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# New methods of predicting and prospecting/exploration of hydrocarbon deposits to improve exploration performance in the Timan-Pechora oil and gas province

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**Abstract**

The Timan-Pechora oil and gas province remains rather promising for the discovery of new hydrocarbon fields and deposits, including large ones. However, in recent years, the efficiency of oil and gas prospecting and exploration has been rather low. At relatively high exploration maturity of prognostic oil resources (> 50%) and low exploration maturity of gas resources (about 30%), prospecting for new fields and deposits focuses on non-standard geological conditions of their occurrence. This, in turn, requires the development of new methods and technologies for the development of such resources and the simulation of hydrocarbon systems and specific deposits, reflecting their non-standard occurrence and structure, thereby making prospecting more complicated. Therefore, the determination of rational methodological approaches to prediction, prospecting, and exploration of hydrocarbon deposits represents an urgent scientific and applied task.

A comprehensive analysis of geological and geophysical characteristics of the promising targets based on the data of up-to-date seismic exploration and drilling ensures that complex traps are mapped by geophysical methods and prognostic resources and reserves of discovered deposits are estimated more precisely and confidently. Integration and analysis of geological and geophysical research materials using advanced methods and technologies can significantly expand oil and gas prospects and optimize the prospecting for productive traps and increase exploration efficiency by reducing the risk of unproductive wells.

This paper presents and discusses the options for predicting oil and gas potential and provides recommendations for prospecting hydrocarbon deposits using up-to-date methods and technologies for interpreting geological and geophysical data. The research targets were terrigenous and carbonate natural reservoirs in the northeastern part of the Timan-Pechora oil and gas province, including the shelf of the Pechora Sea, Izhma-Pechora and Khoreiver Basins situated in different structural and tectonic zones. The analysis of extensive geological information has revealed that these areas exhibit all the necessary conditions for the existence of unique geological features and the potential for the discovery of oil and gas deposits therein.

**Keywords**

Timan-Pechora oil and gas province, hydrocarbon deposit, resources, reservoir, impermeable bed, seismic exploration, well

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## ГЕОЛОГИЯ МЕСТОРОЖДЕНИЙ ПОЛЕЗНЫХ ИСКОПАЕМЫХ

Обзорная статья

# Новые технологии прогноза и поисков залежей углеводородов с целью повышения эффективности геологоразведочных работ в Тимано-Печорской нефтегазоносной провинции

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### Аннотация

Тимано-Печорская нефтегазоносная провинция остается достаточно перспективной для открытия новых месторождений и залежей углеводородов, в том числе крупных. В то же время в последние годы отмечается низкая эффективность поисково-разведочных работ на нефть и газ. При относительно высокой разведанности прогнозных ресурсов по нефти (> 50 %) и невысокой по газу (около 30 %) поиск новых месторождений и залежей смещается в сторону нестандартных геологических условий их залегания. Это, в свою очередь, требует разработки новых методик и технологий освоения таких ресурсов, построения моделей углеводородных систем и конкретных залежей, отражающих нестандартные условия их залегания и строения, а также усложнение поискового процесса. Поэтому определение рациональных методических подходов к прогнозированию, поискам и разведке залежей углеводородов представляет собой актуальную научную и прикладную задачу.

Комплексный анализ геолого-геофизических характеристик объектов по материалам современной сейсморазведки и бурения обеспечивает картирование геофизическими методами сложнопостроенных ловушек и более точную оценку прогнозируемых ресурсов и запасов обнаруженных залежей. Комплексирование и анализ материалов геолого-геофизических исследований с применением прогрессивных методик и технологий позволяют значительно расширить нефтегазовые перспективы, оптимизировать процессы поисков продуктивных ловушек и повысить эффективность геологоразведочных работ за счет рисков снижения непродуктивных скважин.

В статье авторы рассмотрели варианты прогноза нефтегазоносности и дали рекомендации поисков залежей углеводородов с применением современных методов и технологий интерпретации геолого-геофизических данных. Объектами исследований являлись терригенные и карбонатные природные резервуары северо-восточной части Тимано-Печорской нефтегазоносной провинции, включая шельф Печорского моря, Ижма-Печорской и Хорейверской впадин, расположенных в разных структурно-тектонических зонах. Анализ обширной геологической информации показал, что на этих площадях есть все необходимые условия существования уникальных геологических объектов и возможность открытия в них нефтегазовых залежей.

### Ключевые слова

Тимано-Печорская нефтегазоносная провинция, залежь углеводородов, ресурсы, коллектор, флюидоупор, сейсморазведка, скважина

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Demchenko N.P., Rostovshchikov V.B., Kolokolova I.V., Marakova I.A., Volkov D.S. New methods of predicting and prospecting/exploration of hydrocarbon deposits to improve exploration performance in the Timan-Pechora oil and gas province. *Mining Science and Technology* (*Russia*). 2022;7(4):274–286. https://doi.org/10.17073/2500-0632-2022-04-07

## Introduction

The Timan-Pechora oil and gas province exhibits an unique complexity and diversity of geological features as well as the conditions of their formation. Within the province, the potential for oil and gas is observed almost everywhere and throughout the entire sedimentary sequence, from Ordovician to Mesozoic sediments inclusive.

The main areas of exploration for new deposits here currently include:

a) **for oil**:

– Middle Ordovician-Lower Devonian oil-gas play with an extensive development of non-anticlinal, structural-stratigraphic, lithological, erosion traps within the Bolshezemelsky paleo-dome, Denisovsky trough, the Pechora Sea shelf;

– Permian-Triassic terrigenous oil-gas play with an extensive development of lithological traps of deltaic genesis within the northern part of the Timan-Pechora Province and its Arctic extension;

– The Visean-Lower Permian oil-gas play with bioherm, reefogenic and biostromal traps throughout the Timan-Pechora Province and its Arctic extension;

b) **for gas**:

– the main target is the Pre-Ural foredeep with the widespread development of large structural-tectonic traps in the central and internal zones of the foredeep;

– myogeosynclinal zones hidden under the Ural frontal folds may be a new non-traditional lines [1].

These are the key lines of the research described in this paper. Based on three examples, the authors demonstrated an algorithm for predicting and prospecting hydrocarbon deposits using modern methods and technologies for interpreting geological and geophysical data.

