The sulfur isotopic ratio of Neogene granitoids in Kyushu

Miyuki Furusawa[1]; Munetomo Nedachi[2]

[1] Fac. Sci., Kagoshima Univ.; [2] Space Sci., Kagoshima Univ.

The batholiths and small stocks of granitoids of Neogene are located in the whole area of Kyushu, and the area is divided into three zones, the Outer zone of Southwest Japan near the Pacific coast line (Outer zone 1 : reduced type : Osuzuyama, Takakumayama, Osumi and Yakushima bodies), the Outer zone of Southwest Japan near the mid-tectonic lines (Outer zone 2 : Okueyama, Ichifusayama, Shibisan, Mukaeyama, Suzuyama and Kinpouzan bodies), and the Inner zone of Southwest Japan (Inner zone : oxidized type : Tushima, Goto, and Koshikizima bodies), based on the kind of associated ore deposit, halogen content, redox condition, source materials, tectonics of magma emplacement, and assimilation and contamination of sedimentary rocks. In this study, we measured the sulfur isotopic ratio of these granitoids. There are many reports on the sulfur isotopic ratio of the granitoids in Japan (e.g., Sasaki and Ishihara, 1979).

Pyrrhotite occurs coexisting with biotite and other rock-forming minerals in the granitoids in the Outer zone 1. The sulfur content is correlated with SiO2 of whole rock, decreases from 1400ppm to several ppm with the increase of SiO2. In contrast, sulfur content of the Inner zone varies widely. For instance, sulfur content of many granitoids of the Goto body is lower than several ppm, although, there are some rocks of which the sulfur contents reach thousand ppm. There is no correlation with SiO2 content. The sulfur contents might be related to the mineralization. The Tushima body reaches to 2000ppm. The granitoids in the Outer zone 2 shows the similar features. At the Okueyama complex, sulfur content is hardly contained in the central batholith, but high in the stocks near the Obira and Mitate ore deposits. The Suzuyama stock, intruded into the center of mineralization zone, contains sulfur up to 2000ppm.

The behavior of sulfur in magma depends largely on the redox condition. H2S or HS- might be dominant in the reduced magma in the Outer zone 1. The existence of pyrrhotite as an ordinal rock-forming mineral suggests that magmatic sulfur had been consumed by the crystallization of pyrrhotite and had decreased in the residual magma. The addition of sulfur by the assimilation of country rocks might not be important compared to the subtraction of magmatic sulfur. In contrast, sulfur might exist as SO2 as well as H2S in the oxidized magma in the Inner zone, and SO2 is discharged from the magma. As a result, the sulfur content in the granitoid might become remarkably low. When the discharged SO2 is cooled in the lower PO2 condition than that of magnetite-hematite buffer, SO2 changes to H2S and is precipitated as pyrite or pyrrhotite by the subsolidus reaction (Ohmoto and Goldhaber, 1997). This tendency might appear especially at the granitoids related with mineralization.

In the Outer zone, the sulfur isotopic ratios are all negative values from -1 to -13 per mill, while the Inner zone from +2 to +11 per mill. In the Outer zone 1, the sulfur isotopic ratio correlates with SiO2 content, and becomes lighter with the increase of SiO2. A similar tendency is observed in the Inner zone.

As the fractionation factor of pyrrhotite to H2S and HS- are slightly positive, 34S should fractionate into pyrrhotite. Therefore, the sulfur isotopic ratio of the granitoids in the Outer zone 1 decreased during crystallization. The evidence might be able to interpret without the influence of the country rock, although the assimilation and contamination might be effective. In contrast, in the magma in the Inner zone, both H2S and SO2 might exist. As the sulfur isotopic ratio of SO2 is always about 2 per mill higher than that of H2S at the magmatic temperature, H2S is always oxidized to SO2 under the buffering condition by the mineral assemblages in granitoids. The light sulfur both in the magma and discharged SO2 might increase during the cooling of magma by the Rayleigh effect.