# 2000年三宅島噴火における傾斜ステップに伴う地磁気変化の再検討(序報)

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# Magnetic changes accompanying the tilt-step events during the 2000 eruption of Miyake-jima volcano

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The 2000 activity of Miyake-jima volcano, central Japan, began with magma intrusion, followed by the depression of the summit area along with some episodic eruptions from the new sink-hole. The sink-hole enlarged to form a new caldera. During the caldera formation, a rapid crustal deformation called 'tilt-step' occurred once or twice a day, which was detected by bore-hole tiltmeters in Miyake-jima island (Ukawa et al., 2000): it is characterized by abrupt uplift toward the summit area followed by gradual subsidence with more than several hours duration. Electric and magnetic field variations associated with the tilt-step events were observed by the island-wide SP observation network using telephone cables and by proton magnetometers array (Sasai et al., 2002). As for the mechanical source for the tilt-step, they assumed the sudden inflation of a spherical pressure source (Mogi model), i.e. the magma chamber, and ascribed the SP variations to the electrokinetic effect due to the forced fluid injection from the magma chamber. They also ascribed the magnetic variations to the piezomagnetic effect due to stress changes associated with the inflation of the magma chamber.

However, the forced fluid injection model was rejected recently by Kuwano et al. (2015), in which they concluded that the uniform expansion source could not explain the spatial sign distribution of SP changes. They proposed the poroelastic electrokinetic model, which could reproduce the observed SP variations accompanying the fluid flow induced by sudden appearance of the mechanical pressure source. They adopted a vertical tensile crack for the mechanical source, which was originally proposed by Kumagai et al. (2001) with the aid of the moment tensor inversion for the velocity wave form of tilt-step events. Sasai et al. (2002) proposed the Mogi model as the source for magnetic variations associated with tilt-step events. Currenti et al. (2005) obtained the best-fit source parameters of the piezo-magnetic Mogi model using a genetic algorithm technique.

Moreover, new data for magnetic variations are provided by courtesy of NIED (National Research Institute for Earth Science and Disaster Resilience, Tsukuba, Japan). Fig. 1 shows the location of proton magnetometers (ERI) and 3-components magnetometers (NIED) in Miyake-jima island. TMF (total magnetic field) changes associated with tilt-step events were observed at several points, which are reproduced in Fig. 2 (Sasai et al., 2002). The 3-component magnetometers (NIED) were installed at two sites, MKK and MKT, which are also shown in Fig. 1. The sampling interval of the 3-component magnetometers is 1 second (GPS-controlled) in contrast to 1 minute for proton magnetometers.

The largest tilt-step event took place on July 14, 2000. Fig. 3 shows X (north), Y (east) and Z (down) component magnetic changes observed at MKT and MKK, which are subtracted from simultaneous data at Kakioka (KAK). Two blue-colored bars in each component indicate the duration of the VLP (Very-Long-Period) seismic wave, during which the tilt-step event occurred (Ukawa et al., 2000). The electric field accompanies the fluid flow induced by an abrupt deformation of the volcano (Kuwano et al., 2015), which can produce the magnetic field by the piezomagnetic effect. Now we are to examine if the mechanical source for the tilt-step can explain the observed magnetic variations. New 3-component magnetic data should strongly constrain the mechanical source parameters. According to Kumagai et al. (2001), the first-order approximation to the source was a vertical tensile crack. It can be regarded as a far-field solution for the magma plumbing system. Further studies will be required on the piezomagnetic field due to an ellipsoidal source.

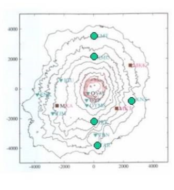

Fig. 1. Observation sites. Blue circle: F. Red square: 3 comp.

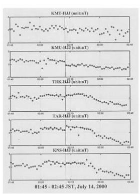

Fig. 2. TMF changes at the tilt-step event on July 14, 2000. Minutely plot.

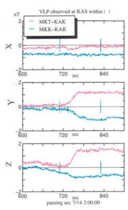

Fig. 3. 3 comp data at MKK (NE: Blue) and MKT (SE: Red).