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OIL SHALE OF SOUTH-TORGAY OIL AND GAS BASIN

Abstract. Prospects of oil and gas potential of the South Torgai oil and gas basin for the presence of "shale" hydrocarbons are considered.

The main features of the rocks, called "oil shale" – a fairly high content of organic matter (OM) under conditions of closed porosity, respectively, their low permeability and residence in the main zone of oil and gas formation for quite some time – about 40–50 million years. At the same time, ripe oil and gas remain in the conditions of a low permeable maternal suite.

Hydrocarbons contained in these low-permeability rocks can be produced on an industrial scale only after exposure to fracturing by fracturing, with drilling mud containing sand (proppant), which ensures the preservation of this man-made fracture and a set of chemicals that ensure oil separation from the mineral matrix.

As a result of the work done, the existence of a highly promising formation on the shale HC formations, the Karagansay Formation of the Middle Jurassic was justifiedin the South Torgai Basin. The next task will be to identify specific horizons (layers) containing hydrocarbons in low-permeability reservoirs. This is a task for specialists in field geology and geophysics to plan the next stage of experimental work on the problem of oil shale in search areas.

Key words: South-Torgay basin, oil shale, shale oil and gas, Akshabulak and Aryskumgraben-synclines.

Works on the topic: "Oil shale of the South Torgai oil and gas basin" were completed in 2015–2017. with the aim of studying the prospects of the basin to identify sediments containing oil shale and suitable for the extraction of "shale" oil and gas.

This problem is related to the "shale revolution" in the US and testing of its technologies in other oil and gas basins of the world. And if the US as a result of the widespread introduction of these technologies came out on top in the world in terms of hydrocarbon production, then in the rest of the countries the results are ambiguous, which indicates the complexity of the problem.

Extraction of hard-to-recover oil and gas reserves (in the media they are called "shale") began in the US in 2006 from the Barnett gas field, which was an experimental ground for the development of horizontal drilling technology with fracturing.

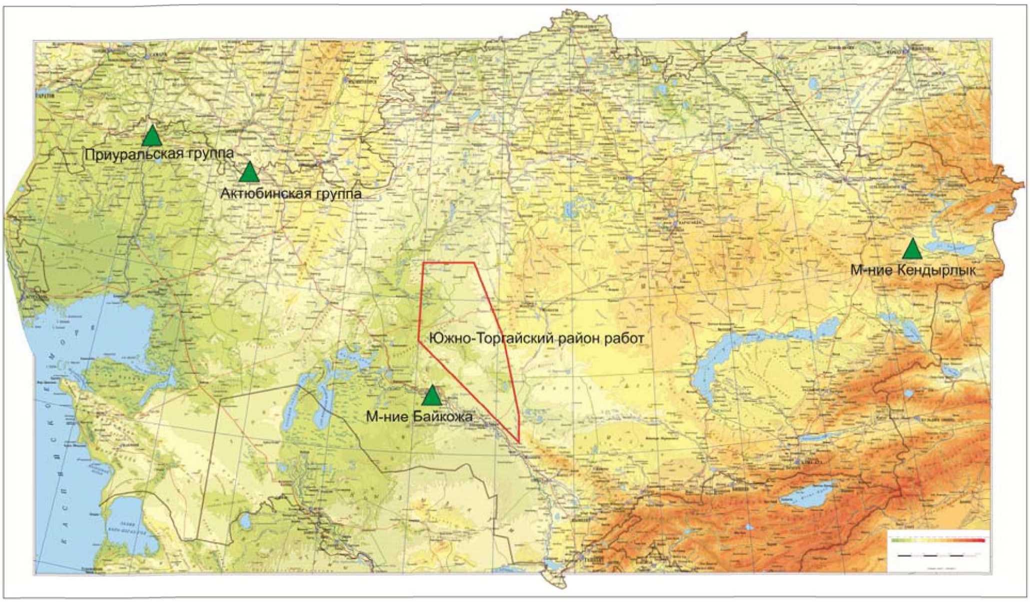
Success, comparable in effectiveness with the US data, was obtained in Argentina, Algeria and Australia. In other countries, the results are less certain or negative.

In Eastern Europe, the testing of "shale" technologies with the participation of American and European firms was completed with a negative result in Poland, Hungary, Bulgaria, Romania, Lithuania, Latvia, Ukraine. And in France, Germany, the Netherlands, there is a ban on the technique with hydraulic fracturing of reservoirs because of possible dangerous environmental consequences. In China, the experimental exploitation of deposits in the south-west and north-west of the country.

In Russia, experimental work in this direction is carried out in Western Siberia in the deposits of the oil-bearing Bazhenov suite of the Upper Jurassic, but the optimal method is under development.

The extraction of "shale" gas is carried out in a number of sedimentary basins from sediments of various ages containing organic matter C_{org}. from 2% and above, and sometimes from 1%in the US.

For shale oil, the requirements are higher, and for this, higher concentrations of C_{org} are needed, in the productive stratum, a higher quality organic matter, predominantly sapropelic or sapropel-humic, extraction of more than 90 liters per ton of "slate", thickness of the productive stratum 30 m and more.



Δ deposits of combustible shales at shallow depths and with access to the day surface.

Figure 1 – Overview of the work area

It should be especially noted that the term "shale oil and gas" does not quite correctly reflect the essence of the problem, since hydrocarbons are extracted not from shales, but from low-permeability rocks enriched by DWOs adjacent to slate-containing sediments or regardless of shale (from dense sandstones).

The main features of these rocks are a rather high content of organic matter (OV) under conditions of closed porosity, respectively, their low permeability and presence in the main oil and gas formation zone (GZN) for a long time – about 40–50 million years. At the same time, ripe oil and gas remain in the conditions of a low permeable maternal suite.

Hydrocarbons contained in these low-permeability rocks can be produced on an industrial scale only after they are affected by hydraulic fracturing, which provides the formation of fractured porosity with a drilling mud containing sand (proppant), which ensures the preservation of this man-made fracturing and a set of chemicals that ensure oil separation from the mineral matrix .

In accordance with these prerequisites, works on the problem of "oil shales" in the South-Torgai basin were carried out.

The basis of the South Torgai basin is a block of Precambrian rocks, similar in composition to the rocks of the Ulytau Massif. Gneisses of the Proterozoic age were discovered by a number of wells in the South Torgai basin (2P Aryskum, 1P Akshabulak, etc.).

In the late Devonian-Early Carboniferous (D_{3fm}–C1), the area of the South Torgai Basin was covered with a shelf sea with the accumulation of terrigenous-carbonate deposits.

