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About the Possibility Of Transformation Of Shear Deformation Modes.

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In this study we present the results of laboratory experiments aimed to investigate the effect of material properties, filling a discontinuity, on transformation of deformation modes from stable creep to regular stick-slip. Qualitative correspondence between experimental results and natural phenomena is detected.

The experiments were carried out in the classical “slider model” statement. A small granite block slid under shear load on a bigger granite block. The contact between rough surfaces of the blocks was filled with a discrete material, which simulated the fault zone. Quartz sand, granite crumb, glass balls and rock salt were used as the filling material. The normal load was applied to the sliding block through a special device excluding origination of tangential forces. Shear load was applied to the block through a spring. The sliding block position was controlled by laser sensors that recorded relative displacement of blocks at the frequency up to 4 kHz with the accuracy of 0.1 micron.

A full spectrum of possible deformation regimes was obtained in experiments - from stable slip to low-velocity motion and to regular stick-slip, with various seismic moments realized per one act of instability. The deformation regime can transform into another one due to a slight change of the filling material structure and humidity. Experimental data can be divided into three groups, which, speaking in terms of seismology, correspond to aseismic creep, slow earthquakes and normal earthquakes with various magnitudes.

Laboratory experiments allowed to determine the main factor that controlls realization of deformation regime of the model fault and to develop the phenomenological model of the process based on assumption that some force mesostructures were forming across the model fault in shearing. The mode of deformation regime is completely controlled by the length and amount of these mesostructures. At the same time narrow particle-size distribution, high degree of order of the filling material and strong interaction between grains also contribute to origination of force mesostructures.

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