

Problems of unconventional hydrocarbons sources on the example of the domanicites of the Timan-Pechora oil and gas province

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Abstract. The first industrial oil in the Timan-Pechora oil and gas province was obtained in 1929. By now more than 230 hydrocarbon deposits have been explored in the Province. A significant part of these deposits is under development. At the same time, the originally explored total resources have been developed in terms of oil only by 50%, in terms of gas - by about 30%. The remaining unexplored part of the initial total resources is forecast to be located in difficult unconventional bedding conditions, in particular, in the domanicites of the Upper Devonian period. The so-called shale oil and gas are associated with them. The forecasting, exploration, and development of oil and gas deposits in the domanicites require new methodological and technological solutions. The article discusses the problems of unconventional hydrocarbon development using the example of the domanicites of the Timan-Pechora oil and gas Province.

1 Introduction

In the worldwide balance of explored reserves and extraction, an increasingly important role is played by shale oil, which is associated with unconventional, poorly permeable reservoirs with low levels of oil recovery.

In the overall balance of explored world reserves, the share of «shale» oil makes up for almost a half, and the production volumes reach 35%. The role of «shale oil» and gas in the world is constantly increasing.

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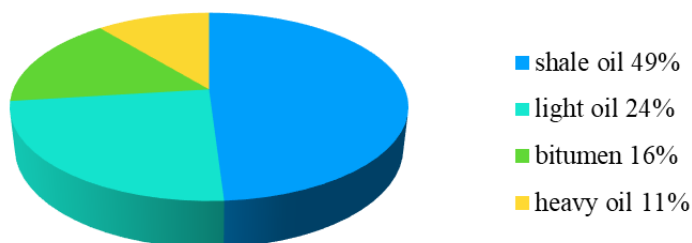


Fig. 1.The share of «shale oil» in the overall global balance.

This is especially evident in the USA, where active research in the field of shale oil has led to a significant increase in the production volumes of both oil and gas[1]

In Russia, active research in the field of shale oil is just beginning.

There is an ambiguous interpretation of the concept of shale oil: in North America, the term shale oil refers to two types of oil:

Shale oil as is a highly viscous shale substance, significantly different in properties (density, viscosity) from traditional light oil. It is obtained from oil shale after thermal exposure.

Tight oil –is light oil contained in dense low-porous low-permeability reservoirs called shales. Shale depths are rocks that consist of maristones and silica, which are saturated with organic matter. That is why they are the main petroleogenetic rocks almost in all oil and gas basins in the world.

In Russia, shale oil refers to the tight oil type. The Bazhenov Formation in Western Siberia, the domanic deposits of Timan-Pechora and Volga-Ural oil and gas provinces, and the Khadam Formation of the Ciscaucasian region are similar to the shale strata in Russia. These deposits are also represented by siliceous-argillaceous-carbonate rocks enriched with organic matter and other oil components in a dispersed state (the micro-oil).

The relevance of the development of «domanikites» is reflected in the government document: «The strategy for the development of the mineral resources base of the Russian Federation until 2035»: «evaluation and involvement of previously discovered, explored, undeveloped fields and deposits of hard-to-recover oil connected with the Bazhenov formation, Domanic horizon, and their anagoges».

2 Research methodology

This article is based on: an analytical review of domestic and foreign literature; complex analysis of geological and geophysical materials; own research, conducted by the authors in the process of performing research work on this topic, as well as significant production experience in studying and searching for hydrocarbon deposits in the Domanic-Tournaisian reef system of Timan-Pechora oil and gas province.

3 Key issues

The Domanic-Tournaisian oil and gas complex, which includes the domanikite», is a system of heterogeneous and diverse facies in similar paleogeographic and climatic conditions. It consists of the shelf, reef, and depositional deposits formed within the passive margin of the East European platform on the border of the shelf and its deeper parts during the regressive-transgressive regimes of the Uralic Paleocan.

The genetic relationship between the different of the various facies zones of the domanicoid system determines the specifics of hydrocarbon generation, accumulation, and conservation.

