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Features of determining the mineral composition of rocks of the Lower Berezovskaya subformation on the example of Kharampursky gas condensate field

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Abstract. In this paper, we consider the problems that arise when determining the mineral composition of the rocks of the Lower Berezovskaya subformation.

The Lower Berezovskaya reservoir is composed of clayey gaize with high porosity and low permeability; clay minerals are represented by smectites, which have a high swelling capacity in an aquatic environment. The main method for studying the material composition is the X-ray diffraction method, but it is complicated by the presence of amorphous silica and clays with low crystallinity and poor stoichiometry in the composition of the rocks of the Lower Berezovskaya subformation. A methodological approach is proposed for the study of the rocks of the Cognac-Santonian-Campanian Stage by X-ray diffraction analysis.

Key words: *X-ray diffraction analysis; sample preparation; the Lower Berezovskaya subformation; x-ray amorphous silica; opal-cristobalite-tridymite; leaching*

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Mechanical properties research of oil bearing sandstones from the Sheshminsk horizon

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Abstract: The results of studies of oilbearing sandstones' mechanical properties from Sheshminsk horizon (P_{2uf2ss}) are presented in the article. Also provided are the description of sandstones in outcrop, and according to core and geophysical data.

The parameters of strength and deformability of studied sandstones (deformation modules, Poisson's coefficient, angle of internal friction, cohesion) were determined by the triaxial compression test device results obtained in the engineering geology laboratory of ASOI. The triaxial compression device is a part of measuring computing complex "ASIS" which is used for automation of mechanical tests in devices for shear, triaxial and monoaxial compressions. All calculations and graphs were done automatically by "ASIS Report" program which is a part of measuring computing complex "ASIS".

Key words: *sandstone, Sheshminsk horizon, outcrops of rocks, Poisson's coefficient, angle of internal friction, cohesion, triaxial compression test device*

For citation: V.M. Gurevich, R.N. Burkhanov Issledovanie mehanicheskikh svoystv neftenasyshennykh peschanikov sheshminskogo gorizonta [Mechanical properties research of oil bearing sandstones from the sheshminsk horizon]. Neftyanaya Provintsiya, No. 2(26), 2021. pp. 18-30. DOI <https://doi.org/10.25689/NP.2021.2.18-30> (in Russian)

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Determination of maximum horizontal stress for terrigenous reservoirs of the Romashkinskoye field

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Abstract. The in-situ stress state of rock mass is described via three principal stresses; particularly, the vertical overburden stress and minimum and maximum horizontal stresses. Determination of maximum horizontal stress which is the intermediate between minimum horizontal stress and vertical overburden stress is the most challenging. Available methods to determine the magnitude of maximum horizontal stress are not always applicable due to deficiency of initial data required for estimates. For example, expensive open hole tests are often eliminated. Even when conducted, these tests do not always yield appropriate results. The paper considers the applicability of existing methods for estimation of maximum horizontal stress. Methods for estimation of maximum horizontal stress based on available data on vertical overburden stress, minimum horizontal stress and Poisson's ratio are proposed. Thus far, a systematic assessment of maximum effective horizontal stresses has never been made and no methods of stress determination have been developed for the conditions of the Romashkinskoye field.

Key words: *maximum horizontal stress, methods for estimation of horizontal stress, stress state, minimum horizontal stress, Poisson ratio, horizontal stress ratio, normal faulting regime, stress contrast, Romashkinskoye field*

For citation: I.I. Girfanov Opredelenie velichiny maksimal'nogo gorizontalnogo naprjazhenija dlja terrigennyh kollektorov Romashkinskogo mestorozhdenija [Determination of maximum horizontal stress for terrigenous reservoirs of the Romashkinskoye field]. Neftyanaya Provintsiya, No. 2(26), 2021. pp. 31-42. DOI <https://doi.org/10.25689/NP.2021.2.31-42> (in Russian)

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Adjustment of reservoir pressure maintenance system to peculiar geological structure of heterogeneous channel alluvial sediments confined to Cretaceous and Jurassic systems

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Abstract. To bring into development unswept reservoir areas and prevent nonproductive injection in channel sediments, a comprehensive approach is proposed to optimize waterflood performance in channel alluvial reservoirs confined to Cretaceous and Jurassic systems of the Republic of Kazakhstan, formed under conditions of low alluvial plain with relatively low energy flow. Based on the results of production data analysis and forecast modeling of several scenarios with different arrangements of production and injection wells, optimal well placement criteria were obtained, waterflood management options were proposed together with candidate production wells for conversion to injection, optimal injection volumes and well operation modes were determined.

