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Comparative assessment of porosity and permeability properties of different reservoir types using express core analysis: a case study of the Tas-Yuryakh field

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Abstract. The purpose of the article is to present the results of comprehensive express petrophysical core studies conducted at one of the wells of the Tas-Yuryakh oil and gas condensate field. The research covers three productive horizons: $Є_1bl^{o-ll}$ (Osinsky), Vbk_1^{bt} (Botuobinsky), and Vcr^{tl} (Talakhsky). The study obtains and analyzes a dataset including the measurements of effective porosity, absolute permeability, residual water and hydrocarbon saturation and carbonate content. As a result, fundamental differences in the reservoir properties of the studied horizons have been established, determined by their lithology and type of void space. The Botuobinsky horizon is characterized as a high-quality terrigenous reservoir with record permeability values of up to 837.1 mD and porosity of up to 27.5%. For the Osinsky horizon composed of carbonate rocks a diagnostic paradox has been revealed between the extremely low matrix permeability (0.42 mD) and clear signs of hydrocarbon saturation that indicates a fractured reservoir type. The Talakhsky horizon, despite the signs of residual bituminization, features isolated void space and low reservoir properties (permeability is around 3.5 mD), which excludes its commercial value in the studied area. The study focuses on the detailed analysis of the porosity-permeability relationship, which becomes a key tool for differentiating reservoirs by the genetic type of void space and their potential assessment. The research results are of significant practical importance for building a reliable geological model of the field and designing an effective development system.

Keywords: core, porosity and permeability (reservoir) properties, petrophysical characteristics, terrigenous reservoirs, carbonate reservoirs, express core analysis

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Сравнительная оценка фильтрационно-емкостных свойств разнотипных коллекторов по экспресс-исследованиям керна (на примере Тас-Юряхского месторождения)

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Резюме. Цель статьи – представить результаты комплексных экспресс-петрофизических исследований керна, выполненных на одной из скважин Тас-Юряхского нефтегазоконденсатного месторождения. Исследования охватывают три продуктивных горизонта: $Є_1bl^{o-ll}$ (Осинский), Vbk_1^{bt} (Ботуобинский) и Vcr^{tl} (Талахский). В ходе работы получен и проанализирован массив данных, включающий определения открытой пористости, абсолютной проницаемости, остаточной водонасыщенности и углеводородонасыщенности, карбонатности. В результате установлены принципиальные различия в фильтрационно-емкостных свойствах изученных горизонтов, обусловленные их литологией и типом пустотного пространства. Ботуобинский горизонт охарактеризован как высококачественный терригенный коллектор с рекордными значениями проницаемости до 837,1 мД и пористости до 27,5 %. Для Осинского горизонта, сложенного карбонатными породами, выявлен диагностический парадокс между крайне низкой проницаемостью матрицы (0,42 мД) и явными признаками углеводородного насыщения, что указывает на трещинный тип коллектора. Талахский горизонт, несмотря на признаки остаточной битуминизации, обладает изолированным поровым пространством и низкими фильтрационно-емкостными свойствами (проницаемость около 3,5 мД), что исключает

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его промышленную ценность на исследованном участке. Особое внимание в работе уделено детальному анализу взаимосвязи пористости и проницаемости, что стало ключевым инструментом для дифференциации коллекторов по генетическому типу пустотного пространства и оценки их потенциала. Полученные результаты имеют важное практическое значение для построения достоверной геологической модели месторождения и планирования эффективной системы разработки.

Ключевые слова: керн, фильтрационно-емкостные свойства, петрофизические характеристики, терригенные коллекторы, карбонатные коллекторы, экспресс-исследования керна

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Introduction

Effective and reliable assessment of reservoir porosity and permeability properties (PPP) is one of the key challenges at all stages of exploration and hydrocarbon field development. Reserve estimation, construction of accurate geological and hydrodynamic models, as well as the planning and optimization[1] of development strategies[2], directly depend on the precise determination of parameters such as porosity, permeability, and saturation character [1, 2]. Sections composed of different reservoir types – terrigenous and carbonate – which can drastically differ in void space structure and, consequently, in fluid flow conditions, present particular complexity [3, 4].

In this context, express petrophysical core analyses (EPCA) performed directly at the wellsite[3] during drilling are of special value[4] [5, 6]. They allow for the rapid acquisition of a primary dataset of high-quality rock properties, bypassing the lengthy stages of sample preparation and transportation to stationary laboratories [7]. Express core analysis data serve as a basis for operational decision-making, adjusting the projected section, and form the foundation for subsequent interpretation of well logging (WL) data. Without reliable petrophysical calibration provided by core data, well logging results can be misinterpreted, leading to the risk of underestimating or overestimating the productive potential of reservoirs.

