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Research Article

GEOLOGICAL AND GEOPHISICAL CHARACTERIZATION OF JURASSIC SEDIMENTS OF THE CENTRAL PART OF THE DENGIZKUL UPLIFT

*** Nodirkhon Abdullaev Kodirkhon ugli[1], Atabaeva Feruza Ravshanovna[2]**
[1]National University of Uzbekistan named after Mirzo Ulugbek
[2]The Abdullayev Institute of Geology and Geophysics
****** *Autor for Correspondence: khon.abdullaev@gmail.com*

ABSTRACT
The article presents a comprehensive geological characterization of the Jurassic sediments of the central part of the Dengizkul uplift, including their structural features and oil and gas prospects. The main geological and geophysical data concerning the formation of Jurassic sediments, their distribution and changes in the structure of the uplift are discussed.

Keywords: *Dengizkul Upflit, Chardzhou Stage, Reflecting Horizon, Terrigenous Jurassic, Carbonate Jurassic, Sediments, Model, Crust, Roof*

INTRODUCTION

For spatial modeling and control of oil and gas field development, it is necessary to know many petrophysical parameters such as porosity, permeability, oil and gas saturation, water saturation, etc. A large number of fields are very complex reservoirs with low filtration-capacitance properties of the reservoirs. In many hydrocarbon reservoirs, the distribution of fluids within the reservoir is tightly controlled by the properties of the reservoir rocks.

A significant contribution to the study of key features of the geological structure, to the identification of patterns of formation and location of oil and gas, as well as to improve the methods of prospecting and exploration work in the Dengizkulupflit and in general in the Bukhara-Khiva region was made by A. M. Akramkhodjaev, A.R. Hodjaev, A.G. Babaev, T.L. Babajanov, Z.S. Ibragimov, B.B. Tal-Valbaev.M. Akramkhodjaev, A.R. Hodjaev, A.G. Babaev, T.L. Babadjanov, Z.S. Ibragimov, B.B. Tal-Virsky, P.U. Akhmedov, A.G. Ibragimov, A.A. Abidov, A.H. Nugmanov, E.Y. Begmetov, A.N. Simonenko, H.H. Mirkamalov and other scientists of Uzbekistan have contributed to this work. L.I. Shulzhenko, S.A. Pak, V.I. Sokolov and many other specialists played an important role in the analysis and generalization of geological and geophysical data, development of geological models of deposits and calculation of their reserves [Radjabov , Atabaev *et. al*., 2010].

MATERIALS AND METHODS

Currently, special attention is paid to the study of petrophysical properties of terrigenous and carbonate rocks. In this context, the study of reservoir properties of rocks in promising areas of Uzbekistan and identification of general regularities of their distribution are of key importance for the development of the oil and gasindustry of the republic.

According to the results of numerous studies in the south-eastern part of Uzbekistan, a wide confinement of gas, gas condensate and oil fields (Khauzak, Shady, Urtabulak, Zevardy, Tegermen, Uzunshor, etc.) to reef massifs developed in the carbonate and terrigenous strata, grouped into several different-age reef systems has been established.

In the interval of the studied part of the Jurassic section, three strata are distinguished, sharply differing from each other both in lithologic composition and formation conditions: terrigenous, carbonate, and salt-anhydrite.

Terrigenous sediments were penetrated in the areas of East Dengizkul by well No.1, Pamuk by well No.1P, Berdikuduk by well No.1 and others. [Radjabov *et al.*, 2010].

Deep drilling of fields is generally characterized by multi-stage drilling. This is due to the fact that each area forming a field was originally envisioned as an independent structure.

Deep drilling was started in 1964 by the parametric well No.1P; the pioneer of the field is the prospecting well (1967). Initially exploration was based on the idea of anticlinal structure of the trap and only from well No.6 - from the position of its reef nature. A total of 21 wells with a total meterage of 52361m were drilled here during 1964-1974.

Exploratory drilling in *the Khauzak area* began in 1967. Well No. 1 was the discoverer of the field, from which commercial gas flow was obtained in 1968. In the process of exploration it turned out that the gas deposit discovered here is the same as the *Khauzak* gas deposit, in connection with which the field was named "*Khauzak*". A total of 18 wells with a total meterage of 48894m were drilled in this area. Earlier (1963-64) within this area was drilled Chashtepa's parametric well with the depth of 2397m, which was liquidated due to technical reasons without opening the Upper Jurassic carbonate section.

