Numerical modeling of a possible mechanism of stick-slip of fault edges under the action of external forces

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A possible model of rupture initiation in the near-fault zone under the action of deformation waves is considered. The calculation is carried out within the framework of the elastic-brittle medium model by the finite-difference method. The role of deformation waves coming from outside, for example, tidal waves, as trigger mechanisms is discussed. The area of the geo-environment containing a fault under the action of deformation waves is considered. The banks of the fault are complicated by a low-amplitude rectangular step, which prevents slippage of the fault banks under the action of shear stresses initially applied to them. Slippage occurs as a result of the application of some stress normal to the crack plane, which, together with shear stresses, plays the role of a trigger. The following scenario of the reaction of the environment to external influence is proposed.

A passing deformation wave (for example, from a nearby earthquake or explosion, or a wave of tidal genesis) pushes the contacting surfaces of the fault banks apart. The presence of a shear force at some point in time leads to the fact that the banks after passing through the extension phase remain hooked on the step. In this case, stresses will be concentrated in the vicinity of the fault tip and in the vicinity of the toe and, as a result, microdamages will accumulate. The stress concentration leads to a loss of strength, which leads to the growth of the fault, that is, to the actual seismic event. In addition, part of the energy will be released on the destruction of the toe. In numerical simulation, the entire environment for which the calculation is carried out is divided by coordinate planes into calculation cells. The problem is solved within the framework of the elastic-brittle medium model in Lagrangian variables. The conducted numerical experiment describes one of the possible scenarios of an external trigger impact on existing faults. It is shown that seismic waves are emitted with delays when using this approach. This approach can be used both in solving problems of seismic forecasting and in processing the results of field observations.