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A. Tleubergenova[*1],
orcid.org/0000-0003-0483-2798,
V. Portnov[1],
orcid.org/0000-0002-4940-3156,
O. Karpenko[2],
orcid.org/0000-0002-5780-0418,
A. Maussymbayeva[1],
orcid.org/0000-0002-7214-8026,
R. Madisheva[1],
orcid.org/0000-0002-5726-9567

1 – Karaganda Technical University, Karaganda, the Republic of Kazakhstan
2 – Taras Shevchenko National University of Kyiv, Kyiv, Ukraine
* Corresponding author e-mail: abdullinakrg@gmail.com

PROSPECTS FOR THE DETECTION OF STRUCTURES WITH HYDROCARBON DEPOSITS ALONG THE GEOTRAVERSE IN THE SHU-SARYSU SEDIMENTARY BASIN

Purpose. To study the paleogeographic situation of the Shu-Sarysu sedimentary basin and its relationship with the accumulation of hydrocarbons.

Methodology. Analysis of lithological and paleogeographic maps, starting from Devonian time (D_3fm) and ending with the Upper Permian period (P_2), compiled by U. Akchulakov, H. H. Paragulkov, geological and geophysical databases (seismic, gravity, magnetic exploration) on proven hydrocarbon accumulations to assess the detection of possible promising areas of the Shu-Sarysu sedimentary basin.

Findings. The regularities of hydrocarbon accumulation obtained based on a comparative analysis of open deposits and promising areas within the Shu-Sarysu geotraverse are justified by the fact that the accumulation of hydrocarbons occurred in zones that, as a result of paleogeographic evolution, are distinguished as territories belonging to alluvial-delta plains periodically flooded by the sea, salt lagoons.

Originality. As a result of the conducted studies using actual data, a forecast assessment of the prospects for the presence of hydrocarbon deposits at sites within the Shu-Sarysu geotraverse was obtained.

Practical value. Forecast is substantiated of the possibility of detecting hydrocarbon accumulations in areas previously assessed as ones of little or no promise in the Shu-Sarysu sedimentary basin.

Keywords: *Shu-Sarysu sedimentary basin, lithological-paleogeographic situation, tectonic elements, hydrocarbons*

Introduction. The oil and gas potential of the Shu-Sarysu basin was studied satisfactorily, but within its limits, the southern margin of the Kokpansor and the central part of the Moyinkum trough have been studied quite thoroughly. Well-known gas fields are connected with these territories. The rest of the basin, more than 70 %, has not been studied enough, which does not allow a reasonable assessment of its generation capabilities.

The proximity of the Shu-Sarysu basin to several large cities and industrial centres of Central and Southern Kazakhstan justifies conducting geological exploration and evaluating the area as a source of Kazakh gas supply.

Forecasting and thematic work on oil and gas within the limits of the Shu-Sarysu depression began back in the fifties when the first information was received about favourable prospects for Paleozoic oil and gas (N. Ya. Kunin, T. V. Dorofeeva, S. P. Babanyants, G. K. Nevsky).

From that time onwards, regional geophysical studies (gravity-magneto-electrical exploration) began here, and since the 60s, detailed geophysical work has been carried out on individual brachianticlinal structures. In parallel, the Paleozoic base of the Shu-Sarysu depression is being studied and structural and support-parametric wells are being drilled. The South Kazakhstan oil exploration expedition conducts prospecting and exploration work for oil and gas; as a result, the authors of the reports identify Devonian, Lower carboniferous and Middle Upper carboniferous deposits; Permian sediments are divided into salt-bearing, salt-bearing and salt-bearing strata.

Clarification of the tectonic structure of the basin, as well as the identification of potential oil and gas bearing structures was carried out in the period 1968–1972 (A. Y. Semin, A. T. Dzhandosov, S. K. Fedorov, M. M. Mailibayev, N. Ya. Kunin, Yu. A. Volozh).

The work on clarifying the patterns and conditions of the formation of oil and gas deposits dates back to the second half of the 70s (F. E. Sinitsyn, V. I. Karpov). Recommendations on the methodology for directing oil and gas exploration in the northern part of the depression were presented by T. A. Alikhanov in 1998.

The study on the basin by drilling began in the 50s of the last century and practically ceased by 1983. However, the development of the Amangeldy gas field led to the resumption of drilling operations, and as of early 2011, 356 parametric, exploratory, exploration and production wells were drilled in the basin.

All forecast-thematic works on the territory of the Shu-Sarysu depression can be divided into 4 groups. The first covers the period associated with the study on uranium-bearing Mesocainozoic deposits. The second group includes works of a general geological nature focused on the study on the geological structure of Paleozoic and Mesocainozoic deposits, as well as issues related to the tectonic development of the region. The third group is specialized in nature and is associated with the assessment of the prospects of oil and gas potential of the Pre-Mesozoic deposits. The fourth group covers research on the study on other minerals (except oil, gas and uranium) and the identification of their industrial accumulations [1].

Despite a large number of wells drilled and seismic studies performed, the state of knowledge of the basin as a whole remains low. This is primarily due to the low resolution of previously performed seismic studies, as well as the density of the network, which in most of the basin does not reach the regional level.

