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LITHOLOGICAL AND STRATIGRAPHIC CHARACTERISTICS AND CONDITIONS OF SEDIMENTATION OF JURASSIC SEDIMENTS OF THE WESTERN PART OF THE KANDYM UPLIFT OF THE BUKHARA-KHIVA REGION

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ABSTRACT
This article presents the results of work on the study of Jurassic sediments, determination of stratigraphic breakdowns, clarification of the capacity and oil and gas content of the horizons of Jurassic sediments of the western part of the Kandym uplift and adjacent territories. The author analyzes the actual data on the existing deposits of this territory and evaluates the characteristics of the productive horizons of already discovered hydrocarbon deposits. Information is provided on the results of drilling at these fields, on productive horizons, and their lithological characteristics.

Keywords: *Field, Hydrocarbon, Stratigraphy, Lithology, Horizon, Drilling Knowledge, Seismic Exploration, Reservoirs, Well Logging, Deposit, Logging, Diagram*

INTRODUCTION
At present, the main task of geological exploration in the world is to provide industry with stable energy resources. The oil and gas industry is an integral part of the economy of the Republic of Uzbekistan. Basically, exploration work to search for hydrocarbon (HC) deposits was carried out in the Bukhara-Khiva, Ferghana, Surkhandarya, South-West-Gissar and Ustyurt regions. The main direction of exploration for oil and gas deposits within the Bukhara-Khiva region are Cretaceous and Jurassic deposits, which are associated with almost all open accumulations of hydrocarbons (Abdullaev *et al.*, 2015)
Geological research to search for hydrocarbon deposits in the territory of the Bukhara-Khiva region (BHR) began in 1929. In 1936, exploratory and structural drilling began in the study area. The studies were carried out in different years by many famous geologists (Sotiriadi, S.I. Ilyin, O.S. Vyalov, P.I. Mikhailitsky, A.G. Babaev, etc.).
Since 1945, mainly regional geophysical studies have been carried out aimed at studying the deep structure using magnetometric, gravimetric, electrical and seismic methods. As a result, general ideas about the tectonic structure of the region were obtained and the possibilities of various methods were clarified (Abdullaev *et al.*, 2015).
The geological structure and prospects for hydrocarbons of the Jurassic terrigenous formation of the Bukhara-Khiva region, as well as the Kandym uplift, were the object of research by such scientists as G.S. Abdullaev, A.A. Abidov, A.A. Akramkhodzhaev, A.M. Akramkhodzhaev, V.P. Alekseev, K.A. Alimov, E.I. Arnautov, P.U. Akhmedov, A.G. Babaev, T.L. Babadzhanov, R.A. Gabrielyan, Sh.D. Davlyatov, F.G. Dolgopolov, G.B. Evseeva, I.V. Eremenko, E.N. Zhdanova, Ya.Kh. Iminova, O.A. Karshiev, I.A. Krylov, H.Kh. Mirkamalov, A.K. Maltseva, A.Kh. Nugmanov, V.V. Rubo, L.I. Rubo, Yu.M. Sadykov, S.K. Salyamov, B.K. Safonov, L.N. Safonova, A.N. Simonenko, S.G. Sitdikov, G.S. Solopov, K.A. Sotiriadi, D.B. Sultanova, B.B. Tal-Virsky, V.I. Troitsky, U.Kh. Khakimov, L.S. Khachieva, B.S. Khikmatullaev, L.G. Cherkashina, M.E. Egamberdiev and others. One of the most important results was the discovery of such gas condensate fields as Khakkul, Northern Syuzma, Khodjikazgan, Atamurad, which for the first time proved the commercial gas potential of the Jurassic carbonate and terrigenous formations within the Kandym uplift.

MATERIALS AND METHODS

As a result of geological prospecting work, more than 170 oil, gas and gas condensate fields have been discovered in the Bukhara-khiva region (BKhR) to date, and the regional oil and gas potential of subsalt Jurassic rock complexes has been established.

To date, a large amount of drilling work has been carried out on the territory of the (BKhR) at various depths and sedimentary complexes.

