

## Water mass pathways off the Argentine coast traced by REE concentrations and Nd isotopic composition

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Ocean circulation off the Argentine coast reflects the interactions between the energetic Deep Western Boundary Current originating from the northern Atlantic, recirculation loops involving different water masses such as the South Atlantic Central Water and the Antarctic Intermediate Water and Mode Waters recently formed in the Subantarctic Zone. Surface waters are also influenced by the freshwater discharge from the Rio de la Plata. As a result, water circulation in this region is very sensitive to variations in global circulation patterns on decadal or larger timescales, and monitoring these changes could provide an early warning system of impending changes in global circulation.

In addition to classical hydrological parameters, Nd isotopic composition of seawater is a powerful tracer to reconstruct present day pathways of water masses; furthermore, the imprint of this tracer in metalliferous sediments, fish teeth, or foraminifera shells is a good tool to reconstruct paleocirculations

We present here the Nd characteristics on vertical profiles collected at 13 stations between 35 and 40°S, in the framework of the Confluence 4 cruise (October 1994) and 4 stations collected along a section from Punta Arenas to 47°S-54°6' W, during ANTXVII/4 (Polarstern, 2000). Profiles obtained by Jeandel et al (EPSL, 1993) at 33°S-41°W and 49°39'S-33°23'W stations are also linked to the present work, in order to give the largest view of the Nd behavior in this area. Nd concentrations are oceanographically consistent, varying between 1.5 ng/l at the surface and more than 4 ng/l in deep waters. Nd isotopic compositions vary broadly, from  $\epsilon_{Nd}(0) = -6.8 \pm 0.2$  (characterizing Rio de la Plata Waters) to  $-12.5 \pm 0.3$  (NADW at the northern entrance of the Brazil/Malvinas confluence area). The effect of the Rio de la Plata waters on the studied area is quantified. The change affecting NADW flowing southward ( $\epsilon_{Nd}(0)$  values vary from  $-12.5 \pm 0.3$  at 30°S to  $-11.3 \pm$  at 48°S) is due to a mixing of 81% of NADW with 19% LCDW. Similar mixing processes explain the Nd signal variation along the LCDW pathways. The conservative behaviour of the Nd signatures emphasizes the potential use of this proxy as tracer of past circulation.

## Li isotope fractionation in the mantle

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Li is the lightest non-volatile element, with the largest relative mass difference between its stable isotopes, <sup>7</sup>Li and <sup>6</sup>Li. Alteration of the oceanic lithosphere both increases Li concentrations and its <sup>7</sup>Li/<sup>6</sup>Li. Mixing of this material back into the mantle should impart a distinct Li isotope signature on sources that contain recycled material. Realisation of this promise has become more tangible with recent developments in plasma ionisation multicollection mass spectrometry (PIMMS). The Thermo Finnigan *Neptune*, PIMMS shows excellent stability and sensitivity for Li. Using rapid sample-standard bracketing, Li isotopes can be measured with better than 0.5 per mil reproducibility, at low concentration 10-20 ppb, with intense <sup>7</sup>Li beams of 5-20 V. In tandem a chemistry that very effectively and rapidly separates Li from silicate matrix but quantitatively recovers Li has been developed using a two-column procedure with inorganic acid-methanol mixtures.

However, one further important issue needs to be addressed before Li isotopes can be effectively used as tracers of recycled material. It is possible, as has been well documented for oxygen, for example, that significant equilibrium isotope fractionations occur between host mantle phases and melt. Interpreting the Li isotope signature of mantle-derived melts requires a quantification of such fractionations. Work by Tomascak et al, 1999 and co-workers have demonstrated no systematic variation (within  $\pm 1.5$  per mil errors) within a suite of lavas related by olivine fractionation. This places some constraints on the possible magnitude of olivine-melt Li isotope fractionation, but significant isotope fractionations remain permissible within the bounds of the natural experiment. Tighter controls can be obtained studying the Li isotope compositions of co-existing phases from mantle xenoliths. We will present Li isotope data for olivine-opx-cpx-aluminous phase for garnet and spinel lherzolites, together with melt-olivine pairs for mafic lavas.

### References

Tomascak P.B., Tera F., Helz R.L., Walker R.J., (2000). *Geology*. **28**. 507.