The Tas-Yuryakh oil and gas condensate field is characterized by a complex geological structure with several productive horizons belonging to different lithostratigraphic complexes. The interval penetrated includes three such horizons: the Osinsky ($Є_1bl^{o-II}$), Botuobinsky (Vbk_1^{bt}), and Talakhsky (Vcr^{tl}). Their reservoirs potentially belong to different types: the carbonate rocks of the Osinsky horizon may be fractured, the terrigenous sandstones of the Botuobinsky horizon may be porous with high productivity (Fig. 1), while the rocks of the Talakhsky horizon, according to preliminary data, may exhibit low reservoir PPP [8, 9]. Such diversity requires detailed, differentiated study.

The purpose of this work is a comprehensive analysis of the reservoir PPP of the $Є_1bl^{o-II}$, Vbk_1^{bt}, and Vcr^{tl} horizons of the Tas-Yuryakh oil and gas condensate field based on data from a suite of express petrophysical core studies. To achieve this goal, the following tasks were addressed: determination of effective porosity, absolute permeability, residual water and hydrocarbon saturation, carbonate content, and surface properties of rocks; establishment of correlative relationships between key petrophysical parameters; differentiation of reservoirs by void space type based on analysis of the porosity–permeability relationship; and integration of the obtained results with well logging (WL) and production testing data for a

[1] Avchyan G.M., Bayuk E.I., Veinberg A.K., Dortman N.B., Zotova I.F., Ivanov V.N., et al. *Physical properties of rocks and minerals (petrophysics): A geophysicist's handbook*. 2nd ed., revised and expanded. Moscow: Nedra; 1984, 455 p.
[2] Nekrasov A.S. *Physics of rocks: A textbook*. Perm: Perm State National Research University (PSNRU); 2025,190 p.
[3] Burlin Yu.K., Ivanov M.K., Kalmykov G.A., Karnyushina E.E., Korobova N.I. *Petrophysical methods of core material studies (terrigenous deposits): A textbook. Book 1.* Moscow: Lomonosov Moscow State University; 2008, 112 p.
[4] Belokhin V.S., Ivanov M.K., Kalmykov G.A., Korost D.V., Khamidullin R.A. *Petrophysical methods of core material studies: A textbook. Book 2. Laboratory methods of petrophysical core material studies.* Moscow: Lomonosov Moscow State University; 2008, 113 p.