In the late Triassic – Early Jurassic, a system of grabens was formed in Southern Torgai, which were then filled with Mesozoic – Cenozoic terrigenous lacustrine-bog sediments represented by a gray-colored stratum of sandstones, siltstones, clays with intercalated coals, carbonate packs, carbonaceous and combustible shales.

The main features of the structure of the Jurassic complex are reflected on the structural map on the roof of the Middle Jurassic in accordance with Figure 2.

The South Torgai sedimentary basin consists of three main tectonic elements: the Aryskum trough in the south, the Zhilanshik trough in the north and the Mynbulak saddle separating them. There are differences in the structure and development of the northern and southern parts of the basin [1, 2].

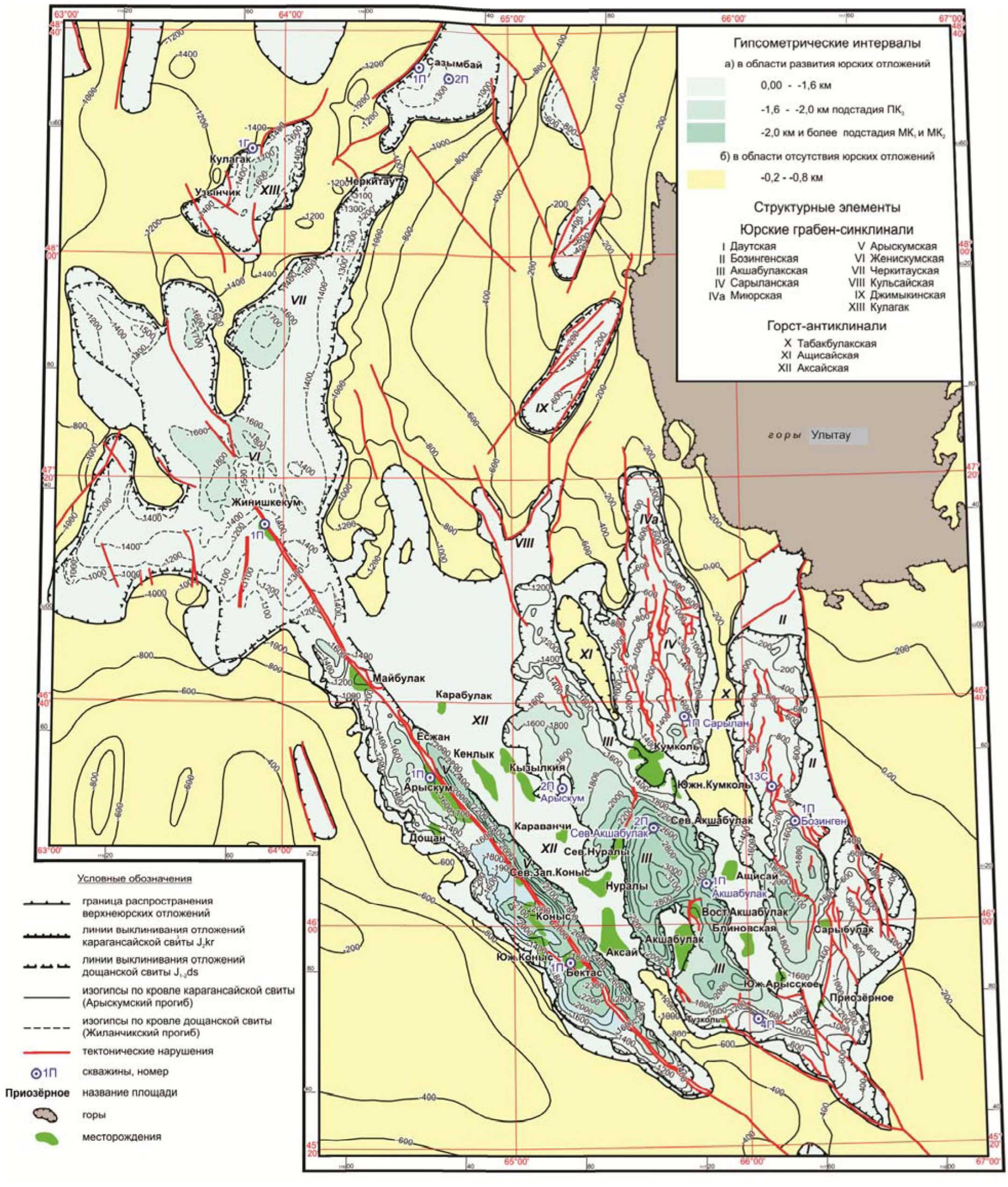


Figure 2 – South Torgai deflection map on the roof of Middle Jurassic deposits

In the Aryskum trough, the Jurassic complex is represented by all the suites, and in the Zhilanshiksky it is reduced due to the Upper Jurassic and Karagansay Formation of the Middle Jurassic.

The deepest grabens, with a depth of up to 5–7 km, were formed in the Aryskum trough: the Aryskum, Akshabulak, Bosingen and Sarylansk graben-synclines (g/s). The Jurassic deposits that fill them are represented by the sediments of all three divisions of the Jurassic system. They are divided into six suites: the Sazimbay suite (J1cz). *aybalinskaya* (J_1ab), *doshchanskaya*(J_{1-2} ds), *Karagansai* (J_{23}kr), *kumkol* (J_3km), *akshabulak* (J_3ak).

The Zhilanshik trough. The differences between the Zhilanshik trough and the Aryskum deposit consist in a shallower depth of the graben-syncline – no more than 3.0–3.5 km, in their northeasterly direction (in the Aryskum – northwestern or submeridional), and in a reduced section of the Jurassic deposits.

The reasons for the reduced section in the Zhilanshik trough are that if the Aryskum trough was submerged continuously throughout the Jurassic time with the accumulation of precipitation, then in the Zhilanshik trough the immersion stopped at the border of the Middle and Upper Jurassic (Karagansay Formation) and resumed only in the Lower Cretaceous. Therefore, the upper part of the Jurassic incision in the Zhilanshik trough has not been postponed or disappeared as a result of denudation.

According to the lithological composition, the Jurassic deposits are divided into strata, each of which begins with coarse clastic formations and ends with clayey formations.

The lowersubcomplex, which combines the Sazimbay (J_1cs) and Aibalin (J_1ab) suites, is represented, respectively, by sandy-conglomerate and aleuro-sand-argillaceous formations. It is present in all graben-synclines and denotes the riftogenic stage of their development.

In general, this subcomplex ($J_1cs + J_1ab$) is characterized by fairly high concentrations of organic carbon (1–3.7%) on the rock (in mudstones and siltstones) of sapropelic-humic composition in the Aryskum trough and predominantly of the humus composition in the Zhilanshik.

