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Initiation of Acoustic Emission in Fluid-Saturated Rock Samples under Electric Current Action

Alexander Ponomarev[1], Vladimir Smirnov[1,2], Andrey Patonin[3], and Tatyana Kartseva[1,2]
[1]Schmidt Institute of Physics of the Earth, Seismological Dept., Moscow, Russian Federation (avp@ifz.ru)
[2]Lomonosov Moscow State University, Moscow, Russian Federation (vs60@mail.ru)
[3]Borok Geophysical Observatory of Schmidt Institute of Physics of the Earth, Yaroslavl region, Borok, Russian Federation (patonin_borok@mail.ru)

We present the results of the laboratory studies of the activization of acoustic emission in fluid-saturated and uniaxial stressed sandstone and granite samples under the electrical current action. The experiments were carried out at the Geophysical observatory "Borok" of Schmidt Institute of Physics of the Earth (Russian Academy of Sciences) using servocontrolled press INOVA-1000 under strain control.

We recorded acoustic emission (AE), axial load, axial and radial strain of the sample and controlled the electric current flowing through the sample. The electrodes for creating an electric potential difference were mounted at the ends of the cylindrical samples. The experiments were carried out both in the presence and in the absence of a galvanic contact of the electrodes with the sample. We examined dry cores and partially saturated cores with an aqueous NaCl solution of various concentrations.

A significant increase in acoustic activity (more than several times) was found during periods of current action, as well as a decrease in activity after termination of electric action. Radial strain increases during periods of electric current flow, which indicates an increase in the sample volume. We did not find acoustic emission initiation on dry samples and on fluid-containing samples in the absence of galvanic contact of the electrodes with the samples.

The increase in the AE activity depends mainly on the electrical power and the duration of the exposure interval. The product of these parameters gives the amount of Joule heat. This indicates that the mechanism of AE initiation by electric current is of a thermal nature. Acoustic activation increases with an increase in the heat generated by the electric current passing through the sample. This makes it possible to relate the initiation of fracturing by thermal expansion of the fluid in the sample cracks and an increase in pore pressure. Found increasing of the radial deformation during the heating intervals supports this idea. Thus, the discovered phenomenon can be considered as a consequence of an unconventional way of increasing pore pressure in rocks saturated with a conducting fluid.

The effect of increasing the acoustic emission activity under electric current action is observed both in mechanically stressed samples and in free, unloaded samples.

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