THE TRIGGERING OF SUPERSHEAR EARTHQUAKE RUPTURES

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One of the problems that has caused increased attention of geophysicists and mechanics in recent years is the identification of some earthquakes fault sections with an unusually high rupture propagation velocities, exceeding the value of the Rayleigh wave velocity CR, which is the maximum possible for the crack growth speed in the framework of traditional analytical models of fracture mechanics.

The report provides a brief analysis of the seismological information accumulated in recent years on the propagation of "fast"ruptures during earthquakes, in the context of the structural features of fault zones. A qualitative comparison of the results of observations with the results of numerical calculations of the formation of a supershear ruptures along a homogeneous and heterogeneous discontinuity surface is carried out.

The results of calculation on a simple model do not contradict the data of seismological measurements, reflecting such observational facts as a gradual increase in the velocities of propagation of the rupture, acceleration and deceleration of the ruptures, a higher probability of the occurrence of a “supershear” ruptures on the ancient fault sections with flatter and wider “asperities” , the possibility of propagation of a "supershear"rupture over long distances and its sudden stop.

On a heterogeneous contact surface, a necessary condition for the transformation of a rupture into a supershear regime is the presence of a sufficient number of contact spots “asperities”, which are characterized by a fairly rapid frictional weakening during shear. At the same time, the more “brittle” the spot (the lower the value of the residual frictional strength compared to the peak value), the lower the level of average stresses, the transition to supershear fracture can occur. The increased microroughness of the contact area increases the frictional "brittleness"of the spot, thereby increasing the probability of initiating a supershear fracture.

The heterogeneity of the mesoscale leads to a complication of the wave pattern, the appearance of intervals of decrease and increase in the rate of discontinuity propagation and the amplitude of the coseismic displacement. After entering a long section with stable friction, the supershear discontinuity continues to propagate at a velocity close to that of the longitudinal wave, although the amplitude of the differential motion decays. Ultimately, the gap stops when it encounters a blocked area, for the destruction of which the amplitude of the dynamic impact is no longer enough.

Macroscale heterogeneities - systematic changes in the properties of the fault along the strike lead to an increase in the probability of the occurrence of "fast"ruptures in the older sections of the fault.