The development of the Chardjou stage by deep drilling in order to study the deep structure, the prospects for the oil and gas potential of the section and the search for commercial accumulations of hydrocarbons began in the late fifties. Systematic study of the territory by deep drilling on a large scale began to be carried out after the discovery of a number of gas fields: Urtabulak, Kultak, Zevardy, etc. Deep parametric and exploration drilling for oil and gas in the northwestern part of the Chardzhou stage began in the early sixties at the Dayakhatyn, Kulbeshkak, Uchburgan and other fields. Over the past period, such fields as Kandym, Akkum, Parsankul, Khodzhi, Western Khoja, Khakkul, Garbiy Hakkul, Chakkakum, Andakli, Kuvachi-Alat, Kumli, Tailak, etc. (Abdullaev and Dolgopolov, 2016).

As of January 1, 2022, deep exploration and parametric drilling in the northwestern part of the Chardjou stage was carried out in more than 32 areas. In total, 184 deep wells have been drilled, of which 3 are parametric, 83 are prospecting and 98 are exploration. Of the total number of deep wells drilled, 45% are exploratory, 53% are exploration, and 2% are parametric.

In 29 areas, 111 wells penetrated terrigenous Jurassic deposits, of which 49 wells penetrated the full thickness of terrigenous Jurassic deposits, the remaining wells partially penetrated the thickness of terrigenous Jurassic deposits. Of the total number of deep wells drilled, 27% were wells that penetrated the full thickness of the Jurassic terrigenous formation, 39% were wells that partially penetrated, 34% were not penetrated the Jurassic terrigenous formation.

DISCUSSION

The rocks of the Paleozoic, Mesozoic and Cenozoic ages take part in the geological structure on the territory of the western part of the Kandym uplift.

<u>Paleozoic group (Pz).</u> In this area, Paleozoic deposits were discovered at the Dayakhatyn (wells No. 1, 7, 50), Kulbeshkak (well No. 1p), Khodzhikazgan (well No. 8), Atamurad (well No. 1), Akkum (well No. No. 1p, 2), Khakkul (well No. 1, 2, 3), North Syuzma (well No. 1, 2, 3, 5, 6), S. Dayakhatyn (well No. 1p), South .Kulbeshkak (well No. 1p), Chorikul (well No. 1), Garb.Khakkul (well No. 1, 2) where they are represented by volcanomictic sandstone, greenish-gray, partially metamorphosed. The rock consists of unevenly sorted and loosely packed clastic material, represented by the bulk of effusives of medium and basic compositions (Abdullaev and Evseeva 2014).

<u>Mesozoic group (Mg).</u> Mesozoic deposits with angular and stratigraphic unconformity lie on the dislocated surface of Paleozoic deposits and are represented by rocks of the Jurassic and Cretaceous systems.

<u>Jurassic system.</u> The deposits of the Jurassic system, according to their lithological features and paragenesis, are divided into three strata corresponding to the formations. From bottom to top along the section, terrigenous, carbonate and hydrochloric-anhydrite formations are distinguished, which are represented by two sections, respectively, lower + middle and upper (Akramkhodzhaev, 1971).

<u>Lower Middle Jurassic department.</u> Sediments of the terrigenous sequence with stratigraphic and angular unconformity overlie Paleozoic deposits.

The stratification of the considered sequence was mainly carried out according to the spore-pollen complex and flora remains, which have a wide range of development time.

Core research. In terms of age, the composition of the terrigenous sequence includes sediments of the Bajocian-Bathonian stage of the Lower Middle Jurassic.