The middle oil and gas bearing subcomplex is represented by the formations of doshchanskaya ($J_{1\text{-}2}$ ds) and Karagansai ($J_{23}kr$) suites in the form of sandy-siltstone and argillaceous formations. It occupies an area larger than the lower subcomplex.

The Doschanskaya suite is widespread in all graben-synclines and is represented by the alternation of sandstones with siltstones with interbeds of mudstone and small-pebble conglomerates.

The Karagansay Formation (J_2^3kr), an "argillaceous formation", is mainly distributed in the Aryskum trough. Perhaps its presence in the transition zone from the Aryskum trough to the Zhilanshik. But in the wells that uncovered the Jurassic deposits in the Zhilanshik trough, only the presence of the doshchanskaya suite ($J_{1\text{-}2}$ ds) was documented.

The Karagansaysuite is composed mostly of mudstones almost black and brown, massive to thin-sheeted and leafy, silty, carbonate. They are interbedded with sandstones and siltstones. The inclusion of ORO is numerous.

In the upper sections of the sections of the suite among the mudstones is the alternation of their strongly humified varieties with interlayers of combustible shales, the thickness from centimeters to 40 cm. The amount of aleurite material is also variable, the "sanding" of the formation in the direction from the deepest parts of the basin to the side areas is noted.

The rocks of the middle oil and gas bearing subcomplex contain organic matter of sapropelic-humic composition, which determines its isolation as a petroleum-bearing stratum, provided it is in the main oil and gas formation zone, i.e. at depths of the order of 2.0 km and more. Hydrogen generation zones are immersed parts of graben-synclines, filled with sediments of the Lower-Middle Jurassic.

The upper oil and gas complex in the Upper Jurassic deposits combines a sandy-aleurite formation of the Kumkol Formation and a clayey-aleurite formation of the Akshabulak Formation.

Interbeds of carbonatized argillites and limestones interbedded with combustible shales (borehole 13C in Bosingen h/s) [3] are noted in the middle part of the Kumkol suite.

The Akshabulak suite is composed of variegated mudstones and clays massive and cloddy, interbedded with siltstones and sandstones, with a thickness of 3 to 8 m.

At the depths of the Upper Jurassic complex from 800 to 3200 m, only its most submerged parts in the central sections of the g/s (deeper than 1500-2000 m) entered the main oil and gas formation zone. The remaining parts of the subcomplex contain only epigenetic hydrocarbons.

The Lower Cretaceous oil and gas bearing complex is mainly developed in the Aryskum trough and is represented by the red-colored continental deposits of the DaoulNeocomite Formation. The known industrial deposits of this complex are found in the Lower Saulian sub-basin in the Aryskum horizon K1nc, ar. The upper clay part of the Daoul Formation serves as a regional tire.

The dynamics of hydrocarbon generation processes and the degree of realization of the petroleum potential of rocks enriched in DW are investigated by D. A. Shlygin and H. Kh. Paragulgovym [2]. According to their data, the catagenetic zoning in the South Torgai Basin is mainly determined by the depth of deposit occurrence.

The beginning of the main zone of oil formation (GZN) is formed in the transition zone from substage PK3 (beginning at a depth of 1700–1800 m) to MK1 (2100–2300 m); the upper limit of MK2 is at a depth of 2500–2600 m, MK3 at a depth of 3000–3100 m.

Structural-tectonic features of the South-Torgai basin are represented on the structural map over the surface of the Middle Jurassic deposits (Figure 2), for the Aryskum trough – this is the surface of the Karagansay suite, for the Zhilanshiksky – erosion surface of the Doshchanskaya suite on the border with the Lower Cretaceous deposits.

As a result of the work on the South Torgai oil and gas basin, the Karagansay suite of the Middle Jurassic (J23kr) was identified as the most promising formation for the search for "shale" oil and gas deposits, provided it lies at a depth of 1.8 km and deeper, i.e. in the main oil formation zone (PC3-MK1-2). This is explained by the increased content of dispersed organic matter (DOM) in the humus-sapropel composition formed in the reducing environment, as well as the presence of interlayers of oil shales in the upper part of the suite.

Further work was directed to a more detailed study of the promising strata throughout the basin and to the selection of the most promising areas.

The central parts of the graben-synclines of the Aryskum trough-Aryskum, Akshabulak and Bosingen, in which the Karagansay Formation reaches its maximum thicknesses and are located in the main oil formation zone (GZN) for a long time, are identified as the most promising areas.

In the graben synclines of the Zhilanshik trough, the Karagansay suite is not opened with drilled wells as a result of a long interruption in the sedimentation that spans the interval from Karagansai to the Lower Cretaceous and is assumed only in the transition part from the Aryskum trough, in the form of the remainder of this formation from subject erosion.

Manifestation of combustible shales in the deposits of the Upper Jurassic. Surface manifestations of oil shale in the South Torgai basin are absent [5]. And their presence was first established in 1984 when studying a core in a structural well 13-C with a depth of 1548 m., Drilled in the Bosingengraben syncline [3].

Combustible shales are found in the sediments of the Kumkol suite of the Upper Jurassic among the carbonate rocks in the form of a compact pack in the interval 1081–1134 m. The interval is covered with continuous core sampling.

As part of this bundle, oil shales are interbedded with mudstones enriched with organic matter, fine-grained sandstones, limestones, dolomites and marls. The total thickness of shales is not less than 7–8 m.

A. K. Buvalkin [4] made an attempt to trace this pack in the Upper Jurassic sediments along the northern edge of the Aryskum trough, but did not find any obvious signs of the spread of shales outside the Bosingen gyroscope, but noted only slightly increased carbonate content in the middle part of the Kumkol suite. Probably, the manifestation of oil shale in the Upper Jurassic is local, this can be facilitated by an inclined fault in the area of the 13-C well (according to seismic data of the MOGT).

Manifestations of oil shales in the sediments of the Middle Jurassic. When processing data on parametric wells drilled in the South Torgai basin in 1985–1992, along with the solution of the main tasks, manifestations of combustible shales in the deposits of the Karagansay suite of the Middle Jurassic J23 kr were established [2].

The documentation of the sections of the parametric wells records the presence of thin interlayers of oil shales with a thickness from the first mm to 40 cm. The core in the boreholes was selected with an interval of 25–50 m, sometimes more often. At the same time, in the Karagansay suite, the organic carbon content of the rock reached 5–10%, which is higher than in the adjacent suites. Directly from the thin layers of shales samples for analysis were not selected (data in the reports are absent).

Description of the core with interlayers of oil shale is present in the documentation of the sections of the parametric wells Akshabulak 1P, Akshabulak 2P, Aryskum 1P, Bektas 1P, Bosingen 1P.

