Analysis of microseismic noise before strong earthquakes

Besedina A.N.

Institute of Geospheres Dynamics of Russian Academy of Sciences, Moscow, Russia

e-mail: besedina.a@gmail.com

Monitoring of parameters of low-frequency seismic noise is one of the possible methods of controlling the stress-strain state of potentially dangerous fault zones. An assumption that when the focal area of a future earthquake goes into a metastable state, the mechanical characteristics of the fault zone should change significantly was confirmed in laboratory experiments. It was previously shown that the effect of reducing the stiffness of the contact is caused exactly by the beginning of the intermittent sliding. The effect detected suggests that changes in the stress-strain state of the fault zone at the final stage of preparation of the dynamic slip process can be found out by analyzing the parameters of low-frequency microseismic noise. One of the most favorable for determining the characteristic values of the region under study is the recording area during and after the passage of surface waves from distant earthquakes. These oscillations with a period of several tens of seconds have significant amplitude and duration, which contributes to the excitation of resonant oscillations of the blocks.

A sample of earthquakes that can excite resonant oscillations of blocks, as well as pairs of earthquakes that occurred sequentially was conducted for Chile and Sumatra. In this case, the first event is considered as initiating the resonant oscillations of the blocks, and before the second event there is a shift in the spectral peak, corresponding to a decrease in the stiffness of the oscillatory system before the system goes into a metastable state. The analysis of the earthquake records in the area under study allowed identifying a pair of earthquakes for each region over the past decade: (i) the first remote earthquake 2010-02-26 Mw 7.0, Japan, followed by regional 2010-02-27 Mw 8.8, Chile; (ii) the first remote earthquake 2009-09-29 Mw 8.1, Samoa, followed by regional 2009-09-30 Mw 7.6, South Sumatra. To quantify the microseismic noise and estimate the characteristic frequency of natural oscillations, the center-of-mass algorithm was used. The spectral centroid was evaluated, which indicates where the oscillation energy is mainly concentrated. For each event, a decrease in the spectral centroid was noted after the arrival of the waves from the first distant earthquake, which continued until the second regional earthquake. The analysis of microseismic noise parameters for the considered regions for those years, during which the considered earthquakes occurred, was also carried out. This work is supported by RFBR project № 18-05-00923.