

The analysis for the seismic waveform of the 2001 earthquake swarm in Hakone volcano

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1. Introduction

The active swarm earthquakes occurred in Hakone caldera, western Kanagawa Prefecture, between June and November-2001. The hypocenters lay in the shallow portion just under the central cone of Hakone Volcano. These earthquakes were micro or ultramicro earthquakes, even the largest earthquake was $M=2.9$. Many seismic waveform records were obtained by the seismic station network of Hot Springs Research Institute of Kanagawa Prefecture(HSRI) in this swarm activity. In this study, we estimated the fault parameters of these sources by using the seismic waveform data.

2. Data and method

In this study, the seismic waveform data which obtained by HSRI's stations of Komagatake(KOM), Kozukayama(KZY), Koziri(KZR) and Owakudani(OWD) were used. These data are the velocity seismograms with 120Hz sampling frequency. In this study, we used only the vertical component, and removed the data with a wrong s/n ratio.

In order to estimate the fault parameters, Brune's model was applied [Brune(1970)]. This model defines a relation between a source spectrum of S-wave and the fault parameters. The displacement waveform was obtained by integrating our velocity seismogram. And we corrected the effect of attenuation, in order to obtain the source spectrum. Finally, we calculated the fault parameters(fault radius, seismic moment, stress drop, dislocation) by a corner frequency and long-period spectral level which are determined from the source spectrum plot.

3. Results

The earthquakes observed by HSRI's station in this swarm were only the A-type volcanic earthquakes with clear P-wave and S-wave. However, the B-type earthquakes and volcanic tremors were not found. Therefore, it seems that this swarm activity was caused by the simple faulting.

In this study, we analyzed M0-M1 earthquakes which had a good waveform. The summary of the source fault character is as follows; (a)the length of fault is about 40m and not related to the magnitude, (b)the amount of seismic moment is in the range of 10^9 to 10^{10} Nm, (c)the amount of stress drop is in the range of 10^{-1} to 10^0 MPa, (d)the amount of dislocation is in the range of 10^{-4} to 10^{-3} m.

Now, the area of this swarm activity had about 4km length. However, the length of the source fault which is obtained in this analysis is far smaller than the activity area. Therefore, it is considered that the activity area was composed of a group of these small faults which had about 40m length. While, the fault formation may be influenced by the existing internal structure of the volcanic edifice, because the length of fault is not related to the magnitude.