In the Zhilanshik trough, the only manifestation of oil shale was noted in the Kulagak-1 well [2]. At a depth of 1640–1648 m, a layer of strongly humus argillites, interbedded with combustible shales, coal and direct solid bitumen, is noted in the sediments of the dossary formation J1-2ds. Geochemical analyzes on the manifestation are absent, and the features of the manifestation coincide with those in the Ubagan brown coal basin. In addition, this manifestation of depth lies outside the main zone of oil formation. The PC3 zone here starts at a depth of 1800 m, and the MK1 zone starts from a depth of 2300 m.

A Brief Overview of Shale Oil and Gas Deposits in US and Russia. Before proceeding to assess the prospects of the territory for the presence of oil shales (their search and study), it is necessary to get acquainted with the experience of working in this direction in other regions and searching for analogues for the South Torgai basin – it is the "homeland of the slate revolution" – the USA, The West Siberian oil and gas basin, closest to Kazakhstan, where the slate-bearing (and oil-bearing) Bazhenov suite is developed on an area of more than 1 million km^2.

All known shale deposits in the United States are confined to well-studied oil and gas basins. It was known about the presence of the slanting areas, but their development became possible only after a technological breakthrough, which opened access to a previously closed resource.

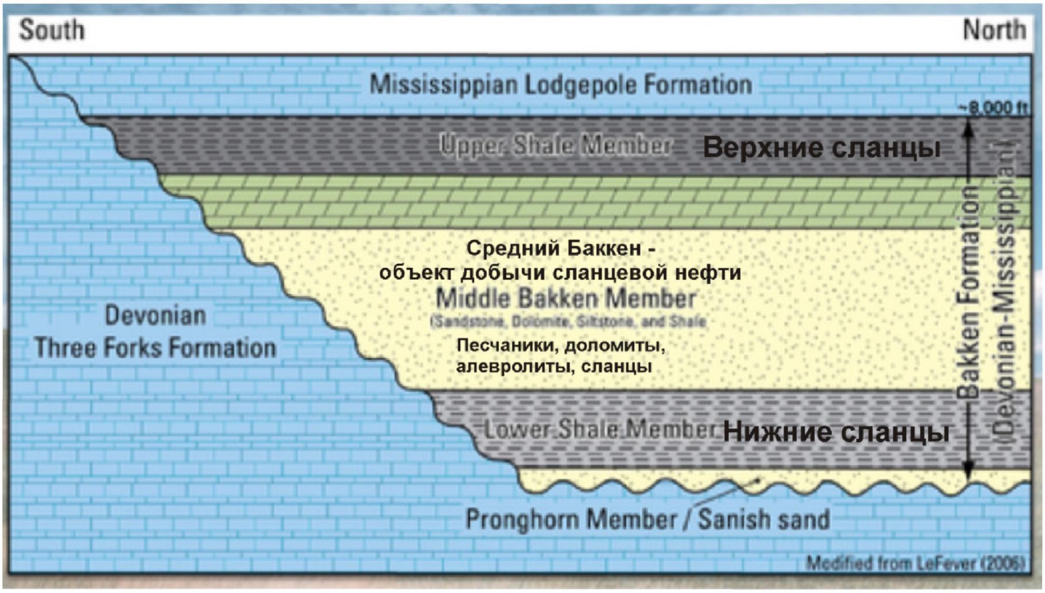


Figure 3 – Bakken oil shale deposit

The production of shale oil and gas, the phenomenon of the last 10 years, which began in 2006 with the Barnett gas field after testing on it the technology of horizontal drilling with multiple fracturing of fractures (fracturing) and pilot operation. In other deposits, production began later, following a law passed by the US Congress on the release of shale projects from environmental control [1, 1].

On the majority of exploited shale deposits with an OM content of 2% or higher, gas is produced, and, in some cases, gas with condensate is sometimes from 1%. For the production of shale oil, deposits with higher sapropelic type OM (kerogen type III) are suitable, and the profitability of hydraulic fracturing is provided only for a sufficiently large thickness of the formation – about 30 m and oil production of 90 liters per ton of "shale".

The most frequently mentioned in the press are the large oil fields Bakken, Nyabrara, Permian, oil and gas – Eagle Ford, and gas – Marcellus, Utica, Barnett. At Bakken, Permian and Eagle Ford account for 88% of all produced shale oil in the US.

Half of the US shale gas is produced by the Marcellus field with annual production of about 180 billion m^3.

For comparison of shale deposits in the USA and Western Siberia, we give data on the Baken oil field (Figure 3) and the gas Marcellus.

Bakkenovskaya formation of light oil of low-permeability reservoirs (light tight oil) was formed on the boundary of Upper Devonian and Lower Carboniferous deposits and lies at depths of 2.5–3.5 km. It is located in the US and Canada and covers an area of about 500 thousand km^2.

