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Research Article

PROSPECTS FOR OIL AND GAS POTENTIALOF LOWER JURASSIC STRATIGRAPHY OF THE SUDOCHY DEFLECTION'S EASTERN PART BASED ON A GEOLOGICAL STRUCTURE OF THE ARSLAN FIELD

Z.S. Djuraeva*
Institute of Geology and Prospecting for Oil&Gas Deposits, Tashkent, Uzbekistan
**Author for Correspondence e-mail: z.a.r.a@bk.ru*

ABSTRACT
In this article, the Arslan field's geological model has been researched. A new approach to the allocation of productive horizons based on a lithologically shielded type of deposit has been applied. A paleochannel and coastline, which are not limited by the deposit and extend from the southeast to the northwest has been traced. Kuyi Surgil, Arslan, Inam and Kuyi Sharkyi Berdakh fields are located in the paleochannel. It is necessary to consider the paleochannel direction and the coastline when planning drilling production wells.

Keywords: *3D geological model, oil and gas, well, exploration, field, deposit, sediment, reservoir, zone, paleochannel.*

INTRODUCTION

Due to the high degree of discovered oil and gas fields within the upper level of exploration of the main oil and gas promising regions of the Republic of Uzbekistan, the main direction of building up the energy base is research of deeply submerged oil and gas promising objects. The Ustyurt oil and gas region has remained a leader in hydrocarbon production in recent years. According to this, it is of particular interest in this matter and detailing of it's geological structure is an actual task.

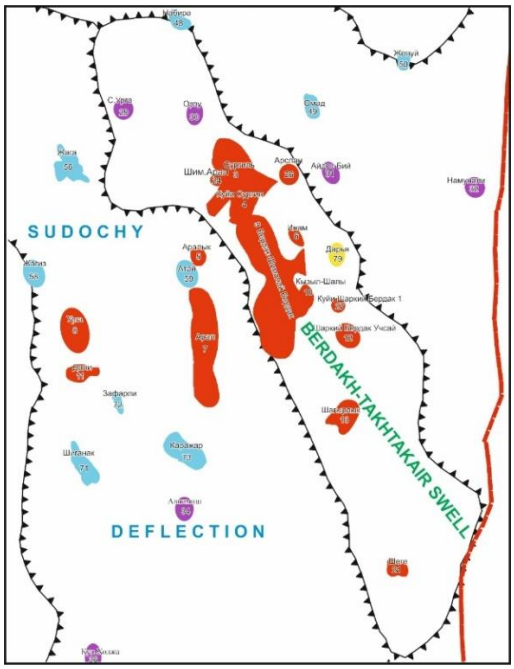

Figure 1: A fragment of the scheme of tectonic zoning of the Ustyurt oil and gas region according to the deposits of the Middle Jurassic (compiled by: Karshiev O.A., Mamirov J.R., Djuraeva Z.S. et al., 2022).

On the territory of the Ustyurt oil and gas region in the eastern part of the Sudochy deflection within the Berdakh-Takhtakair swell (according to the new scheme of tectonic zoning of the Ustyurt oil and gas region, Karshiev O.A., Mamirov J.R., Djuraeva Z.S. et al., 2022) a number of gas condensate fields were discovered, such as Surgil-Northern Aral, Berdakh-Northern Berdakh, East Berdakh-Uchsay, Shagyrlyk, Shege, Arslan, Inam, Kyzyl-Shaly, Kuyi Surgil, Western Kuyi Surgil, Aralik, Kuyi Sharkiy Berdakh, etc. There prepared and drilled areas and identified structures are located. The main gas content of the above fields is confined to the sandy horizons of all Jurassic period sediments (Fig. 1) (Abdullaev *et.al.,* 2019).
Gas and condensate deposits are confined to the Upper Jurassic and Middle Jurassic sediments, which form anticlinal traps of the reservoir-arch type at the Surgil-Northern Aral, Berdakh-Northern Berdakh, East Berdakh-Uchsay, Shagyrlyk, and Shege fields (Zorina, 2002).
In 2017, a decision was made to purposefully research the underlying Lower Jurassic sediments in order to confirm the oil and gas potential and search for hydrocarbon deposits.

