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特 別 講 演

The Caldera Eruptions in Ryukyu Arc : as Inferred the Thermal Anomaly in Kyushu

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Abstract

The volcanism results from the subduction of the Philippine Sea plate under the Eurasian Plate at the Nankai Trough and the Ryukyu Trench, respectively formed 34 active volcanoes in Kyushu and Okinawa areas. Based on the tectonic provinces, these volcanoes can be divided into two groups, the South-West Japan Arc and the Ryukyu Arc, respectively. The Quaternary volcanic front extends from Taiwan to Kyushu. The extensive huge eruptions in the Quaternary formed the four major calderas in Kyushu area. The names of caldera from north to south are as Aso, Aira, Ata, and Kikai, respectively (Figure-1). As for the heat flow pattern in Kyushu, the higher 120 mW/m^2 contours are closely reconciled with the caldera areas. Therefore, the purpose of this paper will focus on the relationship between the huge volcanic eruptions and the thermal anomaly.

Four major huge eruptions in the Aso caldera occurred in 270 ka, 140 ka, 120 ka and 90 ka, respectively. The total eruption volume from the Aso caldera was estimated at much more than 800 km^3 (Machida, 1999). The Aira caldera was formed by co-ignimbrite eruption at 24 ka, which eruption volume was estimated as more than 450 km^3 (Machida, 1999). The Ata caldera located at the southern tip of Kyushu formed in 95 ka ago, which supplied much abundant of dacitic pyroclastic fall and vitric ash. The total eruption volume of the Ata caldera eruption was estimated as more than 300 km^3 (Machida, 1999). There were two huge eruptions in the Kikai caldera, which were 6.3 ka and 95 ka, respectively. The total eruption volume of the Kikai caldera was estimated as 300 km^3 (Machida, 1999). Cumulated the above eruption volumes from four calderas, the conserved estimation of eruption volume along the northern Ryukyu arc is about 1580 km^3 in last 0.3 Ma period. The average eruption rate per year is calculated around 5×10^{-3} km^3, which is the similar range with that of the Yellowstone, USA and the Taupo, NZ, 3.2×10^{-3} km^3/year and 8.5×10^{-3} km^3 /year, respectively (Hochstein, 1995). There did not obviously appear any anomaly in the average eruption rate. In general, the eruption rate could reflect the magma production rate in the mantle wedge under the volcanic front. Therefore, the surface higher heat flow did not imply any higher magma production rate.

Various model has been proposed to explain that the phenomenon of anomalously high heat flow coincident with the caldera localities. The rifting and crustal rotation in the northern Ryukyu arc due to the accelerated trench retreat along the Ryukyu trench in last 2 Ma (Kamata and Kodama, 1999). They offered the very suitable tectonic environments for the growth of magma chamber. The voluminous felsic magma of caldera eruption was stored up at the high-level of the upper crust for the long time, in terms of it caused the higher heat flow on the surface naturally.

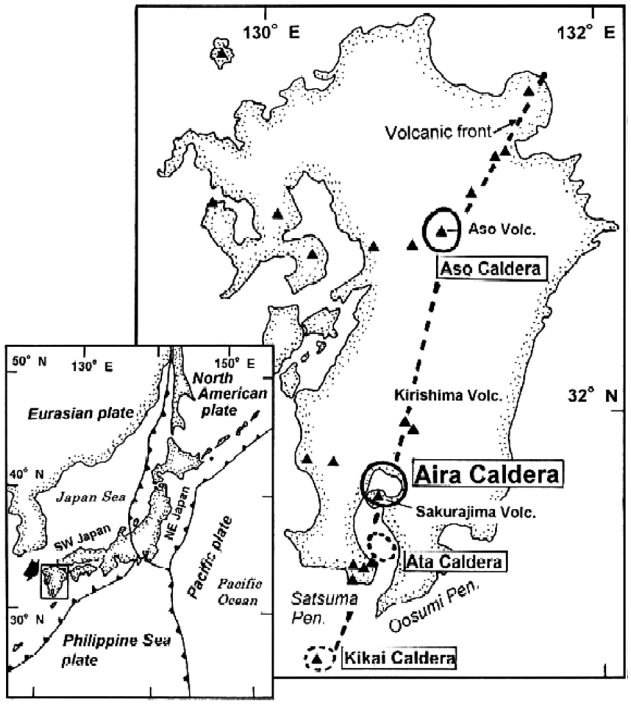

Fig. 1 Location map of the caldera and Sakurajima volcano on southern Kyushu. Japan Quaternary volcanoes are indicated as filled triangles. Major calderas are also shown in the map.
(This map adapted from Arakawa *et al.,* 1998)

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