



Reconstructing Past Ocean Circulation and Water Mass Mixing with Radiogenic Neodymium Isotopes: Potential and Pitfalls

Martin Frank, GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany
(mfrank@geomar.de)

Over the past two decades radiogenic neodymium isotope compositions have been increasingly used to reconstruct past ocean circulation and water mass mixing. This application is based on the quasi conservative behavior of Nd isotopes in the open ocean and on the ability of Nd isotope compositions to fingerprint the contributions of distinct continental source areas. Weathering inputs label the water masses with distinct isotope compositions of the rocks on land in those areas where the waters were last in contact with land. In addition, the precise and accurate measurement of Nd isotopes in waters and sediments is comparably easy given the widely available TIMS or MC-ICPMS instruments, accepted standard values, and internationally intercalibrated techniques, such as for water samples in the frame of the international GEOTRACES programme (van de Flierdt et al., 2012). The wealth of seawater data that have now become available allows a detailed picture of the present day Nd isotope distribution, to which the sedimentary records can be directly compared.

I will discuss some of the recent successful applications to reconstruct past ocean circulation but will focus a large part of my presentation on the pitfalls that may arise from non-conservative behavior of Nd isotopes in the water column of particular areas of the ocean. This will include the effects of particle inputs and dissolution, exchange with reactive margin sediments, as well as contributions from pore waters. Considering these processes there are clearly areas of the ocean where the Nd isotope signatures will not reflect ocean circulation but rather weathering inputs. To avoid such pitfalls it is evident that the Nd isotope method will deliver the most reliable records in areas where water mass exchange is rapid and which are not located close to reactive continental margins and the associated detrital particle fluxes.

A second focus of my presentation will be the issue of reliable extraction of the Nd isotope composition of seawater from the sedimentary archives. There are different approaches and archives considered reliable which include deep sea corals and ferromanganese crusts and, most widely applied, early diagenetic ferromanganese coatings of bulk sediments and of planktonic foraminifera. There is, however, also clear evidence that the reliable extraction from particular archives in certain areas for example affected by volcanic ash particles is complicated or even impossible. I will discuss recent advances and improvement of the extraction methods that will allow a wider and more reliable application of the Nd isotope circulation proxy.

van de Flierdt et al., 2012, Limnology and Oceanography Methods 10:234-251

12th International Conference on Paleocyanography
29 August – 2 September 2016, Utrecht, the Netherlands