Benthic foraminifera as a novel substrate for deep-water Nd isotopes

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The neodymium (Nd) isotopic composition of Fe-Mn crusts, fish teeth and leachates of Fe-Mn oxides from bulk sediment have all been used to reconstruct deep ocean circulation. However, each has its limitations, including low temporal resolution or terrigenous contamination. Here we present species specific Nd isotope records, coupled with multiple element/calcium ratios, from a highly available substrate, benthic foraminifera. Comparisons are made with a seawater Nd isotope profile to assess their ability to accurately represent modern ocean composition.

Holocene depth profiles from two sites, and core-top scrapings from 4 sites, all in the NE Atlantic, were hand picked for monospecific samples of *Cibicidoides wuellerstorfi, Planulina ariminensis, Melonis barleaneum,* and *Uvigerina peregrina*. Nd concentrations are found to be three times higher in epifaunal species than in infaunal (1.5ppm compared to 0.5ppm). The epifaunal ε_{Nd} profile reveals a constant down-core (0-10cm) value of -12, whilst the infaunal profiles are identical for all but the upper 2cm. Nd concentrations in benthic foraminifera are also found to co-vary with Cd/Ca ratios, a widely used palaeoceanographic water mass proxy, providing confidence in the use of Nd isotopes from benthic foraminifera.

The foraminifera Nd isotope data are compared with both a new nearby seawater profile and with Fe-Mn oxide leachate data. Though the ε_{Nd} of bottom water, foraminifera and leachates all agree, elevated Nd concentrations in bottom water samples suggest an addition of Nd to bottom water from sediment and/or pore water. Benthic foraminifera are therefore thought to reliably record bottom water Nd isotopic composition. Bottom water at this ocean margin site is influenced by interaction with sediments as recently proposed for many ocean margin settings [1].

References

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Mantle-derived carbonados: Insights from Dachine diamonds (French Guiana)

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Carbonados are black/greyish almost graphitic in appearance non gemmy polycrystalline diamonds, up to 3100 carats in size, made of sintered irregular diamond grains in the nano- to micrometer range. Carbonado sensu-stricto seem geographically restricted to Brazil and Central Africa. Understanding the formation of carbonado is one of the most enigmatic problem in diamond geology. It has been suggested that carbonado may either be formed during impact metamorphism, by irradiation of carbonaceous-rich material or even formed in exploding super-novea. A mantle-derived origin is generally rejected based on the observation that carbonados do not occurr within either lamproite and kimberlite which bring deep mantle-related diamonds to the surface and because carbonados have a series of features clearly distinct from any other type of diamond : among them their carbon isotope signatures centered at ~ -28‰ (e.g. [1]) and their poorly advanced nitrogen aggregation state [2] which require that the sample spent virtually no time in the Earth's mantle.

We studied 160 diamonds from the Dachine area (French Guiana). These diamonds are the only samples recovered so far from a volcaniclastic komatiite [3]. The samples are monocrystalline (i.e. non polycristalline) macrodiamonds (> 500 microns) mostly (> 95%) irregular in shape with resobred octahedron and cubes being occasionnally recognised. No syngenetic inclusion has been identified yet. Most (>90%) samples are nitrogen free (Type II) and the few samples containing nitrogen (Type I) are characterised by low aggregation states. Their carbon isotope compositions range from -31.9 to +0.15‰ with an average of -24.4‰.

The observed general ^{13}C-depletion among diamonds from Dachine including both octahedron and cuboids (and their respective resorbed forms), among both Type II and Type I diamonds demonstrates that an entire diamond population with ^{13}C-depletion can originate from the mantle. Thus the long-standing statement that carbonados could not derive from the mantle based on distinct carbon isotope composition and N-speciation is now contradicted by our new data and the possibility of carbonados being formed in the mante deserves closer examination. A mantle-related formation of carbonados would succeed in explaining first order observations in particular their large size.

References

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