We have analyzed and interpreted more than 200 wells, 30,000 linear km of seismic exploration using the Common Depth Point (CDP) Method (2D), 900 km$^2$, 3D.

The used data processing and corresponding graphs were performed applying up-to-date geological, mathematical and graphical software packages: Kingdom Suite (SMT), Petrel (Shlumberger), IESX (Shlumberger Sparc GeoFrame), Paradigm Geophysical (Probe and Vanguard), Excel, CorelDRAW.

## Research Findings

### *Example 1. The use of the historicalandgenetic method for predicting traps and hydrocarbon deposits*

The assessment of the prospects of oil and gas potential of a territory on the basis of the historicalandgenetic method underlies almost all methods of predicting the oil and gas potential of the subsoil and is broadly used both in the Russian Federation and in foreign countries. Such well-known scientists as A.P. Afanasenkov, L.I. Bogorodsky, L.N. Boldushevsky, I.P. Varlamov, G.D. Ginzburg, A.I. Danyushevsky, S.V. Yershov, N.S. Kim, A.E. Kontorovich V.A. Kontorovich, Robert Lowkes, John Dolsen, Stefan M. Luti et al. The use of the historicalandgenetic method contributed significantly to the discovery and development of such deposits as Zapolyarnoye, Urengoy, Medvezhye, Yamburgskoye, Messoyakhskoye, Solyoninskoye, Yuzhno-Solyoninskoye, Pelyatkinskoye, Ushakovskoye, Deryabinsky, Vankor Group, Giddings, Black Giant (East Texas), and other deposits in Texas, Louisiana and Mississippi [2–4].

In the paper, the authors, based on the study of various factors in the formation of traps and deposits, propose to consider a systematic scientific approach to the historicalandgenetic method for predicting traps and hydrocarbon deposits, which consists in the analysis of events that took place in Permian and Triassic periods that affected:

1) tectonic-dynamic development of the investigated area;

2) sedimentation processes;

3) generation and accumulation of hydrocarbons;

4) reformation of hydrocarbon deposits during the Permian period, and then during the Triassic and Jurassic periods.

**The subject of the research.** The northeastern part of the Timan-Pechora oil and gas province, terrigenous deposits of Permian age (Fig. 1).

Sedimentation originates from the main source of ablation of terrigenous material in the Early Artian time from the Ural Orogen. The development of orogenic processes in the Urals gave rise to extensive regression, then in each period of time up to the Kazanian-Tatarian time, sedimentation conditions changed.

Regionally, in the early Artian time, carbonate sedimentation was gradually replaced by terrigenous sedimentation, and coastal marine conditions with carbonate-terrigenous sedimentation originated within the depressions of the Pre-Ural Foredeep; in the central part of the Varandey-Adzvinsky structuralandtectonic zone and the Kolvinsky megaswell, deep-water and shallow sea sediments were accumulated, and formation of organogenic structures took place. Deep-water sedimentation conditions occurred in the area of the present Korotaikhinskaya Basin. As terrigenous sedimentation developed over the investigated areas during the Permian period, a new sedimentation basin with coastal marine, deltaic, and alluvial sedimentation conditions formed [5].

At the zonal level, the sedimentation and post-sedimentation sub-stages of trap formation of coastal-marine, channel and deltaic origin in Artian-Kungurian and Ufian-Tatarian time are considered.

The Permian terrigenous sediments within the Korotaikhinskaya Basin are one of the main targets for prospecting for hydrocarbon deposits. The resulting oil inflow from these deposits in well 1-VK (Vorkutinskaya) indicates their high prospects.

In the investigated part of the Korotaikhinskaya Basin, time sections in the interval between the reflecting horizons (RH) I-II and A-I are characterized by a clinoform recording according to the wave pattern, which is identified with the formation of presumably deltaic Permian sediments (Fig. 2).

The Permian terrigenous clinoform complex constitutes a system of progradational clinoforms – cyclites that formed during the regressive phase of the Permian stage of the basin evolution, and is associated with the final orogenic stage of the Hercynian-Early Cimmerian cycle.

The clinoform complex was studied using six wells: 2-Zapadno-Korotaikhinskaya, 1-, 2-Reef, 1-Vorkutinskaya (VK), 1-Khavdeyskaya, 15-Labogeyskaya. Downhole information on them is incomplete, there are no data in the Perm part of the section: self potential (SP) in well 2-Zapadno-Korotaikhinskaya; acoustic logging (AK) – in wells 1-Khavdeyskaya, 1-VK; NGK – in wells 1-Khavdeyskaya, 1-VK. The quality of available materials for geophysical studies of wells was affected by the long research intervals and the long period of time from the moment the section was opened to the field geophysical survey research. The insufficient amount of core material also makes it difficult to conduct a facial-paleogeographic analysis of these sediments.

