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FAULT BEHAVIOR UNDER PERIODIC DYNAMIC DISTURBANCES

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It is well known that mechanical vibrations cause short-term fluctuations of stress fields. Sources of vibrations may be of different nature – earthquakes, explosions, machinery operation, etc. Stress field fluctuations can have a noticeable effect on the fault behavior and process of tectonic stress relaxation.

The advance in understanding the mechanism of variations of fault behavior and seismicity is promoted, among other things, by laboratory experiments that investigate regularities of fault deformation under vibrations. Using laboratory experiments in this study, the regularities of cumulative small deformations along a stressed fault under weak impulsive disturbances and the possibility for triggering powerful dynamic events by weak impulsive disturbances were investigated. It should be noted that the presented laboratory experiments are aimed toward a qualitative reproduction of the process of triggering slip events by weak disturbances and are not relevant to realistic fault conditions.

The fault was simulated by an interface between two granite blocks loaded with normal and shear stresses, and the impulsive disturbances were excited by impacts of steel balls. The effects of weak periodic impacts essentially depend on the initial mode of fault behavior. The weakest effect is observed in the case of high-amplitude stick-slip. In contrast, in the case of slow, irregular quasi-dynamic slip, tapping leads to an almost complete transformation of the potential energy of deformation into aseismic creep.

Thus, a short dynamic disturbance propagating within a stressed blocky medium can trigger a slow deformation process whose contribution to the cumulative deformation may be quite appreciable. Because postdynamic movements can contribute substantially, a delay in the manifestation of dynamic events with respect to the moment of the initial disturbance may be observed. In turn, periodic dynamic disturbances of the stress-strain state can essentially change the mode of background seismicity and the proportion of radiation efficiency of events.