The purpose of the research presented in the article is to study the lithological-paleogeographic history of the development of the Shu-Sarysu basin and to identify patterns of distribution of potentially promising structures for the presence of hydrocarbons.

To achieve this goal, the following tasks were solved:

1. Study on geological sections according to seismic survey data and other field methods of geophysics along the studied strip of geotraverse and adjacent areas.

2. Study on the paleogeographic situation along the studied geotraverse strip in the period from D_3fm to P_2.

3. Determination of the period of transgression-regression of the sea, the study on the salinity of sea waters and the relationship with promising gas-bearing deposits.

Within the framework of the state program of regional geological exploration for 2021–2025, it was decided to study the area of the Shu-Sarysu sedimentary basin and assess its prospects based on regional geological and geophysical studies on the reference regional profile (geotraverse).

When designing the position of the geotraverse, a regional profile line was taken as a basis, justified by the results of a comprehensive study on the sedimentary basins of Kazakhstan, the position of which was adjusted taking into account modern data on geophysical and drilling studies, the results (obtained and planned) of geological and geophysical studies in neighbouring sedimentary basins – the Yuzhno-Torgai and Syrdarya [2].

The Shu-Sarysu basin is located in the central part of Kazakhstan and is geologically connected with the depression of the same name, stretching in a north-westerly direction for 700 km with a width of 200–250 km. The sedimentary basin is bounded by the Karatau, Shu-Ili and Kirghiz Alatau mountain ranges (Fig. 1) [3].

The structure of the basin involves the formation of three structural floors: Proterozoic-Lower Paleozoic, forming the foundation; Middle-Upper Paleozoic (quasi-platform cover) and Mesocainozoic platform cover [4].

The foundation is composed of metamorphic rocks of the Proterozoic, and within the individual blocks of the central part of the depression, intensely dislocated and intruded rock strata of the Lower Paleozoic are present in the upper sections of the foundation [4].

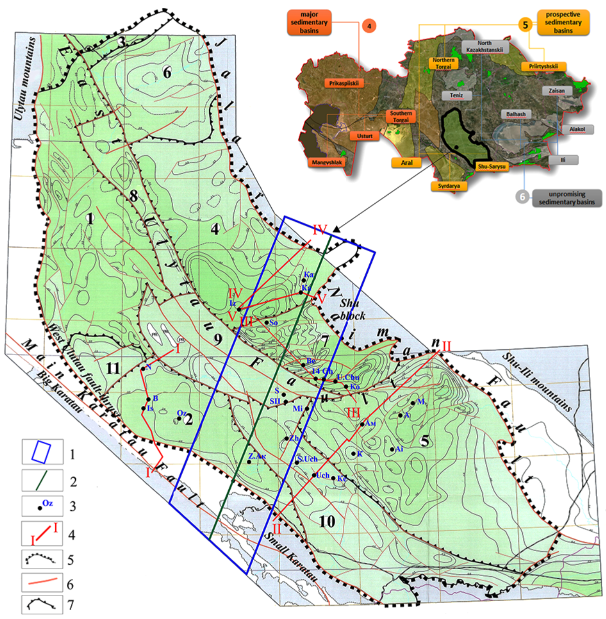

Fig. 1. Structural and tectonic zoning of the Shu-Sarysu basin:

1 – study area of the Shu-Sarysu regional profile; 2 – Shu-Sarysu regional profile line; 3 – deposits and structures (Z. Ak – Z. Akzhar, Oz – Ozernaya, Is – Istamkazy, B – Bars, N – Naiman, Zh – Zhailma, S. Uch – S. Ucharal, Uch – Ucharal, Ke – Kempirtobe, Mi – Mishty, K – Kumyrly, Am – Amangeldy, Ai – Airakty, A – Anabai, M – Maldybai, SII – SatybaldyII, S – Satybaldy, Ko – Kolkuduk, U. Ch – U. Chuiskaya, Ch – Chuiskaya, Be – Bestobe, So – Sokyrtobe, Iz – Izykyr, Ka – Kamenistaya); 4 – geological section; 5 – sedimentary basin boundary; 6 – faults; 7 – troughs and uplifts boundary (1 – Kokpansor, 2 – Suzak-Baikadam, 3 – Zhezkazgan, 4 – Tasbulak, 5 – Moyinkum, 6 – Sarysu, 7 – Nizhneshu, 8 – Baikadam, 9 – Tastin, 10 – Talas, 11 – Bugudzhil)

The average, quasi-platform cover lies with angular and stratigraphic disagreement on the basement rocks. In contrast to the tense folding of the lower floor, the structures of the quasi-platform cover are represented by relatively simply constructed predominantly brachiform folds [4].

The platform cover of the basin is composed of horizontally deposited sediments of the Upper Cretaceous and Cenozoic on rocks of the lower and middle structural floors. It has no independent structures [5].

