DX.DOI.ORG//10.19199/2023.170.1121-9041.05

Reservoir characteristics of jurassic terrigenous deposits in the Kandym Uplift, Bukhara-Khiva Region: an in-depth analysis (in Uzbekistan)

Raffaele Romagnoli*
Yusufjon Kumakov*
Isroil Holmurodov**
Akbar Elomonov**

* Polytechnical University of Turin
** Institute of Geology and Exploration of Oil and Gas Fields

Corresponding author:
yusufjon.kumakov@studenti.polito.it

This article focuses on the evaluation of the oil and gas potential and the investigation of reservoir properties within the terrigenous horizons of the Middle and Lower Jurassic deposits located in the Kandym uplift of the Bukhara-Khiva region. The assessment methodology presented in this study is based on the analysis of geophysical well logging data curves. The authors conducted an analysis using real data obtained from existing fields in the region to evaluate the characteristics of productive horizons. The article provides information on drilling results in these fields, the productive horizons encountered, and their lithological properties. The research findings lead to several significant conclusions that should be considered when planning future geological exploration activities. The authors recommend directing exploration efforts towards the Middle-Upper Jurassic deposits, with particular emphasis on the detailed study of productive horizons XVII, XVIII, and XIX, as they exhibit the most promising prospects.

***Keywords**: field, clay reservoirs, hydrocarbon, sand reservoirs, geophysical well logging data, deposit, oil, gas, horizon, structure, fold, uplift.*

1. Introduction

Located in the southwestern part of the Kyzyl-Kum desert, on the right bank of the Amu Darya River, the Kandym uplift holds significant industrial oil and gas potential within its Jurassic deposits, a fact that has been recognized for over 50 years. Extensive geological and geophysical data have been diligently collected over the years, resulting in a wealth of reliable information on the lithological composition, stratigraphy, tectonics, and reservoir properties of the rocks in the region. Multiple exploration and research activities have contributed to this knowledge.

The geological structure, reservoir properties, and potential hydrocarbons in the Jurassic terrigenous formation of the Bukhara-Khiva region, including the Kandym uplift, have been the focus of research by notable scientists such as A.M. Akramkhodzhaev [1,2], A.A. Abidov [3], G.S. Abdullaev [4,5,6,7], V.P. Alexeev [8], A.G. Babaev [9], T.L. Babadzhanov [10,11], R.A. Gabrielyan [12,13], Sh.D. Davlyatov [14], G.B. Evseeva [15], O.A. Karshiev [16], Kh.Kh. Mirkamalov [17], A.Kh. Nugmanov [18-19], L.I. Rubo [20], B.B. Sadykov [20], B.K. Safonov [21], S.G. Sitdikov [22], B.B. Tal-Virsky [23], V.I. Troitsky [24], B.I. Khozhiev [25-26] and others. Their contributions have been crucial in advancing the understanding of the region's geology and hydrocarbon potential, shaping the direction of future geological studies.

Systematic seismic exploration work within the Bukhara-Khiva region began in the 1950s, employing various techniques such as explosive sources, refracted-reflected waves (CRW), and reflected waves (RW). These methods effectively addressed both regional (CRW) and exploration (RW) objectives. By meticulously interpreting seismic exploration data and combining them with insights from deep drilling, the first schemes of tectonic zoning for the sediments covering the territories of Uzbekistan were developed. Additionally, this integrated approach facilitated the identification of numerous local anticlinal structures, primed for subsequent deep drilling campaigns in the Lower Cretaceous and Upper Jurassic deposits, ultimately leading to the discovery of several fruitful oil and gas fields.