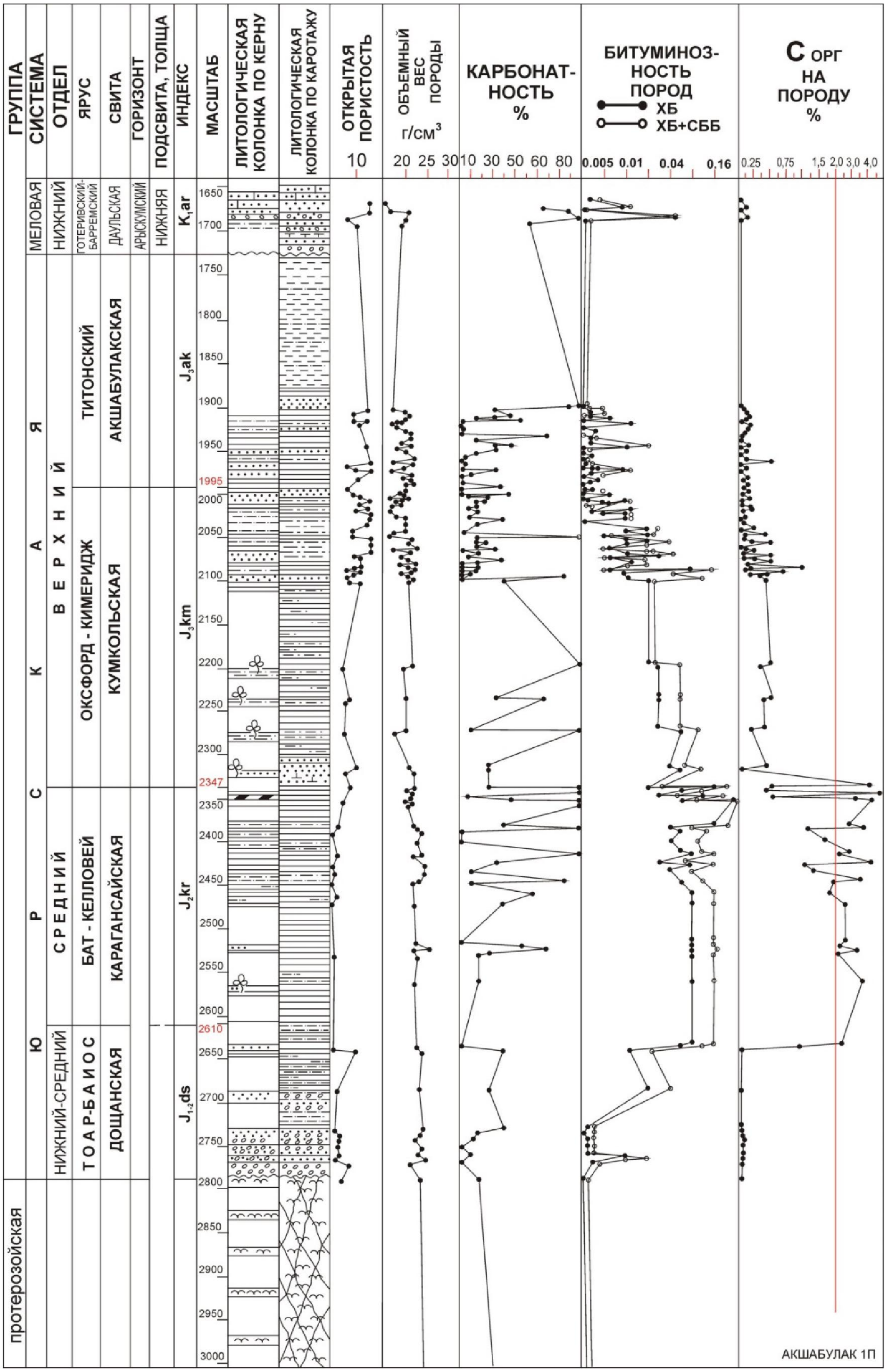


Figure 4 – Lithological and geochemical column of Akshabulak 1P well

The Bakkenovo formation has a three-tier structure:

– Lower shale part - shales rich in sapropelic OM from 11%, in some places up to 35%;

– the average "sandy" part – up to 7%. OB; interbedding of sandstones, dolomites, siltstones and shales, up to 40 m thick. It is this layer that is productive for fracturing;

– the upper slate part - up to 25 m thick, the analog of the lower part.

Marcellus is a shale gas deposit in the eastern United States in the Lower Carboniferous sediments with an OV content of 5%. Extraction – gas and condensate. It is considered to be the most profitable gas field in the US due to geological parameters and position in a region with developed infrastructure.

Western Siberia. Bazhenov suite. The Bazhenov suite in the West Siberian oil and gas province is composed of black and dark gray rocks – bituminous argillites. Depths from 300 to 3500 m and more with thicknesses, on average, 30–40 m and up to 60 m in the central part of the basin. Formed suite on the border of the Chalk-Jurassic (Tithon, Berrias).

These deposits were formed in conditions of a shallow sea basin far from sources of terrigenous material. In the article A. A. Trofimuk and Yu. N. Karagodin (2008), their generalized name – bituminous mudstones, and diagnostic features - anomalous enrichment of OM (up to 10–25%), thin-layered layer and leafy structure with horizontal and vertical cracks, abnormally high pressures in the formation of AVPD (1.3–1.6), low porosity, permeability, temperature from 80^0 to 135^0.

In recent years, it has been established that the Bazhenov suite has a more complex structure. In its central part there are dense interlayers – aporadiolarites, limestones, dolomites, silicites. These interbeds are analogous to the "Middle Bakken", from which shale oil is obtained, but their total thickness is an order of magnitude smaller – up to 5–6 m [8-10, 12].

Collector properties of the Bazhenov suite are associated with the presence of dense rocks within the formation and their fracturing. Where fracturing is present, productive wells are located, and in the zones of a monolithic argillaceous stratum there are "dry" wells.

According to G.V. Vygon (Skolkovo), the total OM content in the Bazhenov suite is on average about 14% (including 2.7% liquid oil, kerogen type II about 12%) and mineral matrix 85%.

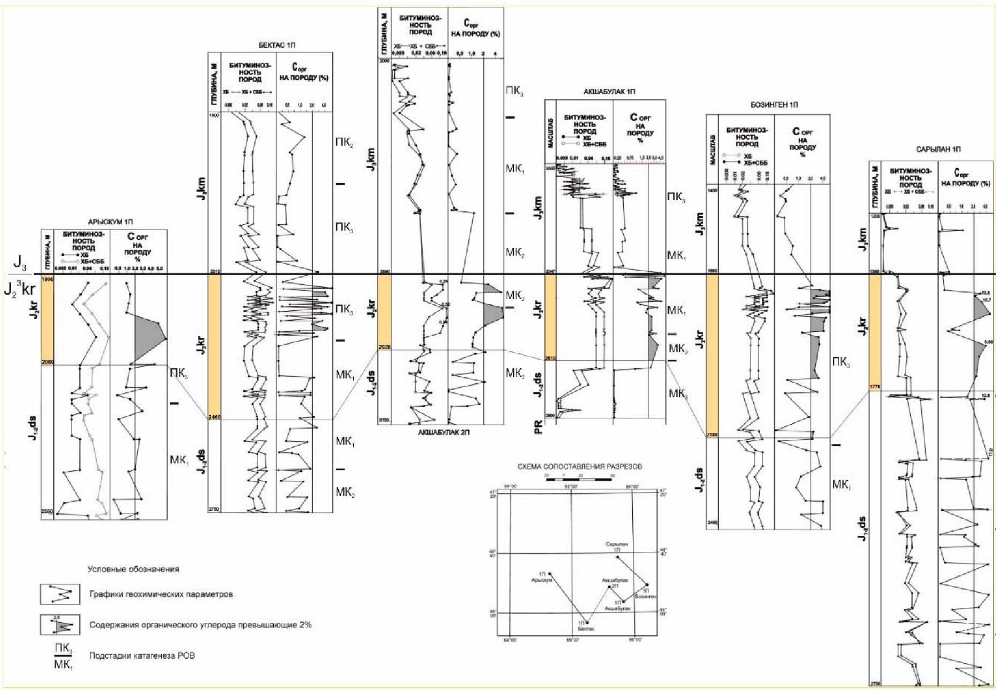


Figure 5 – Geochemical columns of parametric wells that opened the Karagansay suite of the Middle Jurassic (J_2^3kr)

According to the Bazhenov suite, there is no developed universal technology for production.

In the analysis of materials on "oil shale" in the South Torgai Basin, the materials described in the reports of the Institute of Geological Sciences on reference wells and published in specialized literature were used [1, 2].