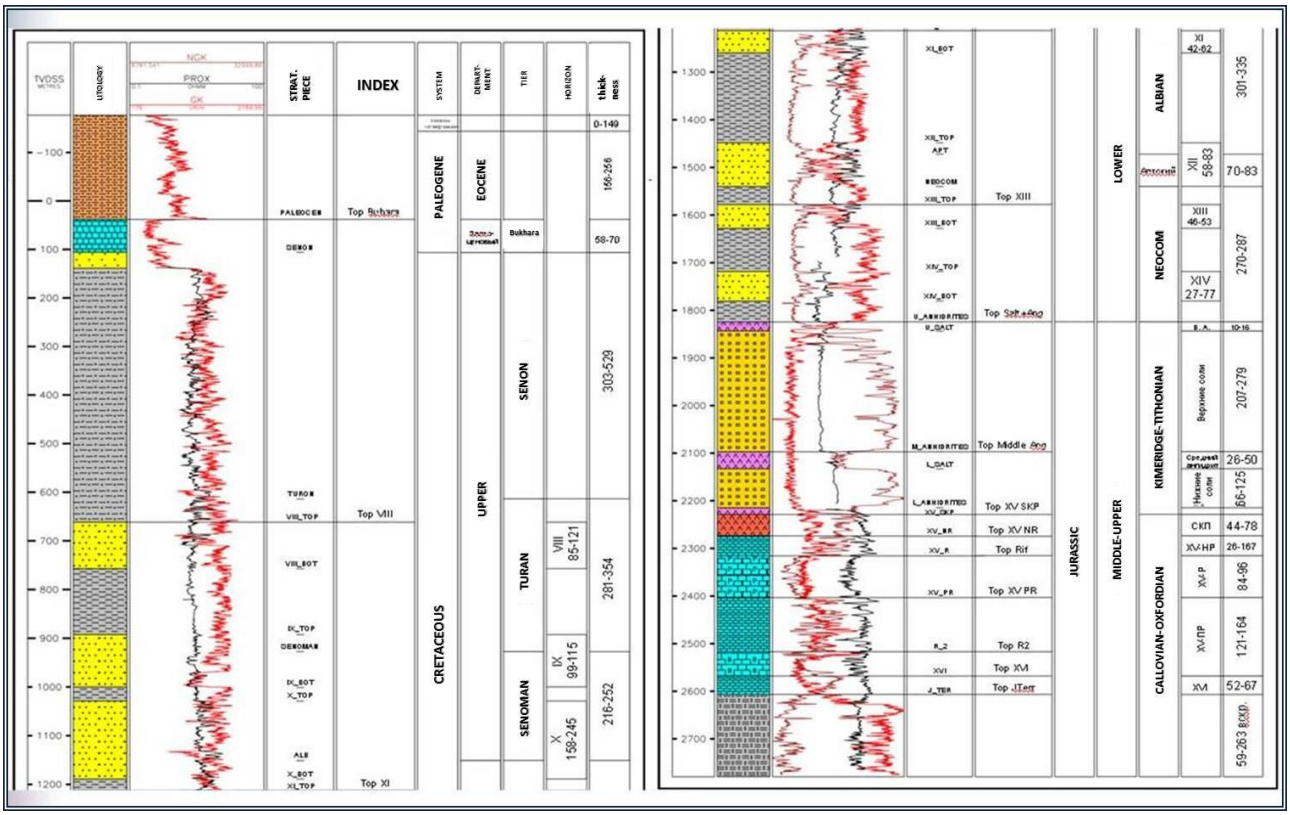

Figure 1. Summary geological and geophysical section of the Khauzak–W.Shady

The *West Shady area* was put into exploratory drilling in 1972. Its commercial productivity was established in 1974 by testing well No. 1. Based on the results of drilling of prospecting (Nos. 1, 2, 3) and exploration (Nos. 4, 5, 6) wells, it was assumed that the *Western Shady area, together with Khauzak and Dengizkul, constituted a single large field* for which gas, condensate and sulfur reserves were estimated in 1975. Exploration drilling continued later in the year.

A total of 9 wells with a total meterage of 24821m were drilled here, but well No. 9 turned out to be within another independent gas deposit confined to the North-West Shady dome. In addition, well No. 1P West Shady with a bottom hole of2900m was drilled in the north-western part. [Babaev *et al.*, 2000].