Key words: *channel alluvial sediments, Cretaceous and Jurassic systems, flow energy, field production data, reservoir pressure maintenance system, non-productive injection, waterflood system, unswept areas, production and injection wells, interference, productivity, increase of oil recovery factor, economic efficiency, geological and reservoir simulation model, fluid, water-oil displacement, production of oil reserves*

For citation: Z.S. Idiyatullina, T.S. Usmanov, A.R. Badamshin, E.K. Plaksin, E.Zh. Kaiypov Adaptacija sistemy podderzhaniya plastovogo davleniya (PPD) k osobennostjam geologicheskogo stroenija neodnorodnyh ruslovyh alljuvial'nyh otlozhenij, priurochennyh k Melovoj i Jurskoj sistemam mestorozhdenij [Adjustment of reservoir pressure maintenance system to peculiar geological structure of heterogeneous channel alluvial sediments confined to Cretaceous and Jurassic systems]. Neftyanaya Provintsiya, No. 2(26), 2021. pp. 43-55. DOI <https://doi.org/10.25689/NP.2021.2.43-55> (in Russian)

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Prospects for the application of radial oil drilling in the fields of the Udmurt Republic and neighboring regions

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Abstract. This article discusses the advantages of using the "Perfobur" technology over the already used methods of increasing oil recovery, such as hydrochloric acid treatment, large bottom-hole treatment and hydraulic fracturing. The summary result of the work is a proposal for the introduction in the territory of the Udmurt Republic of a promising method for increasing oil recovery of mechanical radial drilling using the "Perfobur" technology.

Key words: *field development, enhanced oil recovery, radial drilling, "Perfobur" technology*

For citation: V.N. Kuzmin, S.M. Martynov, A.I. Mingazov Perspektivy primeneniya radial'nogo burenija neftyanyh skvazhin na mestorozhdenijah Udmurtskoj Respubliki i sosednih regionov [Prospects for the application of radial oil drilling in the fields of the Udmurt Republic and neighboring regions]. Neftyanaya Provintsiya, No. 2(26), 2021. pp. 56-66. DOI <https://doi.org/10.25689/NP.2021.2.56-66> (in Russian)

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Strategies for prompt selection of candidates for sidetracking and horizontal sidetracking on the example of fields Western Siberia

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Abstract. The article presents strategies for prompt selection of candidates for sidetracking and horizontal sidetracking, which allow choosing the best formation zones for drilling. Modern software systems, such as IS "RN-KIN", make it possible to build up various assessment maps and look at the complex situation of an oil production facility. The most effective approach to finding candidates for sidetracking and horizontal sidetracking is the construction of a full-scale 3D reservoir simulation model and the location of the design boreholes according to the maps of residual recoverable reserves. However, in practice, there is not always the possibility and times for constructing models; therefore, the authors have developed a methodology for selecting candidates without constructing and adapting the reservoir simulation model. The main idea of the technique is to build a map for assessing the energy state of the reservoir based on changes in reservoir pressure during development, which allows you to determine the sections of the reservoir that are not involved in development. The complex map uses a number of criteria that take into account both accumulated and current well performance. The proposed approach has been tested in the fields of Western Siberia of various producing companies and has shown its applicability.

Key words: *sidetracking, prompt selection of candidates, search for stagnant formation zones*

For citation: M.I. Maksyutov, E.R. Agishev, L.M. Zhdanov, M.A. Fathlislamov Strategii operativnogo podbora kandidatov na ZBS i ZBGS na primerah mestorozhdenij Zapadnoj Sibiri [Strategies for prompt selection of candidates for sidetracking and horizontal sidetracking on the example of fields Western Siberia]. Neftyanaya Provintsiya, No. 2(26), 2021. pp. 67-81. DOI <https://doi.org/10.25689/NP.2021.2.67-81> (in Russian)

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Development of mobile oil reserves from the Yamashinskoye oil field Vereiskian single-pay and lithologically screened reservoirs based on results of geological and reservoir modeling