Seismic exploration remains the primary method for identifying potential areas for exploration drilling, as depicted in Figure 1. Tectonically, the Kandym uplift occupies the northwestern part of the Chardzhou steppe, situated on the northeastern edge of the Amu Darya syncline. This syncline is recognized as one of the largest tectonic elements of the epigercinian Turan platform [25]. The impressive potential of the Kandym uplift's terrigenous formation is underscored by the discovery of multiple gas-condensate deposits, such as Garbiy Hakkul [27],

If there are references to colour figures in the text, the articles are available in open-access mode on the site www.geam-journal.org

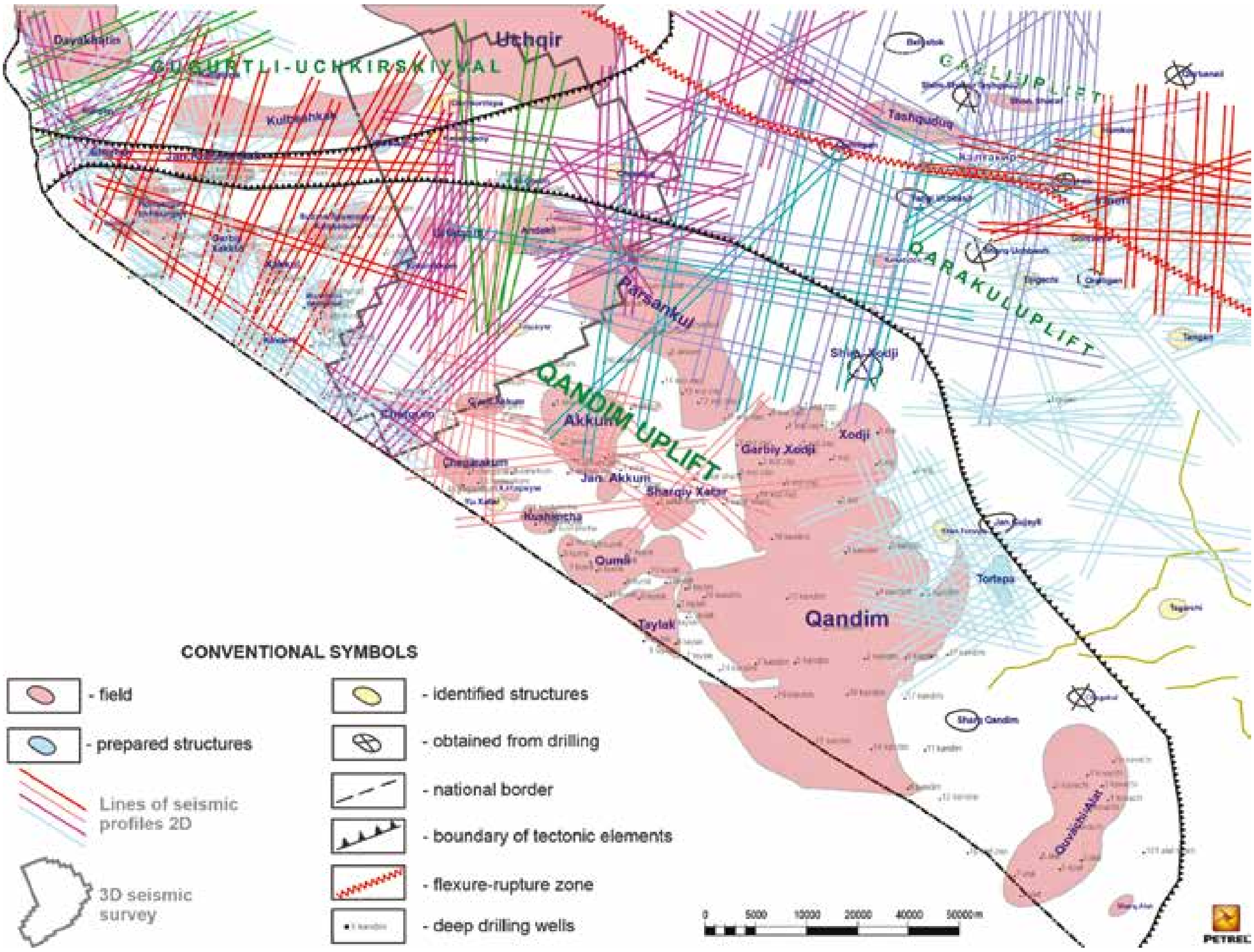

Fig. 1 – Seismic and drilling study of the Kandym Uplift.

Akkum [28], Murodtepa-Atamurad, Khodjikazgan [29], Andakli [30], and others.

