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Reflection of processes of non-equilibrium two-phase filtration in oil-saturated hierarchical medium in data of active wave geophysical monitoring

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The processes of oil extraction from deposit are linked with the movement of multi-phase multi-component media, which are characterized by non-equilibrium and non-linear rheological features. The real behavior of layered systems is defined by the complexity of the rheology of moving fluids and the morphology structure of the porous medium, and also by the great variety of interactions between the fluid and the porous medium [Hasanov and Bulgakova, 2003]. It is necessary to take into account these features in order to informatively describe the filtration processes due to the non-linearity, non-equilibrium and heterogeneity that are features of real systems. In this way, new synergetic events can be revealed (namely, a loss of stability when oscillations occur, and the formation of ordered structures). This allows us to suggest new methods for the control and management of complicated natural systems that are constructed on account of these phenomena. Thus the layered system, from which it is necessary to extract the oil, is a complicated dynamical hierarchical system. A comparison is provided of non-equilibrium effects of the influence of independent hydrodynamic and electromagnetic induction on an oil layer and the medium which it surrounds. It is known that by drainage and steeping the hysteresis effect on curves of the relative phase permeability in dependence on the porous medium's water saturation in some cycles of influence (drainage-steep-drainage) is observed. Using the earlier developed 3D method of induction electromagnetic frequency geometric monitoring, we showed the possibility of defining the physical and structural features of a hierarchical oil layer structure and estimating the water saturation from crack inclusions. This effect allows managing the process of drainage and steeping the oil out of the layer by water displacement. An algorithm was constructed for 2D modeling of sound diffraction on a porous fluid-saturated intrusion of a hierarchical structure located in layer number J of an N-layered elastic medium. The algorithm developed for modeling, and the method of mapping and monitoring of heterogenic highly complicated two-phase medium can be used for managing viscous oil extraction in mining conditions and light oil in sub-horizontal boreholes. The demand for effective economic parameters and fuller extraction of oil and gas from deposits dictates the necessity of developing new geotechnology based on the fundamental achievements in the area of geophysics and geomechanics