Quaternary submarine huge calderas on the Tokara volcanic ridge, northern Ryukyu arc: evidenced from the submarine explorations

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The active volcanoes in the southern Kyushu are densely distributed and continued to the Tokara Islands, which is the northern part of the Ryukyu arc. The volcanological researches on the Tokara volcanic ridge have been confined the subaerial parts. The total volume of it, however, corresponds to only 5% of the whole volcanic product on the Tokara volcanic ridge. Therefore the vast area of the Tokara volcanic ridges remains unexplored. Based on the bathymetric and magnetic data, the huge submarine calderas have been proposed (Ueda, 1986; Yokose, 2007). Recent explorations on the Tokara volcanic ridges discovered vesiculated rhyolitic rocks that imply the submarine calderas (Yokoseet al., 2008a). In order to confirm the huge submarine calderas, we carried out two additional seafloor explorations in 2008 using Nagasaki-maru (NAG267 and NAG 274). We will report the result of 77 dredge samplings and geochemical investigations on the volcanic rocks.

In contrast with subaerial volcanic rocks, the dredge samples are predominated in fresh acidic rocks, rhyolite and dacite, rather than andesitic rocks. Many acidic rocks are highly vesiculated. We need to decipher it whether the vesiculated rocks are drift pumice or not. Volcanic rocks from each volcano have unique geochemical characteristic after excluding altered samples with high LOI (Yokose et al., 2008b). Most of the pumicious samples dredged during the cruises are plotted on the extrapolated area of the geochemical trends that are indicated by the lavas occurred near dredge stations and are in situ not drift pumice.

Calcifide pumices were recovered from the submarine plateau developed around Kuchino-Shima caldera, Takara-Shima caldera, and Amami caldera at ˜100 m depth. These calcified pumices suggest that the submarine plateaus did not produce as a erosional plain during the last glacial age, but submerged surfaces originated by pyroclastic flow deposits. If so, the pyroclastic eruptions may have happened during low sea levels during Quaternary.

Almost all dredged samples are very fresh compared with the rocks of Takara formation and of Nansatsu volcanic field. Highly altered volcanic rocks were confined to the submarine flanks of Takara shima and Nigori bank. Because recovered volcanic rocks are very fresh, the volcanic activity of the seamounts and cones seem very young, which have been previously proposed Miocenein age. Our observations may imply that the seamounts and cones have been established during Quaternary. K-Ar age measurements of the representative three dredged rhyolitic samples are 0.6 Ma, less than 0.3 Ma, less than 0.2 Ma.

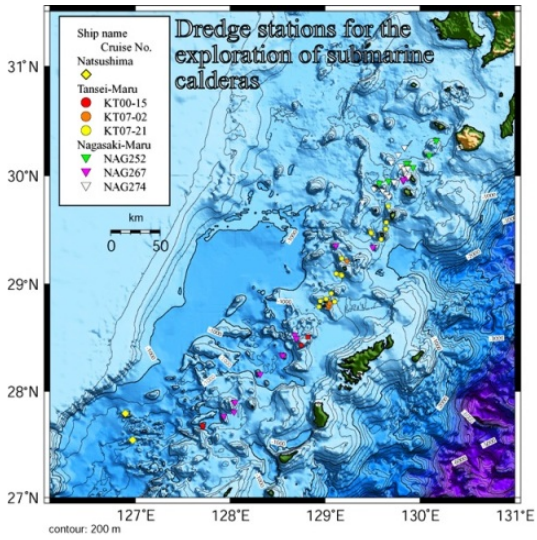
Thus Kuchino-shima caldera, Takara-shima caldera, Amami caldera, which have been deduced from the bathymetric features, could be originated from the Quaternary volcanism. The size of the calderas are equal to those of the Aira caldera categorizing a super-eruption, three more super eruptions must be added to the eruption record in the Kyushu area during Quaternary. Likewise the Tokara submarine calderas, some submarine calderas in the world may be masked by high sea level. The frequency of super eruptions must have been underestimated.

Ueda(1986) Geomagnetic anomalies around the Nansei syoto (Ryukyu Islands) and their tectonic implications. Bull. Volc. Soc. Japan. 31, 177-192.

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

Yokose et al. (2008a) Submarine calderas in the Tokara Islands 1: Geochemical characteristics of lavas from the Tokara Islands. JPGU 2008 meeting abstract, J164-P008.

Yokose et al. (2008b) Submarine calderas in the Tokara Islands 2: recovered fresh acidic rocks during the KT00-15, KT07-2, KT07-21, NAG252 cruises. JPGU 2008 meeting abstract, J164-018.


Dredge stations for the exploration of submarine calderas
Ship name
Cruise No.
Natsushima
Tansei-Maru
KT00-15
KT07-02
KT07-21
Nagasaki-Maru
NAG252
NAG267
NAG274
km
0
50
31°N
30°N
29°N
28°N
27°N
127°E
128°E
129°E
130°E
131°E
contour: 200 m