

Submarine calderas in the Tokara Islands 1: Geochemical characteristics of lavas from the Tokara Islands

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In order to understand the chemical characteristics of volcanic rocks in the Tokara Islands, we carried out land based sampling and ocean survey with dredge sampling (Tansei-Maru cruises: KT00-15, KT07-2, KT07-21; Nagasaki-Maru cruise No. 252). Our dredge sampling was successful at 28 sites. Three hundred and sixty eight representative samples from both on-land and submarine area were selected and analyzed. Because previously reported major element data of the volcanic rocks in the Tokara Islands are largely scattered, we paid attention to the desalination process and evaluation of weathering effects on the volcanic rocks.

As chemical composition of collected rocks from ocean islands and ocean floors probably is affected by sea water, we need to desalinate thoroughly during the sample preparation. The first step in the desalination process involves the cleaning of a small chip (ca. 50g) from original rock using an ultrasonic bath with warm deionized water. This cleaning process was repeated until the sample is salt free in the cleaning solution, which means that the residual water shows a salinity level below the detection limit (0.01%) in a digital salinity meter. The next step in the desalination process is the crushing into a rice size of the dried chip, and then about 8g of the crushed samples was mixed with deionized water in a 30 ml of centrifuge tube. A tightly closed centrifuge tube was soaked in an ultrasonic cleaner for 30 minutes with warm deionized water. Then, the tube was centrifuged and the supernatant liquid was measured by a digital salinity meter. The cleaning process was repeated when the supernatant liquid reach to the salt free level. Supernatant water of some highly vesiculated samples indicated high salinity content even in the second desalination step.

The weathering condition of the volcanic rocks in the Tokara Islands is different from the main land of Japan due to its hot and humid subtropical weather. Therefore, some samples are probably highly ferrallitized by the weather condition. Indeed volcanic rocks with high loss on ignition value (LOI of the rock is greater than 1%, LOI of the pumice is greater than 3%) are poorer in K₂O and SiO₂ and richer in Al₂O₃, Fe₂O₃, TiO₂ compared with other low LOI rock groups. When we discuss the chemical compositions of the volcanic rocks, the LOI could be an available threshold for excluding unreliable sample data.

We revealed that each volcano indicates individual tight trend or cluster. The volcanic rocks from Akuseki-Shima and Suwanose-Shima are plotted on the same trend. The trend is located just below the boundary of high-K rock series. The trend of volcanic rocks from Yokoate-Shima is delineated above boundary of low-K rock series. Volcanic rocks from Ioutori-Shima and farther southern submarine volcanic rocks are plotted in the low-K area. The volcanic rocks located in the southern extension of Suwanose-Shima show a systematic decrease in K₂O systematically along the Ryukyu arc. Although the volcanic rocks from Nakano-Shima and Kuchino-Shima are plotted on the same trend, the volcanic rocks from Kuchino-Shima are plotted in the higher SiO₂ rich dacite area.

Relatively fresh trachy andesite and trachyte, having LOI=1.20 % and 1.50 %, respectively, were newly discovered from Nigori-Sone and Kogaja-Shima. The occurrence of the rock types suggest that alkalic volcanism was occurred in the volcanic front at least during the Quaternary. Some altered K₂O rich volcanic rocks occurred at Nigori-Sone, Takara-Shima, and Kodakara-Shima and are plotted on the alikaline rock series area in a TAS diagram.

Although volcanic rocks in the Tokara Islands are considered to be andesite, the results confirm that the volcanic rocks show a wide variety of chemical composition and a regularity of spatial distribution. The coexistence of alkaline and calc-alkaline rock series may indicate of a tectonic history of the arc that has been separated from the continental margin.