MATERIALS AND METHODS

Construction of a 3D geological model of the field, drawing up a correlation scheme, sampling scheme based on geological and geophysical materials: CDP-3D seismic survey; well logging; drilling data (well tests, depths, absolute marks) and core.

RESULTS AND DISCUSSION

The Arslan structure, based on the CDP-3D seismic data, is an isometric anticline fold bounded by faults on the east and west.
The Arslan field was discovered in 2015. The pioneer of the field was well No. 1. During testing in an open hole in the perforation interval of 3337-3304 m on a 19 mm fitting, a gas inflow with a flow rate of 800 thousand m^3/day was obtained from the Lower Jurassic sediments. During further prospecting and exploration within the Arslan field, 29 wells were drilled. Of these, 3 prospecting, 10 exploration and 16 production wells with a total penetration of 106,633 linear meters(Djuraeva, 2022).
Gas deposits in the Jurassic sediments are confined to sandstones. There are a strong facies variability both territorially and along the section, the replacement of sandy reservoirs by clay varieties, etc. within them.
In general, thirteen productive reservoirs were identified at the Arslan field. Six of the reservoirs are in the Middle Jurassic sediments (J_2^6, J_2^{12}, J_2^{14}, J_2^{16}, J_2^{17}, J_2^{18}), seven are in the Lower Jurassic sediments (J_1^2, J_1^3, J_1^{4a}, J_1^5, J_1^{5a}, J_1^6, J_1^7).
The Lower Jurassic sediments are represented by productive strata.It's thickness varies from 55 to 340 m. Gas flow rates in each productive stratum vary within 28-800 thousand m^3/day, flow rates from 100 thousand m^3/day prevail.
The Middle Jurassic sediments are characterized by lower reservoir thickness, on average from 20 to 60 m within the gas-bearing contour, as well as a lower gas flow rate. The gas flow rate was 30-200 thousand m^3/day in the Middle Jurassic sediments. In view of their higher productivity, the layers of the Lower Jurassic sediments are of greater interest relative to the Middle Jurassic.
Analysis of geological and geophysical data shows that the fluid-bearing rocks in the natural reservoir of the field are sandstones, sandy siltstones, with a fractured-porous reservoir type.
For the Arslan field modeling it was necessary to select the most appropriate type of deposit and what the formation's conditions of reservoirs took place. The type of reservoir "stratified arch" used earlier does not explain why the reservoir, opened at one absolute mark in one well is represented by sandstone, in the other became clayey. Also,no reason why, the reservoir is clayey in the arch, butconsists of collectors with gas inflows in the submerged part.
The basis for achieving this goal was a research of the available actual geological and geophysical data. The Arslan field is characterized by the channel distribution of deposits. They belong to the mixed type, and combine elements of lithologically and tectonically shielded types, bounded from the east and west by faults. As a result, it was found that the Arslan field is classified as very complex.
An example of the distribution of similar channel deposits is the West Siberian fields (the southeastern part of the oil and gas province). In the research conducted by Ivanova N.A., the method of complex facies