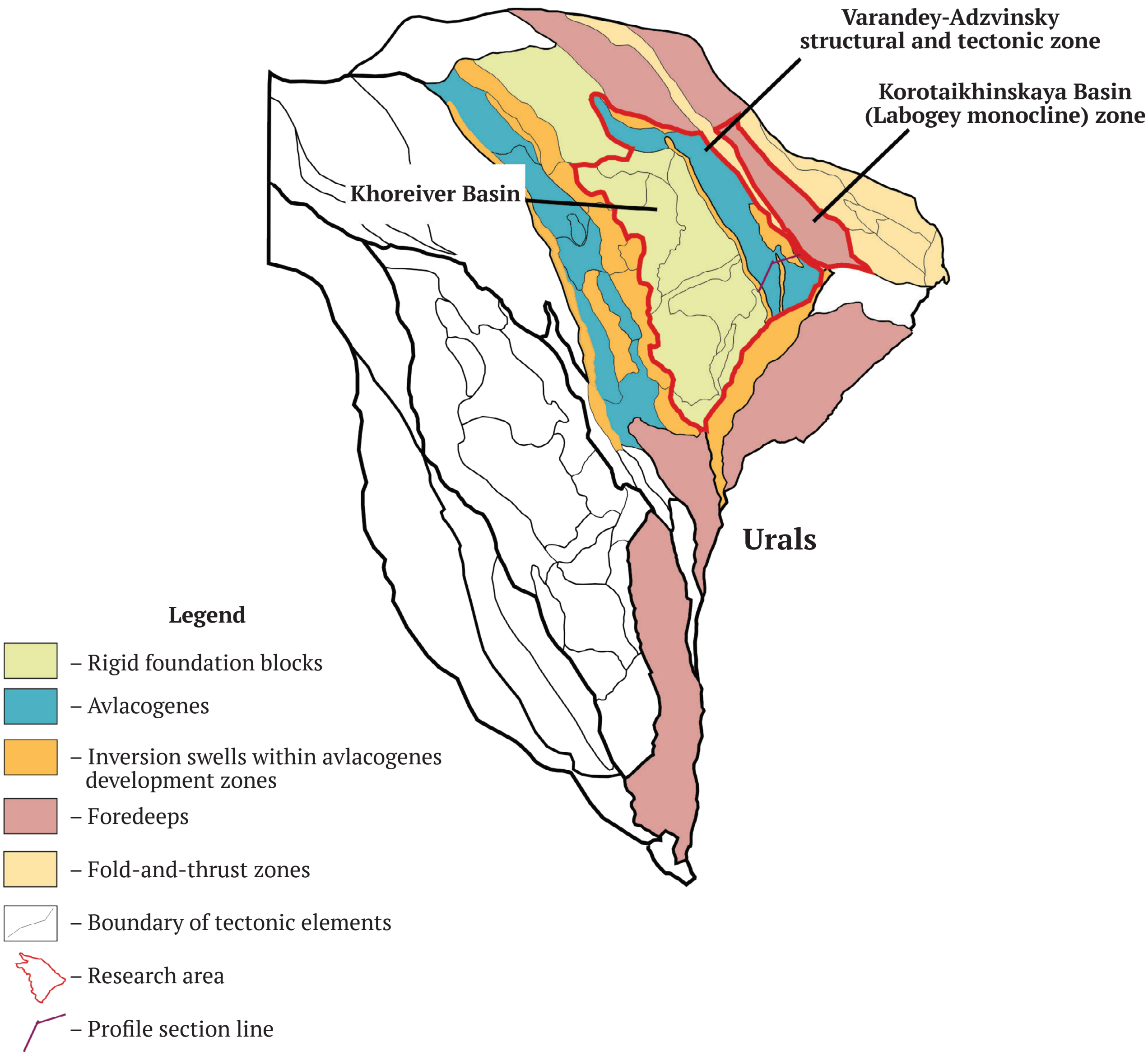


**Fig. 1.** An overview map of the investigated area (compiled by I. A. Marakova)

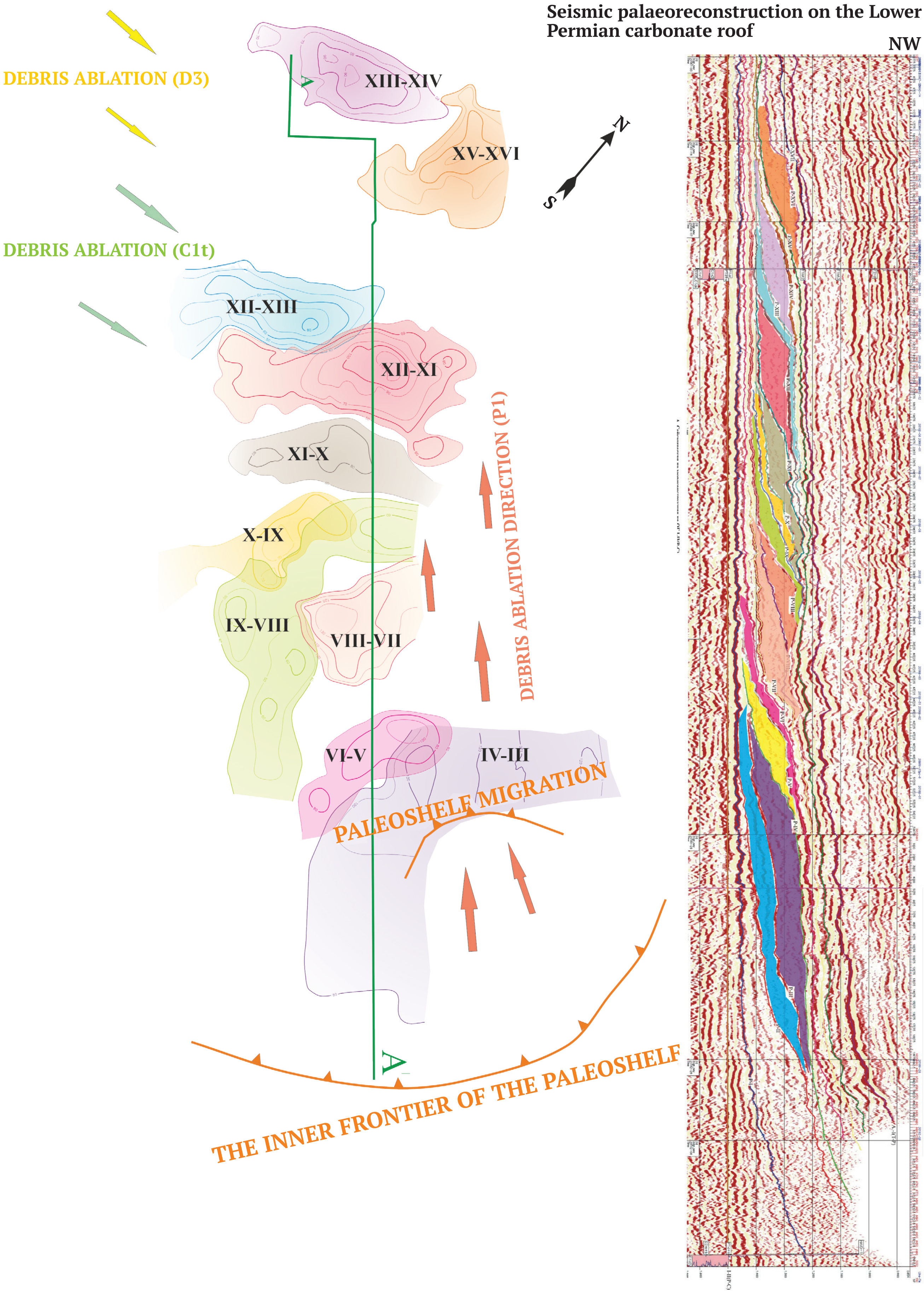


**Fig. 2.** Model for the formation of a progradational complex (based on materials from Severgeofizika)

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Since there are no equivalent deposits in Permian clinoform sediments in the Timan-Pechora oil and gas province, the methodology and prospecting criteria developed in the course of studying West Siberian clinoform sediments were used to identify promising targets in the Timan-Pechora province.