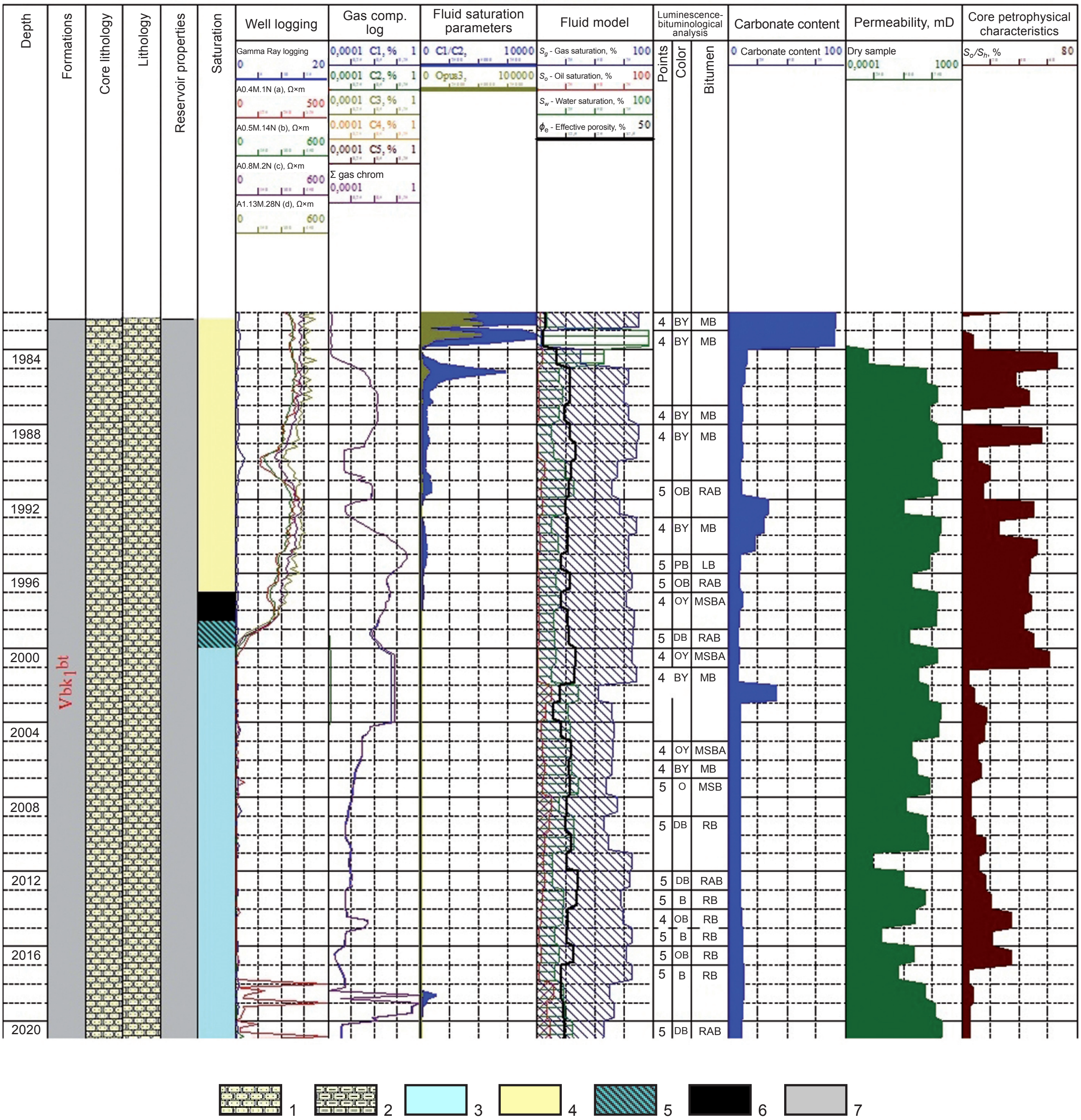

Fig. 1. Complex diagram of express petrophysical core studies for the Botuobinsky horizon:
1 – sandstones; 2 – clayey sandstones; 3 – water; 4 – gas; 5 – water + oil; 6 – oil; 7 – reservoir

Рис. 1. Комплексная диаграмма экспресс-петрофизических исследований керна для Ботуобинского горизонта:
1 – песчаники, 2 – песчаники глинистые, 3 – вода, 4 – газ, 5 – вода + нефть, 6 – нефть, 7 – коллектор

comprehensive assessment of the productive potential of each horizon.

Materials and methods

Assessment of rock reservoir PPP forms the fundamental basis for predicting productivity and estimating hydrocarbon reserves[5] [10]. The theoretical foundation for such studies is petrophysics, which establishes quantitative relationships between the physical parameters of rocks and their ability to store and transmit fluids.

[5] Ametov I.M., Kovalev A.G., Mirzadzhanzade A.Kh. *Physics of oil and gas reservoirs: A textbook.* Moscow: Nedra; 1992, 269 p.

The key parameters determining reservoir potential are effective porosity ϕ_e, which characterizes the volume of void space capable of containing fluids, and absolute permeability *k*, which reflects the rock's ability to transmit fluids under a pressure differential. These parameters are not independent; their interrelationship, described by correlative dependencies, serves as a critical diagnostic indicator of reservoir type[6] [11].

Porous terrigenous reservoirs typically exhibit a stable direct correlation between porosity and permeability, resulting from good connectivity of pore channels. In the case of fractured or vuggy reservoirs, represented by carbonate rocks, this relationship weakens or becomes non-obvious, as fluid flow occurs primarily through the fracture system, while matrix porosity may remain low [12]. Another critically important aspect is the saturation character of the rock, determined by residual water saturation S_{wr} and hydrocarbon saturation S_h. Analysis of these parameters makes it possible to differentiate commercially saturated reservoirs from zones with residual hydrocarbon saturation that has no economic significance [13].

Interpretation of reservoir property data is largely dependent on rock lithology, which predetermines both the initial reservoir characteristics and the direction of post-depositional alterations. Terrigenous reservoirs, typically represented by sandstones, usually form under relatively stable sedimentation conditions, ensuring high sedimentary homogeneity. Their reservoir properties are primarily determined by primary characteristics: grain size distribution, grain sorting, packing arrangement, and authigenic cement composition. Consequently, they exhibit more predictable and statistically stable correlative relationships between key parameters such as porosity and permeability, and their void space is mainly represented by intergranular porosity with relatively good connectivity. In contrast, carbonate reservoirs (limestones, dolomites) are distinguished by fundamentally different, often extreme heterogeneity, which begins at the sedimentation stage (biogenic origin, reef buildups) and becomes dramatically more complex during diagenesis and catagenesis [3, 14, 15]. Complex post-depositional processes – recrystallization, intense fracturing due to tectonic stress, vug formation through leaching, and secondary dolomitization – play a key role in shaping their final character. These processes not only modify but oftn ceompletely redistribute the void space, creating complex dual systems: a low-permeability matrix combined with high-permeability fractures and vugs. Such complex architecture leads to significant property anisotropy, non-linear relationships between void volume and flow capacity, and substantial local variations in parameters within a single horizon. Therefore, correct assessment of potential and construction of predictive models for carbonate reservoirs require not only standard core analysis but also mandatory consideration of fracturing data, results of specialized studies (e. g., capillary pressure), and application of integrated geophysical interpretation methods to differentiate the influence of different void types [16–20].

