Demagnetized zone of Kuchierabujima Volcano inferred from the geomagnetic total intensity variation

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Kuchierabujima is a volcanic island located about 15 km west of Yakushima Island, about 100 km south of Kyushu, Japan. Phreatic eruptions had been repeatedly occurred at intervals of several to a few tens years around Shindake crater of the volcano since the oldest historic eruption in 1841. Although eruptive activity ceased after the latest fissure eruption in 1980, swarms were observed in 1996 and in 1999 just beneath the crater, which worried that the volcanic activity would reactivate in the near future. We installed three overhauser magnetometers at the summit area and the geomagnetic total intensities have been recording at 5 minutes intervals since August 2000 (Kanda et al., 2001). The objective of this study is to detect the heat supply, which is high temperature enough to reduce magnetization of rocks, to a preparation area of phreatic explosion.

Geomagnetic total intensities observed at two sites located south of the recent active crater have shown decreasing tendency since the spring season in 2001, however they were not clearly recognized with a simple site difference technique. In general, the geomagnetic total intensity observed in the volcanic circumstances involves variations of various origins, so that we have to extract volcanomagnetic one among others by precise estimation of those. A time series model including a trend component, a periodic component, an external magnetic field response, and a white noise was considered and separated to each component with a Kalman filter algorithm (Fujii and Kanda, 2003). Three components geomagnetic fields recorded at Kanoya geomagnetic observatory (JMA) were used as the reference data for the estimation of the geomagnetic field variation of external origin.

The application of the method revealed that decrease of the total intensity begun in May 2001 at a site (C1) just south of Shindake crater, subsequently at other site (B1) located about 1km south of Shindake, and increase was observed at the remainder (A1) located just north of the crater. After these changes ceased in October 2001, the total intensity at C1 resumed decreasing in March 2002 and the total amount of the change has reached about 8 nT. If the observed changes result from variation in the subsurface thermal state, the mechanism should be thermal demagnetization of rocks. The demagnetized zone was roughly estimated by an equivalent magnetic dipole and inferred at a depth of 700 m just beneath the crater. This source location corresponds to an aseismic zone between an inflation source inferred from the GPS data and a focal area of the high frequency earthquakes (Iguchi et al., 2002). High frequency earthquakes occur just beneath the western rim of the crater where thermal anomaly was observed (Iguchi and Kagiyama, 2002). In addition, fumaroles were recognized at the crater bottom in February 2003 for the first time since the start of the observation. Those evidences strongly suggest that the thermal energy has been supplied to the preparation zone of the next phreatic explosion just beneath the Shindake active crater.