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Original Article

Geological and Geochemical Modelling of the Kudryashovskoye Field

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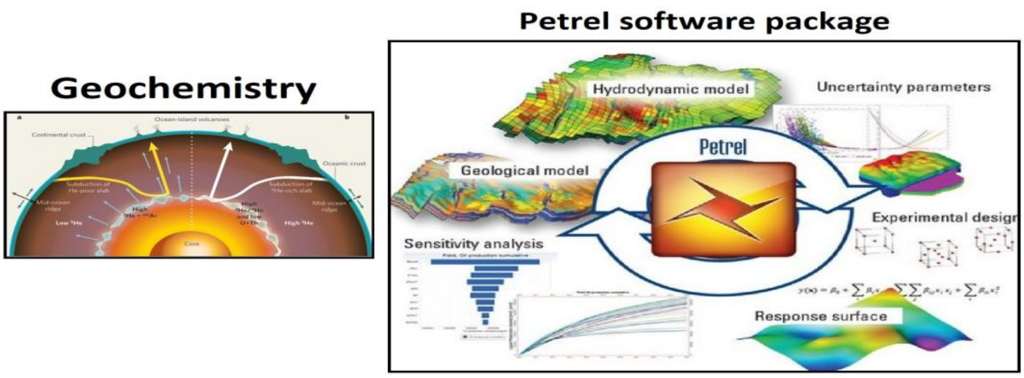
ABSTRACT

The practice of using chemical thermodynamics, chemical kinetics, or both to analyze chemical reactions affecting geological systems, usually with the aid of a computer, is geochemical modeling. In high-temperature geochemistry, it is used to simulate reactions occurring deep inside the Earth, in magma, for example, or to model low-temperature reactions near the Earth's surface aqueous solutions. According to the geological structure, the Kudryashovskoye field is multilayer. The placement system is selective in this field. The development of all facilities takes place using a reservoir pressure system. The well stock for drilling (throughout the field) is 42, including 28 producing wells and 14 injection wells. In 2015, 12 wells were planned to be drilled. The paper considers and analyses two options for the development approach. The first option: drilling, is planned in 2019 according to the approved layout of wells. The density of good grids is 10.6 ha/well. The second option: drilling is carried out according to the areal system with a distance of 200-250 m between the wells. The density of the wells is 8.1 ha/well. It is planned to use the technology for simultaneous-separate operation in 19 wells Modelling is carried out using the Petrel software package. After the work is done and comparative analysis, development options are proposed. The second development option is most suitable from the economic point of view and approach.

GRAPHICAL ABSTRACT



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Introduction

In several areas, including environmental protection and remediation, the petroleum industry, and economic geology, geochemical modelling is used [1–4]. For example, models can be built to explain the composition of natural waters; the mobility and breakdown of pollutants in flowing groundwater or surface water; the formation and dissolution of rocks and minerals in geological formations in reaction to industrial waste, steam, or carbon dioxide injection; and the production of acidic waters and the leaching of mining waste metals. Geochemical methods have greatly added to our global understanding of petroleum processes. However, we must continue to advance our understanding of these processes through new geochemical methods and analytical advances to meet the growing challenges of finding new hydrocarbon resources. Such growth requires that research initiatives led by academia and industry converge in ways that are unique to geosciences [5,6]. Kudryashovskoye deposit is at an early stage of development. The features of this deposit include the complexity of the formation structure. Besides, this field's reservoir oil is characterized as highly viscous, with a sufficiently high content of asphalting-resinous components and paraffin [7–11]. The main goal of the work: to develop the geological model for the objects A3-4. The tasks solved in the course of work:

- To consider the geological structure of the deposit;
- To review the development status
- To develop a geological model for the selected objects to calculate geological reserves;
- To offer development options and evaluate their cost-effectiveness.

