Identification of the mechanisms of acoustic events in rock damage experiments

Shikhova N.M., Patonin A.V., Ponomarev A.V., Smirnov V.B.

Schmidt Institute of the Physics of the Earth of Russian Academy of Sciences, Moscow, Russia

e-mail: shinami@yandex.ru

According to laboratory experiments, the mechanisms of recorded acoustic events during triaxial testing of rock samples were investigated. The analysis was carried out by two methods based on data on the coordinates of events, signs, times and amplitudes of elastic wave arrivals to each of the 16 ultrasonic sensors. Application of the polarity method [Zang et.al ., 1998] showed that at the beginning of the experiment, when the load increases to the level of 0.5 of the tensile strength, the proportion of tensile cracks (T-type events) increases while the proportion of collapse mechanisms (C-type) decreases. The loading stage corresponding to the formation of the main fault is accompanied by an increase in the proportion of shear events (S-type) up to 60 %.

The second, original method - Acoustic Emission Source Axial Method (AESAM) [Shikhova, Patonin, 2021] for calculating the seismic moment tensor (TCM) was used to determine the direction and magnitude of compression and stretching vectors acting in the acoustic emission (AE) focus. This approach is based on a quadrupole model of the source, taking into account the radiation pattern of AE sensors. The application of the AESAM algorithm allows us to calculate the TSM and estimate the parts of isotropic (ISO), shear (DC) and the part of compensated linear vector dipole (CLVD) in the general mechanism of the source. A similar dynamics of changes in the proportions of the types of events calculated by the polarity algorithm and the components of the seismic moment tensor determined by the AESAM method is shown. Statistically stable patterns of change of angles between the direction of the applied excessive axial load on the sample and the compression –stretching vectors in the AE source are obtained. The calculation results demonstrate the dependence of variations in the compression-stretching directions on the ratios of the values of the acting stresses and the types of tested rock .

The work was performed in the Research Equipment Sharing Center of IPE RAS “Petrophysics, Geomechanics and Paleomagnetism”

Zang A., F. Christian Wagner, Sergei Stanchits, Georg Dresen, Reimer Andresen and Mark A. Haidekker. Source analysis of acoustic emissions in Aue granite cores under symmetric and asymmetric compressive loads // Geophys. J. Int. 1998, 135, 1113–1130

Shikhova N., Patonin A. Methods for determining focal mechanisms in laboratory experiments // EGU General Assembly 2021,online,19-30 Apr 2021, EGU21-3305, https://doi.org/10.5194/egusphere-egu21-3305.