Slip-behavior of a heterogeneous linear fault

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The report presents the results of the analysis of field observations, laboratory experiments and numerical calculations in which the peculiarities of the slip along a heterogeneous fault surface were studied.

Coseismic slips are localized along a narrow sliding surface, which is located either within the zone of the main rupture or on the border of host and modified rocks.

The properties of the geomaterial in the vicinity of the slip zone are not uniform, but vary widely. One of the most important is the presence of areas made by geomaterials with different dynamics of frictional characteristics during sliding - areas of weakening, hardening and almost neutral with respect to slip velocity and displacement.

Dimensions and frictional properties of such "spots"determine the high-frequency part of the emission spectrum, i.e., the parameters of "strong according to seismological terminology, motions in the vicinity of the source.

Dynamic slip always begins at a spot that has the property of velocity softening. The ruptures propagates along a tectonic fault or to a site with velocity hardening properties, or to the intersection with another fault. For propagation of seismogenic rupture, it is necessary a certain ratio between the stiffness of the intact massif and the fault. The section of velocity hardening is either a zone with low values of effective stresses normal to the fault plane, or made of a corresponding geomaterial.

The rupture length and, correspondingly, the low-frequency part of the emission spectrum, and, consequently, such parameters as seismic moment and magnitude at large distances, are determined either by the macro-structure of a rock mass (mutual locations of existing fault zones) or by locations of the areas at the sliding interface that exhibit velocity strengthening (a property of the geomaterial).

To start the slip of the earthquake of a certain magnitude, it is necessary that the dimensions of the high-speed softening section exceed a value that at present can only be estimated very approximately - about 1% of the length of a future earthquake break (10m for an event with a magnitude M = 4, energy class K = 10.8). The higher the total part of areas with weakening, the higher the value of radiated energy.

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