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Lithological-Stratigraphic, Paleo Geographic, and Geochemical Conditions of Formation and Petroleum Potential of the Lower Jurassic Petroleum Complex of the North Ustyurt Depression

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Abstract

This article presents the history and results of studies on the sedimentation conditions and structural features of Lower Jurassic deposits; the targeted study of whose productivity is being conducted in the Ustyurt region. Currently, gas saturation in Lower Jurassic deposits has been proven in the central part of the region, within the Kuanysh-Koskala and Berdakh swells, the Sudochye trough, and the Shakhpakhta step, where gas condensate reservoirs are confined to a depth interval of 3100...5200 m (Yuldasheva, 2019). It has been established that the greatest range of gas saturation in Lower Jurassic deposits is confined to the rift zone in the central part of the Ustyurt region, identified by geophysical data and partially confirmed by deep drilling results in the areas of the Berdakh swell and Sudochye trough. Within the Kuanysh-Koskala swell, due to the structural features of the Lower Jurassic deposits, no more than four productive horizons have been identified. However, the possibility of their increase in the subsided parts cannot be excluded. Based on analysis of geological-geophysical materials, areas are identified that are forecasted as prospective sites characterized by increased thicknesses of sediments, presence of reservoirs and seals, enrichment in dispersed organic matter, where deep drilling results have identified a Lower Jurassic potentially productive complex (Yuldasheva, 2024). To effectively conduct exploration work, this direction has been substantiated with the aim of obtaining reserve increments of gas, condensate, and possibly oil. Unlike other oil and gas-bearing regions of Uzbekistan, where development of new directions is associated with depletion of the main productive horizons, the Ustyurt region is characterized by poor geological-geophysical investigation. Work on the Lower Jurassic direction does not preclude continuation of work on the search for hydrocarbon deposits in the regionally productive Upper-Middle Jurassic deposits, including territories poorly studied and unstudied by geological-geophysical methods.

Keywords: Condensate, Gas, Lower Jurassic, Mudstone, Petroleum Complex, Sandstone

Introduction

Lower Jurassic deposits constitute one of the petroleum complexes with which high prospects for replenishing the hydrocarbon resource base of the Republic of Uzbekistan are associated (Yuldasheva, 2024). This direction has particularly gained momentum in its northwestern part - the Ustyurt petroleum region, where in recent years targeted research has been conducted to determine petroleum potential, resulting in high-rate

flows of gas and condensate from terrigenous reservoirs of Lower Jurassic age. Further development of exploration for new hydrocarbon deposits of various phase compositions is justified by the presence within it of all features of a petroleum system (reservoirs, seals, gas-generating deposits). The history of their study began in the middle of the last century, when terrigenous deposits were penetrated, whose age was determined as Lower Jurassic; the lithological-stratigraphic and reservoir properties of rocks were studied, and commercial flows of gas and condensate were obtained at the Kuanysh, Akchala, and Eastern Barsakelmes fields (Abdullaev et al., 2019)

Alimov, 2006, Yuldasheva, 2019, 2024). During subsequent appraisal, only non-commercial flows of gas, condensate, and oil were obtained. As a result, a conclusion was made that by the end of the Cretaceous, the gas source rocks contained in the formation had realized their productivity potential, and the hydrocarbons contained in them were of remigration character (Abetov et al., 2000]. However, the peculiarities of the geological structure of the Lower Jurassic terrigenous sequence depending on the history of geological development and sedimentation conditions were not taken into account, and there are territories where Lower Jurassic sediments have their own generation potential. The next conclusion concerned the lenticular structural character of the Lower Jurassic sequence and low prospects for discovering accumulations on the Kuanysh-Koskala swell (Rybalchenko et al., 2011). It should be noted that within this tectonic element, Lower Jurassic deposits have a very consistent character, in which sandy horizons are confidently traced throughout the territory and whose productivity has been confirmed at the Beskala, Saikhun, and Kushkair prospects based on the results of renewed exploration work. One of the reasons for the low prospectivity of the Kulbai trough was the presence of dense rocks of Permian-Triassic age underlying the Jurassic section (Krylov et al., 2015). However, on the Kuanysh-Koskala swell, under similar conditions of interaction between Jurassic and Permian-Triassic deposits, flows of gas and condensate were obtained from Lower Jurassic deposits at the Eastern Barsakelmes, Kuanysh fields, etc.

Thus, it can be stated that the level of investigation of Lower Jurassic deposits in the Ustyurt region is quite low and the petroleum prospects were ambiguous. At the current stage of their appraisal, it has been established that the structure of Lower Jurassic deposits depends on their confinement to various tectonic elements, which affects the generation, migration, and accumulation of hydrocarbon fluids, the presence and number of productive horizons, etc. (Yuldasheva, 2024).

