

Various volcanic crustal deformations in recent years, Part 2

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Japan Meteorological Agency (JMA) are announcing Volcanic Alert Levels for 26 active volcanoes for disaster prevention on the basis of the volcanic activity scenario made referring to the history and the characteristics of each volcano. However, the volcanic activity scenario depends on the experience rule from the past eruptive history, so the criteria of the decision of the Volcanic Alert Level mainly consist of visual phenomena and seismological activities and less of geodetic information.

JMA detected small tilt change just before the eruption of Asama volcano on 2 February 2009 and issued a Volcanic Alert. This fact showed importance of geodetic observation for the evaluation of volcanic activity. However, there is less geodetic information on the past activity for most volcanoes, so we are investigating volcanic ground deformation models found at various volcanoes in recent years and doing efforts to find some systematic characteristics in order to make some general criteria for the watch of the volcanoes (Yamasato and Miyamura, 2009).

There is wide variety in the volumetric changes estimated from geodetic observation; from large amount magma intrusion of 10^9m^3 as Niijima-Kozu region (Yamaoka et al., 2005) to very small inflation of less than 10^4m^3 at Adataru (Yamamoto et al., 2008). We found that the volume change rate is correlative with the seismic activity around the source. On the other hand, small and slow inflation at shallow area sometimes precede

phreatic eruptions or some other visual thermal phenomena and they are considered to be originated from hydrothermal system.

Magma intrusion of more than $10^6\text{m}^3/\text{day}$ is accompanied with vigorous seismic swarm and wide ground deformation, therefore, such events must be detected by geodetic and seismological networks around Japan. There seen to be more possibility in the case of magma intrusion in more shallow part. It is important to watch seismic activity, especially migration of hypocenters in this case.

On the other hand, the slow ground deformations were detected only by geodetic observation near the active crater and there were no sign in the seismic activity in some cases. As the change is very small and slow, it is difficult to identify the timing of eruption, therefore, it is important to watch more carefully seismic activity or other phenomena.

JMA is developing new volcano observation system with borehole seismographs and tiltmeters for 47 volcanoes with the supplementary budget. The capability of detection of volcanic earthquakes, especially identification of their depths, detection of slow and / or small ground deformation from volcanic activity is expected to rise greatly.

Keywords: ground deformation, volcano monitoring, seismicity