The study of Domanik deposits has been conducted for more than 50 years, not only in the Timan-Pechora, but also in the Volga-Ural oil and gas provinces. According to geologists, such as A. Solomatin, V. I. Bogatsky, B. P. Bogdanov, V. B. Rostovshchikov, N. I. Nikonov and others in the Timan-Pechora province and S. G. Neruchev, E. A. Rogozina, S.Ya. Vainbaum, etc. in the Volga-Ural provinces, domanicites are represented by high bituminous siliceous-clay carbonate deposits of the domanic horizon and considered primarily as regional oil and gas source rocks.

On the whole, the depressive deposits of this system can be combined under the term domanicoids, that means deposits similar to domanicites, but not purely domanicites. Figure 2 presents a general picture of the distribution of domanicoid deposits in the Timan-Pechora Province (TPP)).

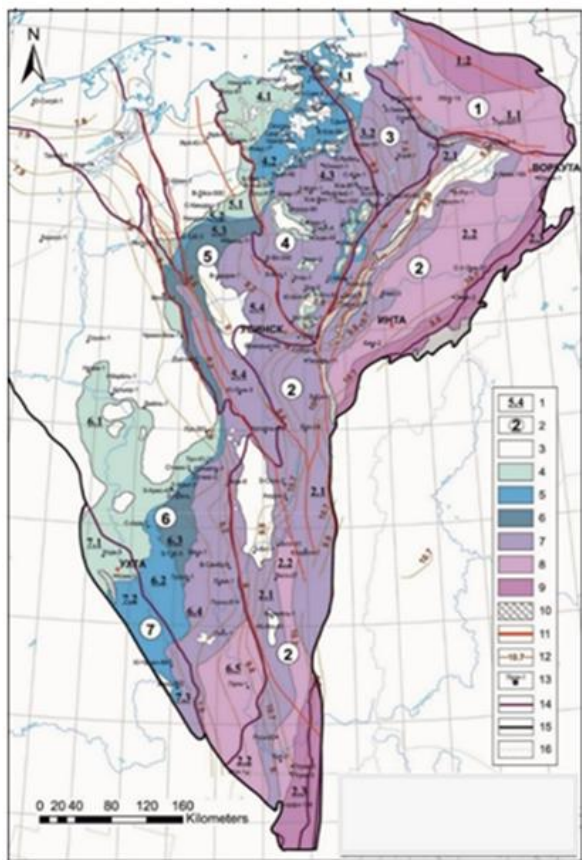


Fig.2.Schematic map of the distribution of domanicoid deposits of the Timan-Pechora oil and gas province (according to LLC TP NITS). Legend: 1 - oil and gas zone indices (OGZ), 2 - indices of oil and gas fields (OGF), 3 - areas without domanic type deposits, 4-9 - zones with different stratigraphic intervals of development of Domanic type deposits: 10 - zones of modern erosion and outcropping of D3f2 sediments -C1t, 11 - deep faults, 13 - wells, 14 - boundaries of the OGF, 15 - boundaries of the Timan-Pechora OGP, 16 - administrative boundaries. OGF: 1 - Pripaikhoisko-Priyuzhnonovozemelskaya, 2 - Severo-Pre-Uralskaya, 3 - Varandey-Adzvinskaya, 4 - Khoreyverskaya, 5 - Pechora-Kolvinskaya, 6 - Izhma-Pechora, 7 - Timanskaya.

The area of promising lands of domanicoids within the continental part of the Timan-Pechora Province is more than 250 thousand km². In addition, domanicoids are widespread in the Volga-Ural oil and gas province, as well as on the Arctic shelf. The total area can reach 1 million km², with the bedding depth from 300 m to 5-6 km.

Currently, more than 150 wells with various manifestations of oil and gas potential in the domanicites have been detected within the territory of the Timan-Pechora Province, with industrial oil deposits discovered in 11 structures.

Analysis of the accumulated geological and geophysical materials allows us to compile and justify a geological model of the structure of domanicoids, to characterize the filtration-capacitive properties of productive deposits, and to identify the features of the formation and the bedding of hydrocarbons in these deposits.

The geological model of the structure of dominicoids based on the study of several hundred wells and seismic exploration is presented in Figure 3.

