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Neodymium Isotopes in Modern Foraminifera from Indian Ocean: Assessment of the Use of Nd Isotope Composition of Foraminifera as a Tracer for Palaeo-Oceanic Circulation Changes

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The ε_{Nd} stratification of the water column has been shown in all the main ocean basins of the world (e.g. Piepgras and Wasserburg, 1980; Bertram and Elderfield, 1992; Jaendel et al. 1998). The variations in Nd isotope composition of the water column indicate changes in the water masses circulation, which may in turn reflect major palaeoclimatic variations. Foraminifera are wildly present in oceans and can be sampled with a very high time resolution. They live at different depths (ca. Benthic and Planktic species) and potentially record Nd isotope composition of the water masses where they live. Therefore $\varepsilon_{Nd}(0)$ of foraminifera tests should provide high resolution information on variations of the sea water column composition related to palaeoclimatic transitions. Nevertheless, three important assumptions have to be made: (1) the Nd is integrated in the calcite lattice during calcification of the foraminifera test (2) Nd composition is preserved after the foram death through the water column and while in the sediment (3) it is chemically possible to remove any diagenetic contamination using special cleaning method (Boyle 1983). The Mn/Ca ratios is usually used to check for low contamination but since the partition coefficient of Nd in biogenic calcite is not well known, it is difficult to evaluate the impact of adsorption processes. We present the Nd systematics of planktic foraminifera tests which were collected offshore Somalia and in the Somali basin during the 1992/1993 cruise of the R/V Tyro in the framework of the Netherlands Indian Ocean Program (NIOP). The behaviour of the Nd in two foraminifera species tests, *G. ruber* and *G. bulloides*, have been studied through the water column, sampling shallow planktic tows, sediment traps and box core tops. The sediment traps provide a 9 months time series record of particle fluxes throughout both the south-west and north-east monsoon periods. The Nd concentration of both species increase through the water column, from 0.04 ppm at 50 m depth to 0.3 ppm at 21 m above the sea floor (1512 m water depth). This gradient could be related to several processes: secondary calcification, formation of a calcium manganese coating, dissolution processes. No $\delta^{18}O$ variations were recorded between foram sampled for the same period of time at different depths. The first observed increase in Nd concentration of foraminifera test occurs below the oxygen minimum zone at 1000 m. Furthermore, the Nd concentrations of foraminifera from the deepest traps vary according to the season. These Nd concentrations are lower for non upwelling season (0.2 ppm) than for upwelling SW monsoon period (0.35 ppm). These results are consistent with the uplift of the bottom water mass, with relatively high Nd content (3-4 ppt), during upwelling period. Nd isotope compositions of foraminifera from sediment traps were measured using NdO technique (5000 individuals) for both upwelling and non upwelling seasons as well as for sea water samples collected at the same location. Even though the chemical processes responsible for variations in Nd concentrations are unknown, these results show that Nd is continuously accumulated onto foraminifera test in the water column prior to sedimentation. The Nd isotope compositions measured in foraminifera from sediment cores have been shown to record the timing of the main palaeoclimatic transitions (Vance and Burton, 1999; Burton and Vance, 2000). Currently, however, there are too many questions that remain regarding the source of Nd in planktic foraminifera for them to be used as tracer of changes in provenance of the surface water masses. We have first to explain (1) why the typical Nd concentration measured in cleaned planktic foraminifera from sediment cores (Vance and Burton, 1999; Burton and Vance 2000) vary from, 0.6 to 2 ppm, much higher that those measured in the shallowest tows (0.02 ppm) and (2) which processes raise the Nd content of foraminifera tests.

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