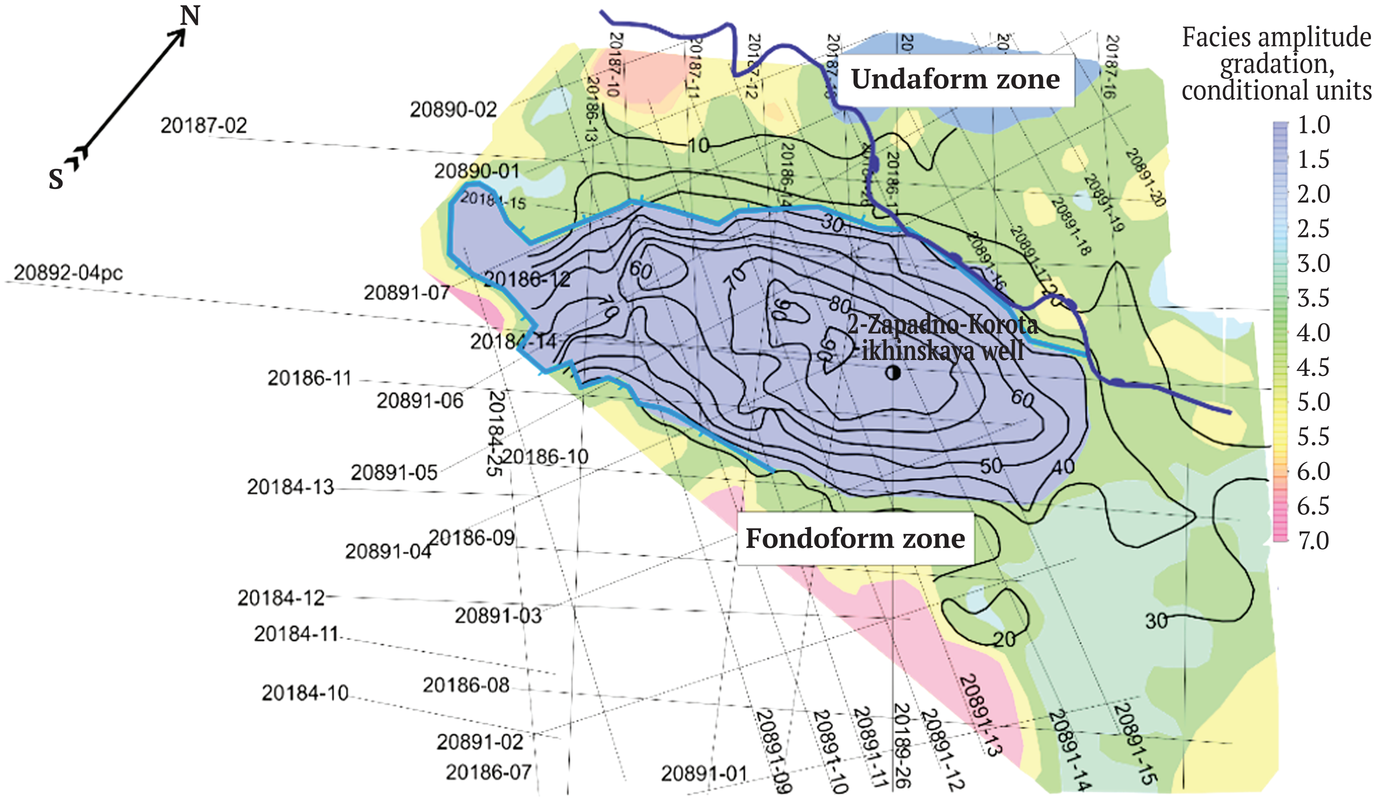
The clinoform complex is characterised by a complex structure, which is evident in the variability of reflections from profile to profile, the complex relationship between reflections in the shelf, slope, and foothills, as well as the variability of clinoforms along the strike, which is evident in the formation of locally developed zones of increased thicknesses, namely depocentres.

The presence of depocenters indicates the existence of a feeding canyon, through which the amount of sedimentary material introduced was more significant as compared to the periphery, and their configuration and extension suggest different intensities of the material processing and movement by currents along the slope.

Within the depocenter of the clinoform formed by the R-XIV and P-XIII reflecting boundaries, 2-Zapadno-Korotaikhinskaya well was drilled (Fig. 3). Core logging (interval 2,355.2–2,416.3 m) revealed the sequence primarily consists of interbedding of siltstone, dense strong and sandy mudstone with sandstone layers.

The P-XIV sigmoid seismic boundary surrounding this clinoform is expressed confidently and clearly. According to geophysical studies of wells, the roof of the sandstone stratum (2,323–2,334 m) is identified with this reflection. It is difficult to estimate the storage capacity and fluid content of the identified sandstone, since this interval is characterized by an incomplete range of geophysical logging, the absence of core and well tests.

Within this clinoform in the well, sandstone layers of low thickness (interval 2,362–2,376.4 m) saturated with bitumen-like viscous oil in sparse pores are observed.




Paleoslope base line

The boundary of the suggested lithological replacement (the strokes are directed towards the of clayey-aleuritic formations occurrence area)

Seismic profile line, pickets

40 Isolines of temporal thickness (ms) between reflecting boundaries P-XIII and P-XIV traced in the clinoform complex of Permian-age terrigenous sediments

**Fig. 3.** Map of seismic facies (based on the materials from Severgeofizika JSC)

Based on the calculations of the Komi Scientific Center of the Ural Branch of the Russian Academy of Sciences [6] and VNIGRI (All-Russian Petroleum Research Geological Exploration Institute) [7], Table 1 presents the extent of hydrocarbon expulsion from the oil source horizons of the Timan-Pechora Sedimentation Basin (TPSB) and the distribution of liquid and gaseous hydrocarbon expulsion volumes by Permian age sediment in the Korotaikhinskaya Basin.

The extent of hydrocarbon expulsion in the Korotaikhinskaya Basin has been so enormous that, even with extremely low hydrocarbon retention rates, significant oil and gas resources are expected to persist. The oil and gas potential of the studied Permian sediments in the Korotaikhinskaya Basin is also confirmed by the results of the Basin modeling [8].

