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Complex Method of Detection Reliable Precursors of Stressed Rock Samples Failure

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Abstract

Studies of brittle rock samples failure were carried out in Laboratory of Geodynamics of Far-Eastern University, Vladivostok, Russia. It was assisted by servocontrol loading machine MTS-816, acoustic emission (AE) complex, and multi-channel complex. The regularities of formation and development of dissipative mesocracks structures in rock samples under uniaxial compression were determined as a result of complex deformation and acoustic experiments at final stage of loading. Anomalous deformations of high stressed rock samples were associated with acoustic characteristics. The system of reliable precursors of failure involving long-term and middle-term was established. This system of precursors reflects the stages of formation and development of dissipative mesodefects structures in high stressed rock samples.

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Keywords: rock sample; deformation; acoustic emission; precursors; complex method.

1. Preparation of experimental studies

Achievement of put goal of detection reliable precursors of rock samples failure needs a realization of complex experimental researches [1]. It is direct to research of regularities of source of failure forming in rock samples under uniaxial compression and changes regularities of deformations of lateral surface of rock samples which associates with source of failure forming [2].

Complex deformation and acoustic-emission method have to be carried out with some special necessities.

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The minimum number of acoustic emission sensors should be four [3]. And the record of signals should be provided at all stages of the development of source of failure [4]. Fixing the position of acoustic emission events should be done with an error less than 1 mm.

The number of strain gages fixed on the sample must be at least four for each type of deformation. They are placed evenly around the perimeter in the average height of the side surface of the sample without overlapping each other [5].

The strain gages should be placed at a minimum distance of 5 mm from the planes created for place of AE sensors to prevent distortion of the sensor readings.

Synchronization of readings of acoustic emission and deformation should be carried out on one computer on the testimony of a system timer for maximum synchronization accuracy with the accuracy of clock cycles of the central processor unit. If this is technically impossible, it is necessary to synchronize the system time of both systems on the same local server time synchronization that gives acceptable accuracy within 50 milliseconds.

The research to identify reliable precursors of the destruction was carried out on cylindrical specimens. The ratio of height to diameter was made h/d=2 [6].

Developed a complex method of deformation and AE researches was used for test cylindrical samples of rhyolite with a diameter of 64 mm and a height of 128 mm. Layout of sensors for complex researches is presented in Fig. 1.

Laboratory experimental researches should be carried out by complex acoustic-emission and deformation methods. It lets relate deformation anomalous and source of failure forming in rock samples under pre-failure load.

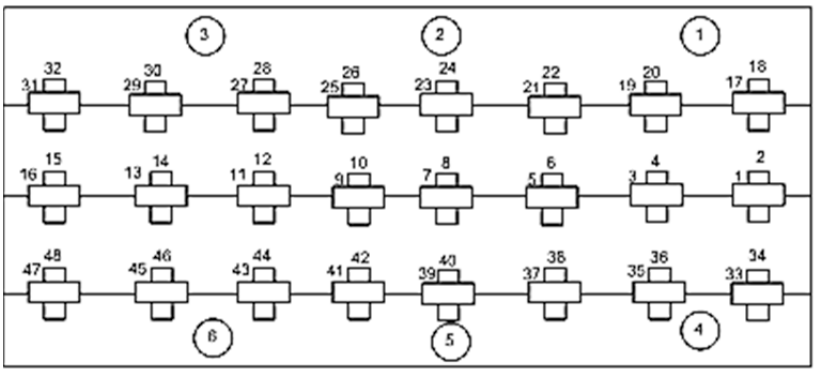

Fig. 1. Layout of sensors.

The process of sample preparation for the test involves grinding the faceplates, marking positions for the fixing of sensors. Further, the side surface of the sample is degreased, strain gauges are glued in accordance with the selected scheme of their placement, AE sensors are mounted.

Testing of rock samples by complex deformation-AE method was carried out in the Laboratory of Geodynamics of the Engineering School, Far Eastern Federal University, Vladivostok, Russia. Loading was performed by servo-hydraulic test machine MTS-816.

2. Results of test

Below the results of measurement of parameters of AE rock sample tested by complex method are presented. Data on changes in the rate of acoustic emission radiation and the average amplitude of AE signals are presented in Fig. 2 and Fig. 3.