The Kandym uplift in the Bukhara-Khiva region of Uzbekistan possesses substantial oil and gas potential within its Jurassic deposits. The acquisition of extensive geological and geophysical data, along with contributions from researchers, has yielded invaluable insights into the geological structure, reservoir properties, and hydrocarbon potential of the region. The continued utilization of seismic exploration methods, combined with a comprehensive understanding of the tectonic elements at play, holds the promise of further discoveries within the highly prospective terrigenous formation of the Kandym uplift and its surrounding areas.

2. The methods, results, and discussion

Drilling and testing results show that the prospectivity of the Jurassic terrigenous formation in the studied area is associated with the multi-layered XVII, XVIII, XIX, and XX (in many places blurred) horizons [26]. The geological structure of the western part of the Kandym uplift involves rocks of Paleozoic, Mesozoic, and Cenozoic ages.

In this region, Paleozoic deposits are exposed at Garbiy Khakkul (wells No. 1, 4), Khodzhikazgan (well No. 8), Atamurad (well No. 1), Akkum (wells No. 1p, 2), Khakkul (wells No. 1, 2, 3), North Syuzma (wells No. 1, 2, 3, 5, 6), South Kulbeshkak (well No. 1p), Urtaqum (wells No. 1, 2), Chakkakum (well No. 2). These deposits are characterized by volcanogenic sandstone, greenish-gray, and partially metamorphosed. The rock is composed of unevenly sorted and loosely packed fragmental material, mainly consisting of medium and basic effusives. [26]

Mesozoic deposits with angular and stratigraphic unconformities lie on the dislocated surface of Paleozoic deposits and are represented by rocks of Jurassic and Cretaceous systems.

Jurassic deposits, based on their lithological characteristics and paragenesis, are divided into three thicknesses corresponding to formations. From bottom to top, the terrigenous, carbonate, and salt-anhydrite formations are distinguished in the section, which are represented by two sections, lower + middle and upper, respectively.

Terrigenous deposits with stratigraphic and angular unconformities lie on Paleozoic deposits.

The layering of the investigated formation predominantly depended on the spore-pollen complex and flora remains, indicating a wide developmental span. As of January 1, 2022, comprehensive exploration and parametric drilling have taken place in more than 32 areas within the surveyed region. A total of 184 deep wells have been drilled, including 3 parametric, 83 exploration, and 98 production wells. Among these, 45% are exploration wells, 53% are production wells, and 2% are parametric wells.

Jurassic terrigenous deposits were uncovered by 110 wells on 29 sites, with 49 wells exposing the full thickness of the Jurassic terrigenous deposits. The remaining wells revealed only partial thickness. In terms of the total number of drilled deep wells, 27% revealed the full thickness of the Jurassic terrigenous formation, 39% exposed it partially, and 34% did not reveal the Jurassic terrigenous formation.

Despite these challenges, the effectiveness of geophysical studies on Jurassic terrigenous formations is comparatively lower than that on carbonate formations in the region. This is attributed to the limited application of geophysical methods (BK, GK, NGK, caliper) in studying Jurassic terrigenous reservoirs. Consequently, interpreting geophysical materials to determine specific resistance, Ks saturation, and Kp porosity of the rock posed significant difficulties. The lack of reliable petrophysical data further diminished the efficacy of geophysical studies.

Previously, petrophysical studies involved examining cores from the entire sample of terrigenous rocks, encompassing both reservoirs and dense non-reservoirs, low-porosity rocks with increased clay and aleurolite content. The resulting petrophysical dependencies were significantly complicated by the influence of clay and aleurolite components. It's known that the terrigenous section includes not only pure non-clayey sandstones and clays but also clayey sands, to some extent enriched with clayey material. Sandstone-clay formations, in some cases, serve as reservoirs, associated with rich oil and gas reserves globally [31] (Fig. 2).

These factors, along with the unique structure of Jurassic terrigenous reservoirs, their moderate capacity and filtration properties, and the deep penetration of drilling fluid filtrate into permeable formations, negatively impact the interpretation of geophysical data and reduce their reliability. Hence, the development of reliable petrophysical dependencies and an effective methodology for interpreting geophysical materials using modern research techniques becomes crucial.

