Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SVC48-P19 Room:Convention Hall Time:May 19 18:15-19:30

Estimation of magma chamber related to the 2011 eruption of Shinmoedake volcano, Japan

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The estimation of location and geometry of a magma chamber is essential for understanding characteristics of volcanic activities including possible aspects for the future. Previous studies show that t here is a strong relationship between the movement of magma and the surface displacement (Dzurisin, 2006). Basically, when magma injection into the magma chamber causes the pressure increase at the depth, corresponding surface bulge can be observed. The surface area sinks as magma removes from the chamber. In this study, we analyzed GPS data and estimated the magma chamber related to the 2011 eruption at Shinmoedake volcano of the Kirishima volcano group in southwest Japan.

Shinmoedake volcano is one of the most active volcanoes in Japan and started to erupt in January 2011 after long-lasting earthquake swarms which occurred directly beneath the volcano. Prior to the eruption, an extending trend in displacement was observed between Ebino and Makizono from September 2010. After several explosions in February 2011, small-scale eruptions occurred intermittently till September 2011. (JMA report, 2011) There was no eruption in 2012, although the seismic activities continued. (JMA report, 2012)

The data used in this study were GEONET GPS displacement data provided by Geospatial Information Authority of Japan (GSI) from 2003 to 2012 around Shimoedake volcano. The GEONET is a permanent observation station network established for crustal deformation observations. These stations were installed with spacing of approximately 25-30km. In this study, we mainly used nine observation points around Shinmoedake volcano for our analyses. In addition to that, we included southern points from the volcano in order to evaluate ground deformation signals from Sakurajima volcano, which is another active volcano located about 40 km southwest of Shinmoedake volcano. We divided 2003-2012 into five separate terms so as to examine the variations of displacements and calculated possible magma chamber models for each term. The results showed that displacement changes may be explained by a combination of a spherical pressure source and a tensile fault with northwest trend.