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Review of Volcano Science at Mt. Asama volcano

- Magma supply path beneath Mt. Asama and resemblance of seismic activities and density profiles between before and after the 2004 eruption -

M. Takeo[1]

[1]Earthquake Research Institute, the University of Tokyo, Japan

Mt. Asama, which is one of the most active volcanoes in Japan, is an andesitic volcano located in the center of the country. The summit elevation is 2560m above sea level, and the size of the active summit crater is 450m in diameter and 150m in depth. To the west of Mt. Asama, there is a row of older Quaternary volcanoes collectively known as Eboshi Volcanoes. The volcanism near Mt. Asama appears to have progressed eastward, with Asama volcano as its eastern end and the youngest member of the row.

At 11:02 (GMT) on 1 September 2004, a moderate-sized eruption occurred for the first time in the last 21 years. From 14-18 September, a continuous stromblian explosion emitted volcanic ash that reached as far as the Tokyo metropolitan area about 130 km away. The volcanic activity seemed to have subsided thereafter, except for moderate-sized eruptions occurring on 23 September, 29 September, and 10 October, and some small-scale eruptions afterwards which became smaller and smaller with time. The last moderate-sized eruption occurred on 14 November, and since then no eruption has occurred up to the end of 2007.

Obtaining a sharp image of magma supply path through dense geophysical observations is important for forecasting time and magnitude of hazardous future eruptions. Here we reveal a clear magma plumbing system using dense seismic and geodetic networks around Mt. Asama, central Japan. Magma intrusions occurred several times beneath the western flank of Mt. Asama, forming a WNW-ESE directed zone with 1 km below sea level. The eastern end of this zone connects a narrow vertical pathway extending right under the summit crater, which erupted in 2004.

Before the eruption, long-period volcanic earthquakes were observed with two broadband seismographs located at the summit of Mt. Asama since October 17, 2003. The signals are so feeble that we can hardly recognize them even at the second nearest station from the summit crater, having very singular waveforms like impulsive waves. Based on the particle motions, the source of these singular long-period earthquakes were located relatively shallow at a depth of a few hundreds meters, just beneath the summit crater. The activity of these events had been synchronized with the activity of

volcanic earthquakes until the last ten days of July 2004. However, the activity had dropped gradually, and no event had been occurred after the eruption [Yamamoto et al. (2005)]. The two summit broadband stations were broken by the first eruption, therefore we have not determined whether the singular long-period earthquakes have recurred after the cessation of volcanic activity at Mt. Asama.

In November 2007, we rebuilt an integrated observation station at the eastern rim of the summit crater, and developed other two broadband seismic stations at eastern and southeastern sides of Kamayama (the summit crater cone). A commercial power source (AC100V/10A) is available at the summit integrated observation station, which has enough space to install several kinds of observation equipments. An optical fiber cable with 4 lines is installed between the summit station and Asama volcano observatory, assuring high-speed high-capacity data transmission. The other two broadband seismic stations also have commercial power sources and optical fiber cables with 2 lines. In order to improve the sensitivity of the seismic network at Mt. Asama, we have deployed other two broadband seismic stations in the western region of Mt. Asama. These two stations are linked up with Kurofu wireless LAN relay station, which covers wireless LAN connection in the western summit region of Mt. Asama.

Since the deployment of the summit seismic network, we have observed a lot of singular long-period earthquakes, whose waveforms are quite similar to the singular events observed before the 2004 eruption. However, the amplitudes of the previous earthquakes are several times larger than those of the recent earthquakes. The particle motions of the three summit stations suggest that these recent singular earthquakes also occur just beneath the summit crater.

Tanaka et al. [2007] installed an emulsion cloud chamber for the detection of horizontal incoming cosmic-ray muons at Maekake station (height: 2256 m) to survey the inhomogeneous structure of the shallow part of vent. Their result reveals that there is a low-density region at the shallowest portion in the vent (height: around 2300 m) covering by a high-density region at the bottom of the summit crater that corresponds to a lava mound created during the last eruption. Before the 2004 eruption, Tanaka et al. [2003] performed another cosmic-ray muons observation at Mt. Asama. The spatial resolution of this observation is about 300 m, therefore it is difficult to detect a density profile in the vent without an assumption about a size of vent. We reanalyze the previous data assuming that the radius of the shallowest part of vent is 75 m, which is estimated from the result of Tanaka et al. [2007]. The reanalyzed result suggests an existence of low-density region in the vent around 2200 meter above sea level. These

results clearly represent the resemblance of the seismic activities and the density profiles in the shallowest portion of vent at Mt. Asama between before and after the 2004 eruptions. This resemblance indicates anew that a clarification of an internal state of the shallow part of vent is quite important to reveal an eruption process and advance a prediction of eruption.

References

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