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.24380

It's What's on the Inside that Counts: New Insights into Nickel Isotope Cycling in the Ocean

CATHERINE E ODENDAHL, DR. XIAOPENG BIAN, PH.D. AND SETH G. JOHN

University of Southern California

Presenting Author: odendahl@usc.edu

Nickel (Ni) is an essential trace metal for phytoplankton in the ocean, required for various enzymes that are linked to global carbon and nitrogen cycling. Nickel stable isotopes (δ60Ni) provide a powerful tool to better understand Ni biogeochemistry in the ocean. Typical seawater δ60Ni profiles are characterized by higher δ60Ni in surface seawater than in the deep ocean, indicating preferential assimilation of lighter Ni isotopes during biological uptake. Therefore, as water moves from the north Atlantic to the north Pacific, one would expect the deep ocean δ60Ni signature to get lighter due to the accumulation of lighter Ni isotopes from remineralizing phytoplankton. However, results from the US GEOTRACES GP15 cruise (covering the entire North Pacific) show that δ60Ni is homogeneous in the deep ocean across ocean basins. To explore the mechanisms for the homogeneity of δ60Ni in the deep ocean and better understand Ni biogeochemistry, we developed a Ni isotope model using the AWESOME OCIM (AO)—a transport matrix modeling tool that can simulate steady-state distributions of elements within the ocean. Our Ni model includes major Ni sources to the ocean such as riverine input and key internal cycling processes that control the distribution of Ni and Ni isotopes, such as biological uptake and regeneration of Ni, Ni remineralization in sediments, and reversible scavenging of Ni in the water column. The model is optimized using the high-resolution Ni isotope data from the recent GEOTRACES GP15 cruise in the North Pacific, as well as Ni isotope data in other oceanic regions. We have found that reversible scavenging of Ni onto POC and Mn oxides in the water column coupled with Ni isotope fractionation plays a key role in creating a homogeneous deep ocean. We have also found that the release of scavenged Ni from marine sediments with isotope fractionation improves the model-observation match and minimizes the deep interbasin difference. Our model highlights the importance of internal cycling processes in regulating the distribution of Ni and Ni isotopes in the ocean and improves our understanding of Ni biogeochemistry.