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Effect of Fluid Filtration on Relaxation of Stress in Saturated Porous Rocks

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To understand the process of emergence, accumulation and relaxation of stresses in the fault zone is necessary to consider the effect of heterogeneities of all types that there exists. In particular, an important role plays the behavior of fluid in saturated porous rocks.

In this paper, two-phase saturated porous media, which is under the influence of inhomogeneous bulk and shear stress is considered. Solid phase it is a skeleton of rock liquid phase is a viscous fluid. Such medium should be considered as a continuum of the physical characteristics that are random functions of coordinates. In particular, modulus of elasticity and viscosity are random functions of coordinates. The problem is to find the averaged equations to describe the behavior of the whole medium. For the solution of this problem is used modern method of averaging differential equations with random coefficients (Shermerhor T.D., 1977). This problem is statistically nonlinear and obtain its exact solution is impossible, so we have to make some approximations. In particular we have neglected the fluctuations of stresses in the solid phase. Based on statistical averaging of the equations of motion for the two-phase visco-elastic medium are obtained equilibrium equations

$$\lambda \left(grad\ div\ \vec{u} - grad\, p \right) + 2\mu \Delta \vec{u} = 0,$$

and equation of fluid filtration

$$\Delta p - \frac{\eta}{kK} \frac{\partial p}{\partial t} = 0.$$

Permeability coefficient in the equation of filtration is a physical characteristic of the environment and can be estimated based on the geometric structure of the pore space.

In this paper is made the theoretical analysis of differential equations using numerical methods. Filtration equation is an equation of parabolic type, similar to the heat equation. For their solving is used the Laplace transform. Numerical analysis of these equations leads to solutions that are localized in space and slowly change over time.

Based on this investigation, the following conclusions can be made. Inhomogeneous shear and volumetric strain arising during tectonic movements lead to the appearance of micro cracks in the rocks, thereby increasing permeability of medium. This in turn leads to an flow of fluid from the area of higher pressure to the area with less static stresses, thereby reducing the concentration of stresses in a fault. Thus we conclude that in the relaxation of stresses the decisive role played by the process fluid filtration. Thus we may assume that in the dry and impermeable rocks probability of accumulation of ruptured stress is higher than in permeable.

REFERENCES

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