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**Features of the distribution of microelements
in the marine waters of oil and gas deposits
of the Bukhara-Khiva region – as exploration factors
and hydromineral raw materials**

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Abstract. The article examines the distribution features of trace elements in the marginal and aquifer waters of oil and gas fields in the Bukhara-Khiva oil and gas region and ways of using them as hydromineral resources. Formation waters in many hydrocarbon deposits are an essential element of oil and gas deposits. Underground mineral waters and brines are valuable mineral raw materials of interest for extraction with a standard content of a number of microcomponents and rare elements, as well as various salts.

In the Mesozoic deposits of the study area, formation waters are complex solutions saturated with various mineral salts, microcomponents and rare elements. Studying formation water samples from near-contact zones for the content of rare and trace elements makes it possible to trace changes in their concentration depending on the position of the sampled interval relative to the water-hydrocarbon contact, in plan and along the section. To jointly take into account the remoteness of the studied object from the deposit along the section and by area, the work uses graphs of spatial changes in the contents of rare elements relative to the position of the hydrocarbon deposit.

Based on the conducted research, it was established that in the distribution of microcomponents and rare elements in the reservoir-water-rock system, in the hydrochemical environment of displaced phase equilibrium for most microelements, a connection is manifested between their increased concentrations and hydrocarbon accumulations. The main manifestations of interaction are geochemical processes of distribution of reservoir components and the rocks enclosing them, into the surrounding groundwater. As a result of such mass transfer, water areoles of microelement dispersion are formed around the oil and gas reservoir. Such phenomena have been established in a number of structures and deposits in the region, especially in the formation waters of the Jurassic aquifer complex.

Key words: *microcomponents, microelements, underground water, hydromineral raw materials, deposits, region, basin, hydrocarbon, deposit, fields*

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Study of patterns and analysis of the formation of hydrocarbon deposits as an effective method of evidence base in the historical period (using the example of a group of fields in the Ustyurt oil and gas region)

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Abstract. This article is devoted to fundamental scientific research into the analysis of patterns of formation of hydrocarbon deposits, as an effective method of evidence base over a long historical period (using the example of a group of deposits in the Ustyurt oil and gas region).

The works of many scientists from Russia, China, Kazakhstan, Azerbaijan, Kyrgyzstan, Uzbekistan and many other leading scientific centers of the oil and gas industry in the world are devoted to identifying the patterns of formation of fields over a long historical period. This problem and the research methods and techniques used cause a lot of controversy and discussion among scientists. Many areas of this fundamental problem have not been fully studied, and each scientific school applies its own research methods. The use of effective methods for studying patterns and analyzing the formation of deposits over a long historical period is an urgent task of modern oil and gas geological science.

Taking into account the above, the authors of this article, when solving some aspects of this problem, consider the process of hydrocarbon formation as an effective method of evidence base. Therefore, to solve this urgent problem, the authors of the article conducted research and presented an attempt to study the patterns and analyze the formation of hydrocarbon raw material deposits (HC raw materials) in the Jurassic and Paleozoic deposits of the Shagyrylyk-Shegein group of fields (Republic of Karakalpakstan) using innovative techniques. Accordingly, the solution of this type of large-scale fundamental research makes it possible to determine the prospects for the development of the oil and gas sector, carrying out geological exploration work (GRR) and identifying deposits of hydrocarbon raw materials.

The use of innovative techniques for searching for oil and gas promising structures in Jurassic and Paleozoic deposits by identifying and tracing submerged local extension zones that control oil and gas shows and hydrocarbon deposits in Jurassic and Paleozoic deposits contributes to the effective solution of the tasks.

It should be noted that the process of searching for oil and gas deposits can be compared to the search for truth, where all forecasts, arguments and arguments must be based on an evidence base.

To carry out this kind of fundamental research, it is necessary to have theoretical (knowledge base) and practical experience based on a large amount of factual material. Also, to analyze them, use modern methods of geological modeling, methods of exploration and deep drilling of wells, information and communication technologies, software systems, tools and practical skills. It is also necessary to effectively apply modern standards of oil and gas geology.

