

High precision Nd isotope analysis using TIMS with improved dynamic-multicollection method

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High precision Nd isotopic analysis has been the center of interest in the community of geoscience. Nd has seven stable isotopes including two radiogenic nuclides of ¹⁴²Nd and ¹⁴³Nd, the decay products of short-lived ¹⁴⁶Sm ($T_{1/2} = 68$ Myr [1]) and long-lived ¹⁴⁷Sm ($T_{1/2} = 1.06$ Gyr), respectively. In addition to chronological applications, Nd isotopes have been extensively used in the study of isotope anomalies in meteorites. An outstanding result is the discovery that chondrites possessed ¹⁴²Nd/¹⁴⁴Nd ratios ~20 ppm lower than that in terrestrial rocks, suggesting the existence of a hidden reservoir with a subchondritic Sm/Nd ratio deep in the mantle [2]. However, the effect of nucleosynthetic isotope variability in the solar system must be evaluated more in detail.

Nd isotopes have been commonly measured using TIMS in the “static-multicollection” mode, of which the result can be affected by the time-related deterioration of Faraday cups [3]. In contrast, the “multi-static” [4] or “dynamic-multicollection” methods can reduce the effect of cup deterioration by acquiring Nd isotopes with multiple lines of different cup configurations within a single analytical cycle. In this study, we developed a modified “dynamic-multicollection” method in which ^{142,148,150}Nd/¹⁴⁴Nd ratios were obtained with 2-line cup settings. In addition, we corrected the effect of the time difference between two lines within a cycle. The results were obtained by averaging 360 ratios with 2 σ rejection, taking 4.5 hours per single isotopic measurement.

Repeated analyses ($n = 12$) of a standard JNdi-1 with our dynamic method achieved the following reproducibilities; ¹⁴²Nd/¹⁴⁴Nd: 2.8 ppm, ¹⁴⁸Nd/¹⁴⁴Nd: 4.5 ppm, ¹⁵⁰Nd/¹⁴⁴Nd: 9.2 ppm. The reproducibilities are 3-5 times better than those in the static mode. Furthermore, improvement is evident for ¹⁴⁸Nd/¹⁴⁴Nd and ¹⁵⁰Nd/¹⁴⁴Nd ratios even compared to those in the multi-static method (6 ppm and 19 ppm, respectively) conducted in [3]. Analyses of several chondrites by this method resulted in nearly no anomalies for ¹⁴⁸Nd/¹⁴⁴Nd ratios while they still showed deficits in ¹⁴²Nd/¹⁴⁴Nd ratios 10–20 ppm lower than the terrestrial value.

[1] Kinoshita et al. (2012) *Science*, **335**, 1614. [2] Boyet and Carlson (2005) *Science*, **309**, 576. [3] Brandon et al. (2009) *GCA*, **73**, 6421. [4] Caro et al. (2006) *GCA*, **70**, 164.