Review of the Related Literature

Research on the petroleum potential of Uzbekistan, particularly the Ustyurt region, has evolved through decades of stratigraphic, lithological, and geochemical investigations. Foundational works such as Abdullaev et al. (2019) provide a comprehensive overview of the country's oil and gas fields, establishing the regional context for exploration. Early studies by Davlyatov and Pak (1987) highlighted the significance of rift structures in the Turan Plate, while Abetov and Labutina (2000) emphasized lithological-stratigraphic and facies-paleogeographic criteria for Jurassic deposits in Southwest Priaralye.

Subsequent research shifted toward detailed stratigraphic and sediment logical analyses. Alimov (2006) and Boykobilov et al. (2008) examined Jurassic sedimentation patterns in Ustyurt, contributing to the understanding of depositional environments. Gafarov and Gulev (2010) introduced new perspectives on petroleum prospects in Eastern Ustyurt,

while Krylov et al. (2015) applied play analysis to guide exploration strategies. Lyugay et al. (2010) further integrated lithological-facies analysis with petroleum potential assessments in Southern Priaralye.

Recent studies have increasingly focused on geochemical and reservoir characteristics. Mukhutdinov et al. (2019) assessed petroleum prospects of Lower Jurassic deposits using geological-geochemical data, complemented by Rybalchenko and Zabolotnaya (2011) who analysed reservoir properties of Jurassic sand-clay formations. Yuldasheva (2019, 2022, and 2024) contributed significantly to understanding the structural and productive horizons of Lower Jurassic sediments in the North Ustyurt Basin, marking a progression toward more refined exploration models.

Collectively, these works demonstrate a trajectory from broad regional assessments to specialized stratigraphic, geochemical, and reservoir-focused studies. This literature underscores the evolving methodologies and growing sophistication in evaluating the petroleum potential of Uzbekistan's Jurassic deposits, particularly within the Ustyurt Basin.

Objectives

The primary objective of current research on the Lower Jurassic deposits of the Ustyurt petroleum region is to reassess their hydrocarbon potential in light of recent discoveries and renewed exploration efforts. While earlier studies concluded that these deposits had exhausted their productivity potential by the end of the Cretaceous and hydrocarbons were largely of remigration character (Abetov et al., 2000), new findings suggest that certain tectonic elements still retain active generation capacity. Thus, the aim is to clarify the geological structure, sedimentation conditions, and reservoir properties that influence hydrocarbon generation, migration, and accumulation.

A second objective is to evaluate the variability of petroleum prospects across different tectonic elements such as the Kuanysh-Koskala swell, Kulbai trough, and Eastern Barsakelmes field. This involves determining the consistency of sandy horizons, identifying productive reservoirs, and understanding the role of Permian-Triassic basement rocks in shaping petroleum potential. By integrating lithological-stratigraphic, geochemical, and tectonic analyses, researchers seek to establish a more reliable model of petroleum system functioning in the region.

Ultimately, the overarching goal is to reduce ambiguity in the appraisal of Lower Jurassic deposits and to provide a scientifically grounded basis for further exploration strategies. This includes identifying productive horizons, assessing phase compositions of hydrocarbons, and ensuring that the Ustyurt Basin continues to contribute significantly to the hydrocarbon resource base of Uzbekistan.

Methodology

For forecasting the petroleum potential of Lower Jurassic terrigenous deposits, it is necessary to create a geological model of Lower Jurassic deposits with identification of prospective zones for exploration of new hydrocarbon deposits. For this purpose, to study the sedimentation process, rock composition, degree of enrichment in dispersed organic matter, identification of sandy horizons, and characterization of their reservoir properties, materials from seismic surveys in 2D-CDP and 3D-CDP modifications, electrical prospecting materials, a complex of well logging data, and laboratory studies of core and

cuttings from deep reference, parametric, and exploration wells that penetrated Lower Jurassic deposits in the territory of the Ustyurt petroleum region were used. During the work, a reflecting horizon was identified, confined to the top of Lower Jurassic deposits, and within the volume of penetrated rock thickness, productive horizons were identified and their correlation was performed, which represent sandy packages, both laterally consistent and lenticular (Yuldasheva, 2024). The work employed the method of facies analysis of sedimentary formations and integrated biorhythm stratigraphic subdivision and correlation of sections. It should be noted that the territory is covered by exploration work extremely unevenly; therefore, the level of detail of studies varies: from regional generalization to local forecasting.