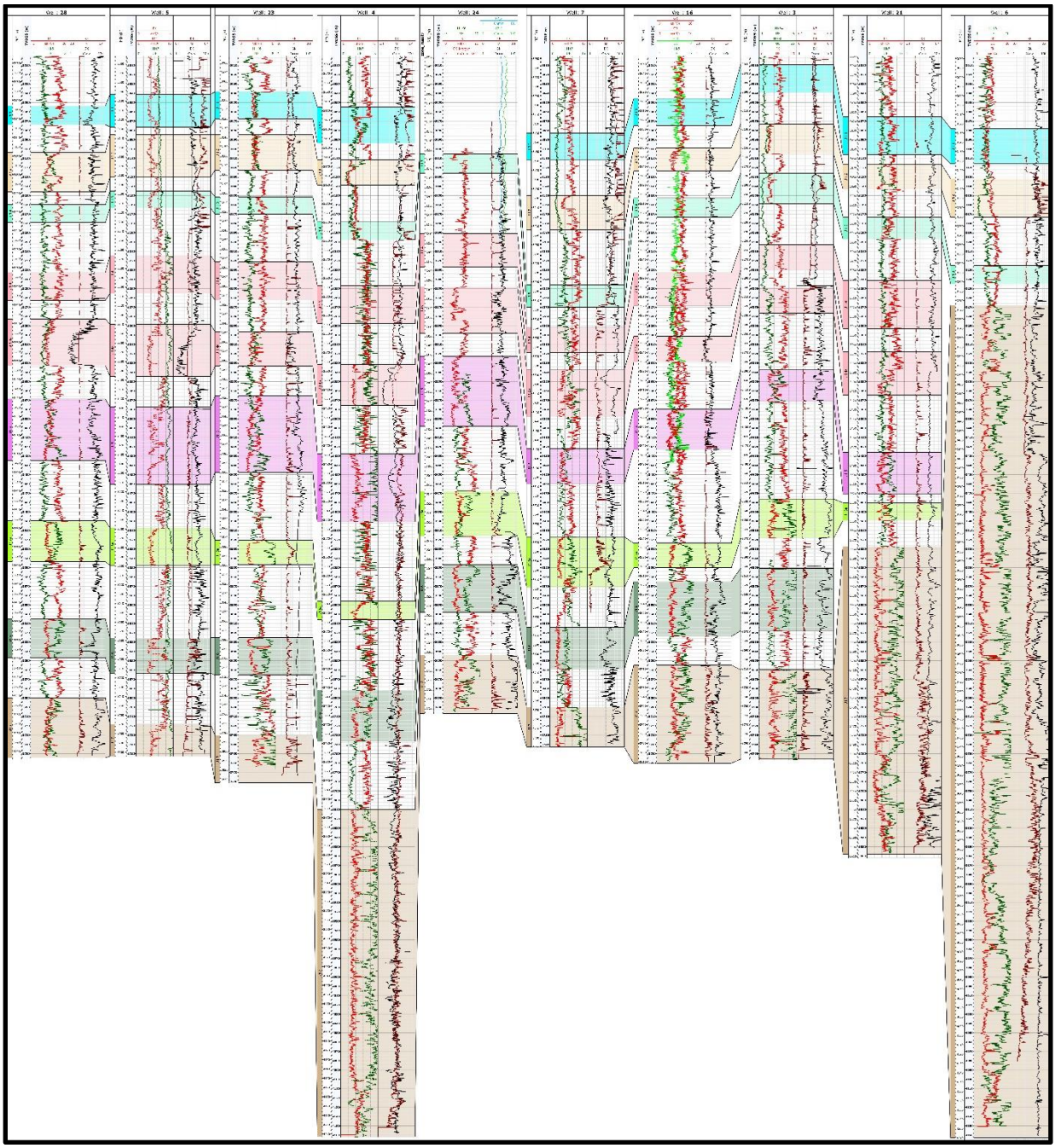

Figure 2: The Arslan feild. A well correlation scheme for the Lower Jurassic sediments (compiled by: Djuraeva Z.S., Mamirov J.R., Khaidarova K.R., 2022).

analysis was applied, including the determination of the genesis of productive strata based on geophysical, lithological and terrigenous-mineralogical data. Based on the research of terrigenous-mineralogical complexes (TMC) of rocks (associations of minerals of heavy fractions), it was proved that during the Upper Jurassic, continental conditions of sedimentation dominated over a large researching area. Channel deposits are traced in a number of wells. The reservoir thickness of the J1/3+4 reservoir in the studied license area reaches 18 m. Sandstones are medium fine-grained, poorly sorted with various types of layering, with clayey kaolinite-chlorite cement (Kiryanovaet.al., 2012).

For the Arslan field's wells, a detailed correlation scheme was compiled, which combined the estimated objects and possibly productive layers in the Lower Jurassic and Middle Jurassic sediments. That made it possible to recreate the full paleogeological situation characteristic of the field during the entire geological period.

On the basis of clearly traceable reference horizons, packs were identified.They conditionally combine either thick, well-correlated layers, or thin layers of reservoirs that are closely spaced along the section (Fig. 2).

As a result of the comparison of wells, the direction of changes in channel flows over time, the size of the paleochannel and the degree of filling of the water area of those periods were determined (the lower and middle sections of the Jurassic system). These features of the channel flows are confirmed in the developed geological model of the Arslan field, which demonstrates how reservoir properties and the direction of the coastline change from bottom to top with each productive formation. It affects to the location of gas accumulation areas with maximum reserves within each formation.

