Development of mass-dependent Nd isotopic analysis to trace natural from anthropogenic Nd

N. BOTHAMY*, A. GALY

CRPG/CNRS, BP 20, 54501, Nancy, France
(*correspondence : nbothamy@crpg.cnrs-nancy.fr)

We improved the isotopic analysis by MC-ICPMS of Neodymium (Nd) allowing the determination of precise and accurate mass-dependent Nd isotopic composition. We used a Neptune Plus instrument coupled to an Apex desolvating nebulizer to introduce Nd into the plasma. Samples were measured with the sample-standard bracketing technique using the JNdi-1 Nd as the reference standard. We define the mass-dependent Nd isotope compositions (δ^{x}Nd) as the relative deviation from the JNdi-1:

$$\delta^{x}Nd = \left[\frac{(^{x}Nd/^{144}Nd)_{sample}}{(^{x}Nd/^{144}Nd)_{JNdi-1}} - 1\right] \times 10^{3}$$

where x = 145, 146, 148 or 150. The external reproducibility of δ^{145}Nd, δ^{146}Nd, δ^{148}Nd and δ^{150}Nd are respectively ±0.045, ±0.051, ±0.080 and ±0.145 ‰ (2σ, N= 29). The accuracy of the method has been validated by the standard addition method. Mixing proportion of two known solutions can be accurately measured using the ε^{143}Nd (radiogenic contribution on ^{143}Nd from the decay of ^{147}Sm) and linear relationship between ε^{143}Nd and δ^{x}Nd where observed.

The measured δ^{x}Nd versus δ^{148}Nd show co-variations consistent with mass-dependent fractionation law. We measured 5 purified Nd commercially available samples (either purchased as solution or metal) against the JNdi-1 reference standard and the range obtained is 0.3 ‰ amu. The highest signal-to-noise ratio was obtained for δ^{148}Nd (range/analytical noise). Extreme values were observed for JMC, the lightest with δ^{148}Nd = -1.013 ‰, and for JM, heavier that he JNdi-1 with δ^{148}Nd = 0.186 ‰. This extands the published anthropogenic range by a factor of 2 and confirms that man-made samples have a distinct Nd isotopic signatures.

According to previous papers, the range of stable Nd isotopic composition of natural terrestrial material is 3 times smaller than that of synthetic man-made purified Nd. This observation suggests that 1) anthropogenic Nd should be distinguishable and traceable in the environment thanks to this new analytical tool, or 2) the range of natural terrestrial rock samples is not yet fully described. Given the small number of terrestrial rocks (8) charaterised for their δ^{148}Nd in the literature, we will present new data on various kinds of natural biological and non biological samples to see if δ^{148}Nd can be a tool to determine anthropogenic Nd pollution.