Analysis

The comprehensive study of Lower Jurassic deposits in the Ustyurt petroleum region reveals a highly heterogeneous and structurally complex sedimentary system, which significantly influences hydrocarbon potential. The integration of lithological, stratigraphic, paleo geographic, and geochemical data indicates that while earlier exploration considered these deposits as simple containers for hydrocarbons, subsequent investigations have demonstrated the presence of multi-tiered sandstone packages interbedded with impermeable clay-mudstone sequences. These packages display variable thicknesses, filtration properties, and lateral continuity, emphasizing the importance of detailed facies and reservoir analyses to identify commercially productive horizons and anticipate zones of weak flow or pinch-outs (Yuldasheva, 2024; Abdullaev et al., 2019).

Structural interpretations based on 2D and 3D seismic surveys, coupled with well-log and core analyses, underscore the role of tectonic features such as anticlinal traps, screened faults, and paleo rift zones in controlling hydrocarbon accumulation. Commercial gas-condensate flows from fields such as Kuanysh, Akchala, and Eastern Barsakelmes validate the predictive power of these geological models. Moreover, geochemical investigations confirm the presence of indigenous source rocks capable of generating hydrocarbons, which, together with lateral migration from adjacent formations, account for variations in productivity across the region (Yuldasheva, 2019; Mukhutdinov et al., 2019).

Finally, the analysis highlights the critical influence of depositional environment and paleogeography on reservoir quality. The differentiation of ancient uplands, deluvial-proluvial belts, lacustrine-paludal zones, and alluvial plains has led to a mosaic of facies with distinct porosity and permeability characteristics. This sediment logical and tectono-stratigraphic complexity necessitates integrated exploration approaches, combining seismic interpretation, geochemical assessments, and core analysis to accurately delineate productive horizons and optimize hydrocarbon recovery in the Ustyurt Basin (Boykobilov et al., 2008; Yuldasheva, 2022)

Findings and Discussion

At the initial stage, Lower Jurassic deposits were studied in reference and parametric wells, in which lithological and stratigraphic features, rock age, and reservoir properties were determined; the identified complex was tied to a reflecting seismic horizon. In 1967, the Kuanysh gas condensate field was discovered in Lower Jurassic deposits, whereas the structure had been prepared based on the top of Middle Jurassic deposits. Subsequently, work was conducted to prepare structures based on the reflecting horizon

T_{IV-II}, confined to Lower-Middle Jurassic deposits, which was actually confined to a mudstone package of the Bajocian-Bathonian stages of the Middle Jurassic. The commercial flows of gas with condensate obtained in Lower Jurassic deposits (Akchala, Eastern Barsakelmes, Kuanysh fields) led to the need to pay attention to the structure of these deposits with the aim of identifying and preparing structures for drilling. One of the first structures prepared based on Lower Jurassic deposits was the reservoir-type anomaly (RTA) Kokchalak, which is represented by a non-structural lenticular screened trap in channel sandstones, from which commercial flows of gas and condensate were obtained (Yuldasheva, 2024).

Subsequently, in the early 2000s, as a result of 2D-CDP and 3D-CDP work, a series of structures was prepared based on Jurassic horizons, including Lower Jurassic deposits on the Kuanysh-Koskala swell (Tillali), in the Sudochye trough (Porlytau), the Barsakelmes trough (Eastern Atorbay, Northern Atorbay, Shumanay, etc.), and in the Kosbulak trough (Sulama, Ak-Tepe, Western Aral, etc.). All structures in Lower Jurassic deposits represent either anticlinal structures or tectonically screened traps adjacent to faults (Abdullaev et al., 2019, Yuldasheva, 2024).

The next stage in studying Lower Jurassic deposits was the deepening of the investigation interval. Based on the results of previously performed work, it became evident that the deposits of the Lower Jurassic complex beneath discovered fields were insufficiently studied. For example, during exploration work at the Shakhpakhty, Urga, Aral, Berdakh, Northern Berdakh, and Surgil prospects, in the first exploration wells from Lower Jurassic deposits, weak gas flows were obtained, often with formation water, which subsequently proved to be the result of possible facies and lithological replacement, confinement to pinch out zones and deterioration of reservoir properties, not only of natural origin but also created by technological conditions of well drilling (Yuldasheva, 2024).

At the initial stage of developing Lower Jurassic deposits, when territories were being studied where small thicknesses of deposits of this age were penetrated (100-400 m), a conclusion was made that these deposits, mainly composed of sandy sediments, are merely containers for hydrocarbons. However, because of further geological exploration work, territories were identified where Lower Jurassic deposits compose thick sequences (up to 2 km and more), consisting of sandstone packages separated by relatively impermeable clay-mudstone sequences, the number of which varies depending on tectonic confinement. Moreover, productive and potentially productive horizons are represented by fine-pebble to sandy rocks of various mineral compositions and filtration-capacitive properties. The peculiarities of sedimentation of the Lower Jurassic terrigenous formation determined the facies diversity of its structure depending on thickness magnitude (Yuldasheva, 2022, 2024).