A large oil accumulation zone is predicted within the Labogey monocline, the Vashutkin-Talotinsky thrust, extending further into the Saremboy-Lekkeiagin zone in a stratigraphic range from the Upper Devonian to the Triassic. This is confirmed by numerous oil shows in Permianage sediments, bituminous saturation and brown oxidised oil admixture in cores from the Devonian and Permian intervals.

**Conclusions (Findings).** The results of dynamic analysis of the sigmoid seismic boundaries (seismic facies maps) enveloping the clinoforms have identified three possible lithologically constrained traps, one of which is located in the fondoform subzone, the second is in the shelf and clinoform subzone, and the third – in the shelf subzone.

To identify a lithologically constrained trap formed in the shelf and clinoform subzones, the data of the 2-Zapadno-Korotaikhinskaya well were used, in which a sandstone layer from the interval of 2,323–2,334 m was identified as P-X IV reflecting horizon. The dimensions of this trap are 24 × 10 km.

The third lithologically bounded trap in the shelf subzone was identified in a manner analogous to the trap identified using the R-XIV reflecting horizon.

To study the facial features as well as oil and gas potential of the clinoform seismic complex, three wells should be drilled. This profile of three wells will make it possible to obtain fundamentally new data on the structure of clinoforms and map, in the future, a zone of possibly oil-saturated reservoirs associated with the edge of the shelf and identified by logging in 2-Zapadno-Korotaikhinskaya well.

The recoverable resources within the investigated area in D1 category are estimated at 18,213 kt and raises the prospects of the investigated area by 30 %.

### *Example 2. Application of the CDP dynamic analysis findings in predicting reservoir occurrence zones in the poorly drilling-explored areas*

**Exploration targets.** Areas located within the junction of the Varandey-Adzvinsky structural zone and the Khoreiver Basin (the northeastern part of the Pechora Sea shelf). 600 km2 of CMP-3D surveying was carried out at the survey sites (areas A and B), wells A-1 and B-1 were drilled, which penetrated into Lower Silurian and Carboniferous sediments, respectively.

**Prospective sediments.** Upper Permian terrigenous strata of the Kazanian-Tatarian Stage, Upper Carboniferous-Lower Permian carbonate strata of the Asselian-Sakmarian Stage and Silurian carbonate strata. The oil and gas content of these deposits has been proven at many fields of the Timan-Pechora oil and gas basin and is confirmed by the inflows of hydrocarbons from wells A-1 and B-1 in the investigated area.

Table 1

**Extent of expulsion from the oilbearing horizons of the TPSB and distribution of the expulsion volumes of liquid and gaseous hydrocarbons in the Korotayikhinskaya Basin**

| Oil and gas source age | Extent of hydrocarbon expulsion | | Expulsion density | | Sediments | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $P_1ar$ | | $P_1k$ | | $P_1u$ | |
| | oil, billion tons | gas, trillion m³ | oil, million tons/km² | gas, gas, trillion m³/km² | Oil, billion tons | Gas, trillion m³ | Oil, billion tons | Gas, trillion m³ | Oil, billion tons | Gas, trillion m³ |
| $S_1 + S_2 + D_1l$ | 568.2 | 220.7 | 0.024–14.559 | 0.005–5.611 | 4.8 | 52.24 | 3.25 | 37.88 | 2.9 | 24.96 |
| $D_2$ | 167.3 | 66.4 | 0.013–3.256 | 0.011–1.309 | | | | | | |
| $D_3$tm-sr | 109.2 | 44.4 | 0.016–1.850 | 0.014–0.713 | | | | | | |
| $D_3$ Dm (sm)-$C_1$t | 410.5 | 114.8 | 0.033–7.890 | 0.01–2.458 | | | | | | |
| $P_1$ar-k | 172.4 | 124.5 | 0.004–7.092 | 0.008–8.982 | | | | | | |
| Σ | 1427.6 | 570.8 | – | – | 4.8 | 52.24 | 3.25 | 37.88 | 2.9 | 24.96 |

The following studies were carried out to assess the identified prospects for porosity & permeability in the reservoir zone and hydrocarbon content:

1. Comprehensive analysis of well data (geophysical well surveys, test results, sampling, drilling);

2. Review of petrophysical properties of rocks (finding correlations between attributes and petrophysical parameters);

3. Structural interpretation: correlation of reflective horizons, isolation of disjunctive dislocations, isochron mapping, identifying seismic recording anomalies;

4. Performing attribute analysis to predict zones of high-capacity reservoir development in the target intervals of the sequence [9, 10].

Changes in the petrophysical properties of rocks, their saturation nature and lithological composition are reflected both in the factual material (cores, cuttings, thin sections) and the curves of geophysical well survey data. Comprehensive analysis of well data (A-1, B-1) does not allow to confidently separate the reservoir and non-reservoir point cloud and identify reliable correlation relationships between elastic and petrophysical rock properties to propagate permeability and porosity in the inter-well space due to the limited set of geophysical well survey data.

Since this area is poorly explored by drilling, the changes in the pore volume of Upper Permian terrigenous deposits are additionally considered on the basis of the results of petroelastic modeling based on the Gassmann equations (Fig. 4). As a priori information, the average porosity ratios of the Kharyaga ($K_p$ = 26%) and Lem'yusky ($K_p$ = 21%) peer fields developed onshore were used. It has been established that when a reservoir with porosity of 21% is found, the reservoir and non-reservoir points keep overlapping: at