The presence of a significant amount of clay material in the rock noticeably affects its specific resistance, the amplitude of the SP curve, radioactive, acoustic, and other geophysical properties. The influence of clay material on the specific resistance of the rock is intricate and intensifies with the increase in the specific resistance of the formation water, complicating the use of the resistance curve to identify clayey reservoirs [32].

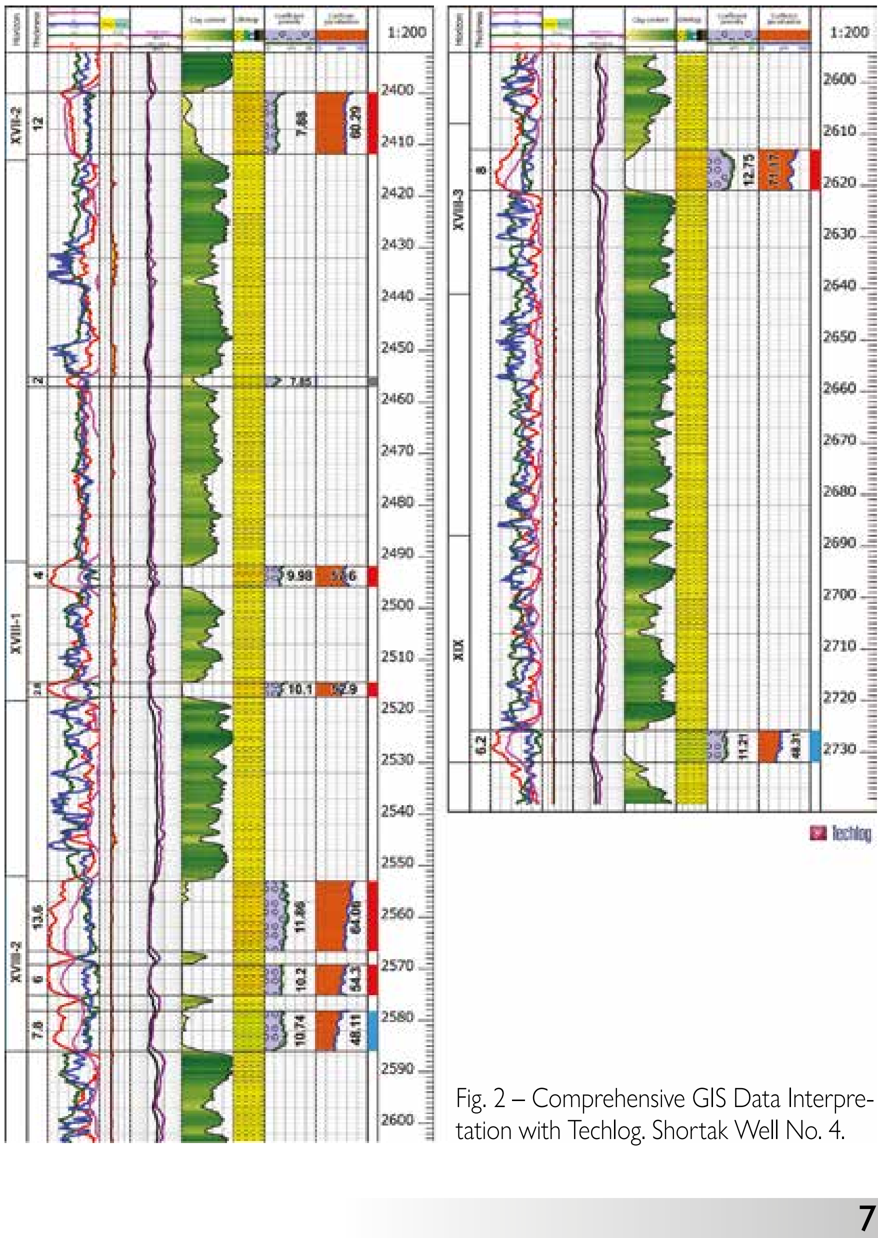

Fig. 2 – Comprehensive GIS Data Interpretation with Techlog. Shortak Well No. 4.

To study the terrigenous reservoirs of the Chardjouskaya stage, it is necessary to conduct well geophysical surveys such as SP, GR, NGR, Caliper, electrical log, and a high-quality interpretation of GIS materials, which will allow for the identification of productive reservoirs with an accuracy of more than 80%.

