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A Kaiser Damage-Memory Effect in Sandstone under Cyclic and Rotated Triaxial Stresses

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The paper describes the mechanisms and conditions for the Kaiser damage-memory effect in rocks subjected to a three-dimensional disproportional cyclic loading with changes in the rocks' shape and the orientation of the Lamé ellipsoid. The experiments with the cubic samples taken from polymictic sandstone were conducted on Triaxial Independent Loading Testing System with continuous recording of an acoustic emission (AE) signals. The results of a disproportionate triaxial compression under the developed two protocols, they are 4- and 9-cycle loading programs, have shown that a dominate mechanism of the damage memory effect in each ensemble of cracks (vectored differently) is the development of micro-cracks of opening fracture mode oriented subnormally to the minimum main stress. It was found that the Kaiser damage-memory effect is detected not so much to the fact of opening cracks, friendly oriented, as to a discrete growing (increase of length) of already existing and newly emerging micro-cracks. The experiments on the cyclic strain of the sandstone at constant average stress and a changing level of a stress deviator allow the authors to conclude that the Kaiser damage-memory effect is not influenced by the intensity level of a shearing stress forcing on the sample. The obtained results can be considered as a trigger for models development oriented to strain and destruction of rocks, considering the anisotropic nature of damage accumulation.

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