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Abstract. The paper presents results of the geological and reservoir modeling of the Yamashinskoye field Vereiskian reservoirs. The fluidal model was matched for production history, and the results of history matching were used to predict key performance indicators. The results of history matching and the calculated production performance demonstrate good agreement between the numerical model and the actual development target. Hydrodynamic calculations included the effect of EOR/IOR operations in the forecast development period. The model shows that by the end of development, the distribution of specific mobile oil in reservoirs with common contact is more uniform compared to the lithologically screened reservoirs. By the end of development, the oil displacement efficiency in reservoirs with common contact is by 4% higher vs. the lithologically screened reservoirs, which can be explained by greater propagation of moving contacts in the former case.

Key words: *field, pay zone, structural framework, geologic cross-section, geological and reservoir (fluidal) model, mobile oil reserves, oil displacement efficiency, residual oil saturation, history matching, water injection, cumulative oil production, oil production rate*

For citation: R.Kh. Nizaev, R.F. Davletshin, A.R. Tolstoguzova, M.R. Yamgutdinov, M.T. Khannanov Vyrabotka podvizhnyh zapasov nefti iz zalezhej s ploshhadnym rasprostraneniem i s litologicheskim ogranicheniem neftenosnyh kollektorov verejskogo gorizonta Jamashinskogo neftjanogo mestorozhdenija na osnove ispol'zovanija geologicheskogo i gidrodinamicheskogo modelirovaniya [Development of mobile oil reserves from the Yamashinskoye oil field Vereiskian single-pay and lithologically screened reservoirs based on results of geological and reservoir modeling]. Neftyanaya Provintsiya, No. 2(26), 2021. pp. 82-99. DOI <https://doi.org/10.25689/NP.2021.2.82-99> (in Russian)

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Multi-objective optimization using artificial intelligence techniques in reservoir modeling

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Abstract. Optimization of petroleum reservoir development requires a robust numerical field model that allows for prediction of system response to various field development scenarios. Deterministic reservoir model can be considered reliable enough only once the model has been history matched. That is the model should be able to match field-wide historical production data. History matching (numerical tuning) is the most labor-intensive step of reservoir simulation modeling. History matching is time-consuming and is generally based on trial-and-error procedure. This is the most complicated step in reservoir simulation study. The main limitation for application of these algorithms is computation time required for assessment of objective relationship for each simulation run. The paper considers computer-based system for identification of reservoir numerical model parameters. The paper also looks into the application of general-purpose optimization methods for decision making, analysis of sensitivities and relationships between target values. History matching is presented as the optimization process, i.e. the search for the objective function of discrepancy between estimated (actual) and simulated data followed by minimization of the objective function. Combination of supplementary methods and optimization theory can significantly reduce the time required to history match a model.

Key words: *optimization, history matching, numerical model, oil reservoirs, natural hydrocarbon systems, uncertainty assessment, evolutionary methods, multi-objective optimization*

For citation: S.A. Aleksandrov, R.Kh. Nizaev, M.T. Khannanov Mnogocelelevaja optimizacija metodami iskusstvennogo intellekta v oblasti plastovogo modelirovaniya nefjtjanyh mestorozhdenij [Multi-objective optimization using artificial intelligence techniques in reservoir modeling]. Neftyanaya Provintsija, No. 2(26), 2021. pp. 100-115. DOI <https://doi.org/10.25689/NP.2021.2.100-115> (in Russian)

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Operation of wells with one-million-tonnes cumulative production in main Pashiyan Accumulation of Bavlinskoye oil field

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Abstract. In the main Accumulation of the Bavlinskoye oil field, twelve wells have been producing from the Pashiyan reservoirs since 1954, each with cumulative oil production over 1 mln tonnes. Several factors facilitated successful operation of the wells: favorable geological setting while drilling, timely water shutoff and EOR operations, waterflooding control and change of fluid flows, displacement of injection front into the periphery to divide the reservoir into water-oil and oil zones and to create a closed waterflooding system and an additional spot waterflooding for targeted stimulation of low-producing intervals.