The Jurassic stage of sedimentation within the Ustyurt region began after a prolonged break that continued throughout the Middle and Late Triassic, when a dissected erosional-tectonic relief was formed, the deep depressions of which began to rapidly fill with coarse clastic deposits of molasse type, for example within the eastern part of the Sudochye trough. As a result, negative forms of paleo relief were filled with the most ancient Jurassic formations, while on elevated areas (Central Ustyurt and Koskala paleo uplifts) sedimentation began only in Middle Jurassic time. In Early Jurassic time, five paleogeographic zones are distinguished, reflecting changes in sedimentation conditions:

ancient uplands, deluvial-proluvial belts, lacustrine-paludal territories, alluvial plains, and paleo rift zones (Fig. 1).

Ancient uplands were located in the central part (Aktumsuk paleouplift), in the south (Central Ustyurt and Koskala paleouplifts), and in the southeast (Kyzylkum) of the territory, which are characterized by rather dissected relief, where denudation processes were actively occurring, resulting in the formation of material for removal, and on adjacent territories extensive deluvial-proluvial belts accumulated around them (Boykobilov et al., 2008). In all wells drilled within their limits, at the Terengkuduk, Kharoy, Sarytekiz, Kassarma, Bayterek, Kokbakhty, and Aybugir prospects, Lower Jurassic rocks are absent.

It should be noted that the southern part of the Aktumsuk paleouplift represented a denudation scarp that steeply dropped toward the intraplatform Kulbai graben-like trough, which was intensively filling with deluvial-proluvial formations, including possibly colluvial ones, as evidenced by the thick Lower Jurassic sections in the Northern Dzhangyzsu and Razlomnaya wells, in whose section the C_{org} content in black silty mudstones reaches 13.5%, and chloroform bitumen "A" (ChBA) - 0.3%, which indicates the presence of allochthonous bitumoids in the host sequence.

Extensive near-slope territories are covered by deluvial-proluvial belts, which frame all the above-mentioned ancient uplands; particularly extensive fields of these are noted in the territory of southern Priaralye and the southern part of the Barsakelmes trough. Deposits of the deluvial-proluvial complex are usually represented by interbedding of clays (mudstones), siltstones, sandstones, gravestones, and conglomerates; lenticular interlayers of mixed, unsorted, sandy-silty-clayey rocks are occasionally encountered, whose composition depended on the relief of nearby source areas and the composition of their constituent rocks. In confirmation of this fact, cores show widespread occurrence of coarse clastic sandstone-conglomerate rocks composed of fragments of various types of Late Palaeozoic rocks.

On the northern slopes of the Aktumsuk paleouplift, the relief was less dissected, the deluvial-proluvial rock complex is more homogeneous in composition, with sandy deposits predominating. It is assumed that the southern slope was higher and steeper, while the relatively gentle surface of the watershed and adjacent slope was inclined to the northwest.

