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Tectonophysical investigations of seismogenic deformations and stress fields associated with the 2003 Ms=7.5 Chuya earthquake, Gorny Altai

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The structure, formation mechanism and evolution of fracturing patterns in the fault zones of the earth's crust are the basic line of tectonophysical investigation. Models and principal regularities in developing the internal structure of the contraction, extension and strike-slip zones are established now. We applied this knowledge to map and analyze the seismogenic deformations produced during the Ms=7.5 Chuya earthquake on September 27, 2003 in the Gorny Altai. A network of sites of the field observations was organized on the 30 km long segment where the rupture system is clearly defined at the surface. The data have been collected and processed by the methods applied in tectonophysics and structural geology for studying fractures of various scales. Our research allows doing several important conclusions. (1) The seismogenic deformations have manifested themselves both in unconsolidated sediments as the R- and R'-shears, extension fractures and contraction structures and in bedrock as the reactivation of existing schistosity zones and individual fractures, growth of the existing fractures, and occurrence of new ruptures and coarse crushing zones. The combination of all new-formed structures represents the paragenesis, in which the NW-SE and NNW-SSE trending faults are dextral strike-slips, the NE-SW and NNE-SSW trending faults are sinistral strike-slips, and the nearly E-W trending faults are reverses with an insignificant strike-slip component. The same offsets occurred along existing reactivated fractures, excepting the steep faults trending nearly E-W where the local variations of state of stress took place, resulting in the small strike-slip displacements. (2) The initial stress field that produced the whole structural ensemble of the seismogenic deformations during the Chuya earthquake, corresponds to strike-slip type with the NNW-SSE, almost N-S, trend of compressional stress, and the ENE-WSW, almost E-W, trend of tensional stress. The state of stress in the newly occurred fault

zone is relatively uniform. The local stress variations are expressed in slight deviation of principal stress axes from the major trends, as well in short-term fluctuations of relative stress values in keeping their spatial orientations or in increasing of dip angle of compressional stress axis to the horizon in front of the already existed fault. (3) As a whole, the pattern of earthquake ruptures represents a typical fault zone trending NW-SE with a width reaching 4-5 km and the dextral strike-slip geometry that is determined by combination of structural elements regularly oriented to each other. According to a tectonophysical model, the obtained regularities of the fracture arrangement correspond to the late disjunctive stage of faulting when the master fault is not fully developed but its segments are clearly defined. So the tectonophysical model of fracturing in the large continental fault zone is applicable to analysis of deformations produced practically immediately during a strong earthquake. Therefore the fracturing in significantly different rocks occurs from common laws of deformations of solid bodies even on the surface and at a high rate of movements. The tectonophysical analysis can be successfully applied together with other methodological approaches in studies of earthquake deformations. The research was supported by Grant of President of Russian Federation (no. MK -1645.2005.5.), Complex Integrated project (no SO RAN-2006-6.13) and INTAS (no. 05-109-4383).