CHANGES IN TREMOR SOURCE LOCATION SYNCHRONIZED WITH AN AMPLITUDE MODULATION AT ASO VOLCANO, JAPAN

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Volcanic tremor is observed at many active volcanoes. It is widely accepted that underground fluid causes the occurrence of tremor, but there still remain many problems to be solved. If we can understand the mechanism of the occurrence of tremor, we can extract valuable information which tremor signals contain. In this study we estimate the source location of the volcanic tremor at Aso volcano, Japan, as a first step to make the mechanism clear.

Because first arrivals of volcanic tremor are not usually clearly observed, we need to deploy a seismic array to locate the tremor source accurately. Observations and analyses using arrays have been done at Deception Island, Stromboli, Kilauea, and so on.

At Aso volcano, two types of tremor are observed: continuous tremor and isolated tremor. The continuous tremor is ground vibration which has dominant frequency between 4 to 10 Hz and has approximately constant amplitudes without any clear beginning and end. An isolated tremor is, on the other hand, an episodic event which starts suddenly and continues about ten seconds. According to our past study, isolated tremor events and continuous tremor consist of body waves and surface waves, respectively. We observed these types of volcanic tremors at Aso using short period seismometer arrays for 3 days in 1999 and 2001. During our observation in 1999, the amplitude of the continuous tremor modulated with the modulation period of about 90 seconds, while such a modulation was not observed in 2001. The surface phenomenon at the crater was the gas emission from fumaroles, both during the 1999 and 2001 experiments.

In this study we focus on the source location of the continuous tremor. To locate the source of continuous tremor, we use semblance coefficients and perform grid searches. We observe that the estimated direction of the epicenter clearly changes synchronously with the amplitude modulation for the 1999 data. For the 2001 data such a periodic change in the epicentral direction is not observed. To explain the result for the 1999 data we assume that there are two sources with fixed locations, and the amplitude of one of them modulates with a period of 90 seconds. We then generate synthetic seismograms based on the model, and apply the same location technique to the synthetic data. The estimated directions vary according to which of the two sources dominates. The distance between the two sources are estimated to be more than 200 m. Amplitude modulations are sometimes observed at other volcanoes, but have not rarely been investigated quantitatively in connection with the tremor source location. The synchronized phenomenon observed in this study may provide an important clue to understand the mechanism of volcanic tremor.