

Spectral Ratio Analysis of Explosion Earthquakes at Sakurajima Volcano

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Sakurajima volcano has been quite active, and hundreds of small explosions of vulcanian type occur every year, throwing ash to heights of up to a few kilometers above the mountain. Sakurajima volcano generates many explosions with various sizes, but we still have not well understood what physical parameters control the magnitude of explosion. In the present study, therefore, we investigate the source characteristic of explosion earthquakes that are associated with vulcanian explosions at Sakurajima volcano.

We analyze explosion earthquake waveform that are recorded by JMA for the two years from 2012 to 2013. The seismogram are recorded by short period seismometers with a natural frequency of 1 Hz and a sampling frequency of 100 Hz. We analyze Up-Down (U) component at SRB station which is located at a distance about 2 km from the active crater (Showa crater).

We reduce the site effect and propagation effect in the observed seismogram by using spectral ratio method to retrieve the source characteristic of explosion earthquake. We classify the explosion earthquake waveform by using RMS amplitude into 4 classes. The RMS amplitude is calculated for about 400 s from the onset of the earthquake. The RMS amplitude ranges up to 470×10^{-3} nm, and we divide the explosion earthquakes into class I (0 nm - 30×10^{-3} nm), class II (30×10^{-3} nm - 60×10^{-3} nm), class III (60×10^{-3} nm - 90×10^{-3} nm) and class IV (90×10^{-3} nm - 150×10^{-3} nm). We calculate the spectral ratios of class II, III and IV to the smallest class (I). We calculate the spectral ratios by setting a time window every 10 sec from the onset to coda wave.

The obtained spectrum amplitude ratio can be described by a flat level at low frequency range (0 Hz - 1 Hz) and that at high frequency range (4.5 Hz - 10 Hz). The spectrum amplitude ratio gradually decreases in the intermediate frequency range (1 Hz - 4.5 Hz). The corner frequencies at 1 Hz - 4.5 Hz does not change significant (change slightly) for the ratio of classes II, III and IV. Analysis of direct waves that begins from the onset for 10 sec show the following characteristics: Ratios at low frequency range for classes III and IV are about 1.6 and 3 times larger than that for class II, while ratios at high frequency range for class III and IV are about 1.3 and 2 times larger than that for class II. Analysis of coda waves that begins 50 sec from the onset show the following characteristics: Ratios at low frequency range for classes III and IV are about 1.4 and 1.9 times larger than for class II. On the other hand, ratios at high frequency range for class III and IV are about 1.06 and 1.1 times larger than that for class II. The ratios for coda waves are slightly smaller than those for direct waves, which implies differences in the source processes between the initial explosion and following continuous ash emissions.

Keywords: Spectral Ratio Analysis, Sakurajima Volcano, Explosion Earthquake