To compile the physical-lithological characteristics of productive sediment reservoirs [12], they used macro descriptions of the samples, the results of core analyses, petrographic descriptions of thin sections of Kudryashovsky and neighbouring deposits. The stratum A3 of the Verey horizon [13] is characterized by a wide distribution of terrigenous rocks in the sole and carbonate rocks in the roof. The terrigenous (lower) part of the section comprises interbedded dark and light green clays, mudstones with the traces of sliding mirrors, greenish-grey quartz-feldspar, often clay siltstones, and sandstones [14].

The mudstones are dark grey, often black, silty, carbonaceous, with large carbonized plant detritus, and thinly layered [15–17]. Siltstones are predominantly dark grey, often black, fine-grained, rarely coarse-grained, uneven, with highly clay interlayers, the areas before the transition to argillite, unevenly carbonated, with carbonaceous and pyritized parts. Sandstones are grey and greenish-light grey, feldspar-quartz, fine-grained, silty, clay, and carbonated, sometimes with carbonized and pyritized plant debris, mostly weakly cemented, unevenly porous due to the inclusions of clay and carbonate material [18–20].

A characteristic feature of the Verey horizon's sandstones is their increased natural radioactivity due to the increased content of potassium feldspars in their composition. The carbonate (upper) part of the section is composed of grey and dark grey limestone, with black spots and interlayers, fine-grained, less often detrital, and clotted with detritus, unevenly clay, dolomitic and aerolitic, solid, with sub-horizontal sinuous hairy and threadlike empty cracks. A4 stratum stands out in the upper part of the Bashkirian stage and is represented by grey, light grey, organ genic clastic, chemo genic, and biomorphic limestone, often cavernous and fractured, and dolomitized to varying degrees. Limestone is often pyritized. Excesses of thick viscous oil along the cracks and microspores are noted.

To assess the residual oil saturation and oil displacement factors [21,22] by water for A3 and A4 formations, we used the generalized dependences obtained after analyzing the Bashkirian stage's laboratory studies the Vereysky field horizon in Bashkortostan, Tatarstan, Perm, and Ulyanovsk regions. At that, they believed that the filtration properties of the

Bashkir and Tournaisian layers differ only in permeability.

Material and Methods

The field was discovered in 1985, and its development started in 1998. At present, three facilities are under development: A3, A4, and B1-2. Twenty-three wells were drilled at the Kudryashovskoye field: three exploration wells (No. 14P, 15P, 16P) and 20 production wells. Exploration well No. 16P was drilled beyond the oil profile. Therefore, it was liquidated and is currently written off the balance sheet for geological reasons. Twenty wells are steep; three wells (No. 17G, 18G, and 19G) are drilled horizontally. All drilled wells except No. 16P participated in production (Methodological guidelines for the construction of permanent geological and technological models of oil and gas fields) [23].

As of 01.01.20 **, 21 wells are listed in the production fund, including 17 operating ones (ESP (VNN) - 16, ShGN - 1), two inactive ones, one in development after drilling, and one is abandoned. The injection fund has one well under injection. The special well stock is represented by one active absorbing well. The dynamics of the main indicators of field development are presented in Appendix B.

By 1.01.20 ** initially approved oil reserves for the field where the following:

Initial oil reserves (category C1):

- Geological - 5421 thousand tons,
- Recoverable - 1775 thousand tons;

Initial oil reserves (category C2):

- Geological - 3404 thousand tons,
- Recoverable - 1069 thousand tons

Within the licensed area of OJSC "Ulyanovskneft" ULN 09104 NE:

Initial oil reserves (category C1):

- Geological - 5379 thousand tons,
- Recoverable - 1759 thousand tons;

Initial oil reserves (category C2):

- Geological - 240 thousand tons,
- Recoverable - 76 thousand tons

Within the licensed area of RITEK CJSC ULN 09156 HP:

Initial oil reserves (category C1):

- Geological - 42 thousand tons,
- Recoverable - 16 thousand tons;

Initial oil reserves (category C2):

