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The influence of water infusion on acoustic activity

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It is well known that physical modeling of the proper seismic process faces a number of problems associated both with methods and technology. At the same time since seismicity structure has a self-similarity quality, in principle it is possible to study the mechanism of seismic process in the laboratory to reveal its interrelations and regularities of manifestations and for the search for destruction (earthquake) precursors. To carry our long-term experiments on deforming geological environment models of complex structure by affecting the model with initiating signals a loading lever device was made with the maximum calculated capacity of 20 tons, which allowed conducting research with small rate of deformation as well as rheology tests. The experiments duration was from tens to first hundreds of a day. Models of the size of about 4000 cm^3 were tested under biaxial compression. Three-layer models from cement, sand and granite or limestone chip were made. Two lateral layers had more high strength characteristics than the central one. The chip size was 2 to 20 mm. The initial average velocity of elastic waves was changed from 3800 m/s in lateral layers to 2500 m/s in the central part. The dimensions of the model were 270 mm (along the axial load) $\times 180 \times 90$ mm. The lateral compressing load was 4 tons. Samples were destroyed by a system of micro fissures gradually forming a composite shift. The acoustic signals, appearing during the experiments were received by piezoelectric sensors and processed by Aline32D, a multiplex computerized measuring system, which enables to locate acoustic emission, to record wave forms (sampling rate 5 MHz) and register auxiliary parameters. As distinct from experiments carried out before we tried to establish in these experiments how acoustic emission varies with water injection in the zone of micro fissuring in the loaded sample. It was shown before that the effects of elastic impulses and electric signals cause appreciable and characteristic variation in acoustic emission. At the same time the triggering effect of the fluid on acoustic emission parameters is less well understood. Models underwent step loading up to ap-

proximately of 0.8 of failure load and then the duration of constant load increased to 5–10 days. These conditions allowed us to obtain acoustic events flow close to stationary at these intervals, allowing distinguishing relatively easily the phases of acoustic emission variation after external actions. After load limit the model was gradually unloaded until it was broken with the main crack. At the intervals of fixed load, distilled water in the amount of 0.5 ml was infused into mouth of cracks and was absorbed by the sample for 1–2 minutes. Such procedure repeated at some stages of loading. In other experiments, water (1–2 ml) was given through a micro well directly into the inner area of the model. After “a fluid” affected the fissuring area a noticeable growth of acoustic activity located in the fracture zone was noted. With applying the same amount of water to an unbroken area of the sample no respond was noted. The analysis of acoustic activity energy variation showed that after applying water a regular growth of acoustic activity is observed and the reaction duration is first tens of hours. In some cases, a delay of reaction was revealed which made tens of minutes. One of likely reasons could be a local decrease of strength caused by water penetration in the area of rupture preparation. It is significant that in these experiments we did not injected fluid under pressure into the loaded sample and therefore hydraulic fracturing was ruled out. The work was supported by Ministry of Science and Education of the Russian Federation, project NSh-1270.2003.5 and by Department of Earth Sciences, RAS, program 5.