Earthquakes series preceding a very long period seismic signal, observed during the 2000 Miyakejima volcanic activity

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We observed Earthquakes series preceding from one or two hours before a very long period seismic signal once or twice a day, with the 2000 activity of Miyakejima, Japan. IN Earthquakes series from 11 July to 12, the maximum amplitudes of earthquakes are almost constant until a few minutes before VLP, while from just before VLP decrease with time linearly. A further astonishing aspect is that the time intervals of earthquakes in series grow in the manner of geometric progression. The region of hypocenters is in the southwest of the crater, the depth is about sea level. We interpret these earthquakes series as a repetition of phenomenon that the stress increasing around source region reaches a certain critical stress, and an earthquake occur, at that time, the stress suddenly drops, and increases again.

1. Introduction

The first eruption in the island occurred at the summit crater on 8 July, and the summit crater began depressing to 18 August. During this period, very-long-period (VLP) seismic signals, whose period is about 50s, were observed once or twice a day. Before each of VLPs, an earthquakes series preceding for one or two hours was observed since 11 July. We will report characteristics of these earthquakes series from 11 July to 12.

2. Characteristics of earthquake series

At first, as time goes by, time intervals of occurrences of earthquakes gradually decrease. The second, the maximum amplitudes of earthquakes are almost constant until a few minutes before VLP, while, from a few minutes before a VLP, decay with time rapidly. The magnitude range of each individual earthquake is between 1 and 2, which is determined from amplitude and hypocentral distance using the relation obtained by Watanabe (1971). Each individual earthquake has almost identical waveforms although amplitudes of them are not the same. Earthquakes occurring during 4 events from 11 July to 12 are all similar. The dominant frequency of earthquakes is about from 0.6Hz to 0.8Hz.

3. Time distribution and time-intervals of occurrences

In order to investigate occurrence pattern, we measure the time interval of earthquake occurrence in each event. We found that the relation between the occurrence time and the time-interval is linear. When we fit a linear equation, we found that the time interval of earthquake in a series grow in the manner of geometric progression. The common ratio is peculiar to each series. An increasing trend is observed.

4. Hypocenter

Hypocenters are at a southwest region of the crater, the depth is about sea level. Earthquakes in four series occur the almost same region. We found that earthquakes locate in the north of VLP, and occur at shallow region more than VLP source.

5. Mechanism of earthquake series

A temporal variation in stress drops estimated by applying the method of Yabe (1996), is similar to that of maximum amplitudes of earthquakes in series. Furthermore, we found the stress recovery rate to the next earthquake increase with time. From these results, we interpret a mechanism of earthquakes series as the following model. The source region is imposed a load, and a stress increases gradually. When the stress reaches a certain critical stress value, an earthquake occurs. At that time, the stress suddenly drops until a certain minimum stress, and the stress increases again. This repetition is an earthquakes series. Critical values undergo a change constantly, and the stress recovery rate increases with time. That is why time intervals decrease gradually. From just before a VLP, the critical values decrease with time linearly.