SGC053-P02 : :5 26 10:30-13:00

3 (TIMS)

Determination of Ce isotopic ratio using a three-step separation procedure and thermal ionization mass spectrometry

1*, 1, 1, 1, 1, 1
Yuka Hirahara[1*], Qing Chang[1], Takeshi Hanyu[1], Takashi Miyazaki[1], Toshiro Takahashi[1], Jun-ichi Kimura[1]

1

[1]IFREE/JAMSTEC

The rare earth elements (REE) have two long-lived decay systems, the ^{147}Sm-^{143}Nd and ^{138}La-^{138}Ce. The combination of those isotope ratios provides information on ages, initial ratios, and enables estimation of the time-integrated REE evolution of complex geological reservoirs in the mantle or crust. However, the variation of Ce isotopic ratio (^{138}Ce/^{142}Ce) due to secular radiogenic decay to ^{138}Ce is smaller than those of Nd isotopic ratio because of the low abundance of ^{138}La and its long half-life. Therefore, highly precise determination of Ce isotopic ratios is necessary to obtain reliable data for application of geochemical studies.

For precise determination of Ce isotopic ratio, it is necessary to separate Ce from the matrix and isobaric interfering elements. A three-step chemical separation procedure was developed for Ce separation in this study, which was proved to be able to sufficiently remove the isobaric interfering elements with low procedural blank. Ce was first separated as a REE fraction via cation exchange column with HCl. Then Ce alone was isolated from other REEs by selective extraction technique with chelating resin (Tazoe et al., 2007). In this step, Ce was separated easily from other REEs by oxidation from Ce^{3+} to Ce^{4+} using $KBrO_3$ in nitric acid. Ce was further purified using a third cation exchange column with HIBA as the eluent, which was modified from Makishima and Nakamura (1991).

The Ce isotopic ratios were measured by multicollector static measurement using TIMS (TRITON TI, Thermo Fisher Scientific Co., Germany) equipped with nine Faraday cups at IFREE, JAMSTEC. The Ce ion beams were measured as oxide species (CeO^+) to obtain stable and large ion beams. During the Ce isotope measurement, Ce oxide ion beams were obtained at the intensity of 3 ~ 10 X 10^{-11} A for $^{142}Ce^{16}O$ using a double Re-filament technique. The mass-dependent fractionation of Ce isotope ratio were normalized to ^{136}Ce/^{142}Ce=0.01688 and ^{140}Ce/^{142}Ce=7.947 using the power law. The ^{18}O/^{16}O ratios were obtained in situ measurement. The data acquisition time for 450 ratios was about 1.2 hours. The analytical reproducibility and precision in the measurement of JMC 304, which is Ce isotope reference material (Tanaka and Masuda, 1982), were obtained +/- 0.008 % (2S.D., n=46) and < +/- 0.003 %, respectively.

The Ce isotope measurements of the Ames Laboratory Ce metal reference material (Willbold, 2007) were performed with an analytical reproducibility of +/- 0.007 % (2S.D., n=36) with normalization to JMC 304 in order to eliminate any inter-laboratory biases. The Ce isotope ratio for BCR-1, the USGS geochemical reference samples, was 0.0225646 +/- 0.0000004 (2 siguma_m, n = 7) and consistent with previously reported data (Makishima and Nakamura, 1991). We also performed the measurement of Ce isotope ratios in seven geological reference materials (JB-1a, JB-3, JA-1, JA-2, JR-1, JG-1a, and JMn-1) and the results were consistent with reported data but with improved analytical precision.

Reference
Tazoe et al. (2007), *Journal of Analytical Atomic Spectrometry*, 22, 616-622.
Makishima and Nakamura (1991), *Chemical Geology*, 94, 1-11.
Tanaka and Masuda (1982), *Nature*, 300, 515-518.
Willbold (2007), *Journal of Analytical Atomic Spectrometry*, 22, 1364-1372.
Keywords: Ce isotope ratio, TIMS, JMC304, BCR-1, chemical separation