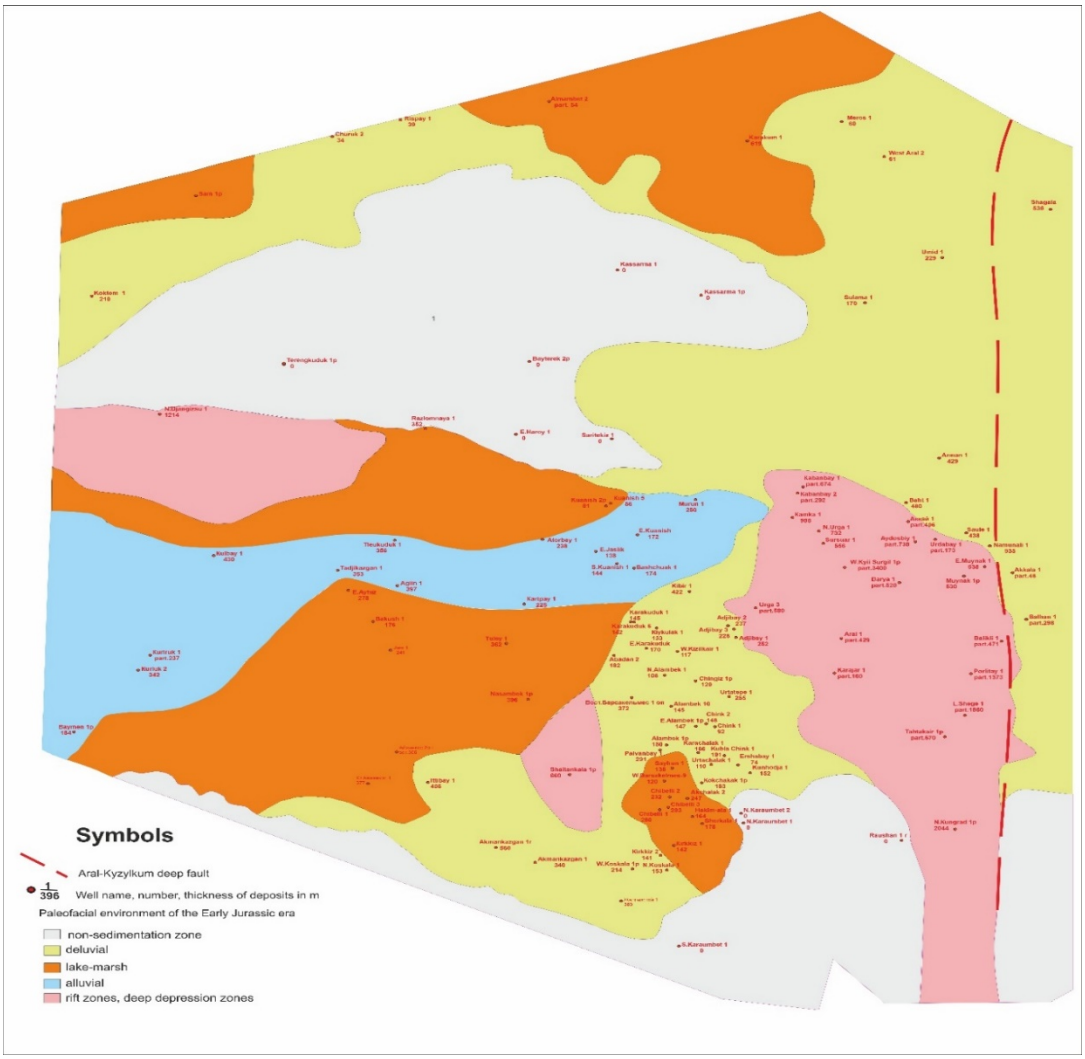

Figure 1: Paleofacies map of the Early Jurassic epoch of the central part of the Ustyurt region. Compiled by M.G. Yuldasheva using data from Boykobilov, Khaitov, Dzhalilov, 2008.

Their attribution to the deluvial-proluvial type is evidenced by the absence of sorting, low degree of rounding, and angularity of clastic material. Lacustrine-paludal territories and alluvial plains were widely distributed in the Early Jurassic epoch within the central part of the Barsakelmes trough and in the northern areas of the Samsky and Kosbulak troughs.

In the zone of lacustrine-paludal territories of the Barsakelmes trough, rocks formed that are characterized by irregular alternation of sandy-clayey sediments, where clayey varieties occur in the upper part. A characteristic feature is the inclusion of pyrite crystals and numerous carbonized plant detritus in the form of interlayers, plant impressions, interlayers of black coals; stratification is observed, which indicates lacustrine-paludal sedimentation conditions. On the southern flank of the Barsakelmes trough, according to chemical-bituminological studies, the presence of potential petroleum source rocks in the Lower Jurassic complex is also noted; elevated organic matter content in siltstones is observed at approximately 1.32...3.17%, chloroform bitumen "A" comprises 3.9-5.71% of autochthonous character. Thus, it can be concluded that the possibility of Lower Jurassic productivity cannot be excluded, especially since the thicknesses of these

deposits according to seismic data increase significantly (up to 700-800 m) (Yuldasheva, 2019)

The presence of zones of alluvial plains in Early Jurassic time is noted in the Kosbulak and Barsakelmes troughs. In lithological terms, this complex of ancient river networks is represented by sandy deposits of various grain sizes, predominantly medium- to coarse-grained, containing numerous inclusions of black-colored organic matter unevenly distributed in the rock; inclusions of well-rounded gravel are observed in the basal part.
At the boundary between the Triassic and Jurassic periods, a transitional stage in the geotectonic and geodynamic development of the region under consideration was ending, and the formation of the sedimentary cover of the Turan Plate was beginning. Therefore, partial inheritance was preserved in the development of some structural elements, such as, for example, the graben system (Davlyatov et al., 1987). Two such structures continued to exist and intensively subside at high rates in the area of the southern flank of the Aktumsuk paleouplift and west of the Aral-Kyzylkum deep fault. They represented deep canyons in which Jurassic sedimentation began much earlier, as evidenced by the features of rocks filling these grabens, which are represented by clastic materials: sandstones of various grain sizes, more often medium- and coarse-grained, with interlayers of gravelstones and conglomerate-gravelstones, and black coals.

