Efficiency of fluid and electric triggering impact on the model fault zones with different levels of acoustic emission

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Recent experimental and theoretical studies showed that the deformation mode of the crust fault and the accumulation of stresses up to critical values, when a dynamic rupture of the fault occurs, is determined by zones of contacting irregularities of the fault walls, which have received in seismology the generally accepted name "asperities". In such zones, when their shear stresses approach critical values, an increase in crack formation will be observed, accompanied by acoustic emission (AE). In laboratory experiments on spring-block models of a seismogenic fault using AE registration and location of AE sources, it is possible to identify zones of asperities and determine their sensitivity to local external trigger actions that can lead to the initiation of dynamic displacement of the model fault wall (laboratory "earthquake"). This paper presents the results of studies of the initiation of a laboratory "earthquake"under triggering action on the zones of a spring-block model of the crust fault with different AE levels. The experiments were performed with a running block of 700 mm length at a normal stress in the simulated fault of 24.4 kPa and a maximum shear stress of up to 14.0 kPa. In the process of slow shear loading of the running block at a load rate of 0.033 N/s through a spring with a stiffness of 16.6 N/mm, the distribution of the density of acoustic signal sources along the length of the block-to-block contact was determined using three AE sensors evenly located on the upper surface of the running block. Upon reaching the shear force at the level of 99 % of the critical value, when the dynamic slip of the running block occurs, the electromechanical drive, which provided a rise of shear stresses in the block-to-block contact, was turned off, and a triggering action was made by injection of water or electric DC current into one of its 12 zones spaced evenly along the length of the running block. In the experiments, the volume of injected water and the DC level were determined, resulted in a sharp AE activation and triggering of the dynamic rupture of the simulated fault, depending on the density of the AE signal sources. It has been found that the minimum volume of water, as well as the minimum value of the DC current triggered the dynamic failure should be injected into the zone of maximum clustering of AE signal sources. At the same time the water injection or the DC current supply of the same volume or level into the area without sources of AE signals does not trigger the dynamic failure of the running block.

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