These reports on the assessment of the territory of traditional oil and gas resources contain a large amount of geological and geochemical information. Including information on the geochemical characteristics of the Jurassic deposits with manifestations of oil shale. These reports (1987–1992) were compiled before the beginning of the "shale revolution" and the prospects for using shale resources at great depths (1.5–3.0 km and more) were not considered, but information on the geochemical characteristics of the sedimentary layer was available.

The work consisted of two stages: analysis of available data on the South-Torgai basin, identification of intervals for the development of sedimentary formations that are promising for oil shale, for the isolation of sediments enriched with organic matter and located in the main oil formation zone:

In the South Torgai Basin, parametric wells are located in various parts of the basin, a large number of conventional prospecting and production wells have been drilled.

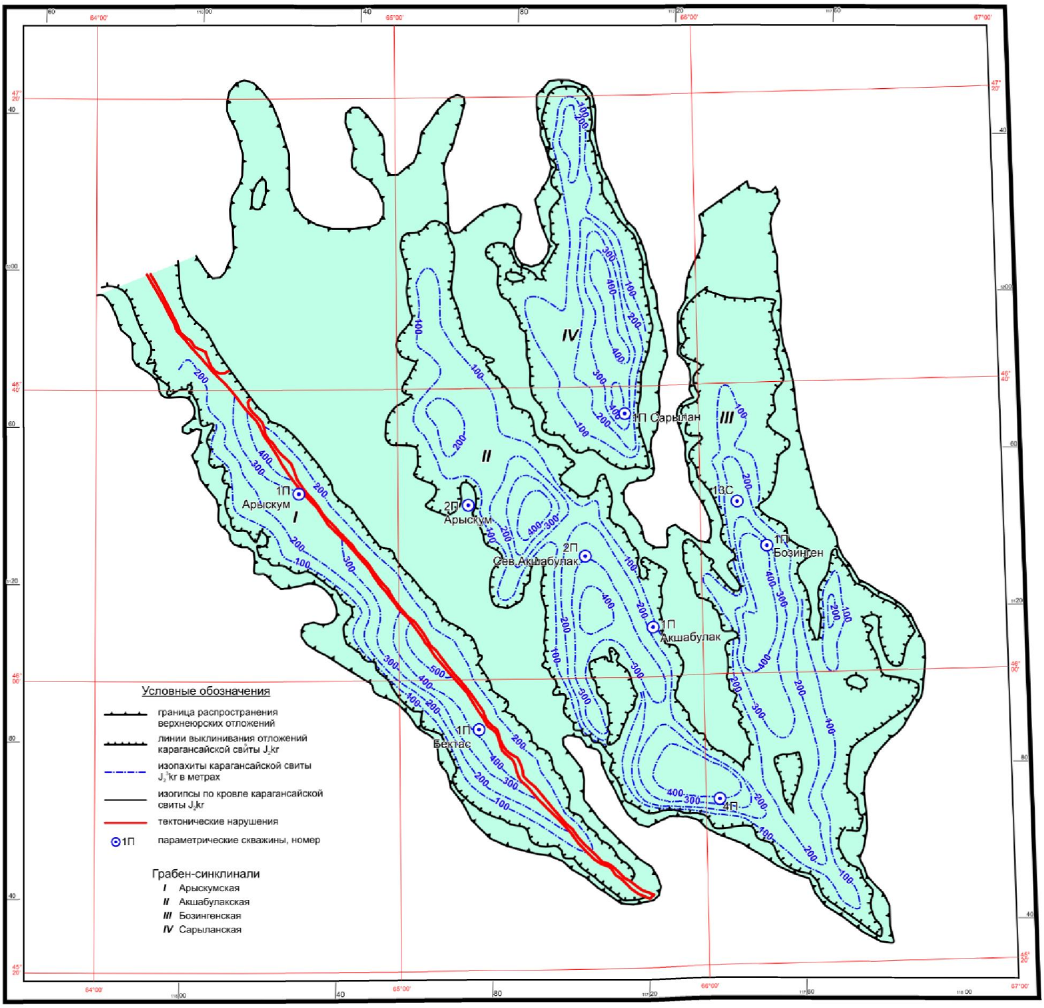


Figure 6 – Aryskum trough. Map thickness of the Karagansay Formation J_2^3kr

But if in the parametric wells there is a selection of a large number of cores with the appropriate volume of laboratory works with sufficient density of sampling (after 25–50 m and more often), the remaining wells are more often drilled without coring, or with selection in limited intervals.

Parametric wells were naturally grouped by grabensynclines – in the Aryskum g/s wells Bektas 1P, Aryskum 1P and Zhinishkekum 1P were drilled. All of them are located in the zone of influence of the Main Karatau fault on the western elevated block.

In Akshabulak h/s there are wells Akshabulak 1P, North. Akshabulak 2P and Aryskum 2P and 4P. Bozingen 1P and Sarylan 2P wells were drilled in Bozingen and Sarylanskoye. In the north, in the Zhilanshik trough – wells Sazymbay 1P and 2P.

Materials on the parametric wells are presented in the form of lithologic-geochemical columns with data on lithology for core sampling and geophysical studies (GIS) in wells, laboratory measurements of organic carbon, soluble bituminous chloroform (CB) and alcohol-benzene (CBF), carbonate, porosity and of the volume weight. In the columns of the contents of C_{org}. andbitumoids are averaged, without subdivision into species of rocks.

