Isotope analysis of ng-sized Nd by total evaporation TIMS and its application to foraminifera samples

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Calcareous foraminiferal shells are used as an archive to trace the temporal changes of the local seawater radiogenic Nd isotopic composition related with changes of the paleoclimate and water mass distribution. Since Nd concentrations of cleaned foraminiferal shells are on the order of several ppm, several milligrams of foraminifera samples are required for Nd isotope analysis. Lowering the sample size limits for Nd isotope analysis may expand the applicability of this approach to foraminifera-poor samples.

In this study, we demonstrate a refined technique to measure radiogenic Nd isotope ratios of ng to sub-ng sized Nd samples together with the low-blank Nd separation chemistry. Isotope ratios of Nd are measured on Thermo Triton TIMS at Kochi Core Center using total evaporation normalization method (Wakaki et al., 2007).

The $^{143}Nd/^{144}Nd$ ratios of the isotopic reference reagent JNdi-1, measured at sample sizes of 0.5, 1 and 2 ng of Nd, all agreed with the reference value with 2SD reproducibility of 100 ppm (n = 8), 60 ppm (n = 9) and 40 ppm (n = 8), respectively. Two GSJ reference rocks, JB-2 (basalt) and JCp-1 (coral), were analysed with small sample aliquots, containing 0.5 and 1.2 ng of Nd. The $\varepsilon^{143}Nd$ values of JB-2 and JCp-1 were -9.1 ± 0.7 (n = 9) and -8.0 ± 0.7 (n = 7), respectively. These results agreed perfectly with the values obtained by measurements of JB-2 and JCp-1 with large sample sizes, -9.22 ± 0.05 and -7.9 ± 0.2, respectively, and demonstrates the precision and accuracy of our technique.

Using this technique, we compared the Nd isotopic compositions of subsurface-dwelling planktonic foraminifera, *Globorotalia tumida,* with mixed speices of benthic foraminifera both collected from a Quaternary sediment core from the West Caroline Basin (western equatorial Pacific Ocean) with the water depth of 3855 m. The $\varepsilon^{143}Nd$ values of the planktonic and benthic forams are -4.0 ± 0.5 and -3.3 ± 0.7, respectively, and are indistinguishable. Our result supports the idea that the forams acquire most of their Nd from the bottom water after deposition onto the seafloor and thus the Nd isotopic composition of the forams are reflecting that of the bottom water (Tachikawa et al., 2014).