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Experimental studies the evolution of stress–strain state in structured rock specimens under uniaxial loading

Viktor Oparin, Pavel Tsoy, Olga Usoltseva, and Vladimir Semenov
Mining Institute, Novosibirsk City, Russian Federation (paveltsoy@mail.ru)

The aim of this study was to analyze distribution and development of stress–stress state in structured rock specimens subject to uniaxial loading to failure. Specific attention was paid to possible oscillating motion of structural elements of the rock specimens under constraints (pre-set stresses at the boundaries of the specimens) and the kinetic energy fractals.
The detailed studies into the micro-level stress–strain state distribution and propagation over acting faces of rock specimens subject to uniaxial loading until failure, using automated digital speckle photography analyzer ALMEC-tv, have shown that:
• under uniaxial stiff loading of prismatic sandstone, marble and sylvinite specimens on the Instron-8802 servo-hydraulic testing machine at the mobile grip displacement rate 0.02–0.2 mm/min, at a certain level of stressing, low-frequency micro-deformation processes originate in the specimens due to slow (quasi-static) force;
• the amplitude of that deformation-wave processes greatly depends on the micro-loading stage:
— at the elastic deformation stage, under the specimen stress lower than half ultimate strength of the specimen, there are no oscillations of microstrains;
—at the nonlinearly elastic deformation stage, under stress varied from 0.5 to 1 ultimate strength of the specimens, the amplitudes of microstrains grow, including the descending stage 3; the oscillation frequency f=0.5-4 Hz;
—at the residual strength stage, the amplitudes of the microstrains drop abruptly (3–5 times) as against stages 2 and 3;
• in the elements of the scanned specimen surface in the region with the incipient crack, the microstrain rate amplitudes are a few times higher than in the undamged surface region of the same specimen. Sometimes, deformation rate greatly grows with increase in the load.
The authors have used the energy scanning function of the deformation-wave processes in processing experimental speckle-photography data on the surface of the test specimen subject to loading until failure.