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Analysis of physical, chemical and mechanical rock properties for effective multiscale modelling of reservoir processes and systems

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Reservoir processes and systems cover wide spatial range of scales from nanoscale physical and chemical transport in the pore to fluid migration in reservoir systems during formation of sedimentary basins. Thorough analysis of physico-chemical properties on each scale allows us to conclude that for adequate consideration of the majority of multiscale features it is necessary to solve a finite number of fundamental problems, which include:

- creation and development of a new concept of Representative Elementary Volume (REV), which takes into account the specificity of multiporous and multi-permeable multiscale cracked environment;

- development of a new approach to solving the problem on phase equilibrium of fluids and solid phase in pores and micropores;

- nano-chemical-mechanical determination of quantitative strength characteristics of rocks due to phase transformations of various inhomogeneities that make up a given rock.

These problems are interrelated [1,2]. The REV problem is of primary importance, both from conceptual and practical points of view. Success of modeling depends on correct selection of REV for different spatial scales. For example, instead of development of double porosity models for fractured rocks, it is possible to grind REV up to its homogeneity in relation to heterogeneities of interest. We support and develop the second approach. We believe, that the future belongs to the ability to describe multiscale processes using the same set of defining relations, in which the coefficients depend on the selected scale. When choosing the second approach, we put great attention to the development of new approaches to solving the problem of phase equilibrium of fluids and solid phase in pores and micro-nanopores. And, if in the first case we are talking about methods based on thermodynamically consistent systems of equations and numerical methods, intensively developed at present and based on minimization of basic thermodynamic potentials, for nanopores there is still a question of expanding the concept of thermodynamic equilibrium, where in the pore may be no more than 1-3-10 molecules [3].

Experiment on the nano-scale acquires a special meaning. Filtration, rock elastic and strength parameters play a desizive role for uch formations. And they may be changed due to field dtvelopment. Such works are currently in progress, however, we believe they are of an exquisitely fundamental nature and are still far from practical oil and gas applications.

[1].Мясников А.В. О моделировании экологически безопасной закачки флюидов в пласт // EAGE/SPE Joint Workshop 2015. Exploration of shale oil resources and reserves

[2]Yarushina V., Podladchikov Yu (De) compacion of porous viscoelastoplastic media, JGR, 2015, 120(6), 4146.

[3].Stroev N., Myasnikov A.V. Review of Current Results in Computational Studies of Hydrocarbon Phase and Transport Properties in Nanoporous Structures AIP Conference Proceedings, 2017, 1909, 020213-1–020213-6