Key words: *patterns, formation of deposits, search, Jurassic and Paleozoic deposits, area, structure, section, admixture, drilling, well, horizon, hydrocarbon, deep faults, blocks, interval, local extension zones, CDP-3D seismic exploration, Shagyrylyk-Shegeinsky group of fields, oil and gas potential, Ustyurt oil and gas region, migration, block*

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EDN QUENAN

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Development of search criteria for hydrocarbon traps in the Neocomian clinoform complex in the north of Western Siberia based on acoustic modeling

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Abstract. The main potential of the oil and gas potential of the north of Western Siberia is associated with the Neocomian clinoform complex. Due to the significant depths of the promising objects, their study by deep drilling remains extremely low to this day. In this connection, the question arises in the development of search criteria for finding traps in this section interval. This is the relevance of the presented work.

The article proposes a solution to the described problem using acoustic modeling of sequences of the Neocomian complex on the example of a typical section of the north of Western Siberia. The basis for the application of this technique is the separation of gas-saturated sandstones and clay interlayers in the field of acoustic impedance. A complicating factor in solving this issue is the weak drilling of the studied territory. As a result of the work, the advantages of using the algorithm are highlighted, as well as the possible risks and limitations of the method are highlighted. The results presented in the article make it possible to increase the efficiency of geological exploration in conditions of a shortage of well information.

Key words: *acoustic modeling, seismic facies analysis, classification, attribute analysis, acoustic inversion*

For citation: K.A. Senkina Razrabotka poiskovyh kriteriev lovushek UV v neokomskom klinofornom komplekse severa Zapadnoj Sibiri na osnove akusticheskogo modelirovaniya [Development of search criteria for hydrocarbon traps in the Neo-comian clinoform complex in the north of Western Siberia based on acoustic modeling]. Neftyanaya Provintsiya, No. 4(40), 2024. pp. 47-62. DOI <https://doi.org/10.25689/NP.2024.4.47-62>. EDN QUENAN (in Russian)

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EDN ZTCECP

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Conditions of formation and regularities of bitumen manifestation distribution in southern Uzbekistan

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Abstract. The article discusses the geological structure, structural and tectonic features, lithological and stratigraphic characteristics, material composition and conditions of formation of the newly discovered Sherabad bitumen occurrence in Southern Uzbekistan. Bituminous rocks are confined to Paleogene deposits, which are the product of formation of the most widespread oil deposits in the south of the republic. Structurally, the bitumen occurrence is located within the Sherabad-Sarykamysh uplift of the Surkhandarya megasyncline. In the area of the bitumen occurrence, the Paleogene deposits are strongly dislocated and crushed due to the influence of the Sherabad-Sarykamysh reverse-thrust fault, which runs in the sublatitudinal direction along the strike of the Paleogene deposits. The latter are represented by the Upper Paleocene, Lower, Middle and Upper Eocene, the Oligocene is absent. The bitumen occurrence is characterized by a complex structural relationship of the main Mesozoic-Cenozoic oil and gas complexes, and a wide distribution of thrust tectonics. Based on a comprehensive study of the Sherabad bitumen occurrence, the occurrence, formation conditions, and patterns of placement of natural bitumen deposits, as well as their genetic types, were determined. Within the study area, Bitumen manifestations are predominantly oil-bitumen-saturated rocks consisting of malt and asphalt.

Key words: *natural bitumen, oil, hydrocarbon, bitumen occurrences, accumulations, deposit, genesis, type, Paleogene, sediments, thickness, layers, megasyncline*

For citation: T.Kh. Shoimurotov, G.G. Jalilov, I.N. Khakimzyanov, Sh.K. Yusupov Usloviya formirovaniya i zakonomernosti razmeshcheniya bitumoproyavleniya v yuzhnom Uzbekistane [Conditions of formation and regularities of bitumen manifestation distribution in southern Uzbekistan]. Neftyanaya Provintsiya, No. 4(40), 2024. pp. 63-75. DOI <https://doi.org/10.25689/NP.2024.4.63-75>. EDN ZTCECP (in Russian)

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EDN KWHJYJ

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Technological risk and geological uncertainties minimization with the use of comprehensive lithofacies analysis and multivariate reservoir modeling technique

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Abstract. The methodology of complex lithofacial sedimentary rocks analysis with the subsequent multivariate geological and hydrodynamic reservoir model run is presented. The suggested approach gives opportunity to elaborate and significantly improve the oil production forecast and increase the investment attractiveness of the green assets development projects at the stage of detailed field exploration and appraisal. During the project realization, the sedimentological core description, the seismofacial analysis, the detailed well logs correlation tasks were carried out, three variants of the conceptual model corresponding to the quantiles P90, P50, P10 were substantiated.