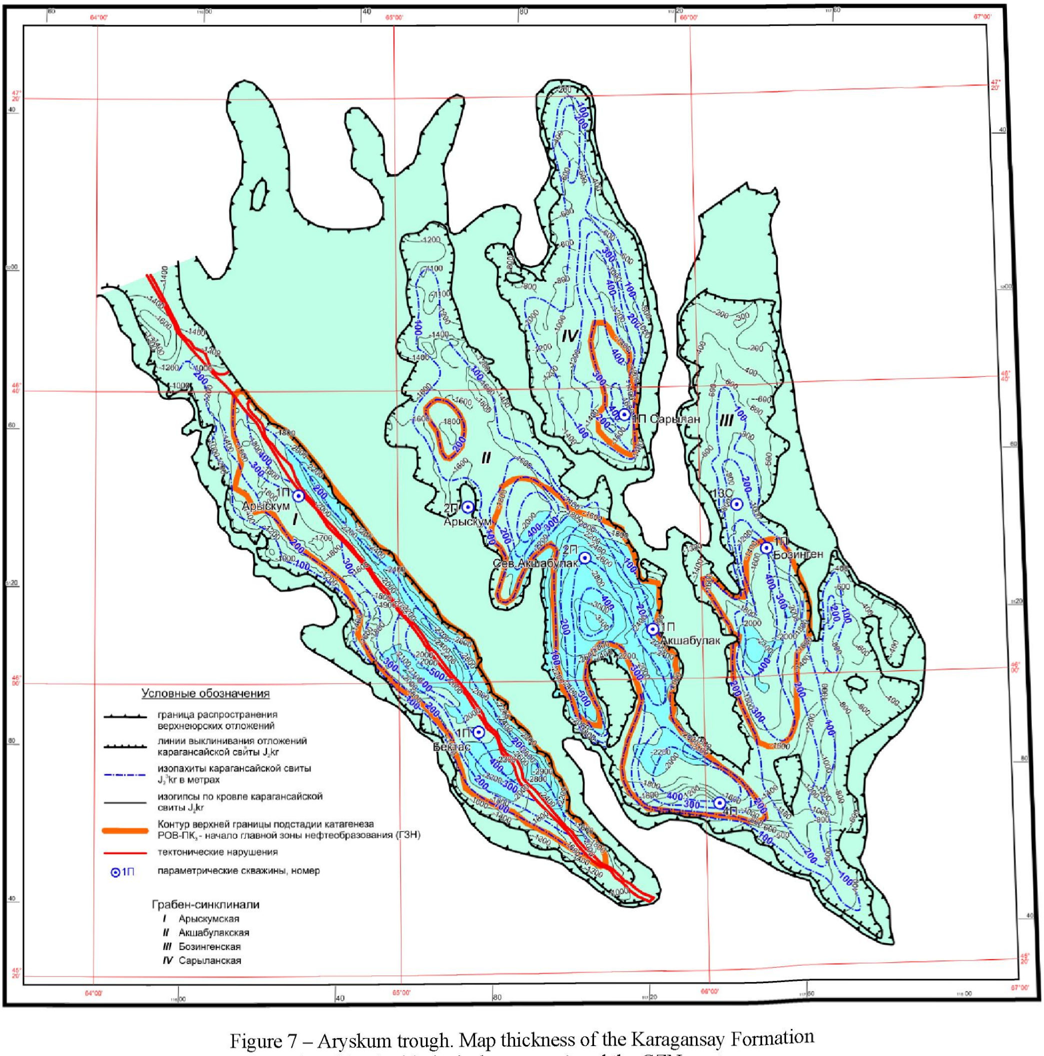


Figure 7 – Aryskum trough. Map thickness of the Karagansay Formation
(combined with the isohypes map) and the GZN contour

As an illustration, the data for the Akshabulak 1P well are given below. These data are accompanied by a brief description of the section. When assessing the saturation of the section with organic carbon, they proceeded from information on the shale topics in the United States that the extraction of shale gas is carried out from sediments containing S_{org}. from 2% and above.

The Akshabulak 1P well is located on the eastern side of the Akshabulakgraben-syncline, in the area of its contact with the Aschisai horst-anticline. At a depth of 3500 m, it opened the entire section of the Mesozoic-Neozoic complex and, at a depth of 2,690 m, entered the foundation rocks represented by the Proterozoic shales.

Deposits of the Jurassic complex in the interval 1724–2790 m were revealed in the composition of the Akshabulak and Kumkol suites of the Upper Jurassic, as well as the Middle Jurassic Jurassic in the Karagansai and Doshchanskaya suites.

The results of geochemical studies of the core from the well are shown in Figure 4, where the boundaries between the Kumkol, Kara-Gans, and Doshchanskaya formations are quite clear. Concentration of Corg. andbituminoids increases stepwise from the shallow depths of the Akshabulak suite to the bottoms of the Karagansay suite and again decreases in the sediments of the doshchanskaya suite.

In the *Karagansay suite*, with a capacity of 263 m. The lower and upper parts are distinguished by petrographic features. Dark argillites and siltstones with interlayers of siltstones and sandstones prevail in the lower one, in the upper part the share of sand material increases, carbonate material appears before the formation of dolomites. In the roof part of the section (53 m.) – dark brown and black mudstones saturated with DOM, which are highly mineralized bituminous shales.

The dispersed organic matter is contained both in the form of detrital forms and gelified, giving the breed a characteristic brownish shade. The increased carbonate content of rocks is noted in the deposits of the Karagansay and Kumkol suites. For the entire interval of the Karagansay Formation, the high content of C_{org} is characteristic. andbitumoids, as well as very clearly marked its upper and lower boundaries.

Organic carbon content C_{org} in sandstones 0.5–2.4%, average 1.6%; in siltstones 1.14–2.67%, average 1.6%, in mudstones 2.4–5.3%, average 3.5%.

Elevated levels of kerogen caused a significant bituminousness of rocks, which in fine-grained varieties amounts to tenths of a percent, and in sandstones and siltstones 0.03–0.05%.

The ratio of the amount of chloroform extracts and alcohol benzene is close to unity, which indicates a small proportion of migration components.

In the composition of bitumen, oleaginous (SMB), resinous (SB) and asphalt-resinous (ASB) varieties predominate, confined mainly to clayey rocks. In sandstones and siltstones bituminoids are of a lighter composition and with lower concentrations.

According to the nature of distribution of DOM in the rocks of the Karagansay Formation, they are classified as petroleum reservoirs, which contain a large number of mobile components.

The Doshchanskaya suite is represented by the interlacing of gray sandstones from shallow to coarse-grained with intercalations of mudstones and siltstones with conglomerates of medium-hectare, fragments of siliceous shales. The contents of Corg. in the suite does not exceed 0.10%, the content of bitumen from 0.005 to 0.1%. Its sediments are formed in coastal conditions, in an oxidizing environment.

In the *Kumkol* suite, the content of Sorg. does not exceed 0.5% and its own generation potential is very insignificant because of the low transformation of rocks and the residual epigenetic differences sorbed by clay substance and syngenetic components prevail in them.

In the section of the Akshabulak 1P well, the Karagansay suite is a promising target for approbation of "shale" technologies.

For the Aryskum trough, geochemical columns were compared by parametric wells for all graben-synclines from Aryskumskaya in the west to Sarylanskaya in the east.

Figure 5 shows that for all wells, a general pattern is observed in the 1A Akshabulak well, consisting of elevated soluble bitumoid and organic carbon contents in the depth intervals corresponding to the Karagansai suite.

The structure of the Karagansay suite is displayed on the structural map along its roof (Figure 2). This is the boundary between the sediments of the Kumkol suite of the upper (J_3km) and the middle (J_2kr) Jurassic. In seismic data, this is the reflecting horizon IV (OG IV). The boundary of the division of the Karagansai and the underlying doshchanskaya suite corresponds to the reflecting horizon IV '(OG IV').