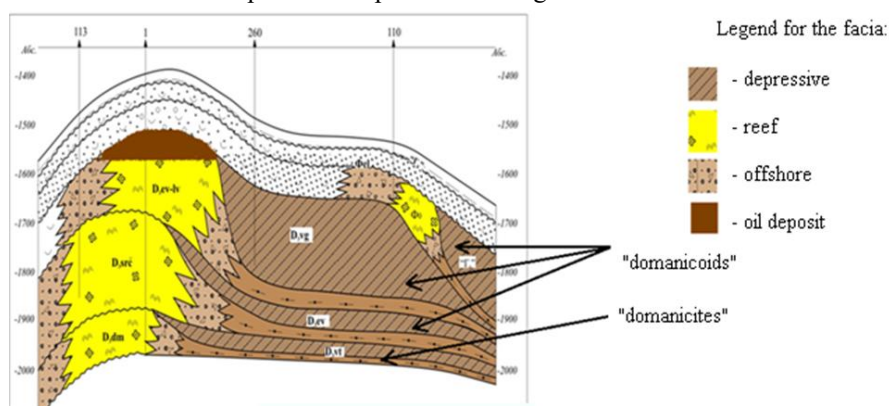


Fig.3. Model of the Domanik-Tournaisian rifogenic system of the TPP South Terekheveiskoe deposit (according to the materials of PAO Severgeofizika and OAO TP NITS - source 4).

In the model, not only «domanicites» stand out in their classical sense: «domanicites» are clay-siliceous-carbonate bituminous rocks of the Upper Devonian [2-4], but also genetically related deposits of rifogenic and shelf facies, that is, it is a single geological system of various facies deposits, united by a common genesis.

This circumstance is extremely important for the justification of the problems when solving the tasks of mastering the domanicoids. The prediction, search, and development of hydrocarbon deposits in such geological and genetic systems provides for a comprehensive methodological and technical approach.

In the process of a detailed study of the conditions for the formation of Upper Devonian reef systems that contain depressive deposits as its part, in particular, domanicites, researchers [5,6] came to the conclusion about the cyclical formation of deep marine water sediments, such as dominicites.

Each cycle was formed under the conditions of regressive-transgressive regimes with a general retreat of the Ural paleocene eastward towards the closing Ural geosynclinal system. As a result, we see elongated zones of development of rifogenic systems of different ages, from the Domanic age in the west to famennian-tournaisian in the east in the Ural marginal trough. Among the main elements of these systems are depositional deposits of different ages, that is, domanicoids.

Therefore, the domanicites as a term received a broader interpretation than the deposits of the domanic horizon, which were first established in the region of the Ukhtariver and Southern Urals.

Depressions of different ages, such as domanicites, should be called domanikoids, that is, similar to the lithological and geochemical composition of domanicites but having certain differences. Some classifications of domanic deposits are listed below as presented in the literature by various researchers (Table 1).

Table 1. Interpretation and classification of domanicoid deposits by various researchers.

Author	Definition
Suprunenko O. I., Tugarova M. A. <i>Geochemistry of naphthides</i> , 2009	Domanicfacies, or domanicites, are high bituminous siliceous-clayey-carbonate strata of the marine, essentially biogenic, of autochthonous genesis.
S.V. Maksimova	Domanic is a siliceous-carbonate sequence with a very insignificant admixture of clay material. The average content of the main mineral components, % by massive material: calcium - 44.3%, free silica – 37.23, clay – 5.96% (about the stratypedomanica of the Timan-Pechora OGB).
T.K. Bazhenova, V.M. Beketova, G. M. Borova	The domanic formation consists of domanicites ($C_{nc} (C_{org}) > 5$, up to 22%) and domanicoids ($C_{nc} (C_{org}) = 0,5 - 5\%$).
I.K. Korolyuk, A.I. Letavin, O.M. Mkrtchyan, R.O. Khachatryan	Two formations were identified in the Upper Devonian-Tournaisian complex: 1) domanic, close in composition to the stratotype, in the volume of the Semiluksky (domanic) horizon, developed within the uncompensated paleo-depression of the Semiluksky basin; 2) domanic type, covering deposits of depressed facies in the axial parts of the KKSP from the Upper Frans to Tournaisian.