Terrigenous reservoirs are divided into two types based on their mineral composition: quartz and polymictic. Quartz terrigenous reservoirs are formed when quartz grains predominate during sediment accumulation. In this case, the rock has a sandy base (up to 95-98%) and usually has good reservoir properties, porosity, and permeability. Such terrigenous reservoirs are pure non-clayey sandy reservoirs. Polymictic reservoirs are formed when, in addition to quartz grains, a large percentage of feldspar grains and products of their chemical transformations are present during sediment accumulation. The resulting rock has a significant amount of clay impurities (up to 25-50%), which deteriorate its reservoir properties.

In the studied area, terrigenous reservoirs are characterized by a very wide range of filtration and capacity properties. The clay content of the reservoirs varies from 2-3% to 24-30%, and the porosity ranges from 20-22% to 8-10%.

In the studied area, terrigenous reservoirs are composed of sandstone-aleurolite, and less commonly, coarse clastic rocks, characterized by heterogeneous composition and mainly having intergranular porosity. Sometimes, there are fissured clay-aleurolite formations where permeability is determined by fissuring. According to the analysis of the material composition of rocks, the reservoir rocks are represented by sandstones with good effective porosity and clay formations that can serve as a cap and contribute to the preservation of hydrocarbon deposits [33,34].

The Jurassic terrigenous formation is divided into five rhythmic suites – Kimmeridgian (Lower Jurassic), Gurudian (Aalenian-Lower Bajocian), Degibadamskian (Upper Bajocian), Tangiduvalskian (Lower-Middle Bathonian), and Baysunskian (Upper Bathonian-Lower Callovian). In the studied area, Lower Jurassic deposits (Kimmeridgian suite – XXI horizon) are absent. Middle Jurassic terrigenous deposits are mainly represented by a thickness of clay rocks containing various thicknesses of sandstones and gravelites, identified as XVII, XVIII, XIX productive horizons. The thickness of Jurassic terrigenous deposits varies from 100 m to 500 m. [35]

The sedimentary rocks of the Middle Jurassic (Bajocian+Bathonian) are included in the terrigenous thickness. They lie with stratigraphic and angular discordance on Paleozoic deposits. XVII, XVIII, and XIX permeable horizons are distinguished in the section. The roof of the Lower-Middle Jurassic deposits is the reflecting seismic horizon – T_7. [36]

The considered deposits represent a complex of continental formations, mainly composed of non-carbonate argillites interbedded with sandstones and aleurolites. Gravel layers are encountered in the lower part. [9]

The oil and gas potential of the terrigenous deposits in the Kandym uplift was first proven at the Khodzhikazgan field, where exploration drilling began in October 1966. From 1966 to 1974, eight exploration wells were drilled on the Khodzhikazgan structure. In the terrigenous deposits (XVIII horizon) of the Middle Jurassic age, well No. 5 at Khodzhikazgan obtained an industrial gas inflow of 138 thousand m3/day. In exploration well No. 6, an industrial gas inflow of 429 thousand m3/day was obtained from the XVIII horizon through a 15.4 mm choke. In addition, in the 1980s, there were several gas shows in the terrigenous formation horizons in the studied area.

At the North Syuma deposit, well n. 1 produced a weak gas inflow of 5.5 thousand cubic meters per day in the interval of 2648-2655 meters (XIX horizon) during testing. To increase the gas flow rate, the reservoir was treated with a surfactant, but after re-aeration, the gas flow rate did not increase. A cement bridge was installed in the interval of 2660-2600 meters. Gas was obtained from the XVIII horizon in the interval of 2588-2580 meters with a flow rate of 51 thousand cubic meters per day. A cement bridge was installed in the interval of 2600-2560 meters. Due to the industrial gas inflow in the carbonate deposits with a flow rate of 305 thousand cubic meters per day, the terrigenous intervals were closed with a cement bridge.

Well n. 2 at the North Syzma deposit also produced a weak gas inflow in the interval of 2695-2687 meters with a flow rate of 4.7 thousand cubic meters per day, but no inflow was obtained from the other perforation intervals. The well was drilled with a drilling fluid with a specific gravity of 1.19 g/cm^3.