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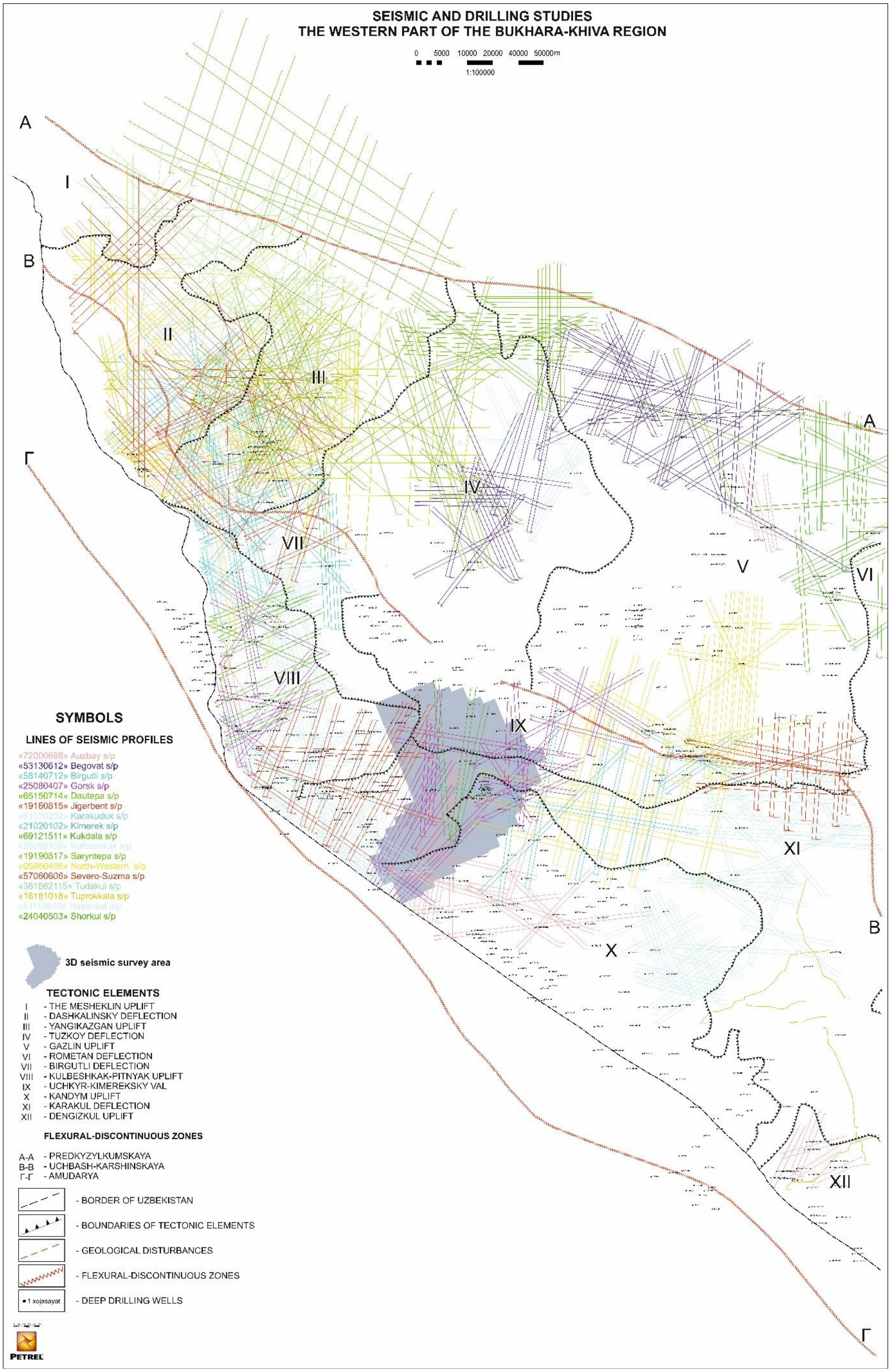

Pic.1. Map of seismic and drilling knowledge of the western parts of the Bukhara-Khiva region.

Bajocian-Bathonian stage. Horizons XIX, XVIII and XVII are distinguished in the section. Sediments of the terrigenous strata are uncovered at full thickness at the deposits of Khodzhikazgan, Kulbeshkak, Dayakhatyn, Khakkul, Garbiy Khakkul, Atamurad, Savatli, Chorikul, etc. (Nugmanov, 2009)

Horizon XIX is represented by interbedding of dark gray, greenish gray, inequigranular, clayey sandstones and layers of gray, dark gray, almost black siltstones and clays. In the study area, the thickness of this horizon varies from 50 to 170 m.