In this paper, the studied territory of the Shu-Sarysu sedimentary basin is represented by a 100-kilometre strip along a 430 km long regional geotraverse originating in the Syrdarya sedimentary basin; crossing the Karatau mountain system and passing through the main tectonic structures of the Shu-Sarysu: the Suzak-Baikadam trough, the Tastin-Talas uplift system, the Nizhneshu uplift, Tasbulak deflection and a Shu block (Fig.1).

Research methodology. The Shu-Sarysu sedimentary basin is part of the Kazakhstan-North Tien Shan massif of the Caledonian consolidation and is located along the southwestern margin, which in turn was a microcontinent surrounded by the South Tien Shan, Ural and Trans-Asian (Irtysh-Zaisan, Dzungaro-Balkhash) oceans preserved from the early Paleozoic [1].

According to the results of a paleogeographic study on the Shu-Sarysu sedimentary basin main transgressive-regressive directions of the development of the district were clarified.

The regional paleogeographic context is the key to understanding sedimentation trends and the location in time of sedimentary rock runoff [6].

The Famen Age stands out as a time of relative tectonic rest. In vast areas of the Epicaledonian massif, the orogenic regime prevailing in the early and Middle Devonian was replaced by a platform regime at the end of the Fran [7].

During the Famen period, most of the territory of the Kokshetau-North Tien Shan microcontinent remained elevated and represented a high denudation plain with low hills, ridges and highlands. The main sedimentation zone was the territory of the Shu-Sarysu basin [7].

At the end of the Devonian, a major Famennian early Carboniferous transgression began here, advancing from the east and northeast. Already in the second half of the Famenian century, sea waters blocked a significant part of the area of the massif, as a result of which large epicontinental seas of complex configuration were formed. In the south and southeast of the Shu-Sarysu depression, a shallow coastal strip was formed during the Famen period. The limited supply of seawater and the hot climate, which was characteristic of the entire territory of the Central Kazakhstan microcontinent, caused the formation of numerous bays, coves and lagoons with increased salinity of waters [7].

In the Lower Carboniferous period, the transgression reached its maximum development, and almost the entire territory of Shu-Sarysu was blocked by sea waters. The land was rapidly shrinking. Continental sedimentation conditions have been preserved only in the southeastern part of the basin [7].

In the Shu-Sarysui basin, under conditions of a humid climate and an ever-expanding transgression, characteristic dark-coloured clay-carbonate deposits containing an increased amount of organic matter accumulated everywhere. The source of organic matter was gradually flooding low marshy plains.

The abundant supply of organic matter in the pool led to the emergence of a stagnant regime characterized by oxygen deficiency and the generation of hydrogen sulfide by sulfate-reducing bacteria. However, the oxygen deficiency zone was not very powerful [7].

Starting from the second half of the early Vise, on the eastern edge of the modern Moyinkum trough and in the central parts of the southern half of the basin, a barrier-type coast is formed due to the abundant supply of detrital material from elevated areas. Formed barrier islands, coastal and coastal bars, spit and low ridges separated the open sea basin from the land, resulting in small lagoons, bays, coves and tidal shoals [8].

In the Middle Visean-Serpukhov time, pressure is exerted on the Kazakh-North Tien Shan microcontinent from the surrounding oceans, resulting in a compression process. From this period, regression begins, and at the end of the early Carboniferous, the water begins to recede, while reaching its maximum. The stabilized sea leads to the cessation of the introduction of terrigenous material. The shallowing process begins [8].

In the Middle Carboniferous, the Shu-Sarysu basin was a wide alluvial-lake plain, where there were lakes in the low parts that led to the flooding of vast areas, and during the hot climate, they were reduced and salted [7].

In the Upper Carboniferous epoch, the area of the alluvial-lake plain decreases, and the area of the alluvial-deluvial plain increases sharply. The climate becomes even drier and hotter, leading to even greater continentalization of precipitation [8].

At the beginning of Permian time, the Shu-Sarysu basin was an alluvial-delta and alluvial-lake plain, in the central part of which a large sea continued to exist.

In the second half of the early Permian, under conditions of increasing aridization of the climate, the gradually saline lake basin gradually turned into salt lagoons located on the territory of the Moyinkum, Suzak-Baikadam, Kokpansor and Tasbulak troughs and the Usharal-Toguzken saddle. Along the framing zones of the studied basin, except its western side, there was a low-lying lake-alluvial plain, which is most extensive in its southeast. In the direction of the central parts of the basin, the plain was replaced by a band of the increased salinity of waters with terrigenous sedimentation. It also included the area of the Tastin uplift and the extreme west of the Kokpansor trough. In the Shu-Sarysui basin at the turn of the early and late Permian, as a result of large tectonic processes occurring outside of it, short-term tectonic shifts occurred. As a result of their appearance, part of its territory was raised and partially eroded [7].

During the Late Permian, sedimentation resumed. The western margin of the Kokpansor and northwestern Suzak-Baikadam troughs represented a zone of increased salinity. The territory of the Moyinkum trough was occupied by a freshwater lake basin, periodically turning into a low-lying lake-alluvial plain with sandy-siltstone sedimentation, framed by a strip of sandy-gravelite sediments. The northern zone of the Shu-Sarysu basin, which had a high salinity, and the southern normal, were separated from each other by a low denudation plain stretching from east to west [7].