Thus, the theoretical basis for reliable reservoir assessment is not the isolated examination of individual parameters but a comprehensive analysis of the entire dataset – porosity, permeability, saturation, lithology, and their interrelationships – which allows for correct classification of reservoir type, identification of its spatial zonation, and construction of a representative petrophysical model that serves as the foundation for all subsequent technological and economic calculations.

In total, the study utilized 8 core samples, amounting to 153 porosity and density measurements and 125 determinations of other key parameters.

The petrophysical parameters determined during express core analysis directly at the wellsite, along with the main objectives for obtaining them, are presented below (Table 1).

Porosity ϕ_e was determined using the gravimetric method with an accuracy of ±0.5% and was applied for reservoir identification, calibration of well log interpretation, and saturation calculation. Absolute permeability *k* was measured

[6] Vakhromeev G.S., Erofeev L.Ya., Kanaykin V.S., Nomokonova G.G. *Petrophysics: A textbook.* Tomsk: Tomsk University Press; 1997, 462 p.

Table 1. Set of petrophysical parameters determined by express core studies
Таблица 1. Набор петрофизических параметров, определяемых при экспресс-исследованиях керна

Measured parameter	Equipment / Method	Measurement accuracy	Application
ϕ_e	Gravimetric method (liquid saturation)	±0.5%	Reservoir identification; calibration of well log calculations; calculation of S_{wr} and S_h; lithofacies characterization of rocks
K	Probe permeameter	±0.1 10^{-3} µm²	Assessment of rock permeability
ρ_b	Balance, gravimetric method	±0.05 g/cm³	Intermediate parameter for ϕ_e calculation
S_{wr}	FDA, liquid distillation (calculated)	±0.5%	Determination of liquid hydrocarbon content; determination of saturation character
S_h	FDA, liquid distillation (calculated)	±0.5%	
Carbonate content	Carbonatometer	±0.2%	Determination of cement type
Wettability	Visual, from droplet spreading	–	–
Luminescence	In rock	–	Presence of residual hydrocarbons as a direct saturation indicator
Bituminology (LBA)	In powd		

using a probe permeameter and served as a direct assessment of the fluid flow capacity of the rocks. Residual water saturation S_{wr} and hydrocarbon saturation S_h were established by the distillation method using a Fluid Diagnostics Apparatus (FDA-2) and were critically important for determining the saturation character. Additionally, carbonate content was determined to assess cement type, wettability was assessed visually to aid in the interpretation of electrical resistivity, and luminescence-bituminological characteristics were analyzed as a direct indicator of the presence of residual hydrocarbons.

Procedurally, the work involved sample selection and preparation followed by their subsequent conditioning, after which a cycle of measurements of the listed parameters was performed for each sample. The obtained data were systematized into summary tables and visualized as cross-plots to analyze interrelationships, among which the key was the porosity–permeability relationship, enabling the differentiation of reservoir types. An important aspect of the methodology was the integration of express core analysis results with well logging and wireline testing data, which ensured comprehensiveness and enhanced reliability of the final interpretation. The results of the core sample analysis are presented in Table 2 (average parameter values are shown).

Results and discussion

General characteristics of the penetrated interval. The porosity of sandstones in the penetrated interval (Vbk_1^{bt}; Vcr^{tl}), excluding carbonate varieties, ranges from 6.1 to 27.5%, while permeability varies between 4.98 and 833.26 mD (10^{-3} µm²). The relationship between porosity and permeability coefficients is shown in Fig. 2.

Based on the porosity–permeability relationship, two zones are distinguished: a zone with a chaotic cloud distribution and a zone with a direct k-ϕ_e dependence. A direct k-ϕ_e dependence indicates the presence of pore connectivity and is a sign of a reservoir. The absence of a k-ϕ_e dependence indicates the opposite. The conditional threshold is a permeability above which sandstone in this interval is considered a reservoir: 450 mD (10^{-3} µm²). Accordingly, to determine the saturation character, sandstone samples with $k > 450$ mD (10^{-3} µm²) should be analyzed.

The absence of data points for the Osinsky horizon in Fig. 1 is not a methodological error but reflects a fundamentally different type of reservoir properties. Unlike the Botuobinsky and Talakhsky horizons, for which reservoir parameters can be approximated by matrix porosity and permeability values and, accordingly, presented as a ϕ_e-k relationship, the Osinsky horizon functions as a predominantly fractured reservoir, where the main role in fluid flow and storage capacity

Table 2. Measured parameters for selected core samples
Таблица 2. Измеренные параметры для отобранных образцов керна