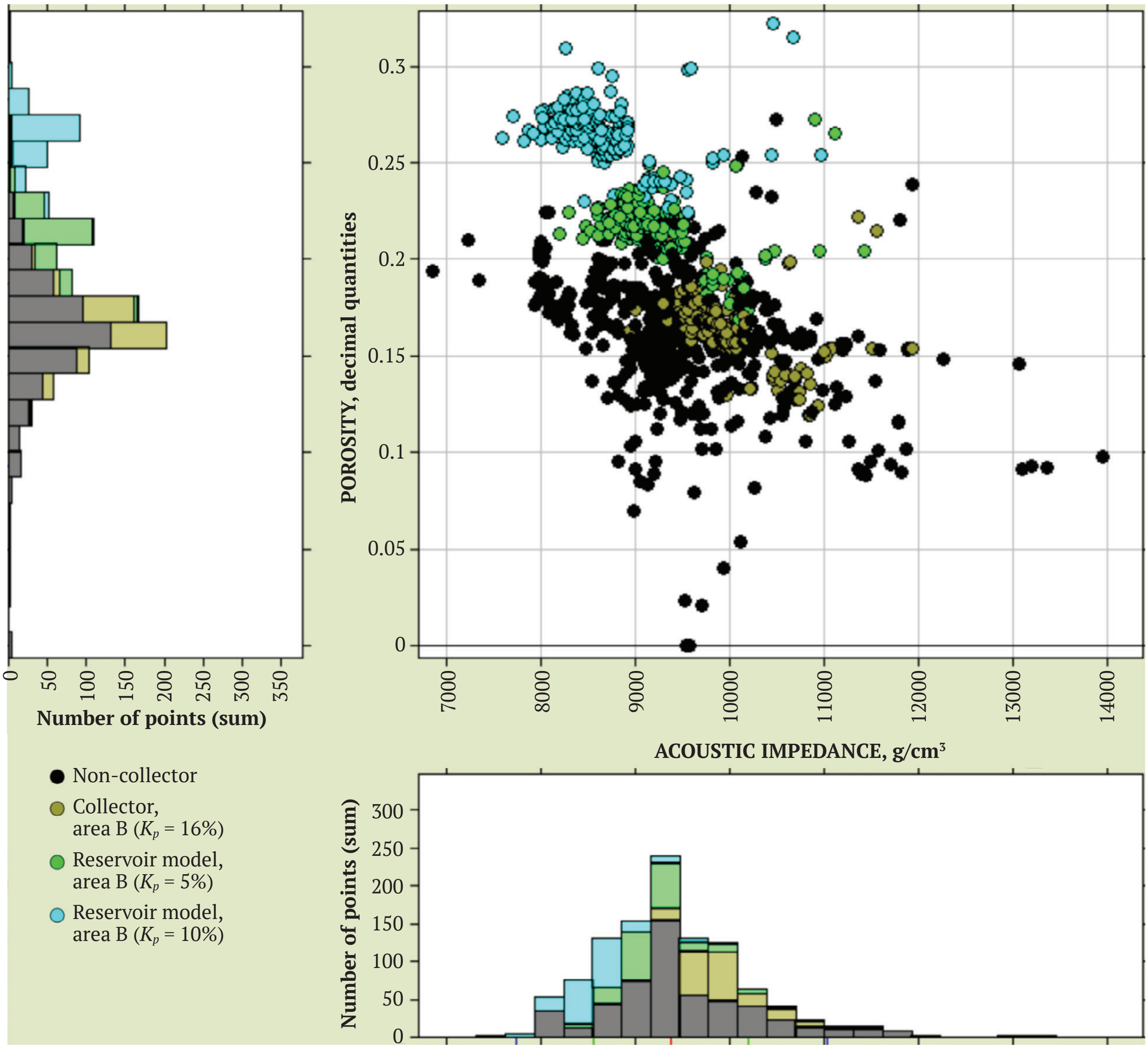



**Fig. 4.** Results of petroelastic modelling using Upper Permian terrigenous sediments as an example. Cases of possible values of porosity in the reservoir were simulated according to a priori information from analogue deposits

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porosity values of about 26%, the difference between a collector and non-collector in the acoustic impedance field is weakly manifested.

Consequently, there may be zones of reservoir spreading in the area with simulated porosity values, but they are not likely to appear in the field of elastic parameters ("missing the target").

The chaotic distribution of reservoir and non-reservoir points in cross-plots in prospective intervals in the carbonate part of the sequence is explained by the lack of well data for the area and the complexity of the reservoir structure, which does not allow high-quality modelling and assessment of the ability to predict rock properties in the inter-well space.

In this case, based on the results of a comprehensive analysis of well data, it is impossible to quantitatively predict permeability and porosity in the inter-well space from available materials of CDP-3D seismic data dynamic analysis. Only a qualitative interpretation technique using wavefield attributes is applicable here, where the acoustic inversion results are an additional attribute that characterises the acoustic impedance of a horizon.

The application of the attribute analysis techniques allows some anomalies identified with geological features that could potentially be hydrocarbon traps in the investigated areas to be identified and traced. The additional application of analogy and a priori geological information makes it possible to perform a generalised interpretation of selected seismic-facial units that have been confirmed on seismic sections.

The results of the dynamic analysis of the CDP-3D seismic data are shown in Fig. 5. The following has been established:

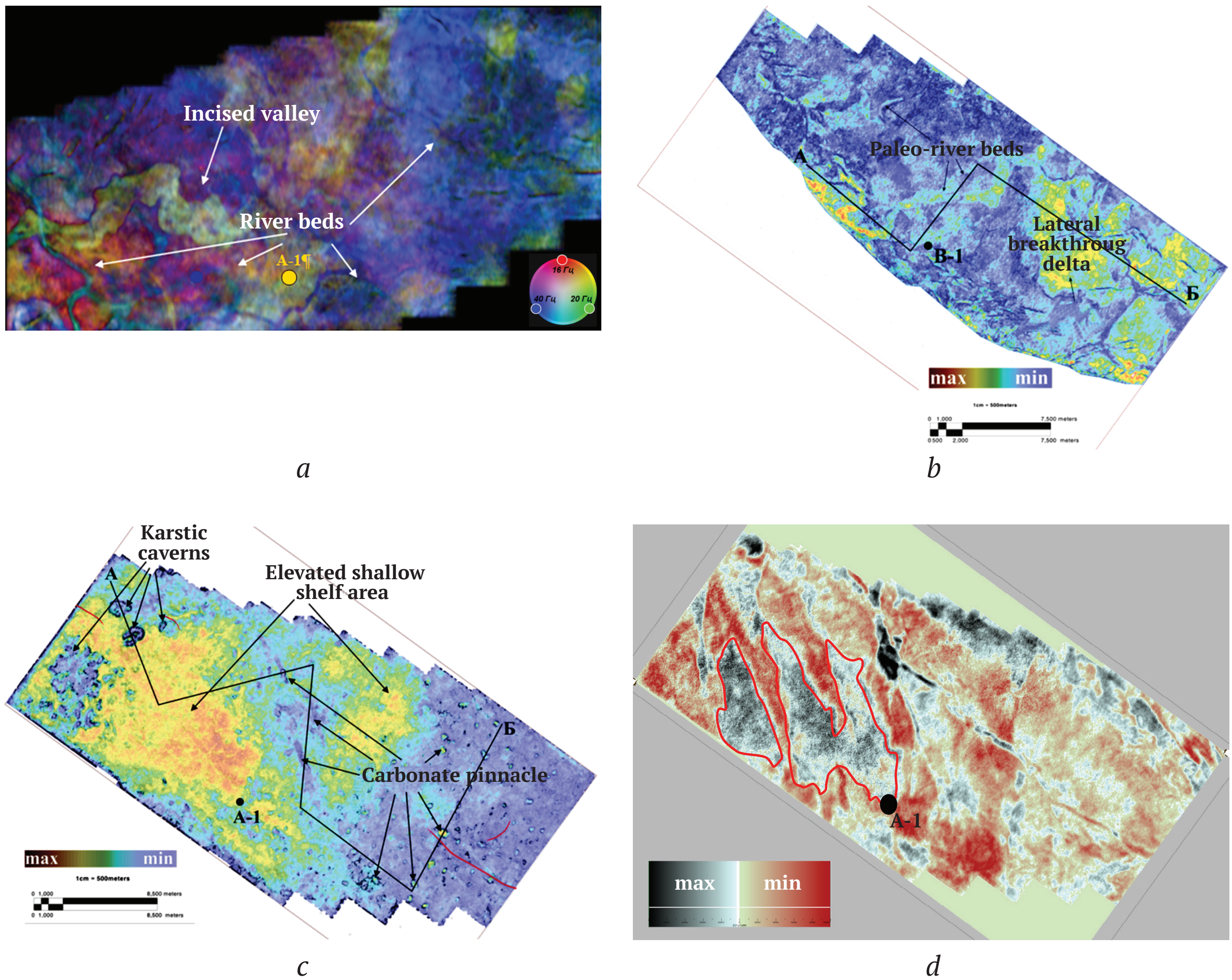


**Fig. 5.** Attribute map:
*a* – spectral decomposition in the Upper Permian roof interval (area A); *b* – RMS (RMS amplitudes) – amplitudes in the Upper Permian reservoir bed interval (area B); *c* – complex RMS amplitude and coherence attribute in the Lower Permian sequence interval (area A); *d* – horizontal slice of amplitudes in the Lower Silurian sequence interval (area A)

**In the Upper Permian interval of the sequence**, a system of branched channel bodies striking northeast. A northwest-trending alluvial valley formed at the turn of the Permian and Triassic periods in area A, has been identified. The in-channel nature of the productive sand bed of Area B was established and the area of its spreading was mapped;

In the **Upper Carboniferous-Lower Permian sequence part, within which carbonate platform with organogenic structures of "pinnacle" type occur, karsting zones have been identified;**

**In the Silurian sequence part**, paleo-incision-type anomalies formed during the Early Devonian, faults and the productive horizon shear zones have been identified. A pay zone (with non-commercial oil influx) interpreted as an organogenic structure (pinnacle) was found further down in the sequence. The pay zone is located in an elevated block, which is quite typical geologically for carbonate structures under similar conditions.

**Conclusions (Findings).** The research findings gave a different perspective on the area's potential. Detailed structural and tectonic models of promising deposits were built: a qualitative prediction of zones with improved permeability and porosity was performed; additional hydrocarbon exploration targets were identified; the resource base of the area was doubled, and the risk of drilling empty wells was reduced. Thus, it proves the effectiveness of dynamic analysis at all stages of exploration.

***Example 3. A method for predicting hydrocarbon reservoir parameters estimation to improve the geological efficiency of mapping net pay thicknesses and permeability and porosity of reservoirs***

As a rule, permeability and porosity maps of reservoir bed properties and maps of total and net pay thicknesses are built to quantitatively predict the estimation parameters of hydrocarbon reservoirs. The maps, built with minimum error, allow specialists to determine the optimum location of wells in the best reservoirs with maximum net pay thicknesses, thereby minimising drilling risks.

The standard mapping algorithm is described in many training manuals and implemented in numerous software tools. The input data are the results of geophysical well logging interpretations, core sampling studies, formation testing and sampling. In an inter-well space, reservoir position, distribution of porosity & permeability and reservoir bed thicknesses are determined in accordance with seismic data [11].

AThe authors propose a new approach to predicting high-yield hydrocarbon reservoirs. Analysis of both Russian and foreign literature sources has shown that this particular method is not yet widely used in the oil and gas geological and scientific community.

Within the framework of the presented methodology, hydrocarbon reservoir parameters were predicted using reservoir parameters: net pay thickness ($h_{np}$) and the product of net pay by porosity factor ($K_p$), $K_p \cdot h_{np}$, and total thickness of the potential reservoir bed $\Delta H$.

Initially, reservoir parameters are determined from the interpretation of geophysical well data. The following regression relationships are then plotted: $h_{np} - \Delta H$, $K_p \cdot h_{np} - \Delta H$. The result is an equation that is used to build net pay maps and predictive reservoir maps. Type of the graph, linear or polynomial, is selected depending on the value of the correlation coefficient $R^2$ which determines the accuracy of the calculations. If the input parameters are satisfactorily matched, it should not be less than 0.5. The $R^2$ value depends on the quality and quantity of the input data (wells, well logging data). The higher the $R^2$ value, the higher the quality of the constructs and forecasts.

The main criterion for selecting the recommended well point on the predict maps of reservoir parameters will be the maximum values of porosity coefficients $K_p$ and effective oil and gas saturated thicknesses $h_{ef}$ of reservoir formations. Let's consider an example.

The Ermolovsky subsoil block is located in the central part of the Izhma-Pechorskaya Depression within the Lem'yusky step in an old mining area with developed infrastructure. No oil or gas deposits have been identified in the area from the previously drilled wells. However, the results of reinterpretation of old logging, new data from geophysical studies of well 1-Ermolovskaya and the CDP-2D seismic data served as the grounds for a detailed exploration to be conducted here, namely the CDP-3D seismic survey. Based on the CDP-3D seismic data, two structures have been prepared for drilling, Sedvozhskaya and Vostochno-Sedvozhskaya, and well locations were identified.