Fig. 2 shows the lithological-paleogeographic situation along the Shu-Sarysu regional profile, describing the period from the Famen time to the Upper Permian.

Research results. The Suzak-Baikadam trough is located in the southwest of the basin. As a result of the ranking of tectonic elements, the deflection belongs to a gas-promising area.

Its southwestern limit is the Itmurun stage of the anticlinorium of Big Karatau, separated from the trough by a fault. In the south, it borders the Akkul Step, in the northwest with the Bugudzhilsky and in the northeast with the Tastin uplift [9].

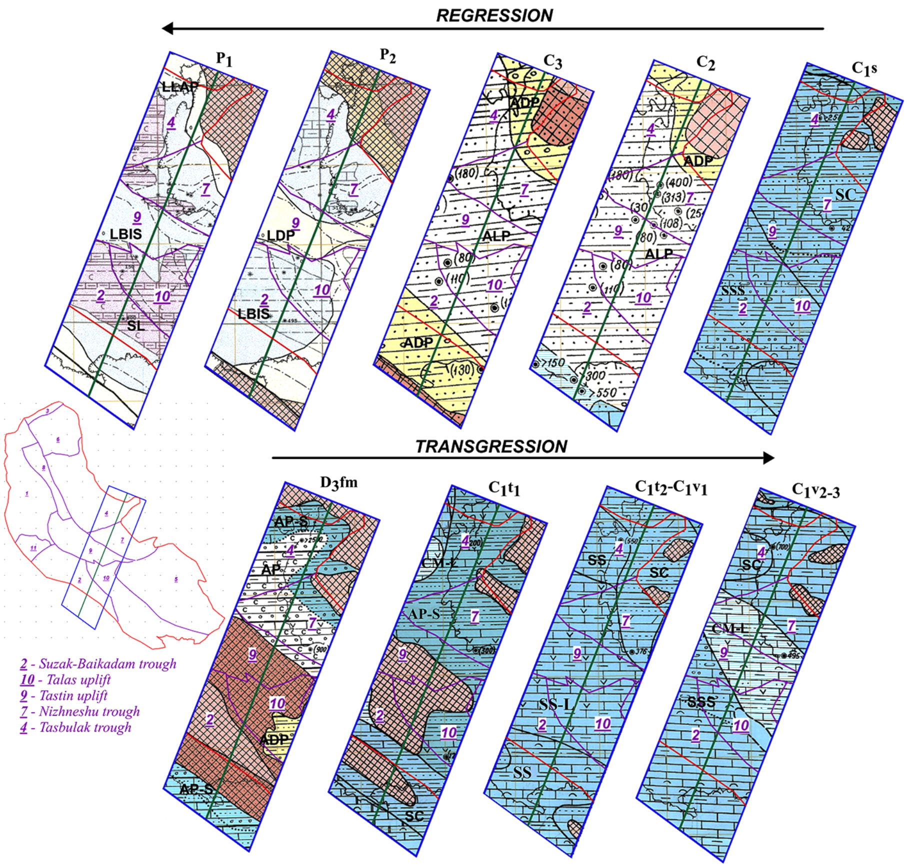

Fig. 2. Lithological and paleogeographic situation along the Shu-Sarysu geotraverse:

Paleogeographic settings: SS-shallow sea, SSS-shallow sea with numerous shoals, SC-shallow sea, coastal zone, SS-L-shallow sea, at times lagoon, CM-L-coastal-marine zone, times lagoon, LLAP-low-lying lake-alluvial plain, ALP-alluvial-lake plain, ADP-alluvial-delta plain, AP-alluvial plain, AP-S- alluvial plain periodically flooded by the sea, LDP-low denudation plain, LBIS-lake basin of increased salinity, SL-salt lagoon.

Lithological differences: – pebbles and gravel, – sand, – siltstone, – clay, – limestone, – clay limestone, – sandy limestone, – limestone sandstone, – organogenic limestone, – oolitic limestone, – dolomites, – marl, – gypsum and anhydrites, – rock salt

Its geological structure involves Proterozoic formations acting as a foundation, deposits of the Upper Paleozoic quasi-platform complex from the Devonian to Permian, and platform formations of the Upper Cretaceous-Cenozoic [9].

The main structural elements of the deflection are the Suzak (in the north) and Baikadam moulds, separated by the Ozhiraitobinskaya saddle.

The features of the tectonic structure of the Suzak-Baikadam trough were studied in the early 60s of the last century. The results of seismic surveys allowed us to contour about 15 anticlines. One deep search well was drilled at the Naiman, Bars and Ozernaya uplifts.

At the Ozernaya structure, in the depth range of 2016–2040 m, during the opening of the Tournaisian-Visean deposits, an influx of hydrocarbon gas with a methane content of 67, ethane 2.8, propane 0.92 % with traces of the presence of heavier methane homologues was obtained. Prospecting wells were drilled at the Naiman and Bars uplifts, where during the sinking of the lower carboniferous deposits, the degassing of the washing liquid was observed, turning into intense gas manifestations (Fig. 3).

