Distribution of the volcanic rock around Kikai caldera submarine volcano, estimated from the geomagnetic anomalies

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Distribution of the volcanic rocks is an essential information for imaging volcanic structure. In general, the high intensity of the crustal magnetization has been observed above the volcanic rock because this type of rock holds strong thermal remanent magnetization due to the inclusion of a volume of ferromagnetic minerals. Therefore, high-resolution geomagnetic survey around Kikai caldera makes it possible to understand the distribution of the volcanic rock in this area. In order to reveal the distribution of volcanic rocks around Kikai caldera, high-resolution total geomagnetic surveys using proton and overhauser magnetometers have been conducted since 2016 with T/S *Fukae-maru*, Kobe University. The magnetometers were towed 150 m behind the ship, the total survey line length is 4558 km, the average spacing of the lines is 0.4 minutes, the average ship speed was 11 knots, and the measurement interval was 30 seconds.

After correction of the sensor’ s position, the geomagnetic anomalies were obtained by subtracting the regional IGRF12 field [Thébault et al., 2015] from the observed geomagnetic field. The distribution of the crustal magnetization was estimated from the geomagnetic anomalies using the inversion method [Parker & Huestis, 1974]. The thickness of magnetization layer was assumed as 0.5 km, and its surface geometry was assumed by using 30m gridded multibeam echo sounding data acquired with T/S *Fukae-maru* and 500m gridded bathymetry data provided by Japan Oceanographic Data Center. Magnetization direction was assumed to be parallel to the present Earth’ s magnetic field at study area, then the magnetization inclination was set to 49.89 degree of geocentric axial dipole inclination. The annihilator was also calculated and subtracted from the inversion solution.

The magnetization intensity was observed in a range from -7.6 to 6.9 A/m around Kikai caldera. The study area was divided into four areas based on the difference in magnetization intensity as follows; (1) very high intensity area: more than 2 A/m (2) high intensity area: 1 to 2 A/m, (3) dome area: in a range from -1 to 1 A/m, and (4) low intensity area: less than -1 A/m. A dome area dominated in particular above the lava dome. High intensity areas were mostly distributed between outer and inner caldera rims identified by Tatsumi et al., (2018) except for northern regions. A very high intensity area discontinuously appeared along the rims. A broad high intensity area was distributed in southwest area between the rims. In the southern region, very high and high intensity areas were widely observed outside the outer rim. While, in the northern region, a noticeable low intensity area was observed between Take-shima and Satsuma-Iwo-jima.

The free-air gravity data and multi-channel seismic reflection (MCS) data were also used for estimation of the distribution of the volcanic rocks. The distribution of the intensity of the crustal magnetization well consist with the depth of the basement rock inferred from MCS data obtained at Kikai caldera. The very high and high intensity areas between the rims describes the double caldera structure. Very high intensity areas represent the exposure of the basement rock. The low intensity area, as well as the discontinuity of the very high intensity areas, are possibly caused by the difference in the basement depth and/or the regional collapse of volcanic rim. The regional collapse which elongates to east-southeast from inner to outer rims is also implied by the gravity data. At the southwest area between the rims, broad and gradually variable magnetization represents the lateral broad structure such as the lava flow. In southern region, the very high intensity area corresponds to the position of the gravity high area, indicating the exposure of the basement rock.

Keywords: Kikai caldera, magnetic anomaly, distribution of the crustal magnetization intensity