Measured parameter	Core number (with horizon indicated)							
	1 (Osinsky)	2 (Osinsky)	3 (Botuobin-sky)	4 (Botuobin-sky)	5 (Botuobin-sky)	6 (Botuobin-sky)	7 (Talakhsky)	8 (Talakhsky)
Interval, m	1533–1555	1555–1560	1968–1991	1991–2013	1981–2004	2004 – 2022	2022–2033	2076–2105
Rock type	Dolomite	Dolomite	Sandstone	Sandstone	Sandstone	Sandstone	Mudstone	Mudstone
ϕ_e, %	3.69	2.06	13.15	15.71	11.73	13.59	17.10	4.87
ρ_b, g/cm³	2.77	2.89	2.73	2.72	2.73	2.74	2.83	2.62
k, mD	0.47	0.24	343.89	625.24	624.86	622.41	2.6	4.9
S_{wr}, %	46.98	59.75	26.23	25.50	24.39	24.56	19.62	35.70
S_h, %	53.02	40.25	73.77	74.50	75.61	75.44	90.38	64.30
Carbonate content, %	92.75	81.96	55.32	9.53	24.81	89.19	11.36	13.48
Wettability	Hydrophobic	Hydrophilic	Hydrophilic	Hydrophilic	Hydrophilic	Hydrophilic	Mixed	Mixed

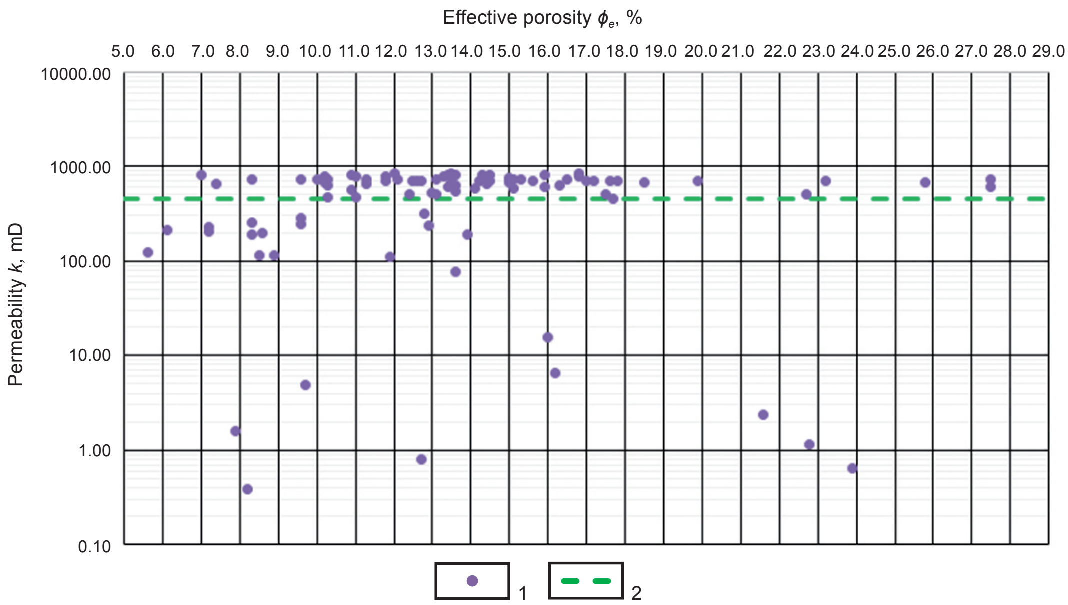

Fig. 2. Effective porosity ϕ_e / absolute permeability k ratio of sandstones in Vbk_1^{bt}–Vcr^{tl} formations:
1 – all measurements; 2 – conditional limit of the absolute permeability coefficient

Рис. 2. Соотношение коэффициентов открытой пористости и абсолютной проницаемости ϕ_e/k песчаников пластов Vbk_1^{bt}–Vcr^{tl}:
1 – все замеры; 2 – условная граница коэффициента абсолютной проницаемости

is played by the network of open fractures rather than by the matrix pore space. Under such conditions, matrix ϕ_e and k values derived from core are poorly representative of actual fluid flow and do not form a stable trend on the ϕ_e-k diagram. Therefore, including them in the general plot would mislead the reader: visually, it would create the impression of a "low-quality reservoir", whereas high productivity is specifically associated with the fracture system, which is accounted for at the stages of interpreting hydrodynamic logging and formation testing data.

Petrophysical characterization of the $Є_1bl^{o-II}$ (Osinsky horizon). In the core sampling interval of 1533–1560 m, the Osinsky horizon is composed of carbonate rocks exhibiting vertical lithological heterogeneity. In the interval 1533–1542 m, the rocks are represented by calcareous dolomites, brownish-gray, fine-crystalline, with massive and parallel-laminated textures. They are characterized by high density and strength, as well as an uneven conchoidal fracture. Subhorizontal bedding is observed, along the planes of which dark brown bitumen crusts are recorded. In the interval 1543–1549 m, clayey limestones are distributed, gray with a brownish tint, fine-crystalline, also with massive and laminated textures. In this interval, a single, gently dipping fracture (10–15° to the core axis) of closed type, up to 0.5 mm wide, is documented, along which bituminous films are also developed. The interval 1550–1560 m is composed of calcareous clayey dolomites, gray, from fine- to medium-crystalline, with massive texture.