The Akzhar structure is located in the studied area along the regional profile. Exploration well No. 33 uncovered Mesocainozoic deposits, Permian deposits with a total capacity of 1270 m, and middle-Upper carboniferous carbonate-terrigenous formations. The Permian sediments are divided into Upper Permian sediments, the salt thickness of the Lower Permian age and the subsalt deposits of the Lower Permian. During testing, the well turned out to be dry. The perforated depth interval is 1410–1842 meters.

During the Devonian period, the studied area of the Suzak-Baikadam trough was a slightly elevated demolition area. Most likely, the gas-prospective strata may be deposits ranging from the early Visei to the Serpukhov time during the period when this area was flooded by the sea with numerous shoals. However, well No. 33 was drilled only to medium-carboniferous deposits. At that time, the region was an alluvial lake plain, which later in Permian time became an area with increased salinity.

The Talas uplift has a northwestern extension and is bounded from the west by the Moyinkum trough, in the southwest it separates from the Small Karatau. The uplift is complicated by a system of faults with an amplitude of displacement along them of 150–300 meters. Narrow shaft-like uplifts are up to 40–50 km long (Koskuduk-Norbay, Alimbet, Toguzken), complicated by high-amplitude anticlines and separated by narrow synclines, are confined to the faults [9].

Large-scale searches for uranium ores, copper sandstones and groundwater were carried out within the Talas uplift. In the course of the work, a sharp reduction or complete absence of Upper Paleozoic sediments in some areas was established, the occurrence of Proterozoic basement rock complexes on a larger area under platform strata. The listed signs indicate the futility of these lands for the presence of hydrocarbon accumulations on an industrial scale [10].

In the process of drilling wells, signs of gas were sometimes noted; the Ucharal Severnyi and Ucharal-Kempyrtobe fields were discovered. But concerning the component composition, the gas contained mainly nitrogen at methane concentrations of no more than the first per cent, rarely more than 10 %. The productive strata in these deposits are the sub-saline deposits

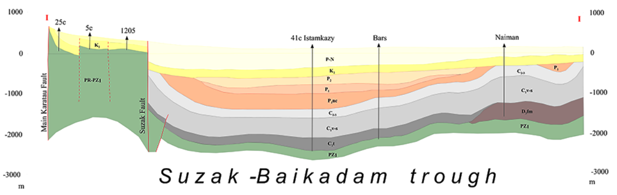

Fig. 3. Geological section along line I–I (Akchulakov U., 2011)

of the Upper Permian. The formation of the productive part of the deposits occurred at a time when the territory was a low-lying lake-alluvial plain.

Fig. 4 shows a geological section along line II–II, which passes through the Ucharal-Kempyrtobe deposit.

On the territory of the Talas uplift, which is part of the studied area along the regional profile, there is a Zhailma structure. Prospecting well 1-P on the Zhailma structure was drilled to a depth of 1704 m, uncovering Mesocainozoic deposits, deposits of Upper and Lower Permian, and middle and Lower Carboniferous.

When tested in the range of 749–1047 m (Lower Perm and middle carboniferous), water inflow was obtained; in the intervals of 1396–1450, 1634–1704, 1459–1704 m (lower carboniferous) – "dry".

In its Permian development, the Zhailma structure is located in an area with increased salinity. Perhaps this explains the absence of hydrocarbons in these deposits. Drilling also showed a negative result in carbon.

During the study on the Peschanaya structure, deposits of the lower carboniferous were also uncovered with a negative result.

The Tustin uplift is located in the centre of the basin and has a north-western stretch and dimensions of 220 × (50–70) km. This uplift is limited by large longitudinal tectonic disturbances of the north-western strike and is broken up by faults into separate blocks, between the faults they are raised to different heights and intensively eroded. The northeastern and southwestern parts of the uplift are most intensively dislocated and eroded. In the centre of the uplift is the Kyzemshek syncline, in which deposits of Permian and middle-Upper carboniferous are exposed on the pre-Cretaceous surface. The depth of the foundation does not exceed 1.5 km. Breccia zones are widely developed along the faults. The main tectonic disturbance is the Zhezkazgan-Kokshetau (East-Ulytau) fault (right shift). The amplitude of the shift is estimated at 100–120 km (according to the displacement of the salt-bearing devon). In the area of the Tustin uplift, the shift bends in an arc. It can be explained by the intense compression and folding within the Tustin uplift. The southwestern fault on the border with the Suzak-Baikadam trough is also probably a shear thrust. Here the lifting is pushed over the deflection. Formation of the uplift occurred at the end of the Permian – in the Triassic [9].

The structures identified as oil and gas promising in the area of the Tastin uplift are Satybaldy I and Satybaldy II, where the reflecting horizon belongs to the lower carboniferous. In the Tournaisian time, this area was a demolition area, most likely no hydrocarbon will be found in these deposits. Subsequently, the area gradually flooded by the sea, and the period of the greatest interest is the period from the Visei, when the territory was a coastal-marine zone, sometimes a lagoon, and when the sea receded, numerous shoals were formed. In the Middle and Late Carboniferous, the area of the Tastin uplift in the geotraverse strip was an alluvial lake plain, but later in Permian time, this area was an area with increased salinity. These deposits are more likely to be unproductive.