At the Arslan field, there is a tendency to change the gradual narrowing of the channel from the Lower Jurassic to the Middle Jurassic sediments, associated with the shallowing of the channel flow, as evidenced by the increasing zone of clay content of the coastlines (Fig. 3).

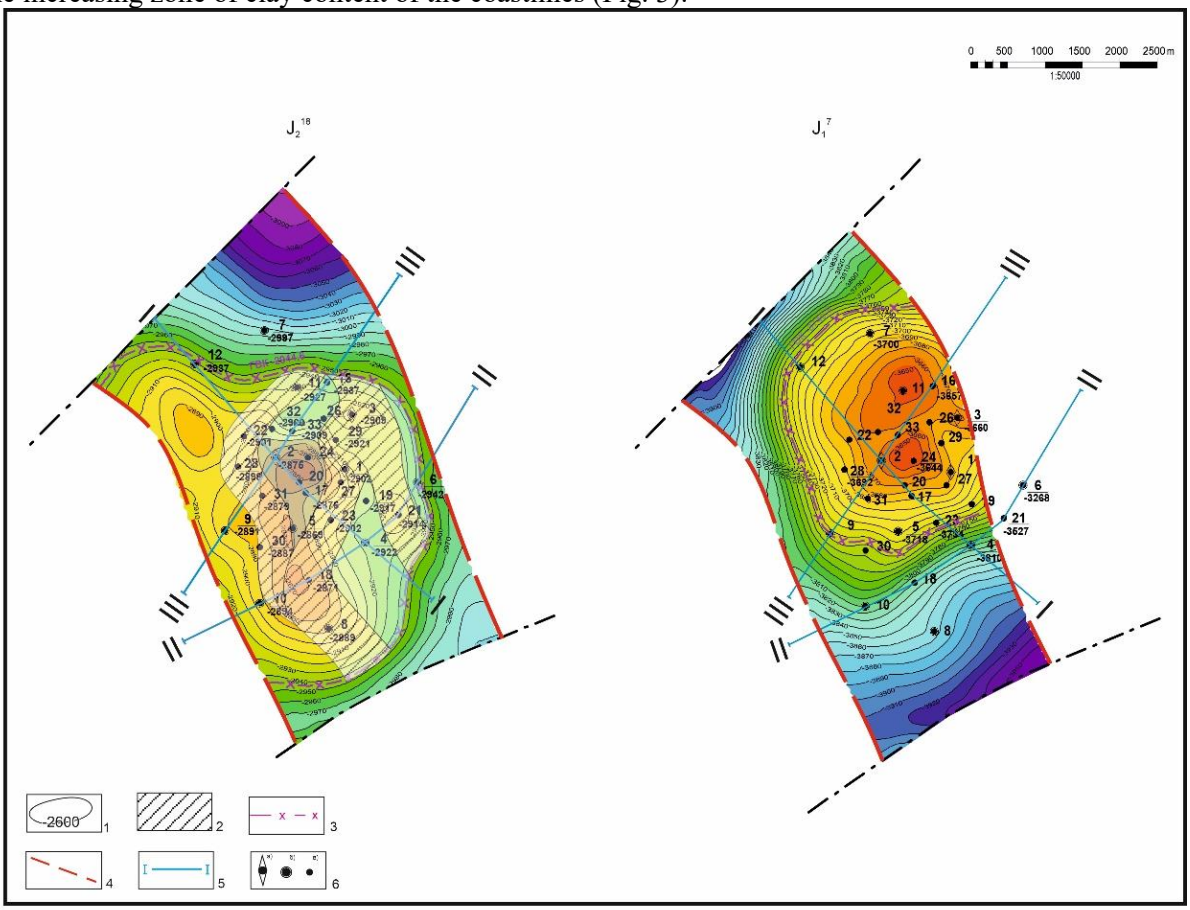

Figure 3: Comparative analysis of calculation plans for productive layers of the Lower Jurassic and Middle Jurassic sediments (compiled by: Djuraeva Z.S., Khaidarova K.R., 2022).
1 - isohypses of the roof of the horizon indicated in the map title; 2 - zone of absence of collectors; 3 - GWC circuit; 4 - fault; 5 - lines of geological profiles; 6 - a) prospecting wells, b) exploration wells, c) production wells.