- Geological - 3164 thousand tons,
- Recoverable - 993 thousand tons

A4 object

The object A4 was put into development on 08.2004 by joining well No. 14R of the Bobrikovsky horizon. The initial fluid rate was 5.3 tons/day, the oil rate was 4.8 tons/day, and the water cut was 10.2%. In 2011, wells No. 18G, 19G were transferred from facility B1-2 with oil rates of 40.7 and 17.4 tons/day, liquid rates of 43.0 and 19.9 tons/day, and water cuts of 4.1 and 10.0%, respectively. In 2013, wells No. 20, 21, 25, 26 were put into joint operation with facility A3. Initial fluid rates were 66.7 - 120.7 tons/day, oil rates - 25.2 - 81.9 tons/day, and water cut - 2.4 - 79.6%. In 2014, wells No. 27, 28, 29, 33, 36, 41, 42, 43, 44, 46 were put into joint operation with facility A3. Initial fluid rates were 40.1 – 131.5 tons/day, oil rates – 30.5 - 70.2 t/day, and water cut - 0 - 60%. As of 01.01.2015, the production fund of facility A4 is 14 wells (all joint with facility A3), including 12 operating (11 - ESP; 1 - BHP), one inactive, and one in development. The injection fund is represented by one well under injection.

Since the start of development at facility A4, 126.6 thousand tons of oil and 163.4 thousand tons of liquid have been produced. The accumulated injection is 7 thousand m3; the accumulated compensation is 4.6%. In 2014, oil production amounted to 74.7 thousand tons, liquid production - 105 thousand tons, average oil production - 29.2 tons/day, liquid production - 41.1 tons/day, and water cut - 28.9%. Injection - 6.3 thousand m3, current compensation - 6%.

Liquid production rates during the development period (from 2004 to 2014) varied in the range from 1.3 tons/day (2006) to 41.1 tons/day (2014), well oil rates - from 1.3 tons/day (2006) up to 29.9 t/day (2013). Oil extraction from wells varies from 0.02 thousand tons (well No. 26) to 19.1 thousand tons (well No. 25). The main amount of oil and liquid produced from the facility by the wells (No. 18G, 20, 25, 28), the cumulative oil production from them varies from 12.2 thousand tons [24] to 19.1 thousand tons [25]. Four wells provided 52% of the accumulated oil production at the facility, which is 65.9 thousand tons. As of 01.01.2015, the average oil withdrawal per well amounted to 7.5 thousand tons, liquid - 9.6 thousand tons.

Object A3

Object A3 was put into development on 01.2012 by interconnecting well No. 14R and transferring well No. 19G of the Bobrikov horizon. The initial production rates for oil are 6.0 and 7.4 tons/day, for liquids - 7.9 and 7.4 tons/day, and water cut - 24.4 and 0.5%, respectively. In 2013, wells No. 20, 21, 25, 26 were put into joint operation with facility A4. Initial fluid rates were 4.1 - 117.1 tons/day, oil rates - 2.6 - 24.5 tons/day, and water cut - 2.4 - 79.1%.

In 2014, wells No. 27, 28, 29, 33, 36, 41, 42, 43, 44, 46 were put into joint operation with facility A3. Initial fluid rates were 5.3 –9.6 t/day, oil rates were 3.7 - 9.6 t/day, and water cut - 0 - 27.6%. The well 34 was put into independent operation at the facility with an oil flow rate of 29.9 t/day, 57.2 t/day, and a water cut of 47.7%. As of 01.01.2015, the production fund of facility A3 is 18 wells (14 are joint with facility A3), including 16 operating (15 - ESP; 1 - BHP), one inactive, and one in development. The injection fund is represented by one well under injection.

Since the start of development at facility A3, 32.9 thousand tons of oil and 61.7 thousand tons of liquid have been produced. The accumulated injection is 40.3 thousand m3, and the accumulated compensation is 66.2%.

