

# A study on spatio-temporal characteristics of volcanic tremor during the 2011 Kirishima eruption by seismic wave analysis

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# Abstract

Volcanic tremors are considered as oscillations occurred in magma supply system and provide us important information about condition of the system from magma chamber to crater through a conduit. Therefore, it is important to investigate locations of their source and their characteristics for understanding the condition and process of volcanic activity and modeling the magma supply system. In this study, we reveal features of volcanic tremor using seismic data at Kirishima volcano.

An array observation help us to get information of incident waves on the stations. The two array seismic observations were carried out around Shinmoe-dake during the 2011 Kirishima eruption. One consisted of 25 seismometers located 3 km southwest of the Shinmoe-dake crater (Matsumoto et al., 2013), and the other consisted of 16 seismometers located 5 km northeast of the crater (Nakamichi et al., 2013). The combining data from two arrays enable us to determine the tremor sources. Moreover, we estimated mechanism of the tremor source by using waveforms recorded at temporal seismic station in Kirishima volcanic area and tremor sources obtained by array analysis.

This study focus on the volcanic tremor which occurred on February 2, 2011, and its duration was about 40 minutes. Peak frequencies of the tremor were about 1, 2, 3, and 4 Hz. We investigated temporal variation in the source location of the tremor from the slowness and azimuth of incident wave by MUSIC method. we found that most part of the tremor were radiated around Shinmoe-dake crater. In this part, the tremor that had

large slowness and relatively long duration was located in shallow region beneath the crater. In contrast, at some parts of the tremor, source location for waves with short duration were near Ohnami pond, 3.3 km northeast of the crater. Based on amplitude analysis for the seismogram recorded by the seismic network, we also found out difference in radiation patterns of the volcanic tremor among the tremor sources. Assuming single crack model, we found the strike and dip direction of the crack beneath the Shinmoe-dake crater is different from those near Ohnami pond. The spatial variation of the crack orientation suggests either conduit shape or spatial change in magma behavior. Throughout of this study, we showed that joint analysis for volcanic tremor by both multi-seismic array and seismic network data enable us to find spatio-temporal behavior of magma. This approach is applicable to data obtained in any places.