Changes in the width of the channel occur throughout the Middle Jurassic period, by the middle of which the river overflows again and the banks recede. The channel narrows again and the eastern part of the coastline is exposed by the end of the Middle Jurassic (Fig. 4).

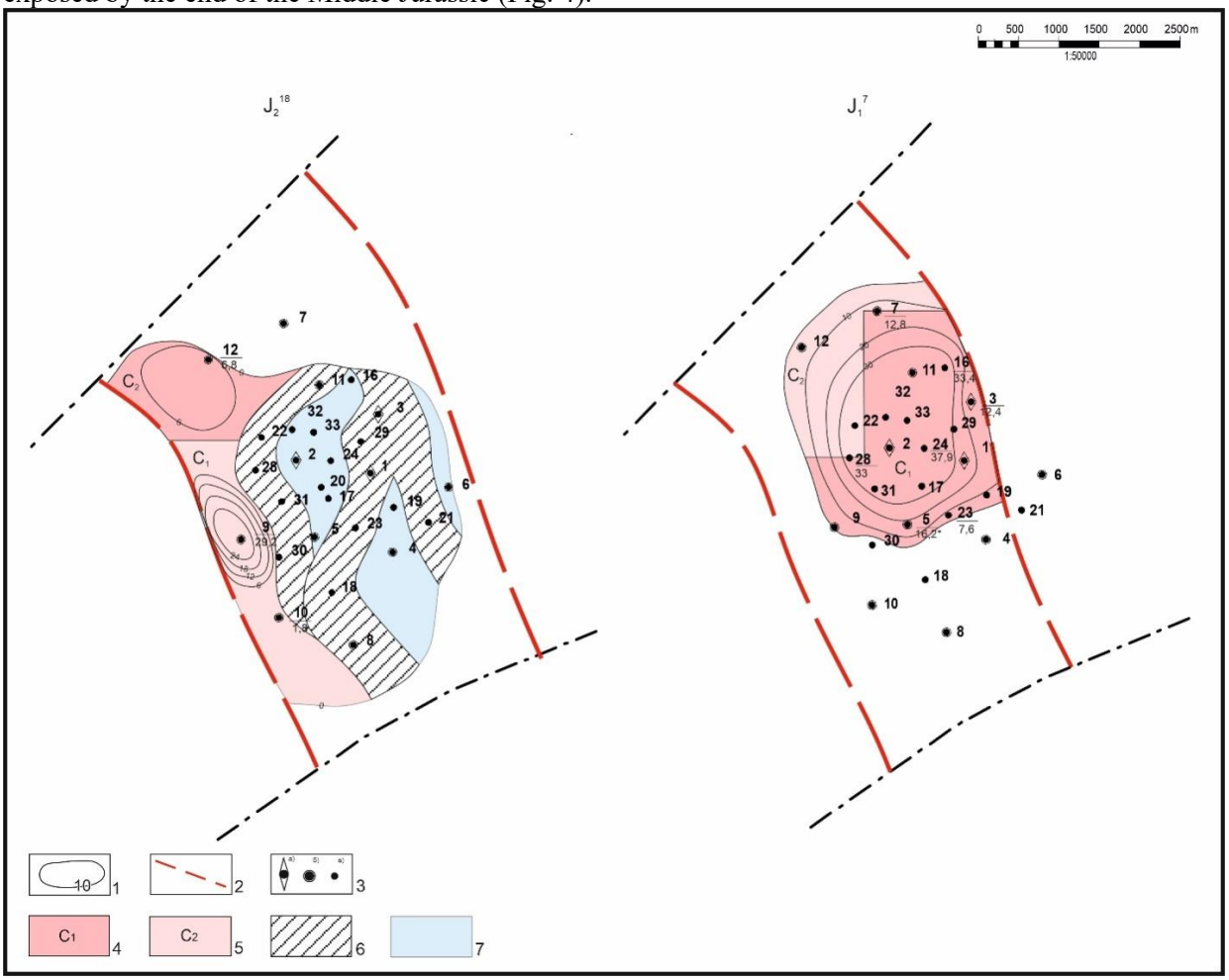

Figure 4: Comparative analysis of changes in reservoir properties in the Lower Jurassic and Middle Jurassic sediments (compiled by: Djuraeva Z.S., Khaidarova K.R., 2022).
1 - equal effective gas-saturated thickness of the productive horizon indicated in the map title; 2 - fault; 3 - a) prospecting wells, b) exploration wells, c) production wells; 4 - field for calculating hydrocarbon reserves of category C1; 5 - field for calculating hydrocarbon reserves of category C2; 6- zone of absence of collectors; 7 - zone of degraded reservoir properties.

According to the Lower Jurassic sediments, it was found that the size of the channel varies from 2.4 km to 3.2 km in width, in the Middle Jurassic - the size of the channel from 0.8 km to 3 km in width.
Zoning for 13 estimated objects (productive reservoirs) based on the 3D geological model of the field was carried out. Gas-bearing zones were identified, characterized by their own specifications.
The first zone of reserves categories C1 and C2. It's oil and gas content is based on industrial gas inflows obtained in wells and on positive results of geological and geophysical data in untested wells.
The second zone of the absence of reservoirs, characterized by the presence of clays, or low-pore reservoirs according to the results of well logging data interpretation.
The third zone of degradation of rock's reservoir properties. In contrast to the zone of the absence of collectors, it is characterized by their presence, but with substandard reservoir properties (Pf below the boundary value, 7.8-7.9%). Weak inflows of gas, formation water or no inflow were obtained during testing some wells within the specified zone. It was indicated like a possible lack of hydrodynamic connection with