While analyzing these definitions for the Timan-Pechora oil and gas basin, it is legitimate to apply the following concept of domanicoid deposits: domanicoids are depositional deposits of a progradation Upper Devonian-Tournaisianpaleobasin represented by a domanicoid formation in two sub-formations: the domanic - in the volume of the semiluksky (domanic) horizon, the uncompensated paleo-depressions of the Semiluksky basin, and the domanicoid, including deposits of the depressive facies of the upper franc tournaisianprograding basin. The first sub-formation includes domanicites containing Corg. from 5 to 25%, to the second consists of domanicoids, where Corg. from 0.5 to 5%.

Domanicites and domanicoids occupy a special place in the formation of hydrocarbon deposits in the reef systems of the Upper Devonian.

First: hydrocarbon generation. The high content of Corg. - 5% or more, makes these rocks the main sources of hydrocarbons, and the domanicites themselves are the main oil and gas source rocks in both the Timan-Pechora and Volga-Ural Provinces. The generation potential of the dominicites is quite high and reaches 700-1000 cm³/m³, which is sufficient under certain thermo baric and geological and tectonic conditions to fill the formed traps, in particular, high-capacity rifogenic reservoirs, and due to the vertical-horizontal migration, this can be an essential source of hydrocarbons for other oil and gas complexes. Some autochthonous hydrocarbons remain in place in the oil and gas source rocks and fill traps of an unconventional type, that is, they create the so-called shale oil and shale gas.

As a result, oil and gas source rocks also become oil and gas-containing. This is one of the features of the oil and gas potential of the domanicoids.

The second feature of domanicoids is the lack of structural control over the placement of deposits, in contrast to traditional hydrocarbon accumulations, where the main control factor for almost all types of deposits, except for lithological ones, is structural (Figure 4).

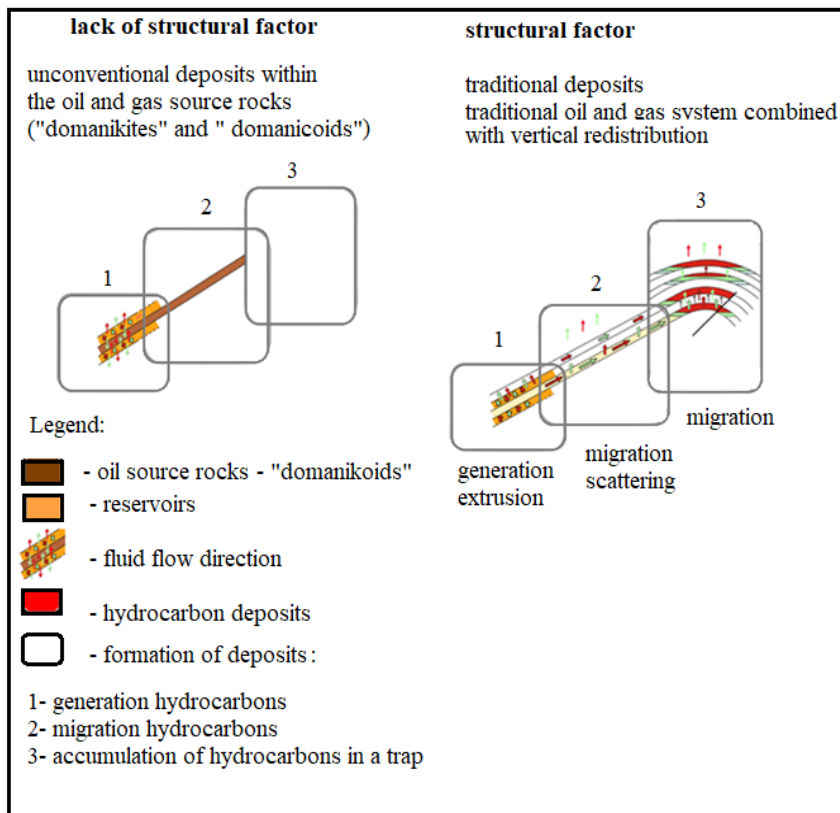


Fig.4.The role of the structural factor in the formation of deposits.

