Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20617

The Effect of Neodymium-Concentration Changes in Sea Water Mass End-members on Neodymium-Isotopes at Mixing Locations: A Bayesian Approach

STEVEN L. GOLDSTEIN[1], MAAYAN YEHUDAI[2], LUCY E. TWEED[3], SEAN RIDGE[1] AND YINGZHE WU[1]

[1]Lamont-Doherty Earth Observatory of Columbia University

[2]Max-Planck Institut für Chemie

[3]University of Cambridge

Presenting Author: steveg@ldeo.columbia.edu

Geochemical reconstructions of past deep water-mass structure show that the deep Atlantic Ocean basin changed dramatically over glacial-interglacial timescales and that these changes were tightly linked to the climate system and the carbon cycle. Over the past two decades, Neodymium-isotopes (εNd) has emerged as one of the major tracers of past oceanic water-mass structure. In today's Atlantic basin, εNd patterns trace the deep water-mass structure, similar to conservative tracers such as salinity, showing more negative values in the North Atlantic and more positive, Pacific-like values in the South Atlantic. This spread of εNd values between two end-members reflects the age differences between the Archean-to-Paleoproterozoic-aged continental-cratonic sources eroding into the North Atlantic, and inputs into the Pacific from mantle-derived volcanics around the Pacific rim. Therefore, to estimate past changes in the mixing proportions of the Pacific and the North Atlantic end-members, one can theoretically use a simple binary mixing equation. However, although the end-member εNd-values can be traced through time by εNd analyses of appropriate deep sea core samples, two major issues plague the εNd proxy, one being variable and largely unknown non-conservative effects such as submarine groundwater discharge, boundary exchange reactions and sedimentary benthic fluxes and the second being unknown past Nd concentrations of the Atlantic and Pacific endmembers. Here we address the latter "paleo-[Nd] problem" with a Bayesian analysis that examines the sensitivity of Nd-isotope ratios to Nd concentration changes in the end-member water masses over glacial-interglacial time scales. Results show that even substantial variability in end-member Nd-concentrations ratio likely has little impact on Nd-isotope ratios at intermediate locations, indicating that Nd-isotope changes reflect the water-mass mixtures throughout the Pleistocene, thus supporting its use to reconstruct Atlantic water-mass structure in the past. This finding is an important step in validating the use of εNd as a past ocean-mixing proxy as it indicates that given the right location choice, where non-conservative effects are minor, the fraction of the different end-members can be quantitatively estimated using the binary mixing equation and the modern end-member Nd-concentration ratio.