A small part of the Moyinkum trough is covered by studies along the geotraverse. As a result of oil and gas zoning, the lands of the Moyinkum trough were classified as promising, as a result of the discovery of some gas fields (Amangeldy, Airakty, Zharkum, Anabai, Maldybai) [10].

Formations from Lower-Middle Devonian to modern inclusive take part in the geological structure of this deflection. Proterozoic formations are taken as the foundation rocks [9].

The following gas-bearing complexes have been established in the sedimentary filling thickness: the salt-bearing deposits of the Upper Devonian, the lower carboniferous, which in turn decomposes into subcomplexes of the Lower Tournaisian, Upper Tournaisian Lower Visean, Upper Visean and Serpukhov tier, as well as the salt-bearing Lower Permian [9].

The deflection is oriented to the northwest, and its dimensions are 310 × (70–150) km. Along the perimeter, it is bound-

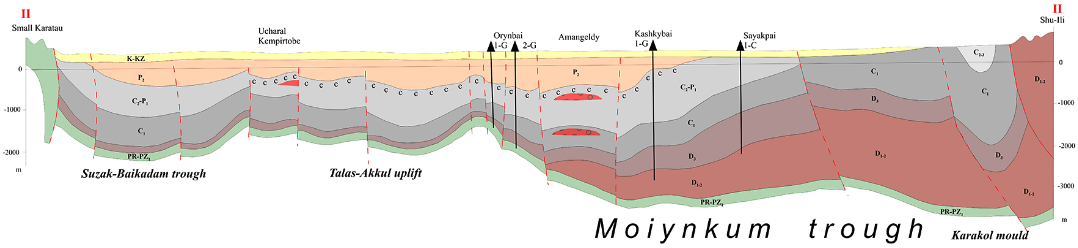

Fig. 4. Geological section along line II–II (Akchulakov U., 2011)

ed by faults along which it articulates in the northwest with the Shu block and the Nizhneshu uplift, in the northeast with the Kendyktas massif and the Shu-Ili anticlinorium, in the southwest and northwest with the Talas uplift [9].

The Moyinkum trough is complicated by several structural and tectonic elements, which include the Mishty, Furman, Airakty, West Kumyrly mould, Sayakpai, Maldybai, Koskuduk-Norbai shafts and the Berlik monocline.

In the studied area, the structural and tectonic element is the Mishty mould. The results of drilling wells 2-C and 4-C showed signs of oil content. The reflecting horizon is the deposits of the lower carboniferous.

During the Upper Devonian period, the area associated with gas occurrences from deposits in open deposits and structures was an alluvial-deluvial plain, where sediments were removed from elevated areas. The Mishty mould was an elevated demolition area. Most likely, Devonian deposits in this area will be unpromising for the presence of hydrocarbons. During the period from early Tournai to early Visei, the area of the trough was gradually flooded, in some places it was a coastal-marine zone, sometimes lagoons. In open deposits, these deposits are unproductive. In the future, the sea recedes and lagune forming occurs during the middle-late Visean, and deposits of this period in a larger number of deposits are considered productive. The Serpukhov tier is productive on a significant number of deposits; during this period, the region was subject to minor flooding. During the Middle-Late Carboniferous, the Moyinkum trough is represented by an alluvial lake plain. In the fields, these deposits are unproductive. The Lower Permian deposits are gas-bearing. In the Lower Permian, the territory was a salt lagoon with sandy-siltstone sedimentation, framed by a strip of sandy-gravelite sediments.

The Nizhneshu uplift (saddle), as a result of oil and gas geological zoning, refers to lands with "unclear prospects", which is justified by several factors: weak geological and geophysical knowledge, dislocation of the depths of the basement, weak knowledge of the internal structure of Upper Paleozoic formations [9].

The geological structure of the Nizhneshu Saddle involves complexes of the Upper Paleozoic and Mesozoic-Cenozoic with thicknesses from 1.5 to 2.5 km.

The saddle in the thrust zone articulates with the Shu block in the northeast, and the Tastin uplift in the southwest. It is complicated by high-amplitude (many hundreds of meters) sub-latitudinal and secant faults of the northeastern strike. The raised blocks are complicated by chains of Famen salt domes, on the wings (Bestobe, Kentaral, etc.) or arches of which deposits of lower carboniferous and Famen are brought to the surface. Permian and Middle-Upper Carboniferous deposits up to 1.5–2 km thick have been established by drilling in synclines and inter-dome zones, which indicates the post-Permian time of formation of salt anticlines.

The structure of the subsalt deposits of the Devonian of the Nizhneshu Saddle has been poorly studied by seismic exploration. The exception is the shafts formed in their marginal parts: Sokyrtobe, Kamenistaya and Kolkuduk. They are confined to faults with an amplitude of up to 500 m. Faults usually represent upsurges (steep thrusts), to which traps (semi-anticlines) shielded with salt are confined on the lowered blocks. There are six shafts planned on the square (including Kolkuduk), of which five are complicated by salt anticlines. The amplitudes of faults along the above-salt deposits of carboniferous are sharply increased due to the formation of salt pillows on the raised blocks, the height of which varies and can reach a kilometre.