Moreover, in territories where the penetrated thickness of the Lower Jurassic exceeds 900 m, the oldest penetrated deposits are rocks including undivided formations of the upper Rhaetian, Hettangian, Sinemurian, and Pliensbachian. In the rest of the territory, the Lower Jurassic section is represented by a sequence of Toarcian age.

The second "graben-paleorift" zone is located within the Sudoch trough system, northwest-trending and deeper in intensity. In the eastern part, it lies beneath the Berdakh swell (Fig. 2), and in the western part, it lies directly in the central part of the Sudoch trough, where a large graben has been recorded.

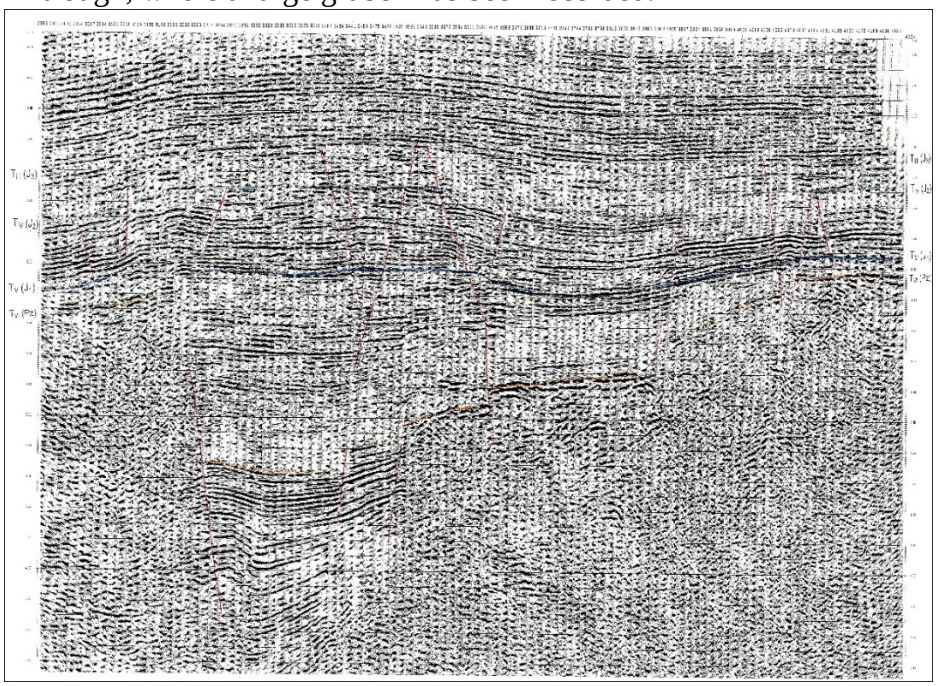

Figure 2: Fragment of a time section through the graben-paleorift in the western part of the Sudochye trough

In this territory, the Lower Jurassic is characterized by maximum stratigraphic completeness compared to other areas of the Ustyurt region. The lower half of the section includes undivided formations of the Rhaetian, Hettangian, Sinemurian, and Pliensbachian, while the upper intervals are composed of rocks of the Toarcian stage. From this, it can be concluded that it was established even in pre-Jurassic time, while its intensive filling began, probably, even in Triassic time. Here, rhythmic alternation of sandstones, siltstones, and mudstones is observed. In the composition of the Toarcian stage, interlayers of gravelstones and conglomerates appear.

In territories where the thicknesses of Lower Jurassic deposits vary within 250...400 m (Kuanysh-Koskala swell, Agyin uplift, Sudochye trough, etc.) and the sequence is represented by coarse-grained sandstones isolated by small interlayers of clays and mudstones, among which four productive horizons were identified that are confidently traced throughout the entire swell territory. However, it should be noted that in the central part of the Kuanysh-Koskala swell, the Lower Jurassic productive sequences consist of three beds, while in the slope parts the presence of four productive beds is noted. Moreover, the highest flow rates of gas and condensate are recorded in the basal part of the section and near the contact with underlying Upper Paleozoic formations and adjacent zones of increased thicknesses of coeval terrigenous deposits enriched in dispersed organic matter. Thus, petroleum occurrence is determined both by vertical migration of hydrocarbons from underlying sedimentary complexes of the Upper Paleozoic and by lateral migration from adjacent grabens composed of clayey Lower Jurassic sediments, while hydrocarbon accumulations were discovered in anticlinal structures, often tectonically screened.

