# On the influence of deformation mechanisms of different scales on regularities of response of shear fault zones under nonequiaxal compression loading

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**Introduction**. It is well known that stress state of geological media is nonuniform and complex and one of its main features are constrained conditions. Degree of constraint, determined through a value of applied stresses, greatly influences on deformation mechanisms and fracture regime of the medium. Significant parts of massifs, are in complex conditions, which could be characterized by the scheme "shear+compression". So, deformation of shearing fault zones takes place under nonequiaxial compression conditions. In this current study is the influence of relationship of normal and lateral pressures on the character of deformation and fracture of the geological medium under shear loading. An important feature of the structure of geological media is a multiscale hierarchical organization of the block structure. The structural blocks separated by a "surface relaxations", characterized by lower effective strength in comparison with the material blocks itself. This helps to alleviate the slipping along interblock interfaces and thus leads to occurrence of large number of additional degrees of freedom (mobility) fragments of the medium. Therefore it is important to analyze the role of the block structure of the medium, in particular, the processes of formation of discontinuities and cracks growth at the interfaces of structural elements. This paper is devoted to the theoretical investigation of the effect of this factor on the deformation parameters, shear strength and other characteristics of the response of block-structured medium under constrained shear loading conditions. The study was carried out on the base of computer-aided simulation by movable cellular automaton method.

In this paper, regularities of response of block-structured media under shear deformation were studied on the example of system with blocks of the same size, separated by interfaces. Analogue interblock interfaces constituted zones with reduced strength and deformation characteristics. It promotes the localization and accumulation of irreversible strains on them. Note that in the case of a real geological medium these features are determined by highest content in the interface zones (in comparison with the blocks) of damages, porosity, etc. This model of block-structured medium was realized in the framework of two-dimensional version of the movable cellular automaton method. For the mathematical description of the elastic-plastic response of the blocks and the interfaces applied the model described in, in approximation, a similar to plain-stress state approximation. For automata that simulate the blocks linear response function was used. Response functions of automata that simulate the interfaces were characterized by a long section, corresponding to the accumulation of irreversible deformation. Initial stress state of the sample set by nonequiaxial compression by forces. Constrained specimen was subjected to a shear deformation with a small constant velocity. Degree of nonequiaxiality of compression of the specimen was characterized by the dimensionless parameter, which is defined as the ratio of the relative values of compresses in the horizontal direction force to a specific value of the vertical compressive force. This parameter characterizes the relative magnitude of compression of the system in the direction of shear.

The results of the theoretical investigation of the general regularities of behavior of block-structured, including geology, media in conditions of shear deformation have shown that an important factor in determining the relative contribution of different deformation mechanisms in the integrated mechanical response of the block system is the degree of nonequiaxiality of compression of the specimen. Thus, the increase in compressive stress in the direction of application of shear loading leads to reducing of contribution of deformation mechanisms of low scale levels, leading to the accumulation of irreversible deformation in the interblock interface areas. The reason for this is increasing of the degree of degradation of medium in the initial stress-strain state,

which leads to rapid formation of discontinuities in the most weak interfaces in the process of shear deformation. At high degrees of constraint formation of these "mesoscopic" flaws and their association into interblock cracks become the dominant deformation mechanism in the block-structured medium. Changing of the dominant mechanism of deformation is manifested as a change of the trend and in some cases of the sign of the integral characteristics of the deformation response of the medium, such as shear strength, the ultimate value of shear strain and changing of the width of shearing zone. In general, results suggest the possibility of introducing of some dimensionless parameter characterizing regime of the mechanical response of the medium during shear deformation. This parameter should be a function which links the applied stresses and rheological characteristics of the medium (in particular, the elastic limit of the material of interblock interfaces).

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