Also the sensitivity analysis of initial geological oil reserves in place and the accumulated production volume to geological and hydrodynamic uncertainties variation was completed.

Key words: *core, facies, sedimentary rock, seismic attribute, conceptual model, geological model, uncertainty, sensitivity analysis, hydrodynamic model*

For citation: Yankova N.V., Topalova T.E., Snokhin A.A., Permyakov A.V., Popov A.Y. Snizheniye riskov i neopredelennostey v proyektnykh resheniyakh po razrabotke neftyanoy zalezhi s pomo-shch'yu lito-fatsial'nogo analiza i mnogovariantnogo modelirovaniya [Technological risk and geological uncertainties minimization with the use of comprehensive lithofacies analysis and multivariate reservoir modeling technique]. Neftyanaya Provintsiya, No. 4(40), 2024. pp. 76-103. DOI <https://doi.org/10.25689/NP.2024.4.76-103>. EDN KWHJYJ (in Russian)

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EDN PTYGQQ

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**The use of Kolmogorov neural networks
in prediction of reservoir properties
on the example of deposits of Western Siberia**

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Abstract. The applicability of using machine learning algorithms to solve problems in the field of seismic interpretation is an urgent issue. This article presents a comparison of the results of testing machine learning algorithms integrated into IP-Seismic software. The obtained results can be used to build trends in the modeling process, evaluate various scenarios and analyze the spread of initial geological reserves.

Key words: *neural networks, seismic exploration, prediction, reservoir property, geological model*

For citation: G.V. Khusainov, A.S. Kovalkova Ispol'zovaniye neyronnykh setey Kolmogorova pri prognozirovanii kollektorskiikh svoystv na primere mestorozhdeniy Zapadnoy Sibiri [The use of Kolmogorov neural networks in prediction of reservoir properties on the example of deposits of Western Siberia]. Neftyanaya Provintsiya, No. 4(40), 2024. pp. 104-120. DOI <https://doi.org/10.25689/NP.2024.4.104-120>. EDN PTYGQQ (in Russian)

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EDN IXVFLO

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The strategy of selecting the optimal system and technology for the development of low-permeability carbonate reservoirs in Eastern Siberia

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Abstract. Currently, the issue of developing little-studied promising oil reserves associated with new oil and gas regions of Eastern Siberia is becoming more and more urgent. At the same time, significant depths of occurrence, low permeability, complex geological structure and multiphase fluid saturation are complicating factors. In the present work, the analysis is performed for deposits of the Preobrazhensky horizon.

For most fields, the Preobrazhensky horizon is in the stage of trial operation, pilot industrial work, or is just beginning to be put into commercial development, in connection with which it can be noted that there is insufficient experience working with the B₁₂ formation.

Practical development experience is available at single fields. At the same time, water injection is associated with difficulties in maintaining pick-up - in conditions of low permeability, it becomes necessary to increase the injection pressure above the pressure of the hydraulic fracturing, which will negatively affect the dynamics of watering when placing rows across.

Key words: *carbonate reservoirs, TRIZ, Preobrazhensky horizon, horizontal wells, MGRP, hydrodynamic model*

For citation: O.A. Bondarenko, D.V. Grandov, Yu.A. Plitkina, M.P. Sorokina Strategiya podbora optimal'noy sistemy i tekhnologii razrabotki nizkopronitsayemykh karbonatnykh kollektorov Vostochnoy Sibiri [The strategy of selecting the optimal system and technology for the development of low-permeability carbonate reservoirs in Eastern Siberia]. Neftyanaya Provintsiya, No. 4(40), 2024. pp. 121-136. DOI <https://doi.org/10.25689/NP.2024.4.121-136>. EDN IXVFLO (in Russian)

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EDN GPVIYD

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Improving the efficiency of the development of returnable/ secondary facilities using the example of BV₃ facility

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Abstract. At the current stage of oil field development, there is an increase in the share of hard-to-recover oil reserves localized in low-permeability reservoirs, as well as in formations complicated by water-oil zones. Stabilization and growth of oil production at development of multilayer fields can be ensured by creation and use of new technological solutions for development of residual oil reserves by increasing the efficiency of development of return / secondary objects.

