Geophysical Research Abstracts
Vol. 21, EGU2019-16393, 2019
EGU General Assembly 2019

Coupled Thermo-Elastoplastic model of the layered unconventional reservoirs and low-temperatures formations behavior

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One of the understudied problems of unconventional reservoirs development and operation are the failure mechanisms in the media containing plastic enclaves and layers. The importance of this problem is related to the development of unconventional reservoirs, which may contain a significant amount of clays and kerogen. Considering such formations in the areas of permafrost propagation also the common problem is soils thawing. Due to the interaction between constructions and foundation soil leads to the thawing and therefore, losing its bearing capacity. Apparently, under specific conditions, such formations' failure mechanism is of ductile nature and they are attended by remarkable plastic deformations. Thus, the question about failure mechanisms in the layered formations with great contrast in strength and elastoplastic properties and frozen soils arises.

In this research, we are considering the problem of stress-strain redistribution due to the long-term loading and time-dependent effects caused by the mechanical and thermal exposure on the formations. The model is stated as a coupled problem: thermal and mechanical.

As a result, we get the coupled model of the processes induced by the mechanical (exploitation and operation of reservoirs) and thermal (thawing or freezing of formations in the permafrost areas) exposures. Which allows solving a wide range of engineering tasks from hydraulic fracturing design and estimation of wellbore stability to the soils thawing, freezing, and thermostabilization.

New predictive technic which considers coupled thermo-mechanical problem for the elastoplastic model of soils behavior under specific conditions of layered unconventional reservoirs and low-temperatures.