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Numerical Simulation of Seismic Process Accompanying the Formation of Shear-Type Fault Zone in Chuya-Kuray Depressions

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Abstract : Seismic activity around the world is clearly a threat to people's lives, as well as infrastructure and capital construction. It is the instability of the latter to powerful earthquakes that most often causes human casualties. Therefore, during construction it is necessary to take into account the risks of large-scale natural disasters. The task of assessing the risks of natural disasters is one of the most urgent at the present time. The final goal of any study of earthquakes is forecasting. This is especially important for seismically active regions of the planet where earthquakes occur frequently. Gorni Altai is one of such regions. In work, we developed the physical-mathematical model of stress-strain state evolution of loaded geomedium with the purpose of numerical simulation of seismic process accompanying the formation of Chuya-Kuray fault zone Gorni Altay, Russia. We build a structural model on the base of seismotectonic and paleoseismogeological investigations, as well as SRTM-data. Base of mathematical model is the system of equations of solid mechanics which includes the fundamental conservation laws and constitutive equations for elastic (Hooke's law) and inelastic deformation (modified model of Drucker-Prager-Nikolaevskii). An initial stress state of the model correspond to gravitational. Then we simulate an activation of a buried dextral strike-slip paleo-fault located in the basement of the model. We obtain the stages of formation and the structure of Chuya-Kuray fault zone. It is shown that results of numerical simulation are in good agreement with field observations in statistical sense. Simulated seismic process is strongly bound to the faults - lineaments with high degree of inelastic strain localization. Fault zone represents en-echelon system of dextral strike-slips according to the Riedel model. The system of surface lineaments is represented with R-, R'-shear bands, X- and Y-shears, T-fractures. Simulated seismic process obeys the laws of Gutenberg-Richter and Omori. Thus, the model describes a self-similar character of deformation and fracture of rocks and geomedia. We also modified the algorithm of determination of separate slip events in the model due to the features of strain rates dependence vs time.

Keywords : Drucker-Prager model, fault zone, numerical simulation, Riedel bands, seismic process, strike-slip fault
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