Comparison between ground deformation events at Sakurajima from January to June 2015 and on August 15, 2015

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We applied some source models to the ground deformations in different stages of volcanic activity of Sakurajima to make clear style and process of magma intrusion.
One is slow ground inflation with highly eruptive activity at the Showa crater during the period from January to June 2015 (first-half 2015 event). This event is similar to that during the period from October 2011 to March 2012 (2011 event). A pressure source analysis based on Mogi model (Mogi, 1958, BERI) during the 2011 event revealed inflation sources to be located at a depth of 9.6 km below sea level beneath the Aira caldera and 3.3 km below sea level beneath Kita-dake, and a deflation source is located at a depth of 0.7 km below sea level beneath Minami-dake (Hotta et al., 2016, JVGR). The characteristics of ground deformation during the first-half 2015 event is similar to that of the 2011 event, and inflation sources beneath Aira caldera and Kita-dake and a deflation source beneath Minami-dake are considered.
The other is much rapider and larger ground deformation on August 15, 2015, when eruptive activity was decreasing from July 2015 (August 2015 event). The pattern of horizontal displacement during the period from August 14 to 16, 2015 shows a WNW-ESE extension, which suggests a tensile fault. A nearly vertical dike with a strike of NNE-SSW is obtained at a depth of 1.0 km below sea level beneath Minami-dake. The length and width are 2.3 km and 0.6 km, respectively. The opening 1.97 m yields its volume increase +2.7 million cubic meters (Hotta et al., under revision, EPS).
Associated with the August 2015 event, 887 volcano-tectonic (VT) earthquakes occurred beside the dike, differently from the first-half 2015 event while only 63 VT earthquakes occurred for the 6 months. Half of the total amount of deformation of the August 2015 event was concentrated from 10:27 to 11:54. It is estimated that the intrusion rate of magma was 1 million cubic meters per hour during the period. This rate is 200 times larger than that of magma intrusion rate beneath Minami-dake prior to the vulcanian eruption on July 24, 2012 (5 thousand cubic meters per hour; Iguchi, 2013, Study on volcanic eruption process by multi-parameter observation at Sakurajima). The quite rapid intrusion rate caused extremely high-rate accumulation of strain in surrounding rocks, and this forced significant increase in seismicity. The first-half 2015 event is considered to be a process of magma accumulation and migration among the pre-existing spherical reservoirs, similarly to the previous activities such as the 2011 event. Conversely, the August 2015 event is dike-creating event at a different place from the pre-existing reservoir beneath the Showa crater, and magma stopped at a shallow depth of 1.0 km. The direction of the opening of the dike coincides with the T-axes of the VT earthquakes at the SW flank and is influenced by tectonic stress around the Sakurajima volcano. The VT earthquakes at the SW flank during the periods of 1976–1978 and 2003–2004 are inferred to be the magma pass from southwestern part of Sakurajima (Kamo, 1989, Proceedings of Kagoshima International Conference on Volcanoes) and vertical tensile crack that across Sakurajima from NE to SW (Hidayati et al., 2007, BVSJ), respectively. The first-half 2015 event was accompanied by the VT earthquakes at the SW flank during the period from March 31 to early April, 2015, similarly to 1976–1978 and 2003–2004. Magma might migrate beneath the dike intruded on the August 2015 event along the magma pass from southwestern part of Sakurajima or along vertical tensile crack that across Sakurajima from NE to SW accompany with the swarm of VT earthquakes at the southwestern part of Sakurajima in the first-half 2015 event.

Keywords: Sakurajima volcano, ground deformation, geodetic data, VT earthquake

