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Changes of kinematic and dynamic parameters of ultrasonic sounding as a result of different types of loading regimes and different orientation of rock foliation

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The relation between rock material structure and its mechanical properties becomes an important issue in connection to prospecting and evaluation of sites for building deep underground disposal of dangerous waste. Mechanical properties affect a long-term stability and strength of rock massive and they are usually investigated by seismic methods in situ. The process of rock fracturing can be modelled in laboratory by loading tests and investigated by seismoacoustic method. In this contribution we focus on the relation of rock fracturing process to the orientation between their texture elements and applied uniaxial loading.

Series of tests were carried out on migmatite samples from locality Skalka, Czech Republic, possible site for deposition of radioactive and other hazardous waste. This migmatite can be characterised by sharply defined visible plane-parallel texture – foliation. The texture of migmatite causes anisotropy of longitudinal elastic wave velocity, as was confirmed by ultrasonic sounding in 132 independent measuring directions on spherical sample at several levels of confining pressure.

A special computer-controlled servo-hydraulic loading system made by the MTS Company, USA, specifically adjusted for long-term testing was used for sample loading. Rock samples were exposed to uniaxial loading up to failure and the duration of the tests was up to 10 hours. Tests were carried out under different regimes of stress-strain conditions, controlled deformation and or controlled acting force regime. The mutual orientation of applied force and the foliation of migmatite was chosen 0, 45

and 90 degrees. During the rock sample loading the ultrasonic emission was monitored by digital eight channel recording system AMSY5 equipped with a net of eight broadband sensors. These sensors were used for periodical ultrasonic sounding of samples during their loading too. Wave pattern analysis of ultrasonic sounding was used for determination of the longitudinal elastic wave velocity and its anisotropy, energy of passing wave and its frequency contents.

The time analysis of changes in longitudinal wave velocity and maximum and minimum velocity directions were used for investigation of the relation of rock fracturing process to the orientation between its texture elements and applied uniaxial loading. The obtained results can be used for interpretation of wave velocity anisotropy measured in situ. The changes in energy and frequency content of passing seismic waves also reflect the changes of stress state and extent of rock material fracturing. It is possible to use them for comparison of fracturing under different type of loading regime – with controlled deformation or with controlled acting force.

Based on the results achieved, and after comparing with deformation characteristics of measured samples, the wave pattern analysis has proved to be useful for evaluation of rock material fracturing state.