In 2014, oil production amounted to 22.3 thousand tons, liquid production - 47.3 thousand tons, average oil production - 6.2 tons/day, liquid 13.2 tons/day, and water cut - 52.9%. Injection - 33.8 thousand m3, current compensation - 72.9%. The dynamics of technological indicators for the development of the A3 facility are given in Appendix D.

During the development period (from 2012 to 2014) fluid flow rates varied in the range from 7.1 t/day (2012) to 13.2 t/day (2014), well oil flow rates - from 7.0 t/day (2012) up to 6.2 t/day (2014). Oil extraction from wells varies from 0.04 thousand tons (well No. 44) to 8.0 thousand tons (well No. 26). The main amount of oil and liquid from the facility is produced by the wells (No. 14, 19G, 20, 26, and 34), the cumulative oil production from them varies from 3.5 thousand tons (the well No. 14) to 8.0 thousand tons (the well No. 26). Four wells provided 66% of the accumulated oil production at the facility, which is 21.8 thousand tons. As of 01.01.2015, the average oil withdrawal per well amounted to 1.8 thousand tons, liquid withdrawal - 3.4 thousand tons [26].

Result and Dissection

The analysis of oil reserves production at facilities A3, A4 (Methodological guidelines for the construction of constantly operating geological and technological models of oil and gas fields). Despite the fact that the A4 layer has been in industrial development since 2004, the object was idle during the period 2008-2010. As of 01.01.2015, there are 12 production wells in operation. The selection from NCDs is 27%, the current CIN is 0.080 with an approved 0.295. Development is actually in its infancy. The main indicators of reserves development (C1) for facility A4 of the Kudryashovskoye field are shown in Figure 1.

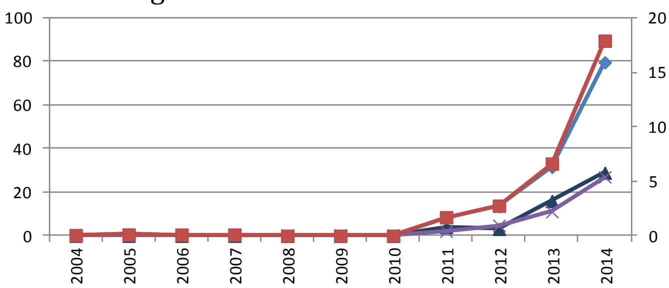

Figure 1: The main indicators of oil reserves (C1). Object A4. Kudryashovskoye field

The layer A3 has been in industrial development since 2012. As of January 1, 2015, 16 production wells are in operation. The selection from NCDs is 13.6%, the current CIN is 0.033, while the approved one is 0.244. Development is actually in its infancy. The main indicators of reserves development (C1) for facility A4 of the Kudryashovskoye field are shown in Figure 2.

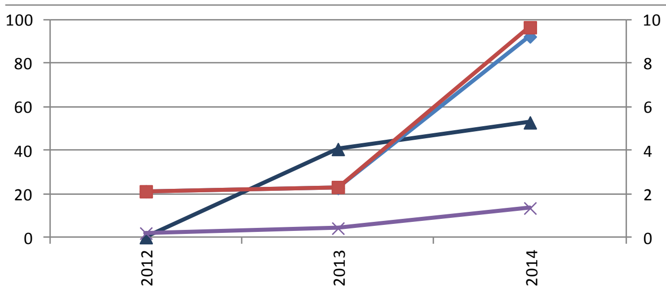

Figure 2: The main indicators of oil reserves (C1). Object A3. Kudryashovskoye field

The active work of the VNK circuit is noted in the well stock area takes place at facility A3-4. VNK progress is observed mainly in the north of the facility. It is also worth noting that the injected water spreads to the producing wells quite evenly. In general, the A3-4 object is at the initial stage of development, and most of the reservoir area is not affected by production.

Comparison of design and actual indicators of A4 development

In 2010, it was planned to operate the facility with one transfer well and start one production well from drilling with a flow rate of 19 tons/day. In fact, since January 2008, the facility has not been developed.