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The main emphasis in the correlation of the horizons of the Lower Middle Jurassic deposits is made on a comparison of their field and geophysical characteristics, the results

Horizon XVIII is represented by intercalation of sandstones and siltstones. Siltstones are gray, dark gray, inequigranular with abundant admixture of organic matter.

Sandstones are gray, dark gray, fine and medium-grained, silty, polymictic with clay-carbonate cement.

The rock is composed of clastic material 70-80% and cementing mass 20-25%. The clastic material is dominated by quartz 1%. In the study area, the thickness of the horizon ranges from 40 to 230 m (Nugmanov, 2009).

Horizon XVII is composed of interbedded clays, siltstones, and sandstones. Siltstones are gray, dark gray, inequigranular with clay interbeds. Sandstones are polymictic, fine-grained, silty, on clay-carbonate cement with an admixture of organic matter, dolomitic, silicified, pyritized. In this area, the thickness of the horizon varies from 30 to 150 m.

In general, the thickness of Jurassic terrigenous deposits in the study area ranges from 100 m to 600 m.

Callovian stage. The middle section of the Jurassic system in this region (from bottom to top along the section) is represented by a carbonate formation, which corresponds to a dissected Callovian stage (XVI and XV-a horizons).

The terrigenous deposits conformably overlie a thick carbonate stratum, consisting of various types of limestones and having a widespread distribution.

Horizon XVI is represented mainly by dark gray, dense limestones, porous and fractured in some areas, slightly clayey in some areas. In this region, the thickness of the horizon varies from 40 to 100 m.

XV-a horizon is represented by gray, light gray, white, porous limestones with an admixture of clay and organic matter, calcitized and pyritized. The thickness of the horizon is from 20 to 50 m.

The upper part of the Jurassic system in this region (from bottom to top along the section) is represented by carbonate and salt-anhydrite formations, which correspond to the undivided Oxfordian-Kimmeridgian and Tithonian stages.

The Oxfordian-Kimmeridgian stage is represented by XV-1, XV-2, XV-3 horizons.

Horizon XV-3 is represented by light gray, hard, clayey limestones. In this area, the thickness of the horizon is from 20 to 120 m.

Horizon XV-2 lies in the middle part of the carbonate sequence and is composed of weakly cemented gray and dark gray limestones, porous in areas, with remains of fauna and flora. The upper part of the horizon is represented by gas-saturated limestones. The thickness of the horizon varies from 25 to 65 m.

Horizon XV-1 is located at the top of the Oxfordian-Kimmeridgian deposits, and is represented by gray, dark gray, fractured limestones. The thickness of the horizon varies from 20 to 50 m.

Tithonian stage. The section of the Jurassic complex ends with Tithonian deposits represented by a hydrochloric anhydrite sequence. In this region, they are not developed everywhere, they have a small thickness in comparison with other regions of the Chardjou stage.

1. The lower member of anhydrites is developed over most of the territory under consideration. Anhydrites are milky white in color with veins of calcareous clay material. The thickness of anhydrites in the study area varies within a small range from -10 to 30 m. Lower anhydrites are covered by a layer of lower salts, which has a white, pink and whitish-pink color. In its structure, along with rock salt, layers of anhydrite up to 10-15 m thick take part, the thickness of the salts varies from 20 to 40 m. The overlying medium anhydrites have a thickness of 10 to 20 m. The color of the rocks is white, sometimes smoky.

The thickness of the upper salts lies on the middle anhydrites. Its material composition differs from the lower sequence of halite by some increase in the number of interlayers of terrigenous red-colored rocks and anhydrites. The section of the salt-anhydrite formation is crowned with a pack of anhydrites (upper anhydrites), light gray with a pinkish tinge, massive, strong, dense (Nugmanov and Shoimuratov 2007).

Chalk system. Cretaceous deposits are represented by the lower and upper sections and lie with stratigraphic unconformity on the Upper Jurassic deposits. The total thickness of Cretaceous deposits in the study area varies from 1400 to 1800 m. Neocomian superstage, Aptian and Albian stages. They are represented by continental and lagoon-marine formations.

