Ground deformation of Izu-Oshima volcano in magma accumulation period

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Izu-Oshima is one of the most active volcanoes in Japan. Although no eruptions occurred after the latest eruptions in 1986-87, an inflation of volcanic edifice has continued over 20 years since the latest eruptions, suggesting magma accumulation so as to prepare for future eruptions. Meteorological Research Institute, JMA started GPS observations in 1998, in order to monitor subsurface magmatic activities and to reveal a magma plumbing system of the volcano. The long-term more than ten years and high dens ground deformation observations by GPS revealed shorter-term deflation - inflation events having periods of about one to two years overlie on the quasi-continuous long-term inflation.

The areal and principal strains obtained from GPS baseline analyses during the short-term deformations approximately show isotropic patterns and indicate that sources locate beneath the northern part of the caldera for both deflations and inflations. Because of the isotropic patterns, we estimated source parameters of single Mogi model for three deflations and two inflation events occurred from 2009 to 2012. Both the deflation and inflation sources are located at depths from 3.7 to 5.1 km b.s.l., when three-components of the relative displacement data are used. The volumetric change of each deflation and inflation reaches of the order of million cubic-meters. However, a cumulative volumetric change due to the short-term deformations from 2009 to 2012 is trivial, because repetition of the deflation and inflation processes cancels out the net volumetric change. Therefore, it can be thought that magma accumulation associating the short-term deformations does not much contribute to the amount of mass increase. Deflations without any magma extrusions may be due to sinking of subsurface magma to deeper region or to degassing of volatile contents from magma, although we do not have substantial supporting evidence.

Preliminary analysis adopting single Mogi model for the quasi-continuous long-term inflation was performed, though there still exist residuals of observed relative displacements from calculated ones so as that the source model should be improved. The result shows that the deformation source locates below the northern part of the caldera as ones of short-term deformations, while a depth is 6.7 km b.s.l., slightly deeper than the short-term ones. Mass increase rate is estimated as to be 7.1×10^6 ton/year, which is about five times and twice greater than averaged mass eruption rates of last 140 and 1,500 years, respectively. This may indicate importance of evaluation of intrusion rate to understand the magma mass budget.