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Modeling of Thermo Acoustic Emission Memory Effect in Rocks of Varying Textures

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Abstract : The paper proposes a model of an inhomogeneous rock mass with initially random distribution of microcracks on mineral grain boundaries. It describes the behavior of cracks in a medium under the effect of thermal field, the medium heated instantaneously to a predetermined temperature. Crack growth occurs according to the concept of fracture mechanics provided that the stress intensity factor K exceeds the critical value of Kc. The modeling of thermally induced acoustic emission memory effects is based on the assumption that every event of crack nucleation or crack growth caused by heating is accompanied with a single acoustic emission event. Parameters of the thermally induced acoustic emission memory effect produced by cyclic heating and cooling (with the temperature amplitude increasing from cycle to cycle) were calculated for several rock texture types (massive, banded, and disseminated). The study substantiates the adaptation of the proposed model to humidity interference with the thermally induced acoustic emission memory effect. The influence of humidity on the thermally induced acoustic emission memory effect in quasi-homogeneous and banded rocks is estimated. It is shown that such modeling allows the structure and texture of rocks to be taken into account and the influence of interference factors on the distinctness of the thermally induced acoustic emission memory effect to be estimated. The numerical modeling can be used to obtain information about the thermal impacts on rocks in the past and determine the degree of rock disturbance by means of non-destructive testing.

Keywords : crack growth, cyclic heating and cooling, rock texture, thermo acoustic emission memory effect
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