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Unified law of evolution of experimental gouge-filled fault for fast and slow slip events at slider frictional experiments

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Excessive tectonic stresses accumulated in the area of rock discontinuity are released while a process of slip along preexisting faults. Spectrum of slip modes includes not only creeps and regular earthquakes but also some transitional regimes – slow-slip events, low-frequency and very low-frequency earthquakes. However, there is still no agreement in Geophysics community if such fast and slow events have mutual nature [Peng, Gomberg, 2010] or they present different physical phenomena [Ide et al., 2007].
Models of nucleation and evolution of fault slip events could be evolved by laboratory experiments in which regularities of shear deformation of gouge-filled fault are investigated. In the course of the work we studied deformation regularities of experimental fault by slider frictional experiments for development of unified law of evolution of fault and revelation of its parameters responsible for deformation mode realization. The experiments were conducted as a classic slider-model experiment, in which block under normal and shear stresses moves along interface. The volume between two rough surfaces was filled by thin layer of granular matter. Shear force was applied by a spring which deformed with a constant rate. In such experiments elastic energy was accumulated in the spring, and regularities of its releases were determined by regularities of frictional behaviour of experimental fault.
A full spectrum of slip modes was simulated in laboratory experiments. Slight change of gouge characteristics (granule shape, content of clay), viscosity of interstitial fluid and level of normal stress make it possible to obtained gradual transformation of the slip modes from steady sliding and slow slip to regular stick-slip, with various amplitude of ‘coseismic’ displacement. Using method of asymptotic analogies we have shown that different slip modes can be specified in term of single formalism and preparation of different slip modes have uniform evolution law. It is shown that shear stiffness of experimental fault is the parameter, which control realization of certain slip modes. It is worth to be mentioned that different serious of transformation is characterized by functional dependences, which have general view and differ only in normalization factors.
Findings authenticate that slow and fast slip events have mutual nature. Determination of fault stiffness and testing of fault gouge allow to estimate intensity of seismic events.
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