In 2011, one observed well was transferred, and two horizontal wells were transferred from facility B1-2, and the project planned to operate one well in 2011 and drill one well in 2012. Thus, oil production levels were exceeded by 695 % in 2011 and by 78% in 2012. In 2013, the lag in the actual level of oil production from project one was 11 thousand tons (26%, within the tolerance range) due to lower oil and fluid production rates for new wells and shorter working hours.

In 2014, oil production levels were higher than projected due to overfulfill of the drilling plan for a new well stock. The mining fund is seven units higher. In 2014, the average oil production rate was 25% higher than the design ones (fact - 29.2, the project - 23.4 t/day), the fluid flow rate was 55% less. Water cut below design by 45%. Actual production in 2014 amounted to 74.7 thousand tons, which is 106% higher than the projected one (with an allowable deviation of 40%). The deviation of the actual indicators of A4 object development from the design ones in 2014 with a comparative analysis. It shows the discrepancy in oil production:

Project: 36.2 thousand tons, actual: 74.7 thousand tons, design fluid production made: 141.6 thousand tons, actual: 105.0 thousand tons, design oil production rate: 23.4 t/day, actual: 29.3 t/day, design water cut: 74.4%, actual: 28.9%; operating mining project fund: 5 units, mining: 12 units; cumulative oil production design value: 99 thousand tons, the actual value makes 127 thousand tons. Thus, the development of facility A4 is being carried out with a large excess of oil production due to more intensive drilling at the facility.

Comparison of design and actual development indicators of the facility A3

The object was put into development in 2012. Since 2013, the actual level of oil production has exceeded the design level due to a larger well stock. In 2014, oil production levels were higher than projected due to over fulfillment of the plan for a new well stock drilling. The mining fund is up 15 units. For 2014, the average oil and liquid flow rates are 73-78% lower than the design ones. The water cut is below design one by 8%. Actual production in 2014 amounted to 22.3 thousand tons, which is 178 % higher than the projected one (with an allowable deviation of 50%). Deviation of the actual indicators of the facility A3 development from the design ones in 2014:

Eight thousand tons for project oil production, actually: 22 thousand tons; projected liquid production - 20.6 thousand tons, actually - 47.3 thousand tons; design oil production rate - 23.1 t/day, actual 6.2 t/day, design water cut 61.2%, actual 52.9%; operating mining fund: project - 1 pc, mining - 16 pcs; cumulative oil production: design value - 13 thousand tons, the actual value - 33 thousand tons.

Thus, the development of facility A3 is being carried out with a large excess of oil production level due to more intensive commissioning of wells.

In this work, the geological reserves of oil are calculated according to the three-dimensional geological model. The calculation is based on the volumetric method. The following sequence of calculations is used to calculate reserves:

- Calculation of the 3D parameter of the rock geometrical volume, limiting the deposits;
- Calculation of the effective volume of rocks, as a product of the geometric volume parameters and lithology;
- Assessment of the pore volume of rocks, as the product of the effective volume and porosity coefficient;
- Calculation of oil volume as the product of the pore volume of rocks and the coefficient of initial oil saturation;
- Multiplying the resulting array of oil saturation values by the conversion factor and the oil density, obtaining the three-dimensional distribution of oil reserves in surface conditions.

The model cells whose center is located hypsometrically above the accepted contact are involved in hydrocarbon reserve calculation. They performed the comparison of the initial geological oil reserves listed on the state balance of the Russian Federation and the three-dimensional geological model (Table 1).

