

Neodymium boundary exchange in two North East Atlantic water profiles

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The neodymium (Nd) isotopic composition of seawater is an important tool for reconstructing palaeo-ocean deep water circulation. The technique relies on the quasi-conservative nature of Nd in seawater, with atmospheric and riverine inputs at the surface and outputs through scavenging by particulate matter. However, it has been noted that the Nd isotopic composition of seawater may also be influenced by isotopic exchange with sediments on the continental margins¹, known as Boundary Exchange (BE), resulting in the alteration of bottom water Nd isotopic compositions.

Here we present two water column profiles, and a number of bottom water measurements, from the North East Atlantic Ocean. The results show bottom water ϵ_{Nd} values that differ from either the measured, or expected, values of the overlying water mass. The first site, on the Rockall Banks, includes an open ocean profile down to a bottom depth of 2168m. This has a bottom water value of $\epsilon_{Nd} = -11.94 \pm 0.10$, which differs by up to 1.5 ϵ_{Nd} from open ocean measurements at the same depth nearby. The second site, in the Whittard Canyon, includes an open ocean profile down to 3595m, and a series of bottom water measurements taken up the slope of the canyon. The open ocean profile exhibits vertical ϵ_{Nd} variation, representing the change in water masses with depth. In all cases the up-slope bottom water ϵ_{Nd} measurements (at 7 depths from 500-4000m) are the same (within 2σ internal error), with a mean value of $\epsilon_{Nd} = -11.53 \pm 0.15$. In a number of cases the bottom water ϵ_{Nd} value is significantly different from the open ocean value at the same depth.

This has important implications for the reconstruction of palaeo-ocean circulation using Nd isotopes. Substrates for recording deep water Nd are always proximal to sediments, so that where BE occurs the record of Nd may not be representative of the overlying water mass. However, a paucity of data and a lack of understanding of the mechanisms of BE, means it is unclear whether this is a universal bottom water feature or a phenomenon isolated to continental margin settings such as those described above.

[1] Je&el, Arsouze, Lacan, Téchiné & Dutay (2007) *Chemical Geology* **239**, 156-164.

The formation of enigmatic carbonados from komatiite-related fluids: A model.

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Carbonados are polycrystalline diamonds made of sintered diamond grains varying <1 to a few hundred micrometers in size. Carbonado only occurs in placer deposits and has never been found in any volcanic rocks, such as kimberlites, that carry mantle diamonds to the Earth's surface. Its origin remains an enigma.

It has been proposed that carbonados would represent either impact-related diamond, be formed within uranium-rich carbonaceous sediments by implementation of alpha-particles, or even be extra-solar being related to an exploding supernova. All these models assume that a mantle-derived origin is unlikely because of their distinct characteristics to other mantle-derived diamonds.

Data obtained on diamonds from the Dachine komatiite (French Guyana) actually show striking similarities with carbonados: these include C-isotopes (average $\delta^{13}C \sim -25$ per mil), N-isotopes and N-aggregation (strictly Ib-IaA diamonds) and demonstrate that some diamonds with carbonados like geochemical features can originate from the mantle.

I will present a model that accounts for most of the available data on carbonados. This model proposes that carbonados grew when oxidised-bearing fluids/melts related to the (proto-?) komatiite magma were introduced into the reduced continental lithosphere (i.e. a relationship somewhat similar to fibrous diamonds and their host kimberlite). The low $\delta^{13}C$ of the diamonds reflects the isotope signature of the transition zone deep-mantle carbon below the Guiana shield. The sintering of the polycrystalline diamond aggregates that makes carbonado unique is produced by the high temperatures of the komatiite melts when entrained to the surface. The formation of carbonado from komatiite related volatiles can thus account for their geochemical features, lack among kimberlites, large size (up to 3100 carats) and sintering. The model predicts two observations that I will present at the conference.