The geological complex, which can be traced throughout the territory and is structurally forming, is the Famennian salt-bearing strata of the Upper Devonian (Fig. 5). On several salt domes, salt rods and massifs have practically broken through the entire thickness of oversalt formations. In the Nizhneshu saddle, abutment structures shielded by salt rods as well as subsalt anticlines are likely to be widely developed.

During the Famen period, the uplift was an alluvial flatland, flooded by the sea in the northeastern part. From the southwestern side, the saddle is surrounded by an elevation and is an area of demolition. When drilling structures (Bestobe, Kazangap, Kentaral), there was degassing of the washing liquid and minor gas manifestations associated with Upper Devonian complexes. In addition, oil inclusions were noted in limestone and sandstone core samples, sometimes turning into effusions.

Drilling of a well located at the junction of the Nizhneshu saddle with the Tasbulak trough on the Sokyrtobe structure showed that the Famennian carbonate-terrigenous-halogen complex of rocks is divided into a halogen part, represented by pure rock salt, and a terrigenous one, consisting of variegated polymictic, multi-grained sandstones on carbonate-siliceous cement.

When testing the Middle-Upper-Visean and Tournaisian strata, no inflow was obtained, the Famen tier is characterized by a weak inflow of water. According to GIS data, all reservoir layers in the well section are characterized as water-saturated. A negative drilling result may be associated with the location of the well in the fault zone of the saddle.

The Tasbulak trough is classified as a promising gas-bearing area. It is located in the east of the Kokshetau-Zhezkazgan fault and contacts along it with the Tastin and Baikadam uplifts and north of it with the Nizhneshu uplift. To the east-northeast along the Zhalair-Naiman shift thrust, the deflection borders on the Shu-Ili folded belt. The deflection has a northwestern orientation [9].

The geological structure of this promising gas-bearing area involves quasi-platform deposits of the Upper Paleozoic with fragmentally developed Mesozoic complexes (in the extreme east of the area), overlain by a low-power Cenozoic cover (Figs. 6, 7).

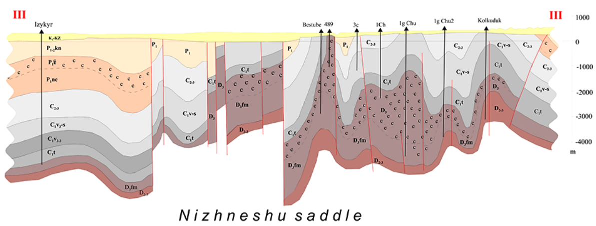

Fig. 5. Geological section along line III–III (Akchulakov U., 2011)

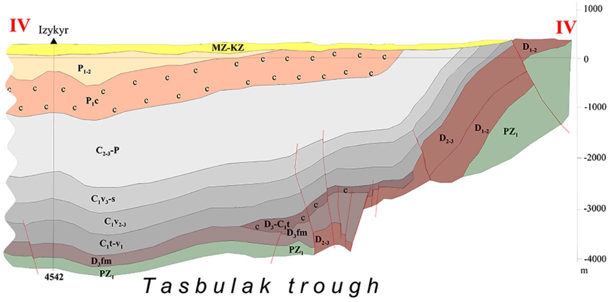

Fig. 6. Geological section along line IV–IV (Akchulakov U., 2011)

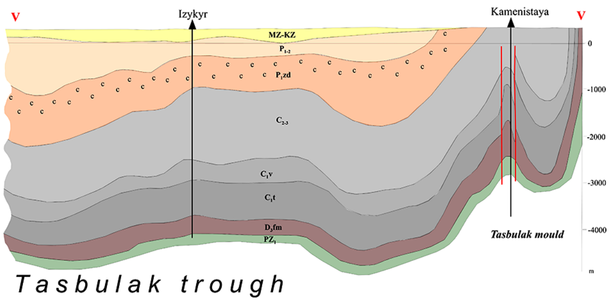

Fig. 7. Geological section along line V–V (Akchulakov U., 2011)

The thickness of the Paleozoic sedimentary cover varies from 2 km in the north to 6 km in the southwest and south. At the same time, the maximum thickness of Permian deposits for the entire basin is set in this deflection – up to 2.5 km. A feature of the Tasbulak trough is a weak dislocation and weak disturbance by faults of the sedimentary cover, and a small number of local anticlines [9]. The latter may be a consequence of its weak study by detailed seismic exploration. Only in its northeastern part along the border with the folded belt, Upper Paleozoic deposits form a series of high-amplitude anticlines (Zhaman-Aibat, Dautbai, Karakoin), accompanied by a series of feathering faults of northeastern and sub meridional orientation, as well as in the southwestern and southern parts, the Taskury, Byurtusken and Koskuduk moulds are isolated.

In the southeast of the trough, Famen salts are forming a salt cushion on the Kamenistaya structure. Along the northeastern border on the above-mentioned shafts and anticlines, lower, middle and upper carboniferous deposits have been removed to the daytime or Cretaceous surface. To the northeast, a general regional rise of all Paleozoic layers is recorded.

