Structure of a tectonic fault plane revealed by weak seismicity data

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The deformation of the rock massif is determined by the processes occurring at the boundaries of the massif, in particular, in the zones of tectonic faults. Depending on the structure of the tectonic fault and the frictional properties of the fault plane, both fast dynamic ruptures and slow slip events can be initiated on the fault. During the fault evolution, some areas of stress localization are formed in the sliding plane – contact spots – zones of formation of which are probably determined by the geometry of the tectonic fault interface. The initiation of slip always occurs in the vicinity of contact spots characterized by the property of velocity weakining. The rupture stops in the zones between the spots, characterized by the property of velocity strengthening. Determining the spatial configuration of contact spots and assessing their frictional properties is an integral component of constructing a geomechanical model of a tectonic fault and determining the dynamics of its sliding.

Both the configuration and the frictional properties can be estimated based on the analysis of weak seismicity localized in the vicinity of the tectonic fault. In this paper, using the example of the Calaveras and San Andreas faults, an algorithm for reconstructing the structural properties of a tectonic fault with a spatial resolution of 100 m is shown. When determining structural properties, an important aspect is the analysis of background seismicity, which does not contain information about foreshock and aftershock sequences. In the background seismicity data, contact spots begin to appear several years after the start of observation. It is shown that events with a magnitude greater than 5 are localized within the contact spots.

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