



Experimental determination of stress variation threshold resulted in earthquake triggering

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There are many field observations of earthquake triggering by static and dynamic stress variations caused by impact of distant strong earthquakes, underground chemical and nuclear explosions, solar-lunar earth tides, strong variations of atmospheric pressure etc., as well as by electric current injection into the Earth crust. It is supposed that the external impacts on the earthquake source result in exceeding the threshold stress and earthquake triggering. Nevertheless, the mechanisms of the earthquake triggering phenomena is not clear, and the problem of determination of stress variation threshold resulted in initiation of seismic events is very important. At present, based on analysis of field observations of dynamic triggering of earthquakes (by wave train from distant strong earthquakes) performed for various regions, including the USA, Japan, China, Greece, etc. it is considered that the triggering threshold of stress variations is about of 500 kPa.

An experimental study at the spring-slider system was carried out for detailed study of behavior of fault area under near-to-failure state and experimental triggering impacts, as well as for determination of the threshold variation of normal stress in the fault gauge resulted in earthquake (slip) triggering. The spring-slider system provides a spring loading rate of 0.001 to 0.02 mm/s. The travelling block of dimensions 250x120x65 mm is connected with electromechanical drive via the spring with 9.5 N/mm spring constant. The normal stress of the travelling block is up to 30 kPa. For determination of the triggering threshold of normal stress variations the electromagnetic system was activated by control system at the level of 0.98-0.99 critical (fault failure) shear stress, which provided reducing the normal stress (by 0.001% to 0.1%) in the form of rectangular pulses of 0.5 to 5.0 s duration generated in time interval of 20 to 40 s. The level of stress variation impact resulted in the slip of travelling block (with stable time delay after the pulse initiation) is considered as the threshold for the present experimental "stick-slip" system. The measured triggering threshold of normal stress variations in the fault simulator is 0.05% to 0.10%. An implication of obtained threshold values for various earthquake mechanisms is discussed.