Determination of zones with localization of residual mobile oil reserves remains a complex process, which does not always take into account the peculiarities of the geological structure of the development objects and the actual operating modes of wells. As a consequence, an integrated approach is important to achieve positive results.

This paper updates the geological model, identifies zones and areas with concentration of residual oil reserves in reservoirs with deteriorated properties. The geological and field analysis of the BV₃ object in the zones with current mobile reserves promising for geological and engineering operations was performed. Evaluation measures were selected and successfully implemented to clarify the current saturation and productivity of the BV₃ target reservoir. The program of geological and engineering operations to improve the development of the BV₃ object was drawn up and accepted for implementation.

Key words: *development object, enhanced oil recovery, sidetracking, horizontal well (HH), production analysis, geological and technical measures (GTM), filtration-capacity properties (FEP), field geophysical survey (FGS), production string (PS)*

For citation: R.I. Fazlullin, O.V. Kolnogorova, I.V. Ryabov, A.A. Mikhaylovsky, N.V. Nosov *Povysheniye effektivnosti razrabotki vozvratnykh/vtorostepennykh ob"yektov na primere ob"yekta BV₃ [Improving the efficiency of the development of returnable/secondary facilities on the example of the BV₃ facility]. Neftyanaya Provintsiya, No. 4(40), 2024. pp. 137-161. DOI <https://doi.org/10.25689/NP.2024.4.137-161>. EDN GPVIYD (in Russian)*

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EDN FOTWAC

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Approach for preparation and study of recombined model of reservoir oil for core experiments

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Abstract. The paper presents a methodology for preparing a recombined gas-saturated model of reservoir oil for multiphase flow core studies. The issues of substantiating the composition of the gas mixture, selecting gas-oil ratio and saturation pressure, quality control of recombined samples and methods of their study are covered. The described laboratory experiments were performed using an original equipment layout for complex core flow studies. The results of the laboratory experiments are compared with numerical calculations with a PVT simulator. The necessity for using a gas-saturated model of reservoir oil for flow studies is justified.

Key words: *reservoir oil model, recombined sample, PVT studies, laboratory experiment, PVT simulator, gas-saturated oil, gas-oil ratio, saturation pressure, oil field development*

For citation: I.I. Ibragimov, I.M. Indrupskiy, I.R. Kamalov, M.V. Yanaykin, A.A. Gibadullin Metodika prigotovleniya i issledovaniya rekombinirovannoy modeli plastovoy nefti dlya fil'tratsionnykh eksperimentov [Approach for preparation and study of recombined model of reservoir oil for core experiments]. Neftyanaya Provintsiya, No. 4(40), 2024. pp. 162-185. DOI <https://doi.org/10.25689/NP.2024.4.162-185>. EDN FOTWAC (in Russian)

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EDN DDAWKL

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Approaches to carrying out geological and technical activities at the complex development formation of the Khamakinsky horizon in Eastern Siberia (using the example of the B₁₀ formation)

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Abstract. The article briefly describes some features of the geological structure of a complex development formation - the B₁₀ layer of the Khamakinsky horizon. The B₁₀ layer of the Khamakinsky horizon has the following specific features that negatively affect the state of the reservoir properties of the layer: hydrophobicity, anhydritization, susceptibility to aggression from aqueous solutions of well killing, bituminization.

The rationale for conducting geological and technical activities is presented, taking into account complicating factors and reservoir characteristics. The article shows that the technological efficiency of the proposed technologies and technical solutions is associated with the use of the most optimal killing fluids for the B₁₀ formation (in workover operations) on a hydrocarbon basis (commercial oil, reverse water-oil emulsion). The technology of gas-dynamic rupture of the B₁₀ formation is presented, which has demonstrated its effectiveness during experimental work on three wells in the study oil field. The complex effect consists of creating artificial fracturing and local heating of the well's Bottomhole zone, which made it possible to obtain an increase in oil flow rate from 3.5 to 5 tons/day and increase the productivity coefficient by 15 %.