Hereinafter you will find the authors' interpretation of such concepts as traditional and unconventional deposits.

Traditional deposits are hydrocarbon accumulations, to which the world's main explored reserves are confined and which have considerable accumulated experience in forecasting, prospecting, and exploration based on fundamental scientific knowledge about the genesis of hydrocarbons and the formation of deposits. In any other case, the main controlling factor of such accumulations is the structural one.

Unconventional deposits are hydrocarbon accumulation in fractured, low-permeability clay-carbonate reservoirs within a single generation system, which is usually not controlled by a structural factor.

The third feature of domanicoid deposits is a complex reservoir with special conditions for the formation of effective porosity.

Table 2 shows some characteristics of lithological rock types according to geochemical studies and well logs of some wells in the south of the Timan-Pechora Province (wells 1-5 in South Timan, Komi), executed by OAO TP NIC.

Table 2.Characterization of lithological types of rocks in domanicoids (according to the data of PAO TP NIC).

Lithology	Reservoir	Properties of lithological rock types			
		Well logging		C _{org} content	
		K _p , %	K _{per} , mD		
High carbon siliceous rocks	Oil source/ reservoir	non	0.5-1	0.001-0.01	Domanicites (C _{org} 5-25%)

	Potential Pore Fissure	3-5	$per^1 < 0,01$, $per^2 \leq 100$	
Radiolarites	Microporous	16-20	0.01	Domanicoids (C_{org} 0,5-5%)
Microcrystalline limestones	Non reservoir	1-2	0.01-0.1	
Tentaculite limestones	Non reservoir	1-3	0,01-0,2	
Breccia limestone with a low-carbon clay-siliceous-carbonate filler	Crack Cavernous	1-4	≤ 100	
Carbonate Breccia Limestone	Cracked /pore fissure	0,5-9	≤ 6	
Organogenic clastic limestones and finely fragmented limestones	Pore, microporous	6-8 (in units up to 20%)	≤ 100	
Clay limestones	Non reservoir	2-3	0.001-0.01	
Limestone clays	Non reservoir	-	-	
Clay-carbonate rocks	Non reservoir	6-8	<0.001	
<ul style="list-style-type: none"> • 1- permeability in the vertical direction • 2-permeability in the horizontal direction 				

Petrographically, the domanicoids include three main components: carbonates (dolomites and calcium), silica, and organic matter. Clay minerals account for no more than 15%. Lithological domanicoid deposits are represented by limestones and siliceous limestones of dark gray, black, bituminous, and silicified with interlayers and lenses of flints and black bituminous siliceous oil shales. Rifogenic formations in the immediate vicinity accompany accumulative lens-shaped bodies formed by clayless carbonated varieties.

The reservoirs in such complex lithological strata are represented by pore, pore-fissure, cavity-fissure, and fissure differences. Moreover, pore and pore-fractured reservoirs, as a rule, are confined to the carbonate differences of rocks that compose accumulative bodies near reefs. The porosity in this case varies from 6-8% to 10-12%. Permeability up to 142 mD. Effective oil-saturated capacities for pore-type reservoirs, which are allocated according to generally accepted methods, are from 0.4 m to 18.6 m in wells. Along with granular porosity, microcracks are observed, which significantly increases the permeability of dominicites. This circumstance has been proven in the Baganskoye field.

Fractured reservoirs are mostly developed within the shafts which experienced tectonodynamic stresses during their formation (Shapkino-Yuryakhinsky shaft, Verkhne-Grubeshorskoye field). Fractured porosity ranges from 0.8 to 1%. Permeability can be significant; its value depends on the structure and number of cracks. Unfortunately, identification of fractured reservoirs presents significant difficulties in the traditional complex of field geophysical studies.

