

# Seismic analyses of Vulcanian eruption at Sakurajima volcano: Spectral ratio analyses of explosion and Volcano-tectonic earthquakes

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Spectra ratios of direct and coda waves between large and small earthquake represent the differences of source time function, and have been used to evaluate the corner frequencies and magnitudes of tectonic earthquakes. We applied the spectral ratio method to explosion earthquakes observed at Sakurajima volcano, and found the spectral ratio changes with the lapse time. We inferred that the seismic waves of explosion earthquakes are generated mainly by initial rapid pressure release in the conduit but also by successive oscillations of the magma system during continuous ash emission. This observation is contrary to the results of tectonic earthquakes in many previous papers which show almost same spectral ratio between the direct and coda waves. In the present study, we further apply the spectral ratio method to the volcano tectonic earthquakes (VTs) observed at Sakurajima to examine whether or not the characteristics of explosion earthquakes represent the source process and are not affected by volcanic structures.

We analyze VTs occurring during a significant swarm in August 2015. The seismograms recorded at three JMA stations located at distances about 3 km away from the active crater (Showa crater) are used. We pick up the VT waveforms that are not disturbed by other event, and select the waveforms from large events. Then, we classify them into 2 classes according to their maximum amplitudes: the amplitudes of class I are ranging from  $2 \times 10^4$  –  $6 \times 10^4$  nm/s and those of class II are ranging from  $8 \times 10^4$  –  $11 \times 10^4$  nm/s. Then, we calculate spectral amplitude ratios of large event (class II) to the small event (class I) by setting a time windows of about 5 s for the S- direct wave and coda waves at a lapse time of 5-10 s. The results show that the amplitude ratios of VTs are similar to each other between direct and coda waves. This is well consistent with the results of previous studies that analyzes tectonic earthquakes. However, VTs during the August 2015 swarm are not large enough to analyze later coda with lapse times of > 20s when the explosion earthquakes show different spectral ratios. We will analyze large tectonic earthquakes occurring around Sakurajima volcano, which generate long coda waves, to examine whether or not volcanic heterogeneous structure affect the spectral ratios.

Keywords: Spectral ratio method, VT earthquake, Explosion earthquake, Sakurajima volcano