The Neocomian superstage is composed of rock units of different lithological composition. The XIV, XIII commercial horizons are distinguished in the section. The Neocomian deposits overlie the Tithonian hydrochloric anhydrite sequence. They are represented by intercalation of clays, siltstones and sandstones. In the bottom part of the section, there is a pack of brick-red, dense clays with interlayers of siltstones.

Horizon XIV is represented by brown, medium-grained, dense sandstones with interlayers of clays. Above the section, there is a member of dark gray, brown, dense clays and siltstones, which separates horizon XIII from horizon XIV.

Horizon XIII is represented by gray, brown sandstones, fine- and medium-grained, with interlayers of dark gray brown clays.

The Aptian Stage conformably rests on Neocomian clays. The XII permeable horizon is distinguished in the Aptian stage.

Horizon XII is represented by gray sandstones with a greenish tint, quartz-glauconite, with interlayers of gray, dense clays.

The Albian Stage rests on the Aptian sandstones and is lithologically represented by clays and sandstones. The clays are gray, dense with interlayers of gray, fine-grained, clayey sandstones. Above the section lies a member of rocks of the XI permeable horizon.

Horizon XI is represented by gray, dark gray, fine- and medium-grained, quartz-glauconite sandstones with clay interlayers.

The Upper Cretaceous deposits are subdivided into the Cenomanian, Turonian stages and the undivided Senonian superstage.

Table 1: Refinement breakdowns of Jurassic terrigenous deposits (on the example of gas condensate field Shortak)

Name		**Shortak**							
Well No.		**1**		**2**		**3**		**4**	
Altitude		**183**		**182**		**185.4**		**184.8**	
		depth, m	**h, м**	**depth, m**	**h, м**	**depth, m**	**h, м**	**depth, m**	**h, м**
1	2	3	4	5	6	7	8	9	10
Neogene-Quaternary – N+Q	top	0	120	0	306	0	336	0	190
	bottom	120		306		336		190	
Paleogene – P	top	120	160	306	67	336	74	190	32
	bottom	280		373		410		222	
Chalky – К	top	280	1584	373	1497	410	1516	222	1660
	bottom	1864		1870		1926		1882	
Upper Chalk – К$_2$	top	280	872	373	809	410	930	222	1032
	bottom	1152		1182		1340		1254	
Senon	top	280	360	373	285	410	284	222	508

	bottom	640		658		694		730	
Thuron	top	640	196	658	316	694	316	730	330
	bottom	836		974		1010		1060	
Cenomanian	top	836	316	974	208	1010	330	1060	194
	bottom	1152		1182		1340		1254	
Lower Chalk – $К_1$	top	1152	712	1182	688	1340	586	1254	628
	bottom	1864		1870		1926		1882	
Alb	top	1152	326	1182	306	1340	168	1254	280
	bottom	1478		1488		1508		1534	
Apt	top	1478	98	1488	102	1508	112	1534	96
	bottom	1576		1590		1620		1630	
Neocom	top	1576	288	1590	280	1620	306	1630	252
	bottom	1864		1870		1926		1882	
Jurassic – J	top	1864	886	1870	930	1926	876	1882	860
	bottom	2750		2800		2802		2742	
Titon	top	1864	104	1870	96	1926	76	1882	78
	bottom	1968		1966		2002		1960	
Upper Jurassic – J_3^{o+km}	top	1968	192	1966	189	2002	190	1960	193
	bottom	2160		2155		2192		2153	
XV-1	top	1968	33	1966	33	2002	33	1960	33
	bottom	2001		1999		2035		1993	
XV-2	top	2009	73	2008	70	2043	73	2002	70
	bottom	2082		2078		2116		2072	
XV-3	top	2118	42	2113	42	2150	42	2109	44
	bottom	2160		2155		2192		2153	
Middle Jurassic – $J_2^{kl+bat+by}$	top	2160	590	2155	645	2192	610	2153	589
	bottom	2750		2800		2802		2742	
XV-a	top	2160	32	2155	33	2192	30	2153	27
	bottom	2192		2188		2222		2180	
XVI	top	2282	51	2278	47	2313	49	2275	50
	bottom	2333		2325		2362		2325	
XVII-2	top	2405	12	2400	13	2432	7	2398	15
	bottom	2417		2413		2439		2413	
XVIII-1	top	2490	32	2491	27	2521	26	2490	26
	bottom	2522		2518		2547		2516	
XVIII-2	top	2546	30	2552	33	2557	65	2546	61
	bottom	2576		2585		2622		2607	
XVIII-3	top	2605	30	2608	32	2644	37	2618	26
	bottom	2635		2640		2681		2644	
XIX	top	2708	42	2689	41	2748	52	2714	28
	bottom	2750		2730		2800		2742*	
Paleozoic - PZ	top	-		-		-		-	
	bottom	-		-		-		-	
Slaughter:		2750 м		2800 м		2802 м		2742 м	