The oil and gas potential of domanicoid deposits in the upper Devonian reef systems in the Timan-Pechora Province has been proven in several areas where industrial oil and gas flows were obtained in the wells. Within the platform part of the Timan-Pechora Province, oil deposits were obtained at the Verkhne - Grubeshorsky field of the Shapkino-Yuryakhinsky shaft, at the Osh and South Osh fields of the Kolvinsky mega swell; in the Bagansky, Zapadno-Yareyaginsky, Verkhne-Makarikhinsky, Kolvinsky, Zapadno-Hatayakhsky, East-Kolvinsky deposits of the Khoreyver depression. Within the Pre-Ural marginal trough, hydrocarbon deposits were discovered in several structures, including oil deposits that were discovered in the West Sopless oil and gas condensate field of the Srednepechorsky transverse uplift, in the Yuzhno-Stepkavozhsky field of the Chernyshev ridge; gas condensate deposits were discovered in the autochthon of the largest Vuktylskoye field.

Besides, oil inflows were obtained on Povarnitskaya Square in the Kosyu-Rogovskaya Depression, on the Cherpayu field of the Gamburtsev shaft in the Varandey-Adzvinskyaulakogen, on the Adakskaya area of the Chernyshev Ridge, Suborsky field of the Bolshesynyskaya Depression, on the Hatayakhsкая and Verkhnyalydumudyla pits. Gas inflows were obtained at the Zapadno-Soplesskoye field of the Srednepechorsky transverse uplift.

Despite the evidence of the high oil and gas potential of the dominicites and dominicoids, no systematic forecast and searches for oil and gas deposits in these deposits are carried out. All of the above discoveries were obtained in passing while exploring other oil and gas complexes.

Based on the foregoing, we can draw the following conclusions:

1. The domanic - tournaisianrifogenic system is represented by polycyclic shelf-age depressions of different ages, which include: domanikites and domanikoids, reefs and shelf deposits.

2. Domanicites and domanicoids in one natural system are at the same time oil and gas producing and oil and gas containing deposits.

3. Location of deposits in dominicites and dominicoids is generally not controlled by the structural factor and, as a rule, hydrocarbon accumulations are confined to decompression zones associated with both primary (sedimentation) and secondary (tectonodynamic) fracturing zones..

4. Reservoirs in the dominicites and dominicoids are represented by granular and fractured porosity, unevenly distributed over the area and sections. This is indicated by a significant difference in the filtration-capacitive properties (FESs) in different parts of the domanic - tournaisianrifogenic system (Table 2).

Analysis of the oil and gas potential of the domanikites and domanikoids in the domanik-tournaisianrifogenic system allows to dwell on the main problems of forecasting, prospecting, and exploration of hydrocarbon deposits in these deposits.

These problems have various aspects.

The problem of forecasting and assessing the resource potential of domanicites and domanicoids: to date, the assessment of the resources of various oil and gas complexes in the Timan-Pechora province has been carried out by the standard method of comparative geological analogies (MSGA). This was justified for traditional oil and gas complexes, which, especially in the platform part, had a significant degree of exploration (about 50%) and reliable reference ranges (sections). But even under such conditions, confirmation of the initial total resources (NDS) is extremely uneven and varies from 60 to 100% or more over the province.

Certain accumulated experience is needed for the assessment of hydrocarbon resources in the dominicites and dominicoids of the domanic-tournaisian reef system, which have non-standard conditions for the formation and placement of deposits, and lack sufficiently tested reference sites. . As far as the authors of this article are aware, there is no such experience either in the Timan-Pechora province or in other similar regions of Russia (the Volga-Ural oil and gas province - domanicites, Western Siberia - bazhenites).

The traditional methods of forecasting based on standard methods of exploration (seismic exploration) and field geophysics do not work here.

Ukhta State Technical University has developed a new method for assessing NDS (A.I. Dyakonov), which is based on an evolutionary approach to the genesis of oil and gas, sequentially covering the stages of formation of deposits, including generation, accumulation, and conservation of hydrocarbons. This method was called evolutionary-catagenetic (ECM) and was intended for use in conditions of low knowledge and lack of a verified reference unit. .

The authors of this article applied this method as part of research on the dominicites of the Ural marginal deflection to comparatively evaluate the initial total resources by the method of geological anomalies (MSGa) and ECM.

