

Stable isotope ratios of rock and environmental standards

Kicheol Shin^{1*}, Yohei Tada¹, Soichiro Kusaka¹, Chie Miyakawa¹

¹Research Institute for Humanity and Nature

A wide variety of natural materials (air, water, biota, soil, and rock) and artificial ones (food, agricultural and industrial products) are used in earth environmental studies. Stable isotopes (SI) can be utilized as a fingerprint of element to trace its behavior in the environment. To enhance the ability of this SI fingerprint, it is desired to determine the concentrations and isotope ratios of many elements in an environmental sample with high precision and accuracy, rapidness, and convenience. Further, as biota, soil, and rock are composed of different components (bone, meat, mineral, etc.), whose concentrations and isotope ratios differ one another, analytical precision according to sample processing should be evaluated.

In order to promote the environmental isotope study, organizations hosting analytical instruments are desired to build the network, which can contribute to the improvement of the analytical reliability for elemental and SI data of various environmental samples. As a first step toward the realization of this network, we started to determine the stable isotope ratios of Sr, Nd, and Pb of rock standards from the National Institute of Advanced Industrial Science and Technology (AIST) using and thermal ionization mass spectrometer of TRITON and high resolution multi-collector ICP-MS of NEPTUNE (Thermo Fisher Scientific K. K.). We also determined the $d^{13}C$ and $d^{15}N$ values of organic material standards (rice, seaweed, fish tissue etc.) used for heavy metals at AIST by isotope-ratio mass spectrometer of Delta plus XP with Elemental analyzer Flash EA (Thermo Fisher Scientific K. K.).

For Sr-Nd-Pb analysis, all samples digested with concentric acid of high grade in Teflon vessel using Microwave sample digestion system ETHOS One (Milestone General K.K.). Sr and Pb separated with Sr spec resin and Nd processed with cation exchange resin and Ln resin (Eichrom co.). Preliminary results using TRITON showed that the external variation of $^{87}Sr/^{86}Sr$ ratios for individual rock standard falls in a narrow range of 10 ppm, this variation being two times as the internal one. This difference between the external and internal variation is also observed when NEPTUNE was used. We suggest that this difference is ascribed to the measurement stage by mass-spectrometry rather than sample heterogeneity and sampling procedure.

The $d^{13}C$ values of four rice standards were uniform -25.7 ± 0.3 permil, whereas their $d^{15}N$ values were more variable from 1.2 to 5.6, indicating that this variation of nitrogen isotope is ascribed to the contribution of nitrogen from human activities in different degree. Marine fish standards showed variable $d^{13}C$ and $d^{15}N$ values. The $d^{15}N$ value of Japanese seabass in Tokyo bay is about 5 permil higher than those of cod fish and swordfish tissues in the oceans near Japan, suggesting the input of human-derived nitrogen.

Keywords: stable isotope, environmental standard, analytical precision, sample heterogeneity