Key words: *siltstone, sandstone, producing rows of wells, oil production, watercut, waterflooding control, cyclic waterflooding, bottomhole flushing, spot waterflooding*

For citation: R.I. Sheshdirov, I.N. Khakimzyanov, O.I. Khakimzyanova, L.V. Zatsarina, M.T. Khannanov Osobennosti jekspluatatsii skvazhin s millionnoj dobychej nefti na Osnovnoj zalezhi pashijskogo gorizonta Bavlinskogo mestorozhdenija [Operation of wells with one-million-tonnes cumulative production in main Pashiyan Accumulation of Bavlinskoye oil field]. Neftyanaya Provintsiya, No. 2(26), 2021. pp. 116-133. DOI <https://doi.org/10.25689/NP.2021.2.116-133> (in Russian)

Technical devices with application of water-swellaable compositions

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Abstract. To date, the technology of selective well completion has gained wide international acceptance. It provides for application of swellaable packers, in which the sealing element is made of elastomer capable to increase in volume upon contact with formation fluids. The essential advantages of such packers include:

- lack of moving parts in the design eliminates the need for special operations;
- self-healing capabilities.

In 2014, for the purposes of import substitution Tatneft's specialists successfully accomplished the task of development and implementation of indigenous water-swellaable packer for zonal isolation in horizontal hole section.

Specialists of PJSC Kvant further improved the technology and created a water-swellaable packer applicable for conditions of SAGD wells. Thermal water-swellaable packer is installed on production casing accessories of steam injection wells as an additional barrier in case of cement leaks.

The technology of selective zonal isolation in the cemented well interval using water-swellaable compositions has been successfully implemented. In 2016, specialists from TatNIPIneft Institute developed a behind-casing self-sealing cup packer (a cup with water-swelling rubber), which allows to restrict the pressure of oil-well cement column and fluid loss into productive formation, protect the cement sheath from failure during perforation and prevent cross flows behind casing during cement sheath development.

In the article, the authors propose several alternative technical solutions for application of water swellaable compositions.

Key words: *casing accessories, swellaable composition, well completion, swellaable elastomer, zonal isolation*

For citation: A.R. Iskhakov, I.M. Zaripov *Tekhnicheskie ustrojstva s primeneniem vodonabuhajushhego sostava* [Technical devices with application of water-swellaable compositions]. *Neftyanaya Provintsiya*, No. 2(26), 2021. pp. 134-144. DOI <https://doi.org/10.25689/NP.2021.2.134-144> (in Russian)

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Investigation of expanding grouting material that allows cementing casing strings with a single compound for the entire length

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Abstract. The article presents the results of studies of expanding grouting material with a density of 1700 kg/m^3 , which allows cementing casing strings for the entire length with a single composition, without exceeding the pressure of hydraulic fracturing of weak layers, while ensuring a high rate of structure formation and strength gain, which in turn will significantly reduce the time of WOC. The solution from the proposed grouting material has: zero water separation, reduced fluid loss, and the stone has improved physical and mechanical properties, the presence of an expansion effect. The specified properties of the mortar and stone allow to increase the tightness of the casing annulus.

Key words: *well cementing, lightweight cement slurry; cement stone expansion; annulus integrity.*

For citation: F.A. Agzamov, E.V. Belyaeva, V.O. Kaliev Issledovanie rasshirjajushhegosja tamponazhnogo materiala, pozvoljajushhego cementirovat' obsadnye kolonny odnim so-stavom na vsju dlinu [Investigation of expanding grouting material that allows cementing casing strings with a single compound for the entire length]. Neftyanaya Provintsiya, No. 2(26), 2021. pp. 145-153. DOI <https://doi.org/10.25689/NP.2021.2.145-153> (in Russian)

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Thermal methods for removing oil and oil products from soil

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Abstract: The article discusses several well-known thermal methods for removing oil and oil products from the soil. A detailed description of the operation of the device and a design diagram are presented. The undoubted advantage of the proposed installation is a self-sufficient closed process, during which, first of all, the light fraction of contaminants is removed, and then the final combustion of oil products occurs, while the condensates formed during the first stage are used as fuel for the multi-fuel burner, and the heat released by the installation, is used to operate the generator of an absorption refrigeration unit, which cools oil vapor after microwave heating, which significantly increases the energy efficiency of the unit.

Key words: *thermal method,, oil and oil products, oil and gas production, environment, hydrocarbon raw materials, natural resources, soil cleaning, ecology, energy efficiency, microwave heating.*

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