The reservoir is of fractured type. Hydrocarbon shows were recorded at depths of 1539, 1545–1547, and 1556–1557 m. Luminescence-bituminological analysis revealed intense fluorescence: 3 points for brown gaseous luminescence, 3 points for brown oily luminescence, 4 points for orange-yellow massive fluorescence of bituminous associations.

During reservoir penetration, an increase in total gas readings from 0.0001 to 0.0403% was recorded. The gas composition is characterized by a predominance of methane (92.94%) with the following homolog content: C_2 – 4.79%, C_3 – 0.93%, C_4 – 0.74%, C_5 – 0.60%.

According to laboratory core studies, the dolomites and limestones of the horizon have low reservoir properties: effective porosity ranges from 1.5 to 5.8% (average 3.4%), permeability from 0.18 to 0.96 mD (average 0.42 mD). Analysis of residual saturation revealed a wide scatter of values: water saturation – 7.7–75.1% (average 50.3%), oil saturation – 0–25.9% (average 5.8%), gas saturation – 11.8–91.1% (average 43.9%). The hydrophobic nature of the rock surface was established.

Interpretation of well log data indicates the productive character of the reservoir: electrical resistivity varies from 8.69 to 53.95 Ω×m (average 28.66 Ω×m), calculated porosity – 11–12%, hydrocarbon saturation – 84–93%. Wireline testing results at a depth of 1545 m confirmed gas inflow.

Thus, comprehensive data from petrophysical core studies, well logging, and production testing unequivocally indicate the productivity of the $Є_1bl^{o-II}$ reservoir with a gas saturation character.

Petrophysical characterization of the Vbk_1^{bt} (Botuobinsky horizon). The lithological structure of the Botuobinsky horizon is characterized by vertical zonation. In the interval 1981–1983 m, the horizon is composed of dolomites; below 1984 m, a lithological change to terrigenous rocks occurs. The sandstones are brownish-gray and brownish-dark-gray in color, with a quartz composition, medium-grained texture, and massive structure. The rocks are characterized by uneven conchoidal fracture and reduced strength due to contact-type carbonate cement. An oily brown liquid with a distinct hydrocarbon odor is observed in the intergranular space. Luminescence-bituminological analysis shows intense fluorescence: 4 points for bluish-yellow luminescence and 5 points for orange-brown fluorescence of bituminous associations.

The upper part of the section (down to 1984 m) is characterized by poorer reservoir properties. During reservoir penetration, an increase in background gas readings from 0.0021 to 0.534% was recorded. The gas composition is characterized by a high methane content (93.1%) with a significant proportion of homologs: C_2 – 4.67%, C_3 – 0.93%, C_4 – 0.70%, C_5 – 0.60%.

Laboratory core studies revealed high reservoir properties of the sandstones: effective porosity ranges from 7 to 27.5% (average 14.4%), permeability reaches 837.10 mD (average 686.54 mD). Residual saturation analysis shows a predominance of the gas phase: water saturation ranges from 6.9 to 49.9% (average 24.4%), oil saturation from 0 to 14.7% (average 4.6%), gas saturation from 35.5 to 92.2% (average 71%). The hydrophilic nature of the reservoir was established.

From a depth of 1998 m, an increase in the intensity of luminescence in the ultraviolet spectrum is observed, with a color change from orange-yellow to light brown, indicating a change in the composition of bitumoids. The porosity-permeability relationship demonstrates a direct correlation (0.32 – moderate positive correlation), characteristic of terrigenous reservoirs in the region (Fig. 3).

Well logging results characterize the Vbk_1^{bt} reservoir as heterogeneous in its reservoir properties and saturation character. Electrical resistivity values demonstrate a significant range from 1.65 to 485.08 Ω×m, with an average value of 162.5 Ω×m, indicating variable hydrocarbon saturation and lithological heterogeneity of the section. Parameters calculated from well log data show: porosity, ϕ_e^{WL} of 10–14% (average 12%), permeability, k^{WL} of 289.5–779.6 mD (average 521.5 mD), and hydrocarbon saturation, S_h^{WL} of 7–98% (average 53%).

Wireline formation testing results allowed verification of the well log interpretation and revealed vertical zonation of fluid distribution:

– interval 1983.01–1996.1 m: gas influx established;

– interval 1997.1–1998.1 m: oil influx recorded;

– depth 1999 m: two-phase oil-water influx noted;

– interval 2000.1–2017.1 m: water-saturated character of the reservoir established.