Within the marginal parts of large troughs (Kosbulak, Barsakelmes), where increased thicknesses of Lower Jurassic deposits are predicted and partially confirmed, which are confined to regional faults where sharp changes in the facies composition of deposits also occur. Their overlying by younger clayey sediments creates very favorable conditions for the formation of lithological and stratigraphic traps of non-anticlinal type. Lower Jurassic deposits within the block, especially in the southern part of the Barsakelmes trough and other subsided areas of troughs, occur at considerable depths (2...3 km), have significant thicknesses, and are characterized by geothermal gradients of 3.4...3.6°C/100 m. All this can ensure significant scales of hydrocarbon generation. This factor is supported by data according to which Lower Jurassic deposits accumulated under reducing and weakly reducing sedimentation conditions, which is confirmed by the presence of pyrite and siderite inclusions. Chemical-bituminological studies established elevated organic matter content in clays of 0.77%, in siltstones and sandstones up to 3.17%, and chloroform bitumen "A" throughout the sequence comprises 3.9...12.7%, which is of autochthonous character. It can be concluded that in the southern direction, within the Barsakelmes trough, the possibility of Lower Jurassic productivity cannot be excluded, where the thicknesses of these deposits according to seismic data increase to 700-800 m (Yuldasheva, 2019).

The greatest thickness of Lower Jurassic deposits is predicted on the Berdakh swell, which according to geophysical data amounts to 4000...5000 m, where the productivity of the entire Jurassic section has been proven. Special sedimentation conditions determined a sufficiently large diversity of sandy beds of various thicknesses, configurations, and filtration-capacitive properties (Fig. 3). In this territory, only in the upper part of Lower Jurassic deposits, covering 900 m of penetrated thickness, up to 12

productive horizons have been identified, occurring to a depth of minus 4450 m, which form both thin and sufficiently massive sand bodies (up to 50-100 m).

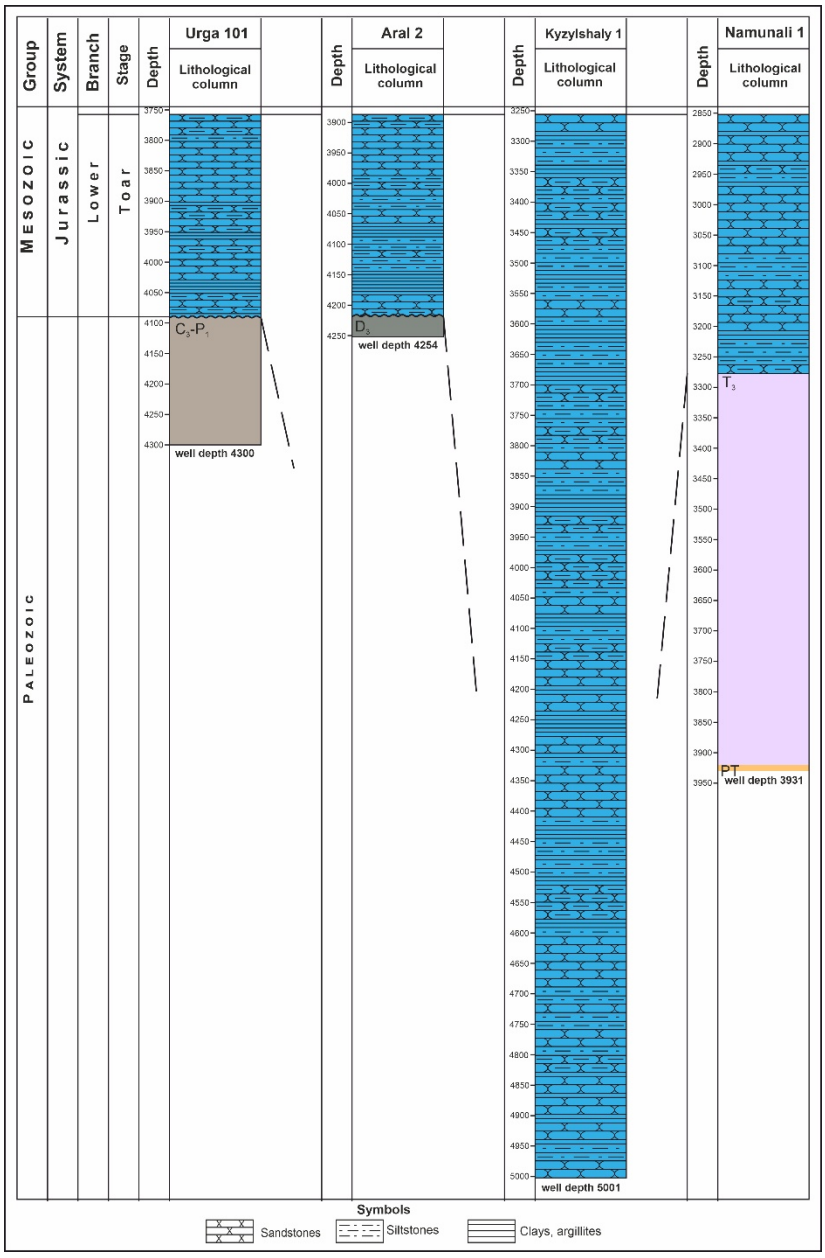

Figure 3: Examples of penetrated sections of Lower Jurassic deposits of the Sudochye trough, the Berdakh swell and the Muynak uplift

