

Earthquake Swarm Activity at Sakurajima Volcano on August 15, 2015

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Explosive eruptions of vulcanian type have occurred at the summit crater Minamidake at Sakurajima volcano, Japan, since 1955. Principal eruptive activity shifted to the Showa crater at the eastern flank of the summit in 2006. The eruptions at the Showa crater were phreatic in 2006-2007 and vulcanian eruptions started from 2008. Minor vulcanian eruptions occurred about 500-1,000 times per year in 2010-2014. The eruptions occurred about 100 times every month until June in 2015. However, the eruptive activity gradually decreased from July. Active earthquake swarm and rapid ground deformation occurred on August 15, 2015 after decrease of the eruptive activity from July. In this study, we research temporary change of the earthquake activity, hypocenter distribution, source mechanism, and relationship the earthquake swarm between the rapid ground deformation.

The earthquake swarm are almost VT (Volcano-Tectonic) earthquake type, reached to 887 events on August 15. This swarm was obvious abnormal activity because the VT earthquakes occurred at most 40 events per month in Sakurajima. Location of hypocenters are calculated by using arrival times of P-wave first motion (more than 12 stations) and S-wave (more than 6 stations) assuming homogeneous half-space $V_p=2.5\text{km/s}$ and $V_p/V_s=1.73$. Hypocenters are located beneath active craters Minamidake and Showa at depths 1.5 to 3.5 km. Source mechanisms determined using polarities of the first motions are normal fault (shallower than 2km) and strike slip types (deeper than 2km). The hypocenter location and source mechanism are similar pattern to general VT earthquake activities of the Sakurajima volcano (Hidayati et al., 2007, Bull. Volcanol. Soc. Japan).

Rapid and large ground deformation was also observed on August 15 accompanied with the earthquake swarm. Pattern of horizontal displacement showed extension to WNW-ESE, which suggested open of tensile crack by magma intrusion. A nearly vertical dike with strike of NNE-SSW was obtained at a depth of 1.0km beneath the Minamidake. Length and width of the dike were 2.3km and 0.6km, respectively. The dike opening was about 2m and its volume increased 2.7 million cubic meter (Hotta et al., submit to EPS).

The hypocenters of the VT earthquakes are close to opening of the dike estimated from ground deformation data. The earthquake swarm started at 07:05. Then, larger earthquake (M1.5 and M1.7) and the largest earthquake (M2.3) occurred at 09:03 and 10:47, respectively. The seismicity was increase during after the largest earthquake to before 12 a.m. The ground deformation was clear from 8 a.m. and inflation rate increased from 9 a.m. Half of the total amount of the inflation was going on 10:27 to 11:54 of the same time as the active seismicity. The inflation rate changed to decrease after 11:54. Two large low-frequency earthquakes (LF events) occurred at 11:32 and 11:43 before the change of inflation rate at 11:54. The decrease of the inflation rate may be related to the occurrence of the LF events. First motions of the LF events were compression (up and away from the summit crater in the vertical and radial components, respectively) at the all stations. We determined the source mechanism of the LF events by waveform inversion. The LF events were generated by isotropic expansion at the depth of 1.0km beneath the Minamidake crater. The hypocenter location and the first motions of the LF events were similar to those of explosion earthquakes accompanied with explosive eruptions from the Showa and Minamidake craters. However, the LF events are not accompanied with eruptions from the active craters. It is thought that the LF events were probably generated in closing magma system.

Keywords: Sakurajima Volcano, Earthquake Swarm