Submarine calderas in the Tokara Islands 2: recovered fresh acidic rocks during the KT00-15,07-2,07-21, NAG252 cruises

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The concept of the four gigantic calderas in Kyushu, Japan, was established from the land-based geological data. Some of the eruptive volumes estimates from these calderas exceed 300 km3 and are classified as super-eruption. Yokose (2007) have suggested that seven calderas which are of the same size as the four gigantic calderas in Kyushu, can be identified along the Ryukyu arc using recent bathymetric data. During the last-interglacial high sea level period, the southern extension of some huge calderas could have been submerged below sea surface.

To confirm whether the caldera-like topographic expressions are of volcanic or tectonic in origin, we carried out four ocean surveys aboard the Tansei-Maru and Nagasaki-Maru (Tansei-Maru cruises: KT00-15, KT07-2, KT07-21; Nagasaki-Maru curuise: NAG252). We collected abundant volcanic rocks in varying degree of vesiculation from two third of the successful dredge haul. The maximum size of the sample exceed 20 cm in diameter (see figure). The dredged samples included highly vesiculated and predominantly sub-angular lava fragments, pumice, and scoria. The chemical compositions of the dredged samples rang from andesite to rhyolite. Trachytic scoria samples were also obtained. Megascopically, the samples can be classified into five groups: coarse grained porphyritic rock, fine grained porphyritic rocks, aphiric white woody pumice, spongy scoria, and banded pumice.

Coarse grained porphyritic rocks were recovered from the northwest submarine flank of Yokoate-Shima, Takara-knoll, the southwest submarine flank of Takara-Shima, and the southwest submarine flank of Suwanose-Shima. These porphyriotic rocks occur in the flanks of dome-like structure. The chemical composition of the porphyritic rocks varies from dacite to rhyolite and are differs from the other samples collected in other deredged sites, but are similar in appearance. Abundant aphyric white woody pumice samples were recovered from the Akuseki-caldera. The pumice is rhyolitic in composition and can be identified by the slight difference in SiO2 and TiO2. The chemical differences in the white woody pumice imply that they were originated from different eruptive events. The varying degrees of alteration observed in the dredged samples also indicate that they were not derived from the same eruptive event.

To identify the origin of the dredged sample, we compared the chemical composition of the dredged pumice sample with the composition of the pumice included in some large pyroclastic flow and fall deposits such as the Funakura pyroclastic deposit, Ata pyroclastic flow deposit, Osumi pyroclastic fall deposit, and Aira Ito pyroclastic flow deposit. The vesiculated dredged samples are differs from pumices erupted on-land in chemical compositions. These observations indicate that the dredged samples are deposited directly from a volcanic activity in the Tokara Islands rather than as drift pumice. Furthermore, the chemical compositions of the trachytic scorias collected from the northeast submarine flank of Akuseki-Shima are different from the reported drift trachytic scorias which are derived from the Fukutoku-Okanoba. The trachytic lava fragments recovered from Nigori-Sone and Kogajya-Shima may not be drift rocks because they consist relatively of fresh sample.

The results of the ocean survey in the Tokara Island support the idea of a regular spatial distribution of seven large submarine calderas related to acidic volcanism along the Ryukyu arc. The on-going research on the submarine acidic volcanic activity in the Tokara Islands could help us mitigate the hazards associated with a potential occurrence of a catastrophic eruption in the area.

Yokose (2007): The southern extension of the four gigantic calderas in Kyushu, Japan: Submarine huge calderas in the Tokara Islands. Monthly Earth 29,561-569.


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