On thermal demagnetization before the 2011 summit eruption of Mt. Shinmoe-dake, the Kirishima volcano group, in S Kyushu, SW Japan

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The Kirishima volcano group is located in the southern part of the Kyushu Island, SW Japan, and is composed of many Quaternary andesitic strato-volcanoes occupying about 600 km^2. Among more than 20 volcanoes in the Kirishima volcano group, Mt. Shinmoe-dake (SM) is one of the recently most active volcanoes and historical records tell that phreatic to magmatic eruptions with large amount of volcanic ash and pumice emission repeatedly took place at SM. Since moderate volcanic activities in 1991-1992, we have performed continuous monitoring of geomagnetic total intensities at several sites in the vicinity of the SM crater, aiming at detecting temporal variation due to thermal magnetic effect or piezo-magnetic effect before and during the main eruptions.

At the SM crater, a weak summit eruption occurred in 22th, Aug., 2008. Since then, 6 weak eruptions took place in 2010, and intense magmatic activities including generation of lava dome and explosive summit eruptions started from 26th Jan., 2011. Just before the main eruption in 2011, we measured geomagnetic total intensity at three sites (SMN, SMW and SMS) just near the SM crator. After making simple difference data by using data at Kanoya geomagnetic observatory, JMA, as a reference, we eliminated gaps and annual variations from the difference data. Then we detected 2 nT increase at SMN (north of SM), 4 nT increase at SMW (west of SM) and 0.7 nT decrease at SMS (south of SM) from Jan. 2010 to the main eruption in Jan. 2011.

Considering spatial distribution of the total force temporal variation, demagnetization source location and its size were estimated by grid search with 50 m grid spacing. Two candidate locations were derived which almost equally explain the total intensity variations. One is at the WSW flank of SM and its depth and diameter are about 300 m below sea level and about 1km, respectively. The other is just at NW rim of the SM cone and its depth and diameter are about 1100 m above sea level and about 200 m, respectively. In this estimation, magnetization is assumed as 1.5 A/m, which is estimated from unmanned helicopter survey (Ohminato et al., 2013).

In almost the same duration from Jan. 2010 to Jan. 2011, ground extension was detected by the GPS array observations (e.g. Morita et al., 2013) and its Mogi-type inflation source location and depth were determined at about 5km NW of SM and about 10km below sea level. They interpreted that the inflation was due to charging of magma and the interpretation was confirmed by sudden shrink of the source at almost the same location coincident with the main summit eruption. Thus the demagnetization must be due to fluid or gas migration from the deep and somewhat deep magma chamber to the locations near the SM summit.