Topography Effect on Spectral Ratio Analysis of Explosion Earthquakes at Sakurajima Volcano

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Spectral ratio method is often used for examining the source spectrum characteristics of tectonic earthquakes, but we applied the spectral ratio method to explosion earthquakes at Sakurajima volcano. The spectral ratio of larger explosion earthquakes are about 3 times higher than those of small explosion earthquakes at about 1-3 Hz, and there is no significant changes in corner frequencies. The spectral ratios further change with lapse time, which may represent the source time function difference between the initial explosion and continuous ash emission. These results are not recognized in the tectonic earthquakes. To understand the origins of the characteristics in the observed spectral ratios of explosion earthquakes, we examine the topography effect of Sakurajima volcano by using numerically simulated explosion earthquakes.

We calculate explosion earthquake waveforms by using OpenSWPC (Meada et al, 2017). We input the ground surface topography data from GSI with a resolution of 10 m and bathymetry data from JODC with a resolution of 500 m. We set a 12 km x 12 km x 9 km grids around the center of coordinate at Showa crater. A vertical single force is exerted to generate explosion earthquakes, which has a source duration T_R of 0.5 s and a unit force. A homogeneous medium with Vp of 2.5 km/s, Vs of 1.3 km/s, density ρ of 2.0 g/cm^3, Qp of 100 and Qs of 70 is assumed. We simulate the explosion earthquake waveforms for different source depths from 0.2 km beneath the summit of Showa crater down to 1 km from the sea level every 0.1 km. The simulated 3-components seismograms are obtained at the three stations (SKRB, SKRC and SKRD), which are located about 3 km away from the active crater (Showa crater). Then, we calculate spectral ratio of the waveforms calculated for shallow depths to the deepest one (1 km from the sea level). The results show the following characteristics: Spectral ratios at shallower depths are larger than those at deeper ones: The spectral ratio of 0.2 km depth from the summit is about 2 times larger than that of 0.6 km below the sea level in the frequency range of about 1-5 Hz. These characteristics are roughly the same as the observed features. These results suggest that the topography of volcano affect the spectral ratios of explosion earthquakes occurring at shallow depths.

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