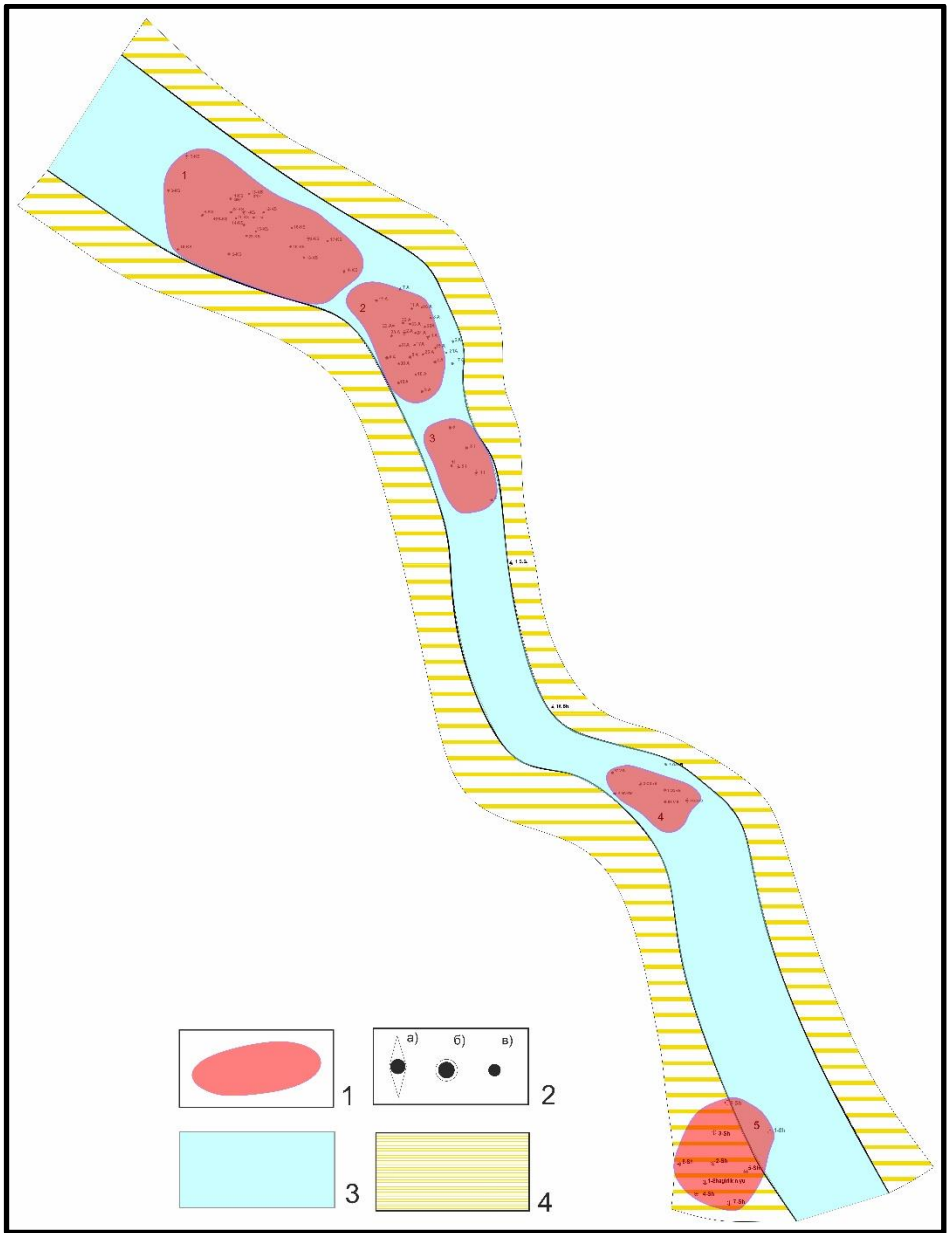

Figure 5: A scheme of the distribution of the paleochannel along the productive formation J_1^7 of the Lower Jurassic sediments. (compiled by: Djuraeva Z.S., 2023).
1 - contour of the fields (1 - Kuyi Surgil, 2 - Arslan, 3 - Inam, 4 - Kuyi Sharky Berdakh, 5 - Shagyrlyk); 2 - a) prospecting wells, b) exploration wells, c) production wells; 3 – paleochannel; 4 - clayey coastline.

the productive part. This zone is not completely unpromising, but it is necessary an additional research to test the missed promising intervals.
These zones help clarifying the geological pattern of sedimentation in the Middle and Lower Jurassic periods. Also they allow us to choose the most optimal placement of production wells in order to test any of the 13 productive formations.
According to the geological model, the high-water period fell on the Lower Jurassic sediments. The presence of pure sandstones practically without clay inclusions, exposed in the lower part of the section is evidenced by that. The cleanest sandstone formation with a large thickness stands out as the productive formation J_1^7.

This sandstone stratum can be traced in almost all nearby deposits (Inam, Kuyi Surgil, West Kuyi Surgil, Kuyi Sharkiy Berdakh), with the exception of the Shagyrlyk field, which is located in the most elevated part on the southeast of the Berdakh-Takhtakair swell of the Sudochy deflection. This stratum was completely replaced by clay sediments as evidenced by well log data. That allows us to make a conclusion about the distribution of this deposit, it's contour and the passing coastline. As a result of the analysis, a clay replacement of this deposit