Characteristics of shallow volcanic earthquakes beneath the summit of Unzen Volcano

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Unzen Volcano is located in the central part of the Shimabara peninsula, western Kyushu, Japan. The last eruption took place in 1990-1995, and a lava dome complex was formed during the eruption. High level seismicity was observed before and during the eruption. In particular, isolated tremor occurred in the volcanic edifice above sea level preceding the lava dome emergence (Shimizu et al., 1992). Predominant frequencies of the isolated tremor’ s waveforms were comparatively low (2 - 4 Hz) and the duration was long (30 - 180 s). Moreover, extremely-shallow earthquakes occurred beneath the growing lava dome. Unzen Volcano has been in dormancy since the end of the 1990-1995 eruption. However, shallow volcanic earthquakes have been observed below the summit since 2010, and the hypocenters are determined by Japan Meteorological Agency (JMA) and Institute of Seismology and Volcanology, Kyushu University (SEVO). In order to reveal the generation mechanism of these earthquakes, we investigated the characteristics of the hypocenters and wave forms.

First, we relocated the hypocenters of these earthquakes from Jan. 1 to Sep. 7 2018. The relocated hypocenters are distributed beneath the lava dome and Mt. Fugen, and they are classified into 3 groups. Focal depths of Group 2 and 3 are located 1km and 2km below sea level under Mt. Fugen, while Group 1 (three earthquakes in this period) locates above sea level beneath the lava dome. The first motions of P-waves for Group 1 are all “down” in this study, and the duration times are longer than those of Group 2 and 3.

Next, we calculated particle motions of these earthquakes using relocated hypocenters. The result indicates that the earthquakes of Group 2 and 3 have clear P and S phases, which are similar to tectonic earthquakes. On the other hand, no obvious S phase is recognized in the seismograms of Group 1.

Spectral analysis shows that the seismograms of Group 1 are lacking in high frequency components and the low frequency (2 - 5 Hz) is dominant compared with Group 2 and 3.

We will discuss candidates for the source mechanism of these earthquakes based on the results of wave form analyses.

Keywords: Unzen, volcanic earthquake, particle motion, spectral analysis