RESULTS AND DISCUSSION

Jurassic system

Jurassic sediments in the Khauzak and Zap. Shady areas of the Nizhne- Yurskoye field have been penetrated by most exploration and production wells. According to formation conditions and lithologic composition, they are divided into three strata: terrigenous (Lower Middle Jurassic), carbonate (Middle-Upper Jurassic) and salt-anhydrite (Upper Jurassic)

Terrigenous Jurassic

In terms of age, the terrigenous Jurassic sediments are represented by three divisions: Lower, Middle and Upper (Lower Kellovian).

Terrigenous Jurassic sediments of the Khauzak field were penetrated in 13 wells. All wells penetrated only the upper part of the terrigenous strata (the maximum thickness penetrated is 236 m in well 1-Khauzak).

In the neighboring Urtabulak area, where the terrigenous Jurassic was penetrated to its full thickness in well 102, its two-dimensional structure is clearly observed: the lower part is predominantly continental and the upper part is composed mainly of lagoonal-marine formations.

The terrigenous Jurassic continental stratum is represented mainly by mudstones with interlayers of siltstones, sandstones and lignite.

The structure of the upper part of the terrigenous strata is also dominated by terrigenous sediments (clays with interlayers of sandstones and siltstones), with the exception of the upper half of the

The formation, in the section of which interlayers and interlayers of limestones with faunal remains appear.

The thickness of the terrigenous Jurassic in well 102 Urtabulak is 601 m.

Middle Callovian-Oxfordian Stage.

The terrigenous Jurassic sediments are overlain by the carbonate strata, in the section of which, according to the lithological and petrographic and field-geophysical characterization, there are clearly distinguished 4 packs (from bottom to top): XVI, XV-PR (subreef), XV-R (reef) and XV-NR (suprareef) horizons.

These horizons are separated according to the stratigraphic principle. Thus, for example, the XV-P horizon includes not only reefogenic formations, but also their age analogs.

The XVI horizon is a reference horizon and can be traced everywhere without significant changes in thickness and material composition. The rocks composing the XVI horizon section are of deep-water genesis and are represented by dark gray dense clayey limestones of aphanitic structure with a characteristic plate structure ("brickwork") with detritus inclusions. Horizon thickness varies from 45 m to 67 m in all section types.

The XV-a horizon consists of algal, lumpy and aphonitic limestones that accumulated mainly in the shallow conditions of the open sea shelf. Deposits of this horizon are widespread and the total thickness is relatively constant in all section types, ranging from 37 to 45 m.

XV-PR horizon - in fishing practice is allocated as: directly under the reef structures, and outside them. In the latter case its stratigraphic equivalent is meant. In terms of thickness it is maintained in all types of sections. In terms of material composition, the rocks of the XV-PP horizon differ in these zones.

In the reef-type zone of the section (area of wells Nos. 7, 9 and 17 Khauzak), this horizon is composed of dark-gray, dense, strong limestones with rare interlayers of porous varieties. The limestones are mainly of aphanitic structure, with rare interlayers of detritus structure and isolated interlayers of algal varieties.

In the zone of the interreef (lagoonal) facies, the section of the XV-PP horizon is composed of aphanitic limestones, dense, strong with interlayers and lenses of algal and lumpy limestones in the lower part; in the upper part, aphanitic limestones are replaced by dolomites and dolomitized limestones of lumpy-aphanitic and aphanitic structure.

In the zone of a single (patchwork) reef (area of well 305), the section of the XV-PP horizon is composed of dark-gray, dense, porous, weakly clayey, weakly fractured, strong, massive limestones.

The thickness of the XV-PR horizon throughout the Khauzak-West Shady section varies in the range 85-

