The silicon isotopic composition ($\delta^{30}Si$) of water masses in the Atlantic

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Use of silicon isotopes ($\delta^{30}Si$) as a paleoceanographic proxy requires sound knowledge of the distribution and behaviour of silicon isotopes throughout the ocean. Over the past few years considerable efforts have been made to map the silicon isotope composition ($\delta^{30}Si$) of silicic acid (dissolved silicon, DSi) and biogenic silica (BSi) throughout the ocean.

We present here new data for the $\delta^{30}Si$ of DSi of water masses in the South Atlantic and eastern North Atlantic. These data include transects from the Drake Passage to the Weddell Gyre, through the Antarctic Circumpolar Current, and through the oxygen minimum zone in the tropical eastern North Atlantic. Seven surface to deep profiles (~4000m) span the southern section of the study from the Drake Passage across the Weddell Sea and then up along the prime meridian. These samples were taken as part of the GEOTRACES Zero & Drake campaign. An additional 5 CTD profiles were taken during a tracer release experiment (MSM10/1) from Ponta Delgada in the Azores to Mindelo, Cape Verde.

These profiles add to a growing dataset from which we are building a comprehensive picture of the distribution of Si isotopes in major Atlantic water masses. This exploration of the evolution of the $\delta^{30}Si$ of water masses such as Antarctic Bottom Water, North Atlantic Deep Water, and North Atlantic Intermediate Water, enables the identification and to some extent quantification of the biogeochemical and mixing processes controlling the isotopic composition of the water masses observed at our stations.

A statistical approach to the Nd isotopes distribution in the oceans

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The reliability of neodymium (Nd) isotopes (ε_{Nd} notation) to trace past ocean circulation and continental erosion builds upon our understanding of the present Nd budget in the oceans. Ocean circulation models have been used for the past decade to test the ability of different processes to explain the present Nd isotopic compositions and concentrations of the oceans. The increasing amount of ε_{Nd} data in seawater now allows a first statistical approach: we used Lacan *et al*. (2012) seawater data compilation, completed with sediment core tops and ferromanganese nodule and crusts data. We used different statistical methods, all contributing with relevant and eachother coherent informations for the understanding of the present ocean Nd behaviour.

First, the ε_{Nd} variogram shows a mean correlation distance of 3500 km for the global ocean, which gives the space scale of the mixing dynamics for this element. This distance is then used to build an interpolated map of the Nd isotopic composition, using least squares method. It reveals global and regional features linked to some of the main continental sources and ocean circulation patterns.

Second, we studied the shape of ε_{Nd} distributions: their interpretation is based on the central limit theorem which implies that mixing processes produce gaussian distributions. After a weighting of the ε_{Nd} distributions by data uncertainties (analytical, sample type) and data densities in each ocean area, we compare it to the Laplace-Gauss distribution. We find that the global distribution is clearly asymetric and multimodal, reflecting the autonomous behaviour of the different oceans and the importance of the Nd inputs in each ocean. Moreover separate ocean distributions suggest rather a better mixing inside each ocean, with distribution tails for the area of Nd inputs. Finally the Antarctic clearly reflects a mixing between the different oceans and constitutes a barrier for a direct mixing of the different oceans with one another.

Third, a box model solved with global inversion techniques let us draw some conclusions about the residence and mixing times in the different oceans and their distributions (confirming the previous remarks), the input and internal processes, and the current limitations about the interpretation of the Nd budget in the oceans.

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