

Periodic activity of deep low-frequency earthquakes in Meakandake, Nikko and Yakedake

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In most volcanic regions, deep low-frequency (DLF) earthquakes occurred at a depth of 10–50 km. Activity patterns of DLF earthquakes are important to understand occurrence mechanisms of the earthquakes. We constructed a catalog of DLF earthquakes in 52 regions all over Japan from April 2004 to December 2018 using matched filter method and grouped based on the classification analysis (Kurihara and Obara, 2020). It was revealed that the temporal seismicity pattern of separated groups classified in each region can be typified as being either episodic or non-episodic. In the groups of episodic activity, swarms of DLF earthquakes sometimes occur. In the group of non-episodic activity, DLF earthquakes constantly occur without seismic rate change. Even in a region, temporal seismicity pattern is different for each group.

In the aspect of the interevent times of DLF earthquakes, periodic activity of DLF earthquakes were observed in episodic activity of Klyuchevskoy volcano in Kamchatka, Russia (Frank et al., 2018) and non-episodic activity of Mauna Kea volcano, Hawaii (Wech et al., 2020). This might be caused by the mechanisms such as second boiling (e.g. Wech et al., 2020). In this study, we investigated interevent times of DLF earthquakes in 52 regions using the catalog of DLF earthquakes.

In result, DLF earthquakes with constant interevent times were observed in the groups of episodic activity in Meakan, Nikko, and Yakedake. In Meakan, DLF earthquakes classified into two groups, Group 1 and Group 2. Episodic activities of DLF earthquakes were observed in both groups. In Group 1, swarms of DLF earthquakes lasted for approximately six months from November 2015 to April 2016 and the lasting period included repeating nine episodes of DLF earthquakes with durations of a few days at an interval of approximately two weeks. Upper limit of the magnitudes of DLF earthquakes in the episodes gradually grew. The interevent times of DLF earthquakes in each episode are larger than 1000 seconds and gradually became shorter and longer in the beginning half and the later half, respectively. In Group 2 of Meakan, each episode had long durations of approximately half a year and the magnitudes and interevent times gradually became larger in each episode.

In Nikko, DLF earthquakes were classified into 7 groups. In Group 1 of Nikko, episodic activities of DLF earthquakes were observed. 6 episodes has the durations of longer than 9 days out of 22 episodes. The interevent times of DLF earthquakes became shorter in the first day of each episode and gradually became longer in the later period.

In Yakedake, DLF earthquakes were classified into 5 groups. In Group 1 of Yakedake, very episodic activities were observed. In this group, DLF earthquakes with interevent times less than 1000 seconds were rarely observed from 2004 to 2018. In other words, periodic activities of DLF earthquakes were observed in each episode.

On the other hand, the characteristic interevent times were only observed in some groups with episodic activity such as Sakurajima except the above three regions. In other words, interevent times were random in other regions and do not have any characteristics unlike the above cases. A large number of DLF

earthquakes were detected in Fuji and they show mixed trend of episodic and non-episodic activity. Durations of most of the episodes in Fuji were less than few hours.

In conclusion, DLF earthquakes with constant interevent times occurred periodically in some episodic groups. On the other hand, DLF earthquakes do not have any characteristics in most groups of most regions which include both of non-episodic groups and episodic groups. Occurrence mechanisms of DLF earthquakes may not be explained by a single mechanism, but rather multiple causes because activity patterns of DLF earthquakes are greatly different from group to group.

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