Table 3: Comparison of the initial geological reserves of hydrocarbons

Plast	Category stocks	Approved Stocks	Calculation according to the geological model	Deviation, %
A3	C1	991	991.6	0.07
	C2	664	663.6	-0,06
A4	C1	1592	1592.3	0,02
	C2	1238	1237.4	-0,05

Technical and economic analysis of development options

Given the change approved after operational recalculation of A3 and A4 formation reserves in 2015 (protocol of the State Reserves Committee of the Russian Federation No. 03-18/127-pr of 03/06/2015). The Kudryashovskoye field contains the initial geological/recoverable oil reserves in the following amount: 991/241 for A3 formation (cat. C1), KIN - 0.244, (cat. C2) - 664/162, KIN - 0.244; as for A4 formation: (cat. C1) - 1592/469, KIN - 0.295, (cat. S2) - 1238/366, KIN - 0.295; After the calculations performed on A3 + A4 facility, the oil recovery factor is higher than the approved one in all cases, due to a denser grid of wells.

Object A3-4

Option 1

The layout of the wells is uneven, with a distance of 200-700 m. The total well stock will be 42, including 39 production ones and three injection ones. Twenty- three wells will be drilled in total, including 20 production and three injection wells. The grid density will be 10.8 ha/well (Guseynov, C. S. 2020).

Calculation results

- The maximum level of oil production is 146.3 thousand tons (2016).
- The maximum level of fluid production is 344.3 thousand tons (2024).

- The maximum level of water injection is 378.1 thousand tons (2023).
- The development period will be 48 years.
- Cumulative oil production makes 1.421 million tons.
- Cumulative fluid production makes 11.3 million tons.
- The accumulated water injection makes 11.9 million tons.
- The oil recovery coefficient makes 0.317 u.f.
- C_{ochw} - 0.547 u.f.
- Q_{vyt}- 0.579 CU u.f.

Capital investments under the option amount to 1,171 million rubles. The value of operating costs for the project period (2015-2062) is 17144 million rubles; the index of cost-effectiveness is 1.06 units. NPV at the end of the project period makes 1202 million rubles. The total discounted state revenue at the discount rate of 10% for the project period is 6428 million rubles. The development is cost-effective until 2031.

Option 2

The layout of the wells is uneven, with a distance of 200-700 m. The total well stock will be 50, including 44 production ones and six injection ones. Thirty-one wells will be drilled in total, including 25 production wells and six injection wells. The grid density will be 9.1 ha/well [26].

Calculation results

- The maximum level of oil production is 151.2 thousand tons (2016).
- The maximum level of liquid production is 400.6 thousand tons (2024).
- The maximum level of water injection is 555.9 thousand tons (2023).
- The development period will be 45 years.
- Cumulative oil production makes 1.544 million tons.
- Cumulative fluid production 12.3 makes million tons.
- The accumulated water injection makes 13.1 million tons.
- Oil recovery coefficient - 0.344 u.f.
- C_{ochw} - 0.594 u.f.
- Q_{vyt} - 0.579 u.f.

Capital investments under the option amount to 1,574 million rubles. The value of operating costs for the project period (2015-2059) is 17785 million rubles; the index of cost-effectiveness is 1.07 units. NPV at the end of the project period makes 1304 million rubles. The total discounted state revenue at a discount rate of 10% is 6847 million rubles for the project period. Development is cost-effective until 2033.

Conclusion

Thus, a geological model of the Kudryashovskoye field was constructed for the objects A3, A4. Parameters assessed the reliability of the geological model. In general, the three-dimensional geological model built on productive formations of the Kudryashovskoye field corresponds to the prevailing idea of the geological field structure and can serve as the basis for hydrodynamic modeling.

The stock calculation was carried out. The deviation according to the model was not more than 5%. This shows that the constructed filtration models adequately reflect the processes occurring in the deposits. Moreover, it can be used to predict the field development process.

In addition, two options were proposed for the further development of the facility. Given that the development objects were similar to each other according to some criteria, it was decided to combine them into one object for further development. Still, the methods have been proposed to increase the intensification and recovery of oil, but currently, the methods are not economically effective. Therefore, the options differ by the number of wells during drilling. Option 2 is recommended for implementation at facility A3-4, as the best one in terms of its technical and economic indicators [26].