Petrophysical characterization of the Vcr^{tl} (Talakhsky horizon). The lithological structure of the Talakhsky horizon is characterized by significant complexity and heterogeneity. In the interval 2077–2091 m, mudstones predominate with occasional sandstone interbeds. The interval 2092–2099 m is characterized by frequent interbedding of sandstones and mudstones. The most promising interval, 2100–2105 m, is composed of brownish-gray and brown sandstones of quartz composition, with a medium-grained texture, massive and weakly expressed banded structure. The rocks exhibit uneven conchoidal fracture and medium strength, due to pore-contact-type carbonate cement. Visual examination of the core reveals signs of hydrocarbons. Luminescence-bituminological analysis shows moderate to intense bituminization: 4 points for orange-yellow massive fluorescence and 5 points for orange fluorescence of bituminous associations.

During reservoir penetration, an increase in gas readings from 0.222 to 0.870% was record-

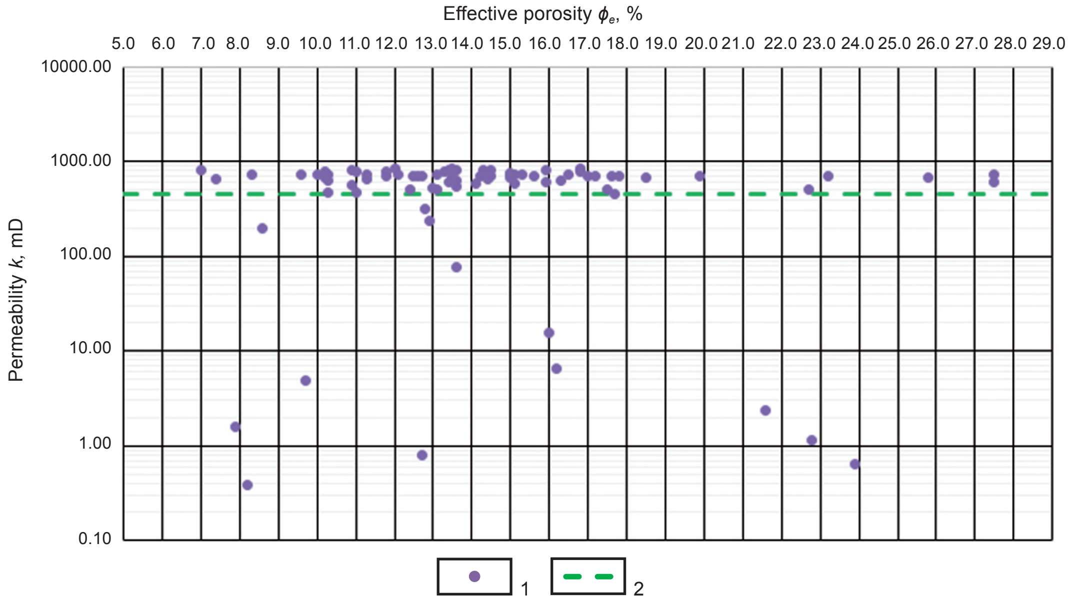

Fig. 3. Effective porosity ϕ_e / absolute permeability k ratio of sandstones in Vbk_1^{bt} formation:
1 – Botuobinsky; 2 – conditional limit of the absolute permeability coefficient

Рис. 3. Соотношение коэффициентов открытой пористости и абсолютной проницаемости ϕ_e/k песчаников в пласте Vbk_1^{bt}:
1 – Ботуобинский; 2 – условная граница коэффициента абсолютной проницаемости

ed. The gas composition is characterized by a dominance of methane (95.47%) with a negligible ethane content (4.53%) and the practical absence of heavier homologs (C_3-C_5 = 0%).

Express petrophysical core studies revealed low reservoir properties of the sandstones: porosity does not exceed 4.8% (average 2.8%), permeability varies in the range of 2.6–4.9 mD (average 3.5 mD). Residual saturation analysis shows a predominance of the gas phase: water saturation ranges from 15.13 to 42.07% (average 32.6%), oil saturation from 3.03 to 14.08% (average 7.18%), gas saturation from 48.18 to 80.82% (average 60.22%). The samples exhibit mixed wettability (hydrophilic and hydrophobic).

A critically important result is the absence of a correlative relationship between porosity and permeability (0.19), which indicates the isolated nature of the pores and the lack of connectivity between them (Fig. 4).

Well log data show a discrepancy with laboratory measurements: calculated porosity (7–14%) and permeability (9.6–124.9 mD) values are significantly overestimated relative to core data, which may be due to the influence of the clay component and the characteristics of the applied interpretation models. Calculated hydrocarbon saturation does not exceed 45%.

Wireline testing results at a depth of 2093.5 m confirmed the water-saturated nature of the reservoir – formation water influx was obtained.

Thus, comprehensive data analysis allows the conclusion that the sandstones of the Talakhsky horizon, despite the presence of residual hydrocarbon saturation, are characterized by low reservoir properties and isolated pore space, which excludes their productivity in the studied area. The discrepancy between core and geophysical data underscores the need for an integrated suite of research methods to reliably assess the potential of complex reservoirs.

