Magmatic strontium stable isotope fractionation within a single granitic pluton

Y. WAKASUGI[1*], Y. TANIOKA[1], S. WAKAKI[2], M. TSUBOI[1] AND T. ISHIKAWA[2]

[1]Sci. Tech., Kwansei Gakuin Univ., Sanda, Hyogo, 669-1337, Japan (*correspondence: wakasugi@kwansei.ac.jp)
[2]Kochi Institute for Core Sample Research, JAMSTEC, Japan

The stable isotopic variation of Sr among igneous rocks has been reported by Charlier *et al*. (2012). They suggested that the variation of $^{88}Sr/^{86}Sr$ ratio was caused by plagioclase fractionation during high temperature magmatic differentiation processes. Their suggestion, however, was based on a dataset of various igneous rocks with different origins. The correlation between magmatic differentiation and Sr stable isotopic fractionation have not yet investigated directly. In this study, we report stable Sr isotopic variation within a single granitic pluton derived from a single parental magma to test the hypothesis that Sr isotopic fractionation is caused by magmatic differentiation.

The Tadamigawa granite, distributes in the northeastern part of Japan, varies in composition from granodiorite to quartz monzonite. It intrudes into the Jurassic sedimentary complex of the Ashio belt with U-Pb zircon ages of 101.5 ± 3.5 and 106.1 ± 1.1 Ma. 24 samples of the Tadamigawa granite (SiO_2 = 59.6 – 76.1 wt%) were analyzed. Samples were decomposed with a mixture of HF, HNO_3 and $HClO_4$. Sr was separated by extraction chromatography using Sr Spec resin (Eichrom). Stable isotopic composition of Sr was analyzed by double spike TIMS technique using ^{84}Sr-^{86}Sr double spike with Thermo TRITON TIMS at Kochi Core Center. The results are expressed with relative to NBS987 as $\delta^{88}Sr = [(^{88}Sr/^{86}Sr)_{sample}/(^{88}Sr/^{86}Sr)_{NBS987}-1]\times10^3$. The reproducibility of $\delta^{88}Sr$ was ± 0.02 during this study.

Major and minor whole-rock chemical composition of the Tadamigawa granite shows clear trend on the Harker's diagram. Most of the samples are plotted on a Rb-Sr whole-rock isochron of 96.4 ± 2.5 Ma. These results show that the Tadamigawa granitic pluton was formed by differentiation of a single parental magma. The $\delta^{88}Sr$ of the Tadamigawa granite shows large variation from +0.27 to -0.41. The $\delta^{88}Sr$ value systematically decreases with decreasing Sr and Ca concentrations. Our results clearly show that the Sr stable isotopic fractionation occured in the magma chamber during magmatic differentiation process. Plagioclase is likely to be the phase that continuously removed "heavy Sr" from the evolving magma.