Key words: *gas dynamic rupture, well killing fluid, well productivity coefficient, geological and technical activities*

For citation: Ya.A. Kruglov, O.V. Tyukavkina Podkhody k provedeniyu geologo-tekhnicheskikh meropriyatiy na slozhnopostroyennyy ob"yekt razrabotki khamakinskogo gorizonta Vostochnoy Sibiri (na primere plasta V₁₀) [Approaches to carrying out geological and technical activities at the complex development formation of the Khamakinsky horizon in Eastern Siberia (using the example of the B₁₀ formation)]. Neftyanaya Provintsiya, No. 4(40), 2024. pp. 186-205. DOI <https://doi.org/10.25689/NP.2024.4.186-205>. EDN DDAWKL (in Russian)

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EDN CKUVPB

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Modeling of selective acid treatment of a carbonate reservoir using soluble fibers

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Abstract. Degradation of hydrocarbon reserves in the fields of the Republic of Tatarstan, characterized by complicated geological conditions, high-viscosity, and paraffin oil, has made it impossible to ensure the high efficiency of traditional methods of treating the bottom-hole zone of the reservoir. The use of hydrochloric acid treatments causes a number of complications at the well, which leads to a decrease in its flow rate. The article discusses the possibility of using improved methods of selective acid treatments using soluble fibers, which make it possible to engage previously untapped productive low-permeability intervals, carried out model calculations of selective treatment on the Rockstim simulator and determined the capabilities of the compositions. Based on the results of modeling on the Rockstim simulator, the best BHT designs were obtained, analyzed and selected, including sequences of stages, volumes and rates of injection of chemical compositions, considering maximum economic profitability. Based on the results of the analysis of the work carried out, conclusions were drawn about possible directions for increasing the efficiency of acid treatment of wells.

Key words: *acid treatment, carbonate reservoirs, bottom hole treatment, soluble fibers, selective bottom hole treatment, oil production stimulation, additional oil production*

For citation: L.I. Garipova, A.A. Abramov, D.Yu. Kataeva Modelirovaniye selektivnoy kislotnoy obrabotki karbonatnogo kollektora s primeneniym rastvorimyykh volokon [Modeling of selective acid treatment of a carbonate reservoir using soluble fibers]. Neftyanaya Provintsiya, No. 4(40), 2024. pp. 206-216. DOI <https://doi.org/10.25689/NP.2024.4.206-216>. EDN CKUVPB (in Russian)

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EDN TLKBPJ

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Prospects for the use of machine learning and neural networks to predict the success of oil reservoir transfer and integration activities

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Abstract. The article considers an approach to increasing the success of oil reservoir transfer and integration activities through the use of machine learning and neural networks. Currently, the success rate of activities on the object of research leaves 50-60 %. During the geological and commercial analysis, 65 parameters were identified that affect the effectiveness of the activities. The training sample included 880 actual activities carried out for the translation and introduction of layers. The neural network model turned out to be the most accurate tool for predicting the success of events – the accuracy of forecasting on the validation sample was more than 80 %. The model was tested on a separate sample, including 50 activities for the transfer and incorporation of layers in 2023. According to the forecast results, 41 out of 50 forecasts turned out to be correct, which is 82 %. An increase in additional oil production from the wells of the test set is possible by 33,9 %. This approach will increase the accuracy of successful forecasts for events by 20-30 % compared to the existing approach, which helps to reduce the number of unsuccessful events and increase additional oil production.