Lower Cretaceous. The deposits of the Lower Cretaceous age according to lithological features and paleontological definitions are divided into the following:

The Cenomanian stage is represented by alternating sandstones, siltstones, and clays. In the section of the Cenomanian stage, X and IX permeable horizons are distinguished.

X horizon is located at the base of the Cenomanian and is represented by gray, inequigranular, quartz-micaceous, glauconite, calcareous sandstones with interlayers of gray, dark gray, dense clays.

IX horizon. The Cenomanian section ends with horizon IX, which is represented by gray, dark gray, quartz-micaceous sandstones, with interlayers of gray, dense clays.

The Turonian stage conformably rests on the Cenomanian sandstones. At the base of the stage lie greenish-gray lamellar clays with interlayers of gray, fine-grained, clayey sandstones. The VIII permeable horizon is distinguished in the upper part of the Turonian deposits.

Horizon VIII is represented by gray, fine- and medium-grained, quartz-glauconite sandstones with clay interbeds. The top of the Turonian stage is composed of alternating sandy clays with interlayers of gray and greenish-gray clayey siltstones (Khozhiev, 2019).

The Senonian superstage conformably overlies the Turonian deposits and is represented by intercalation of sandstones, siltstones, and clays. Clays are gray, greenish-gray, micaceous, variegated. Sandstones and siltstones are gray, greenish-gray, bluish-gray, micaceous.

Cenozoic group (Cg). In the Cenozoic section, two formations are distinguished, expressed by marine and continental facies, corresponding to Paleogene, Neogene and Anthropogenic deposits.

Paleogene deposits are subdivided into a number of packs with a clear lithological characteristic. These members within the study area are subdivided into the Paleocene and Eocene according to the complexes of microfauna and macrofauna contained in them.

The Paleocene deposits in the study area are represented by formations of the Bukhara layers, which lie with erosion on the Senon deposits and are represented by gray, light gray, strong, porous, cavernous, fractured, gypsum limestones, with rare thin gypsum interlayers.

The Eocene sediments are gray, greenish-gray, quartz-glauconite clays interbedded with sandstones. In the upper part of the section, light gray with a brown tint, micaceous, dense, massive marls occur. The top of the Eocene is represented by gray, greenish-gray, dense, weakly calcareous, micaceous clays (Khozhiev, 2017; and Khozhiev, 2019).

Neogene deposits with angular unconformity occur in the Upper Eocene and are often intercalated red sandstones, siltstones, and clays. Neogene deposits are overlain by Anthropogenic rocks, which are represented by loams and brownish-yellowish-gray sands.

CONCLUSION

Information about the structure of the Paleozoic deposits was obtained from the study of natural outcrops within the mountain frame, as well as from the data of drilling a small number of wells that exposed rocks of this age to an insignificant thickness.

The lithological description of the rocks is given on the basis of well logs of deep parametric, prospecting and exploration wells obtained by borehole geophysical surveys involving seismic survey data that correct the depths of the main reference horizons, which are taken as reference.

The most promising deposits within the Kandy uplift are Oxford-Kimmeridgian limestones, where oil and gas deposits are confined to anticline traps and reef masses. Highly promising are the zones of regional deep faults, where the carbonate formations of the Oxfordian-Kimmeridgian have increased fracturing, which contribute to the formation of large accumulations of oil and gas. The next in terms of oil and gas prospects is the Lower-Middle Jurassic complex with numerous sandstone reservoirs.

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