The comprehensive analysis conducted on the three productive horizons revealed fundamental differences in their reservoir and fluid characteristics, which determine their industrial potential and development approaches. The Osinsky horizon ($Є_1bl^{o-II}$), represented by carbonate rocks, exhibits extremely low matrix porosity (3.4%) and permeability (0.42 mD); however, due to developed fracturing and signs of gas saturation, it is classified as productive. The Botuobinsky horizon (Vbk_1^{bt}) is characterized by high-quality terrigenous reservoirs with exceptionally favorable reservoir properties (porosity – 14.4%, permeability – 686.54 mD) and clear vertical zonation of fluid distribution: the

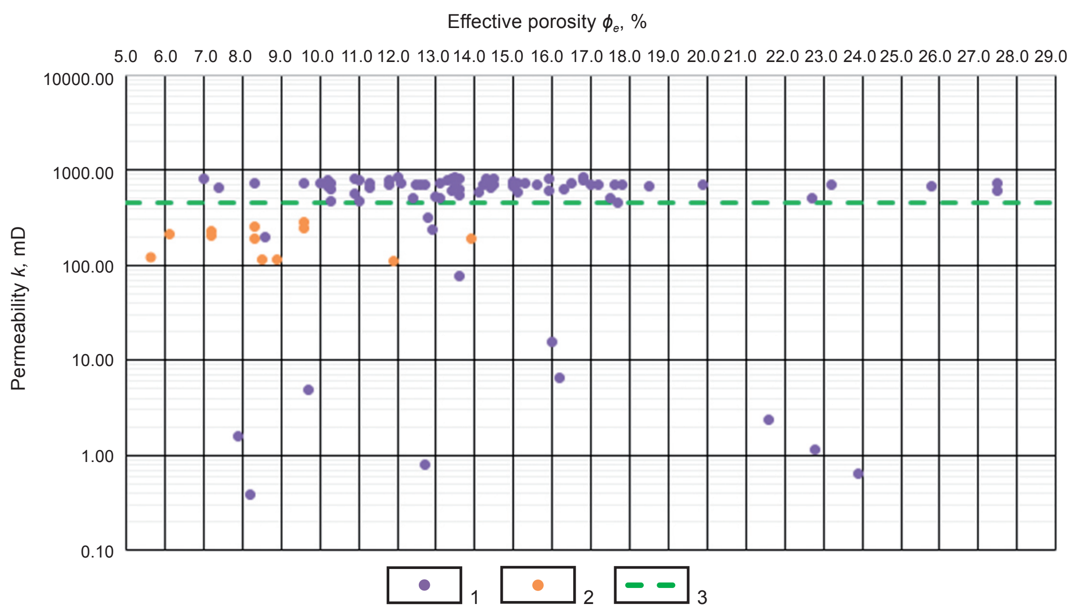

Fig. 4. Effective porosity ϕ_e / absolute permeability k ratio of sandstones in the Vcr^{tl} formation:
1 – Botuobinsky; 2 – Talakhsky; 3 – conditional limit of the absolute permeability coefficient

Рис. 4. Соотношение коэффициентов открытой пористости и абсолютной проницаемости ϕ_e/k песчаников в пласте Vcr^{tl}:
1 – Ботуобинский; 2 – Талахский; 3 – условная граница коэффициента абсолютной проницаемости

gas-saturated upper part (down to ~1997 m) is replaced by an oil-bearing zone underlain by water-saturated rocks. The Talakhsky horizon (Vcr^{tl}), despite the presence of residual hydrocarbon saturation, features isolated pore space and low permeability (3.5 mD), which excludes its commercial significance.

Conclusion

The comprehensive express petrophysical core studies conducted at a well of the Tas-Yuryakh oil and gas condensate field have provided a substantiated characterization of the reservoir properties of three productive horizons and allowed an assessment of their industrial potential.

As a result of the work, fundamental differences in the void space structure and flow capabilities of the studied reservoirs have been established. The Botuobinsky horizon is identified as a high-quality terrigenous reservoir with exceptionally favorable reservoir properties, demonstrating a direct correlative relationship between porosity and permeability and clear vertical zonation of gas and oil phase distribution. In contrast, for the Osinsky horizon, composed of carbonate rocks, a paradox of low matrix permeability coexisting with clear signs of hydrocarbon saturation has been revealed, indicating a fractured reservoir type where fluid flow occurs primarily through the fracture system. The Talakhsky horizon is characterized by isolated pore space and low reservoir properties, which, despite the presence of residual bituminization, excludes its commercial value.

The obtained results have important practical significance, providing a reliable petrophysical basis for constructing a geological model of the field, estimating reserves, and planning development schemes taking into account the specific characteristics of each reservoir type.

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