Intensive researches on Kikai submarine caldera volcano

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Kikai submarine caldera volcano to the south of the Kyushu Island, SW Japan, had at least three eruptions at 140, 95 and 7.3 ka, and its collapse occurred at 7.3 ka during the latest super-eruption in the Japanese Archipelago. Series of research cruises using the T/S Fukae-maru, R/V Shinsei-maru (KS-19-17 & KS-23-3), R/V Kairei (KR19-11 & KR20-11), R/V Kaimei (KM21-05 & KM22-01), and D/V Chikyu (Expedition 912) were conducted around Kikai caldera volcano with several research approaches to understand the melt supply system leading the super-eruption. The research approaches consist of two main parts; one is to trace the past super-eruptions and the other is to understand the current status of the volcano; 7.3 kyr has passed since the last super-eruption. I outline the series of the research cruises and review current results obtained from these cruises.

The past super-eruptions can be traced by investigating eruption products. The products from the past two super-eruptions are mapped by high-resolution seismic reflection surveys (Shimizu et al., 2020; in prep.). They presentevidence that the uppermost seismic unit was originated from a pyroclastic density current due to Kikai-Akahoyaeruption occurred at 7.3 ka. They estimate its total volume as > 71 km^3 based on the seismic profiles covering a large area around the caldera. Their interpretations of upper three seismic units were ascertained by core samples obtained at the northern part of the caldera rim during D/V Chikyu Expedition 912; three seismic reflection units are recognized as 7.3 ka Koya ignimbrite unit, sandy slit unit, and the 95 ka Nagase ignimbrite unit based on geochemical analysis of the ignimbrite and on dating of sea shells in the sandy slit unit (Nakakoka et al., 2022; Hanyu et al., 2022). Tatsuimi et al., (2018) identify a giant lava dome (~32 km^3) by multi-beam echosounder mapping and seismic reflection survey and they suggests that it was created after the caldera collapse at 7.3 ka because the dome-forming rhyolites show different chemical characteristics from those of the super-eruption. Further geochemical analyses of new rock samples suggest that the magma source of the giant lava dome probably existed since 3.9ka at depths of 2–4 km with its temperature of 922 degrees on average estimated from Fe-Ti oxide thermometry (Hamada et al., 2023).

Geophysical approaches allow us to investigate the current status of the volcano through imaging current structure and identifying current volcanic activities. Three approaches were conducted to image structure beneath the Kikai submarine caldera volcano; a seismic refraction survey, a tomographic image using earthquakes, and marine magnetotelluric (MT) experiment. 2-D P-wave velocity structure along 175 km seismic refraction survey line indicates low-velocity anomaly 2km below Kikai caldera volcano, whose size is about 25 km horizontally ×10 km vertically with its maximum velocity reduction of 1.2 km/s (20%) (Nagaya et al., this meeting). They interpret the low-velocity anomaly is due to presence of melt. Yamamoto et al. (2022) presented a preliminary result of a tomographic image using the first arrival time data of earthquakes including available 20 short-period ocean bottom seismometer (OBS) data: Their results suggest low velocity anomaly region beneath Kikai caldera in the deeper depth. Obata et al. (2023) have developed a new MT inversion method and they will present a preliminary result of 3-D resistivity structure by applying this method to 24 ocean bottom electro-magnetometer (OBEM) data. A current volcanic activity is identified as seismicity recorded by OBS and preliminary DAS observation using fiber optic cable. One example is that five OBS data identified 1100 volcanic tremor events during five months (Seto et al., 2019). Imaging current structure and identifying current volcanic activities are still underway as 12 broadband OBSs and 8 OBEMs have been just recovered during KS-23-3 cruise.

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