Key words: *translation and communication, oil reservoir, forecasting, neural network, machine learning*

For citation: D.N. Zolnikov Perspektivy primeneniya mashinnogo obucheniya i neyronnykh setey dlya prognozirovaniya uspeshnosti meropriyatiy po perevodu i priobshcheniyu neftyanykh plastov [Prospects for the use of machine learning and neural networks to predict the success of oil reservoir transfer and integration activities]. Neftyanaya Provintsiya, No. 4(40), 2024. pp. 217-232. DOI <https://doi.org/10.25689/NP.2024.4.217-232>. EDN TLKBPJ (in Russian)

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The use of multidimensional tabulated models in optimizing the operation of gas fields in real time

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Abstract. Modern information systems for managing the operation of gas fields, developed as part of the digital transformation of oil and gas producing enterprises, must have high performance to solve optimization problems in real time. Therefore, the use of sufficiently complex models in the digital twin of the field (DTF), built in commercial simulators of technological processes of gas production, is not always able to provide the required calculation speed. The authors propose a new approach based on the use of simplified tabulated models of gas treatment plants in the DTF, which is implemented by initially constructing initial models in a technological simulator and performing multi-scenario calculations in specified ranges of parameter changes. The calculation results are summarized in n-dimensional spreadsheets – tabulated models that are connected to the DTF. The paper presents an algorithm for constructing and updating tabulated models during the operation of a field, as well as describes the procedures for direct and reverse search of output and input parameters. Testing of tabulated models for the real gas condensate field of PJSC NK Rosneft and comparison with calculations based on the initial model confirmed the efficiency of the proposed approach.

Key words: *gas field, integrated gas treatment plant, booster compressor station, digital transformation, digital twin of field, modeling of gas treatment plants, integrated model, tabulated model, automatic field control system, information system*

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Analysis and development of methods of integrated modeling

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Abstract. Simulation of hydro-dynamic model is the principal pillar for planning of development strategy, while specifics of modeling of gas and gas-condensate facilities associated with significant impact of gas gathering and processing network on well process flow pattern. This stipulates the necessity of integrated model simulation for «formation – wells – surface facilities» system.

The article represents detailed analysis of modern methods and principles of operation of instruments using for integrated modeling during hydrocarbon field development. Represented different approaches to formation and production gathering and processing system simulation as a part of integrated modeling process. Authors delineated basic trends of evolution of integrated modeling instruments allowing improving model speed and accuracy that will give an opportunity to make forecast of more complicated production system dynamics.

Key words: *integrated model, hydro-dynamic model, integrated proxy-model, Network option, gas production*

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Research of the demulsifiers in order to increase the efficiency of oil production in carbonate reservoirs

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Abstract. The article presents the results of laboratory studies to determine the efficiency of demulsifiers using artificial water-in-oil emulsions with oil from the Tournaisian stage of the Lower Carboniferous as an example. As a result of comparing the two reagents, it was found that the demulsifier based on nonionic surfactants (NIS) DE-1 was the most efficient for these samples. It differs from the reagent with NIS (DE-2) in its lower specific consumption, solubility in both water and oil, which allows it to be used in direct and inverse emulsions, and the absence of reaction with salts and acids. The issue of further studying the efficiency of demulsifiers for breaking emulsions remains relevant, since various complications often arise at the final stages of development, which can be prevented with the help of laboratory studies.

Key words: *water-in-oil emulsion, oil, demulsifier, emulsion stability, surface-active substance (surfactant), dehydration, microscopic studies, complications of oil production, oil emulsification, dispersity*

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**Peculiarities of well construction in the deepwater
shelf of the Gulf of Guinea (cote d'ivoire) and prospects
for improving drilling fluids for this environment**

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Abstract. The article provides a summary of the characteristics of deep-water drilling for wells on the shelf of the Gulf of Guinea (Côte d'Ivoire). Additionally, it presents field data on the drilled wells, identifies challenges, and suggests potential improvements to drilling fluids.

Key words: *enhancement, deepwater shelf, absorption, overpressure, high temperature, parameters, drilling, composition, drilling mud, reservoir, Alb, Côte d'Ivoire, Gulf of Guinea, inhibited drilling muds, hydrocarbon-based muds*

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Engineer-geologist-geophysicist Gorgun Vladislav Alexandrovich: mentor, inventor

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Abstract. The production and pedagogical activities of a bright representative of the Kazan Geological School are highlighted. The scientific and practical developments of the inventor are noted.

Key words: *geologist-geophysicist engineer, chief geologist, Tatneftegeophysics Trust, inventor, Kazan University, senior lecturer*

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