Reservoirs are represented by sandstones and gravelstones possessing good filtration-capacitive properties (porosity ≈10...16%) while forming both thin and sufficiently massive sand bodies (up to 50...100 m). With depth, sandstone porosity decreases somewhat to values of 8-10%, but fracturing appears, which increases rock permeability (Yuldasheva, 2019, 2022).

Clayey rocks (mudstones and siltstones) have good sealing properties and, in addition, possess generation properties, having in their composition a sufficient amount of dispersed organic matter, which at depths of 3020 m...4027 m varies from 0.25 to 1.43%.

The highest C_{org} values (3.93-5.74%) are noted in black mudstones at the Arslan field at depths of 3470 m...3472 m, and from a depth of 3500 m microbitumen manifestations are noted (ChBA above 0.065%), which allows forecasting an indigenous source of hydrocarbon generation (Mukhutdinov, Yuldasheva, Akramova et al., 2019). Moreover, in the marginal parts of the swell, the greatest productivity is noted in the upper five horizons; with depth, hydrocarbon flow rates decrease. In the central and southern parts of the swell, an inverse relationship is observed, i.e., with depth flow rates increase, reaching values up to 800-1400 thousand m^3/day, where the influence of tectonic disturbances is noted, contributing to improvement of reservoir properties, while in the upper analog beds, where bed continuity is not disturbed, only signs of hydrocarbon saturation in the form of weak gas flows were obtained (Yuldasheva, 2022).

In addition to the established commercial gas occurrence, it should be noted that signs of oil occurrence have been obtained in Lower Jurassic deposits. At the Karakuduk prospect, non-commercial flows of light, low-sulfur, and low-gasoline oil were obtained. In the northern part of the Garbiy Borsakelmas gas condensate field, from Lower Jurassic sandstones, oil flows were obtained that are similar in density, sulfur content, and gasoline fractions to the oil from the Karakuduk prospect. In the eastern part of the North Ustyurt depression, at the Eastern Muynak prospect, a non-commercial flow of light, low-sulfur, gasoline-type oil was obtained from Lower Jurassic sandstones (Yuldasheva, 2024).

Lower Jurassic deposits of the Ustyurt region have a very complex geological structure that depends on sedimentation conditions, which was not previously taken into account when conducting exploration work. For example, it was assumed that the thicknesses of these deposits were consistent throughout the entire territory of the Barsakelmes trough (Boykobilov et al., 2008); in fact, it has been established that there are zones with increased thicknesses in the southern and northern parts of the territory. The conclusion about unfavorable conditions for the formation of Lower Jurassic reservoir rocks and low filtration-capacitive properties was made based on core analyses [14], which represents a point value but was interpolated to the entire territory of northern Ustyurt. It was also determined that the Lower Jurassic section is composed of sandy beds with good reservoir properties only in the upper part, while the prevailing role is played by fine-grained and pelitic formations, which is the reason for obtaining weak gas flows (Gafarov et al., 2010, Lyugay et al., 2010, Krylov et al., 2015). However, it was established that in the studied sections of Lower Jurassic deposits of the Berdakh swell, sandstones have porosity of 10...15%, and with depth fracturing appears. In addition, the presence of gas source rocks was established within the composition of this rock complex, which indicates the generation capabilities of Lower Jurassic deposits, which was previously excluded (Abdullaev, Yuldasheva, 2019, 2024).

Conclusion

Based on the study of sedimentation conditions of Lower Jurassic deposits of the Ustyurt region, new data have been obtained on the structure of Lower Jurassic deposits, whose productivity to date has been proven in the zone of increased thicknesses of the Berdakh swell and Sudochye trough, where a multi-tiered system of sandy horizons has formed, confirmed by the discovery of gas condensate accumulations. This zone is confined to an

ancient paleorift in which an independent petroleum system has formed that extends in a southern direction.

Within the Ustyurt region, analogous territories have been identified within the Takhtakair swell, Taldyk trough, the junction zone of the Berdakh swell and the Muynak uplift, in the southeastern and northern parts of the Barsakelmes trough, where geological exploration work needs to be carried out with an increase in the depth of research to 6-7 km marks, both seismic work and deep drilling.

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