

Relationship between duration of eruption tremor and eruption volume

*Azusa Mori¹, Hiroyuki Kumagai¹

1. Nagoya University Environmental Studies

We studied the high-frequency seismic signals of eruption tremors during recent eruptions at various volcanoes and quantified their seismic source amplitudes (A_s) and cumulative source amplitudes (I_s) in the 5–10 Hz based on the assumption of isotropic *S*-wave radiation. A_s and I_s correspond to the maximum and the cumulative value of amplitudes at the source during eruption tremor. We previously found that the power law relations between A_s and I_s holds for eruption tremors. We also found the proportional relation between eruption rate and A_s for eruption tremors by comparing seismic and geodetic data during sub-Plinian eruptions at Kirishima. In this study, we further investigated time variations of eruption tremors and found the scaling relation between duration of eruption tremor and eruption volume.

We calculated the envelope width (p) using the estimated values of A_s and I_s and investigated the relation between p and I_s . p is defined as I_s/A_s and can be used as a parameter of duration (T) of a seismic envelope waveform (Kumagai et al., JGR, 2018). We found that p is proportional to 0.4 power of I_s . We also found that envelope waveforms of eruption tremors in 5–10 Hz have the following features; the amplitudes of envelope waveforms gradually increase, remain roughly constant during a certain period, and gradually decrease to the noise level. Moreover, p tends to increase with A_s . These envelope waveforms can be approximated as trapezoids, where A_s and T correspond to their height and lower base, respectively. We found that the ratios of upper to lower bases for these envelope waveforms are roughly constant. In this case, the proportionality between p and T holds. Based on the relation between eruption rate and A_s , eruption volume (V) is proportional to I_s . Therefore, the relation between p and I_s as shown above indicates that T is proportional to 0.4 power of V . We found that this proportional relation is consistent with the estimates of T and V for various Plinian eruptions compiled by Mastin et al. (JVGR, 2009). This indicates that the scaling relation between duration of eruption tremor and eruption volume in Plinian eruptions holds over a wide range of eruption size.