Oil and gas occurrences were recorded during the sinking of the Vise-Serpukhov deposits of the lower carboniferous, and deposits of the middle and upper carboniferous, when the studied area along the geotraverse was a coastal zone. In the Middle and late Carboniferous, with the developing regression, the territory was an alluvial-lacustrine plain, but deposits of this age fall out on the studied area.

Along the geotraverse on the studied territory, one of the large structures is the Kamenistaya area, where drilling of exploratory wells revealed the subsalt layer of the Fransky tier, Upper Devonian-Tournaisian salt deposits, lower carbon Vise-Serpukhov deposits. According to GIS data, all identified reservoir layers in the section of wells are characterized as water-saturated. It should be noted that when drilling wells, numerous gas occurrences were noted and degassing of the washing liquid was observed.

In the central part of the deflection, the Izykyr and Northern Izykyr areas were uncovered by oil exploration wells. At maximum drilling depths of more than 4400 m, only Visean limestones of the Lower carboniferous have been uncovered. The paleogeographic situation is of interest in the Famenian time when the region was an alluvial plain.

Conclusion. The results of the study on the paleogeographic situation of the basin indicate that the accumulation of hydrocarbons occurred during the end of the transgression – the beginning of the regression.

The deposits of the Early Visean (C_1v_1), middle-late Visei ($C_1v_{2\text{-}3}$), and Serpukhov (C_1s), when the area was flooded by the sea and numerous shoals were formed, may be promising strata within the Suzak-Baykadam trough.

The Talas uplift is characterized by the absence of Upper Paleozoic deposits, which reduces the prospects of the area. Accumulations of hydrocarbons in Permian time (Ucharal, Ucharal-Kempyrtobe) tend to areas located outside the salt environment. The studied structure of the Zhailma in its Permian development was located in an area with increased salinity.

The prospects of the Tastin uplift are associated with carboniferous deposits, during the period when the transgression reached its maximum and began to recede, forming alluvial-lacustrine plains.

The Mishty mould on the territory of the Moyinkum trough as a result of sea retreat and expansion of lagune forming is likely to be productive in the sediments of the Middle-Late Visean ($C_1v_{2\text{-}3}$), Serpukhov (C_1s).

The Nizhneshu uplift is characterized by pronounced Famennian salt-bearing strata. Of greater interest is the terrigenous part of the salt-bearing strata. Carboniferous deposits can be productive; this area was periodically flooded by the sea with the formation of numerous lagoons.

In the area of the Tasbulak trough, gas occurrences were recorded in wells that exposed the Vise-Serpukhov deposits of the lower carboniferous (C_1v, C_1s), the lower section of the middle carboniferous section (C_2) and the Dzhezkazgan suite of the upper carboniferous (C_3), when the region was represented by a coastal-marine lagoon, then an alluvial-lake plain.

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Перспективи виявлення структур із вуглеводневими покладами вздовж геотраверсу в Шу-Сарисуйському осадовому басейні

А. К. Тлеубергенова[*1], *В. С. Портнов*[1], *О. М. Карпенко*[2], *А. Д. Маусимбаэва*[1], *Р. К. Мадишева*[1]

1 – Карагандинський технічний університет імені Абилкаса Сагінова, м. Караганда, Республіка Казахстан

2 – Київський національний університет імені Тараса Шевченка, м. Київ, Україна

[*] Автор-кореспондент e-mail: abdullinakrg@gmail.com

Мета. Вивчення палеогеографічної обстановки Шу-Сарисуйського осадового басейну та її зв'язок із накопиченням вуглеводнів.

Методика. Аналіз літолого-палеогеографічних карт, починаючи з девонського часу (D_3fm) і закінчуючи верхньопермським періодом (P_2), складених У. Акчулаковим, Х. Х. Парагульковим, баз геолого-геофізичних даних (сейсморозвідка, гравірозвідка, магніторозвідка) за доведеними скупченнями вуглеводнів для оцінки виявлення можливих перспективних ділянок осадового басейну Шу-Сарису.

Результати. Закономірності накопичення вуглеводнів, отримані на основі порівняльного аналізу відкритих родовищ і перспективних ділянок у межах геотраверсу Шу-Сарис, обґрунтовані тим, що накопичення вуглеводнів відбувалося в зонах, які в результаті палеогеографічної еволюції виділяються як території, що належать до алювіально-дельтових рівнин, які періодично затоплюються морем, солерідних лагун.

Наукова новизна. У результаті проведених досліджень із використанням фактичних даних отримана прогнозна оцінка перспективності на наявність покладів вуглеводнів ділянок у межах геотраверсу Шу-Сарису.

Практична значимість. Обґрунтовано прогноз щодо можливості виявлення скупчень вуглеводнів у зонах, що раніше оцінювалися як малоперспективні або безперспективні у Шу-Сарисуйському осадовому басейні.

Ключові слова: *Шу-Сарисуйський осадовий басейн, літолого-палеогеографічна обстановка, тектонічні елементи, вуглеводні*

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