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Authors' contributions

All authors contributed toward data analysis, drafting and revising the paper and agreed to be responsible for all the aspects of this work.

Conflict of Interest

We have no conflicts of interest to disclose.

References

[1]. Zhang C., Tang Y., Xu X., Kiely G., *Appl. Geochem.*, 2011, **26**:1239

[2]. Leal A.M., Blunt M.J., LaForce T.C., *Appl. Geochem.*, 2015, **55**:46

[3]. Laceby J.P., Olley J., *Hydrol. Process.*, 2015, **29**:1669

[4]. Janoušek V., Moyen J.-F., Martin H., Erban V., Farrow C., *Geochemical Modelling of Igneous Processes: Principles and Recipes in R Language*. Springer, 2015

[5]. Shawai S.A.A., Nahannu M.S., Mukhtar H.I., Isma'il I.M., *J. Med. Chem. Sci.*, 2019, **2**:96

[6]. Bader N., Faraj M., Mohamed A., Alshelmani N., Elkailany R., Bobtana F., *J. Med. Chem. Sci.*, 2020, **3**:138

[7]. Zhapbasbayev U.K., Kudaibergenov S.E., Mankhanova A.E., Sadykov R.M., *Thermophys. Aeromechanics*, 2018, **25**:909

[8]. Taraskin E.N., Piatibratov P.V., Ursegov S.O., *Neft. Khozyaystvo-Oil Ind.*, 2019, **2019**:103

[9]. Sie C.-Y., Nguyen B., Verlaan M., Castellanos-Diaz O., Adiaheno K., Nguyen Q.P., *Energy Fuels*, 2018, **32**:360

[10]. Luo H., Delshad M., Pope G.A., Mohanty K.K., *J. Pet. Sci. Eng.*, 2018, **165**:332

[11]. Ado M.R., Greaves M., Rigby S.P., *J. Pet. Sci. Eng.*, 2018, **166**:94

[12]. Liu Z., Shang Y., Zhao R., Liu F., Xue X., Liu Y., *Acta Geol. Sin.-Engl. Ed.*, 2020, **94**:545

[13]. Ashirov K.B., Kolesov V.S., *Pet. Geol.,* 1974, **12**:241

[14]. Zou C., U*nconventional petroleum geology*. Elsevier, 2017

[15]. Xiang L., Liu X., Liu P., Jiang X., Dai C., *Clay Miner.*, 2020, **55**:71

[16]. Ibrahim W.E., Rafek A.G., Salim A.M.A., *Pet. Coal*, 2018, **60**

[17]. Bhowmik S., Nagata M., Kikumoto M., in *54th US Rock Mech. Symp.*, American Rock Mechanics Association, 2020

[18]. Wang F.G., Xiao G.Q., in *Adv. Mater. Res.*, Trans Tech Publ, 2014, **962**:2708

[19]. Vachova Z., Kvaček J., *Bull. Geosci.*, 2009, **84**:257

[20]. Iosifidi A.G., Khramov A.N., Bachtadse V., *Russ. J. Earth Sci.*, 2005, **7**:27

[21]. Fang Y., Yang E., Yin D., Gan Y., *J. Dispers. Sci. Technol.*, 2019, 3:15

[22]. Akhmetov R.T., Andreev A.V., Mukhametshin V.V., *Nanotekhnologii V Stroit.*, 2017, **9**:116

[23]. Aleksandrov V., Kadyrov M., Ufelman Z., Golozubenko V., Kopyrin V., in *Key Eng. Mater.*, Trans Tech Publ, 2018, **785**:118

[24]. Dozorova T.A., Aleksandrova N.R., Utmanova N.A., *Международный Научно-Исследовательский Журнал*, 2016

[25]. Guseynov C.S., in *IOP Conf. Ser. Mater. Sci. Eng.*, IOP Publishing, 2020, **734**:012174

[26]. Kossov V.V., Livshchits V.N., Shakhnazarov A.G., *Mosc. Econ.*, 2000, **421**

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