Fluid dynamics in multi-ranked compound hierarchical structures with different physical and mechanical properties

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A method is proposed for active mapping and monitoring of a heterogeneous complex constructed two-phase medium, which can be used to control the production of viscous oil in mine conditions and light oil in sub horizontal wells. The requirements of an economically efficient and most complete extraction of hydrocarbons in the fields dictate the need to create new geotechnology for the development of oil and gas fields based on fundamental advances in geophysics and geomechanics. A new 2D modeling algorithm has been developed for diffraction of sound on porous moisture-saturated inclusions of a hierarchical structure, interleaved by plastic or elastic layers and located in the J-th layer of an N-layer elastic medium. An algorithm is constructed taking into account the possibility of moving hierarchical inclusions from layer to layer over time. If oil also has anomalous viscosity, to select the frequency filling of the acoustic impact on the reservoir area filled with this oil, it is necessary to use simulation results in hierarchical environments using the developed algorithms. The phase diagram method is used to evaluate the response of the fluid-saturated array to external active influence, changes in the state of the array associated with its structural adjustment. According to the logging of seism acoustic emission, there is a difference in the saturation of the reservoir in the well section. The positive dynamics of the SAE after acoustic exposure is associated with the reaction of the reservoir area saturated with oil, and negative with water. Only one interval of the 2625 - 2630 meter formation gave a positive dynamics of the induced acoustic emission and can be considered as promising for oil recovery. The results for the two processing methods coincided, but the phase diagram method gave more detailed information about the difference in possible oil recovery within the reservoir area, which is more consistent with the geological information. These results are the basis for building new mapping systems and monitoring geological systems. This is especially in demand for the mapping of oil and gas fields and the forecast of their effective return.