The difference in the depths of the OG IV and IV ', with reference to the sections of deep wells, was the basis for constructing the capacity map (isopachite) of the Karagansai suite (Figure 6). The interval of variation in the thickness of the formation is 0-400 m and more. The maximum power is confined to the axial parts of the graben-synclines, their wedging areas are wedged out.

The area of the Karagansay Formation is the Aryskum trough. In the Zhilanshik depression in deep boreholes, the Karagansay suite is not found, and the Lower Cretaceous deposits lie on the deposits of the doshchanskaya suite.

According to the modeling of catagenesis performed by DA Shlygin and Kh. Kh. Paragulgov, from the depths of 1800 m in the Aryskum trough begins the substage of catagenesis of the POC PK_3, from the depth of 2200 m – the sub-stage MK_1, and from a depth of 2,600 m – the sub-stage MK_2.

These data were used to determine the contour of occurrence of the Karagansai Formation in the main oil formation zone (GZN), and together with the capacity map – to determine the volume of rocks in the GZN.

The outline of the beginning of the GZN was drawn on the map along the roof of the Karagansai suite – according to the depths of the deposits of the Karagansay suite of 1800 m and more (Figure 7).

The volume of the rocks of the Karagansai suite along the Aryskum trough, located in the main oil formation zone of the GZN, was: 1520 km^3 with an area of 5,900 km^2 and a thickness of 0.256 km.

Including:

– according to the Aryskumgensys, 558 km^3; 2325 km^2; 0.24 km;

– according to the Akshabulak railway station, 565 km^3; 2250 km^2; 0.26 km;

– according to Bosingen railway station with 293 km^3; 975 km^2; 0.3 km;

– according to the Sarylanskaya g/s 105 km3; 350 km^2; 0.3 km.

These data can be the starting point for forecasting hydrocarbon reserves in the Karagansay Formation for unconventional "shale" hydrocarbon resources.

As a result of the work done in the South Torgai Basin, the existence of a highly promising formation on the shale HC formations, the Karagansay Formation of the Middle Jurassic, was justified.

The next task will be to identify specific horizons (layers) containing hydrocarbons in low-permeability reservoirs. This is a task for specialists in field geology and geophysics to plan the next stage of experimental work on the problem of oil shale in search areas.

The most promising for the beginning of prospecting for non-traditional "shale" resources of hydrocarbons are the largest graben-synclines – Aryskum and Akshabulak. At the beginning of prospecting for this resource, Akshabulakskaya g/s, due to a simpler geological structure (in comparison with Aryskumskaya gypsy), and the already drilled wells that opened the Karagansay suite with non-industrial oil inflows and signs of a possible (but not realized) oil and gas bearing using traditional methods of sampling.

When selecting the objects for carrying out such work, it is necessary to use the maximum possible complex of geological and geophysical materials for field and field geophysics (seismic survey of MOGT-3D).

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ОҢТҮСТІК-ТОРҒАЙ МҰНАЙГАЗДЫ БАССЕЙНІНІҢ ЖАНҒЫШ ТАҚТАТАСТАРЫ

Аннотация. Оңтүстік-Торғай мұнайгазды бассейнінің «тақтатасты» көмірсутектердің бар болу мұнайгаздылығы перспективалары қарастырылды.

«Жанғыш тақтатас» деп аталынатын таужыныстардың негізгі ерекшеліктері – жабық кеуектілік жағдайында органикалық заттек (ОЗ) құрамының жоғары мөлшері, сәйкесінше аз өткізгіштігі және мұнайгаз пайда болу (МГП) негізгі аймағында шамамен 40–50 млн жыл жатуы. Бұл жағдайда жетілдірілген мұнай мен газ аз өткізгіштікті аналық қабат жағдайында қалады.

Осы аз өткізгіштікті таужыныстар құрамындағы көмірсутектер өндірістік деңгейде тек оларға жару арқылы әсер ету жолымен өндіріледі, ол құрамында техногенді жарылымды сақтауды қамтамасыз ететін

құмы (пропант) бар және мұнайды минералды матрицадан айыруды қамтамасыз ететін химикаттар жиынтығы бар жарылымды кеуектіліктің пайда болуына жағдай жасайтын бұрғылау ерітіндісімен жасалынады.

Орындалған жұмыстар барысында Оңтүстік-Торғай бассейнінде орта юраның қарағансай свитасы формацияларының тақтатасты көмірсутектерге жоғары перспективтілігі дәлелденді. Келесі міндет төменгі өткізгіштікті коллекторларда нақты көмірсутекті горизонттарды (қабаттар) анықтау болып табылады. Бұл іздеу аудандарындағы жанғыш тақтатас мәселесі бойынша тәжірибелік жұмыстардың келесі кезеңін жоспарлау үшін кәсіпшілік геология және геофизика мамандарының міндеті.

Түйін сөздер: Оңтүстік-Торғай бассейні, жанғыш тақтатастар, тақтатасты мұнай мен газ, Ақшабұлақ және Арысқұм грабен-синклинальдары.

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ГОРЮЧИЕ СЛАНЦЫ ЮЖНО-ТОРГАЙСКОГО НЕФТЕГАЗОНОСНОГО БАССЕЙНА

Аннотация. Рассмотрены перспективы нефтегазоносности Южно-Торгайского нефтегазоносного бассейна на наличие «сланцевых» углеводородов.

Главные особенности пород, называемых «горючие сланцы» – достаточно высокое содержание органического вещества (ОВ) в условиях закрытой пористости, соответственно их низкая проницаемость и нахождение в условиях главной зоны нефтегазообразования достаточно продолжительное время – порядка 40–50 млн лет. При этом созревшие нефть и газ остаются в условия низкопроницаемой материнской свиты.

Углеводороды, содержащиеся в этих низкопроницаемых породах, могут добываться в промышленных масштабах только после воздействия на них гидроразрывом, обеспечивающим образование трещиноватой пористости с буровым раствором, содержащим песок (пропант), который обеспечивает сохранение этой техногенной трещиноватости и набором химикатов, обеспечивающим отрыв нефти от минеральной матрицы.

В результате выполненной работы в Южно-Торгайском бассейне обосновано наличие высокоперспективной на сланцевые УВ формации – карагансайской свиты средней юры. Следующей задачей будет являться выявление конкретных горизонтов (пластов), содержащих УВ в низкопроницаемых коллекторах. Это задача для специалистов по промысловой геологии и геофизике для планирования следующего этапа опытных работ по проблеме горючих сланцев на поисковых площадях.

Ключевые слова: Южно-Торгайский бассейн, горючие сланцы, сланцевые нефть и газ, Акшабулакская и Арыскумская грабен-синклинали.