122 m.
XV-R horizon. On the territory under consideration in the area of wells Nos. 7,9, 17 of the Khauzak area an organogenic structure with thickness of the reef horizon according to well data from 84 to 96 m is traced. (S.A. Pak et al., 1996). Based on thehistory of organogenic structures development, the zone of reef plume facies spreading up to 50 m thick in the upper part of the subreef complex is distinguished here, takinginto account which the reef structure height is estimated at 120 m. The latter developedslower in this area than in the eastern (barrier reef) area due to slower rate of deflection, which determined its lower height, in contrast to the eastern organogenic structure, which is a fragment of the barrier reef system traced from the Dzharkuduk area in the southwestern spurs of the Andjed Ridge.
The XV-P horizon here is composed of massive limestones and dolomites, gray, light gray, porous-cavernous, weakly cemented. The limestones are algal, lumpy-algal with inclusions of organic remains in the form of coral fragments. Horizon thickness inthe first zone varies from 84 to 96 m.
In the interreef (lagoonal) zone, the section of the XV-P horizon (analog of the reef) is composed of gray organogenic-clastic, cavernously porous limestones with imprints of organic detritus. The thickness of the horizon varies from 61 to 76 m.
In the zone of the solitary reef, the section of the XV-P horizon is composed of light gray limestones, highly porous, friable, fractured with inclusions of organic remains. Its thickness varies from 86 to 97 m.
The XV-HP horizon is generally characterized by a layered structure and represents the thickness of the reef massif compensation from the rear side, stratigraphically contiguous with it all the way from the western boundary to the crestof the barrier reef.
Such genetic contiguity of reef facies with the XV-HP horizon deposits predetermined a regular increase in the thickness of the latter from zero value on the crest of the barrier reef (Khauzak section) in the western direction to m112 in thezone of its junction with the Khauzak reef structure (area of well No. 9 Khauzak). In the zone of interreef (lagoonal) facies development the horizon thickness increases to
134 m (Khauzak well No. 12) with its subsequent decrease in the zone of "patchwork" reef development to 114 m (area of well No. 305).
The XV-NP horizon section is divided into two parts: the lower part (the supracrustal part proper) and the upper part, where the sulfate-carbonate sequence (SCS) is distinguished.
The lower part of the XV-NP horizon section, which lies on the XV-P horizon, is composed mainly of lumpy, aphanitic algal limestones with interlayers of clastic
and oolitic varieties. The thickness in the reef type of the section reaches 72 m at the Khauzak section and 65 m at the section of well No. 305 in Zap. Shady, increasing to 89 m in the interreef zone.
The upper part of the section of the XV-NP horizon is composed predominantly of aphanitic limestones interbedded with anhydrite. The presence of this sequence in the section indicates that by the time of its accumulation a barrierreef had formed, as a result of which a vast zone of shallow shelf was laced from the open sea by a reef ridge (breakwater) and turned into a periodically saline lagoon. The thickness of the SCS varies from 43 to 59 m.
Kimeridge-Titonian Stage
The section of Jurassic sediments ends with a thickness of chemogenic sediments of Kimeridge-Titonian age. In the area under consideration, these sediments are mainly characterized by a five-membered structure. In field practice, lower anhydrites, lower salts, middle (intermediate) anhydrites, upper salts and upper (cover) anhydrites are distinguished (from bottom to top).
Lower anhydrites occur on limestones and are represented by dark to light gray varieties. The anhydrites are dense, strong, weakly fractured. Their thickness varies from 7 to 14 m.
Lower anhydrite is overlain by lower salts. The salts are white, gray, crystalline, transparent with inclusions and thin interlayers of anhydrite. The thickness ranges from 66 to 128 m.
Above are medium anhydrites interlayered with salts. Their thickness varies from 26 to 50 m.
A thick thickness of upper salts is fixed on the middle anhydrites. The salts are transparent, crystalline, in the upper part of the section with inclusions of red-colored clayey material, with interlayers of anhydrite.

The thickness of this stratum is 207- 239 m.
The section of the Kimeridge-Titon is crowned by a rock unit represented by light gray anhydrite with abundant inclusions of reddish-brown clay, which is why it was attributed to the Neocomian at the early stage of geological exploration. The thickness of this pack is 10-16 m.

CONCLUSION

The identified oil and gas deposits at these fields are localized within the Upper Jurassic carbonate and Middle Jurassic terrigenous formations, which determines the high potential of the structures of this area and adjacent territories for the search for new accumulations of oil and gas. The perspectivity of oil and gas -bearing Upper Jurassic carbonate formations and terrigenous sediments of Middle Jurassic age is confirmed by available forecasts. In addition, the possibility of discovering oil and gas deposits in Paleozoic basement rocks is being considered.
Nevertheless, at present and in the foreseeable future the main attention is paid to the study of carbonate and terrigenous formations of the Jurassic, which makes the study of their structural characteristics a priority task of geological exploration.

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