A quantitative prediction of the parameters of the predicted oil reservoirs was made to determine the order of drilling priority (Fig. 6). In graphs and maps characterizing the dependence of net pay thickness and products of net pay thickness by porosity $K_p \cdot h_{np}$ values on total reservoir bed thickness $\Delta H$, the point of the recommended well 1 has the highest position and is characterized by maximum values. The graph type is polynomial. The correlation coefficient is 0.852, indicating high accuracy of the prediction made.

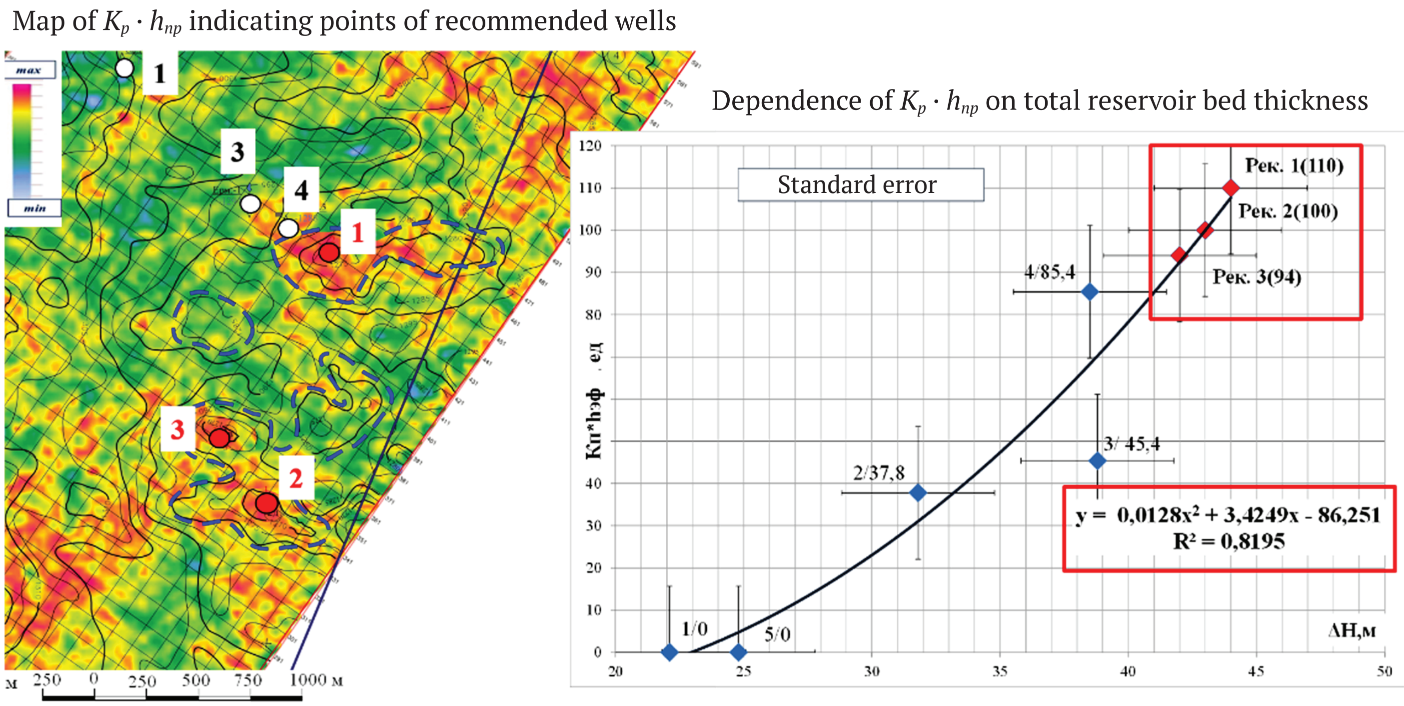


**Fig. 6.** An example of quantitative reservoir permeability and porosity prediction. F5 layer (D3up). Yermolovskaya area (based on materials from the Institute of Oil and Gas Problems of the Russian Academy of Sciences (IPNG RAS))

**Conclusions (Findings).** The method proposed by the authors for predicting parameters of hydrocarbon reservoirs will allow to determine the maximum effective oil and gas saturated thicknesses within the mapped traps.

Maximum values of porosity coefficients $K_p$ and effective oil and gas saturated thicknesses hnp of reservoir beds in the shielded volume indicate highly profitable hydrocarbon deposits. In this regard, the application of the proposed regression relationships in the prediction of hydrocarbon discoveries will allow to place the wells directly within the maximum values and thus increase efficiency of drilling.

Unfortunately, no wells have been drilled on the site so far. However, the effectiveness of the proposed methodological approach has been proven at the North Khosedayuskoye and North Mukerkamylskoye oil fields, where wells were drilled with flow rates of more than 100 t/day obtained from the Lower Carboniferous Serpukhoian carbonates and Upper Devonian Nyumylg-Zelenetsky reefogenic sediments.

## Conclusion

The proposed scientific approach to the historicalandgenetic method for predicting hydrocarbon traps and reservoirs revealed three possible lithologically constrained traps, thereby increasing the oil and gas potential of the area, and made it possible to adjust the further exploration program.

The results of dynamic analysis, which is widely used in domestic and foreign practice at drilled areas and fields, confirmed the feasibility of its application at structures that have been poorly explored by drilling or withdrawn from drilling programs, as well as for the prospecting of missed deposits.

The values of reservoir bed parameters ($h_{np}$, $K_p \cdot h_{np}$) obtained through the interpretation of geophysical data and their regression relationships ($h_{np} - \Delta H$, $K_p \cdot h_{np} - \Delta H$) constitute the basis for constructing predictive maps of net pay thicknesses and high-capacity reservoirs as well as their quantitative prediction. These maps then allow wells to be positioned directly into the points of the maximum values, thereby increasing drilling performance and exploration efficiency.

The presented technologies for detecting oil and gas prospective traps and prediction of estimated parameters of hydrocarbon reservoirs will ensure the conditionality of prospect preparation and thereby increase the quality of planning and efficiency of exploration by reducing the number of drilled unproductive wells. This will improve the accuracy of the estimates of predicted and discovered deposits resources and reserves.

Application of the presented methodological approaches to prediction and prospecting of hydrocarbon deposits can become a substantial addition at any stage of exploration work within the Timan-Pechora oil and gas province and in other oil and gas bearing regions of the country.

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