The assessment of the initial total resources by the evolutionary - catagenetic method had no strict reference to the standard parameters in the MSGa, such as coefficients of analogies, confirmability, structural content, oil and gas bearing area, effective power, porosity, lithofacial and hydrogeological parameters, etc.

All these parameters, the reliability of which determines the reliability of the NDS assessment, can be obtained only at sufficiently studied reference sites for various oil and gas complexes and territories.

For non-traditional conditions of hydrocarbon occurrences, which include the domanicoid formation of the Timan-Pechora province, the authors made a comparative assessment of the NDS by the method of geological analogies and the evolutionary - catagenetic method (Table 3).

At the same time, the assessment of the resources for MSGa was carried out according to the generally accepted methodology (A. A. Bakirov and others).

In the evolutionary-catagenetic method, the volumes of generation, accumulation, and conservation of hydrocarbons were considered step by step using the following algorithm:

Formula for calculating the scale of generation from the beginning of catagenesis at a given stage:

$$Q_{ogg} = V \times d \times OM \times (\gamma \times \beta) \times \tau \times 10^{-3}, \tag{1}$$

Where Q_{ogg} is the scale of oil and gas generation (trillion m^3 , billion tons);
 V is the volume of oil and gas source clayey rocks, cm^3 ;
 d is the density, g / cm^3 ;
 $\gamma \times \beta$ is the oil and gas generation factor;
 OM is the content of organic matter, $g / 1$ kg of oil and gas source rocks;
 A is the amendment taking into account tectonodynamic conditions and correcting the correspondence of the scale of oil and gas formed in the sedimentary basin with experimental and actual data, equal to $NUV-0.1, GUV-0.05$.

The scale of oil and gas accumulation was defined as:

$$Q_{AC} = Q_{OG} \times C_e \times C_{AC} \times 10^{-3}, \tag{2}$$

Where Q_{AC} are the scales of oil and gas accumulation (billion m^3 , million tons);
 C_e is the coefficient of emigration of oil and gas ($KeH = 0.001-0.3, KeG = 0.9$)
 C_{A} is the accumulation coefficient ($H = 0.07-0.1; G = 0.025-0.01$).

The initial potential resources (Q_{IPR}) are

$$Q_{IPR} = Q_{AC} \times K_{do-oil}, \tag{3}$$

$$Q_{IPR} = Q_{AC} \times K_{do-gas}, \tag{4}$$

Where K_{do} is the oil dispersion coefficient ($\approx 55\%$)
 K_{do} is the gas dispersion coefficient ($\approx 60\%$)

Table 3. Comparative evaluation of the NDS domanicoids by the MSGa and ECM methods.

	Evaluation of NSR methods		Evaluation of NSR methods
	MSGa	MSGa	
Structural tectonic element			MSGa

	Gas, billion m ³	Gas, billion m ³	Gas, billion m ³	Gas, billion m ³	
UpperPechoraDepression	139.1	139.1	139.1	139.1	258.8 (36%)
Kosyu- RogovskayaDepression	22.7	22.7	22.7	22.7	
Volumes of NDS, in million tons	465.5		465.5		

The difference in estimates for the two major large depressions of the North Preduralskaya OGF is 258.8 million (36%).

In the evolutionary - catagenetic method, the volumes of generation, migration, accumulation, and conservation of hydrocarbons were considered. At the same time, for the dominicites and dominicoids, due to the uneven distribution of reservoirs and their filtration-capacitive properties, it would be unreasonable to assume significant lateral movement of hydrocarbons, which is characteristic of granular reservoirs. When using an ECM, it is important to determine the optimal loss factors at various stages of the formation of deposits.

The development of a methodology for assessing the NDS shale oil and gas is important for the development of this source of hydrocarbons in Russia in the near future. The combination of two methods (MSGA and ECM) allows receiving the most effective indicators, depending on the knowledge of such complex genetically unified systems as the domanic - tournaisianrifogenic complex.

