

# Characteristics of submarine volcanic activity revealed by the dense magnetic and gravity surveys off Kumejima Island in the Okinawa Trough

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The Okinawa Trough is an active back-arc basin formed by the rifting associated with extension of the continental margin behind the Ryukyu trench. New hydrothermal sites were recently discovered off Kumejima Island in the Mid-Okinawa Trough and the hydrothermal mineral deposits were identified by seafloor surveys and rock samplings by ROV (e.g., JOGMEC, 2015). In order to characterize the sub-seafloor structures and the spatial distribution of the submarine volcanic activity off Kumejima Island, we conducted the dense magnetic, gravity and bathymetric surveys with a line spacing of 0.5 nmi aboard the R/Vs Yokosuka and Kairei, operated by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) in 2016. The data collected during the previous cruises by JAMSTEC were additionally used for this study. Magnetic anomaly was calculated by subtracting the IGRF model and the magnetization intensity was estimated by the method of Parker and Huestis (1974). Free-air gravity anomaly was calculated with subtracting the normal gravity field and with corrections of the drift and of the Eötvös effect and Bouguer gravity anomaly was calculated based on the method of Parker (1972). The crustal thickness was estimated from the calculated Bouguer gravity anomaly. The distribution of magnetization intensity and the crustal thickness variation reveal three characteristics of submarine volcanoes off Kumejima Island: 1) The distribution of magnetization off Kumejima Island shows two different features. One is the distribution related to the submarine volcanoes. Most of the volcanoes tend to have a relatively low magnetization of  $\sim 2.5$  to  $\sim 4.5$  A/M, except the volcanoes located at the northern study area (close to the rifting axis), which show a relatively high magnetization of  $\sim 6$  A/M. The other is an ENE-WSW trending magnetization distribution with relatively high ( $\sim 6$  A/M) and low ( $\sim 3$  A/M) intensities, which is consistent with the trend of the bathymetric lineament. These two features suggest that the submarine volcanoes off the Kumejima Island appear to be affected by magmatism associated with submarine volcanic activity and back-arc rifting. 2) Three groups (VG1, VG2 and VG3) of the submarine volcanoes which have different features in crustal magnetization and thickness were identified off the Kumejima Island. The features were identified for each submarine volcano by crustal thickness and Bouguer gravity anomaly versus magnetization intensity. Two volcanoes in the VG1 have the lower crustal thickness (less than  $\sim 4$  km) with a relatively high magnetization ( $\sim 6$  A/M). VG2 has the higher crustal thickness of  $\sim 8$  km with the crustal magnetization of  $\sim 4$  to  $\sim 4.5$  A/M. The other volcanoes in the VG3 group showed a variety of crustal thickness values ( $\sim 3$  to  $\sim 6$  km) with the magnetization of less than  $\sim 4$  A/M. 3) The hydrothermal site is located on the area where the Bouguer gravity anomaly is steeply changed from  $\sim 10$  to  $\sim 30$  mGal, suggesting that the hydrothermal activity appear to be related to the crustal thickness variation ( $\sim 4$  km) associated with back-arc rifting.

Keywords: back-arc rifting, Okinawa Trough, hydrothermal activity, magnetic anomaly, gravity anomaly