was also established at the Kyzyl-Shaly field, which is located on the southwest of the Inam field and northwest of the Kuyi Sharkiy Berdakh field. It has been seen from the well logging data and allows us to conclude that the paleochannel is sinuate and there is a coastline in the western part of the area (Fig. 5).

CONCLUSIONS

All of the fields are located within the identified paleochannel. This fact is based on that the productive strata are identified in the Lower Jurassic sediments, which are quite confidently correlated with each other and neighboring fields and have reservoir properties similar to the Arslan field. The direction of the paleochannel along the line of the Kuyi Sharkiy Bedakh, Inam, Arslan and Kuyi Surgil deposits has been established. This direction indicates that the paleo-river probably flowed from the southeast (the raised part of the swell) to the northwest (the more submerged part of the swell) and originates in the south.

As a result of applying a new approach to construction a geological model, the Arslan field can be considered a reference for the specified area. In analogies with, it is possible to know about distribution of deposits in neighboring fields with a similar geological structure, such as Kuyi Surgil, Inam, Kuyi Sharkiy Berdakh.

It is possible to determine the placement of wells in certain productive formations more successful, according to the direction of the paleochannel and the change in the coastline. Improving the coefficient of positive results of drilling wells helps increasing gas reserves by involving new productive horizons in the exploration process.

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