Here you can organically and effectively apply traditional criteria, such as structural-tectonic, lithofacial, geochemical, and hydrogeological, as well as non-traditional evolutionary-catagenetic: NGMP maturity, volumes, and coefficients, generation, emigration and migration, hydrocarbon accumulation and conservation, taking into account the tested coefficients losses.

A factual assessment of the NDS of the domanicoid deposits of the Timan - Pechora Province is the basis for the feasibility study of the full range of scientific and practical work on the preparation of new reserves of industrial categories.

The latest assessment of the resources of the domanikcoid formation in the Timan-Pechora Province was carried out at OAO VNIGRI. The assessment was carried out by the method of geological analogies and amounts to 3.4 billion tons of oil and 0.25 trillion. m³ of gas, and taking into account the accumulation of hydrocarbons directly in the stratum of 10% domanicoids, the assessment of the hydrocarbon potential is from 5 to 16 billion tons of equivalent fuel equivalent [5].

If even half of this potential is confirmed, then for the Timan - Pechora region, which is experiencing an acute shortage of diluted oil reserves, the "second wind" will come.

Nonetheless, the above problem is not the only, and, perhaps, not the most important.

The main problem is the practical implementation of the proven potential of domanic deposits. It was previously noted that domanicoids are only part of a single oil and gas genetically linked system: shelf, reef, and depositional deposits.

Search, exploration, and development in such systems are carried out only on standard reefogenic objects, as the most simple-built and long-mastered in the methodological, operational, and technological terms.

At the same time, the components of the reefogenic system, including the domanicoids, remain outside the field of vision of prospectors and developers. Psychologically, it is necessary to cross the reef barrier and comprehensively evaluate resources, search for and explore hydrocarbon deposits in a single rifogenic system, consistently involving its

components, including domanicoids in exploration. This requires a methodological basis for the development of such facilities.

In particular, it is necessary to develop and justify a rational complex of geological exploration, including multi-wave seismic exploration; drill special exploratory wells; appropate modern methods of field-geophysical studies, allowing to efficiently distinguish complex-built fractured and fractured-pore reservoirs.

For this purpose, it is proposed to identify several (at least 4) experimental training grounds in the Timan-Pechora Province, given that rifogenic systems have various morphogenetic forms, such as the most common in the province atoll, carbonate bank, solitary reef, and barriers. There are structural features of reef systems in the platform part and the foothill trough of the province.

Therefore, in the platform part of the province in the Khoreyver Depression, the Bagan carbonate bank and Sandivey atoll are proposed as a proving ground; in the Pre-Ural marginal trough in the Verkhnepechorsky Depression, the Vuktylsky Autochthon with the barrier reef.

These objects have sufficient amounts of geological and geophysical material to justify and develop methodological, methodological, and technological principles for the development of domanic deposits of the Timan-Pechora Province.

4 Conclusions

1. Domanik - Tournaisian reef system is a complex natural association of different facies deposits: reefs, shelves, and depressions. Depression formations include domanicites and domanicoids with high oil and gas transmission potential.

2. In contrast to the standard conditions for the formation of hydrocarbon deposits in natural reservoirs, the domanicites and domanicoids have their specific characteristics, including: domanicites and domanicoids are both oil and gas source and oil and gas bearing rocks; the formation of deposits in them is not controlled by the structural factor exclusively. The main role is assigned to local reservoir areas created by primary porosity and secondary fracturing.

3. Assessment of the resources of domanicites and domanicoids due to the peculiarities of their formation and the low degree of knowledge (the absence of approved reference sites) should be carried out in a complex way by two methods, MSGA and ECM.

4. To master the domanicites and domanicoids of the CCI it is necessary:

- Develop an effective geological model of formation of deposits and assess their resources

- Develop the methodology and technology for forecasting, opening, and testing of domanicoids at experimental methodological sites, in particular, Bagansky and Sandiveysky in the Khoreyver depression, West Timansky in the Izhma-Pechora depression, and Vuktylsky in the Verhnepechorskaya depression.

5. It took more than 20 years for the U.S. to develop effective methods for the development of shale oil, and as a result, a significant effect has been obtained. In Russia, this process can be accelerated by combining efforts of scientific and industrial organizations and by starting this work now.

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