At the Khakkul deposit, hydrocarbon inflows were obtained from several intervals of Jurassic terrigenous deposits. Well n. 3 at the Khakkul deposit showed signs of oil and gas in almost all XIX and XVIII horizon collectors. A weak gas inflow was obtained from the XVIII horizon in the intervals of 2738-2735 meters and 2722-2716 meters with a flow rate of 5.2 thousand cubic meters per day. Perforation work was carried out in 1992. The specific gravity of the drilling fluid was 1.17-1.18 g/cm^3. [10]

Recent analysis of the authors' research shows that to obtain an industrial flow rate from producti-

Tab. 1 – Refined Breakdowns of Jurassic Terrigenous Deposits (as exemplified by the Shorak gas condensate field).

Title		Shortak							
n. Well Numbers		1		2		3		4	
Altitude		183		182		185,4		184,8	
		depth, m	h, m	depth, m	h, m	depth, m	h, m	depth, m	h, m
1	2	3	4	5	6	7	8	9	10
Neogene-Quaternary (N+Q)	roof	0	120	0	306	0	336	0	190
	sole	120		306		336		190	
Paleogene (P)	roof	120	160	306	67	336	74	190	32
	sole	280		373		410		222	
Cretaceous – K	roof	280	1584	373	1497	410	1516	222	1660
	sole	1864		1870		1926		1882	
Upper Cretaceous – K_2	roof	280	872	373	809	410	930	222	1032
	sole	1152		1182		1340		1254	
Cenomanian	roof	280	360	373	285	410	284	222	508
	sole	640		658		694		730	
Turonian	roof	640	196	658	316	694	316	730	330
	sole	836		974		1010		1060	
Santonian	roof	836	316	974	208	1010	330	1060	194
	sole	1152		1182		1340		1254	
Lower Cretaceous – K_1	roof	1152	712	1182	688	1340	586	1254	628
	sole	1864		1870		1926		1882	
Albian	roof	1152	326	1182	306	1340	168	1254	280
	sole	1478		1488		1508		1534	
Aptian	roof	1478	98	1488	102	1508	112	1534	96
	sole	1576		1590		1620		1630	
Neocomian	roof	1576	288	1590	280	1620	306	1630	252
	sole	1864		1870		1926		1882	
Jurassic – J	roof	1864	886	1870	930	1926	876	1882	860
	sole	2750		2800		2802		2742	
Tithonian	roof	1864	104	1870	96	1926	76	1882	78
	sole	1968		1966		2002		1960	
Upper Jurassic – J_3^{o+km}	roof	1968	192	1966	189	2002	190	1960	193
	sole	2160		2155		2192		2153	
XV-1	roof	1968	33	1966	33	2002	33	1960	33
	sole	2001		1999		2035		1993	
XV-2	roof	2009	73	2008	70	2043	73	2002	70
	sole	2082		2078		2116		2072	
XV-3	roof	2118	42	2113	42	2150	42	2109	44
	sole	2160		2155		2192		2153	
Middle Jurassic – $J_2^{kl+bat+by}$	roof	2160	590	2155	645	2192	610	2153	589
	sole	2750		2800		2802		2742	
XV-a	roof	2160	32	2155	33	2192	30	2153	27
	sole	2192		2188		2222		2180	
XVI	roof	2282	51	2278	47	2313	49	2275	50
	sole	2333		2325		2362		2325	
XVII-2	roof	2405	12	2400	13	2432	7	2398	15
	sole	2417		2413		2439		2413	
XVIII-1	roof	2490	32	2491	27	2521	26	2490	26
	sole	2522		2518		2547		2516	
XVIII-2	roof	2546	30	2552	33	2557	65	2546	61
	sole	2576		2585		2622		2607	
XVIII-3	roof	2605	30	2608	32	2644	37	2618	26
	sole	2635		2640		2681		2644	
XIX	roof	2708	42	2689	41	2748	52	2714	28
	sole	2750		2730		2800		2742*	
Paleozoic – PZ	roof	-		-		-		-	
	sole	-		-		-		-	
wellbore:		2750 m		2800 m		2802 m		2742 m	

ve terrigenous reservoirs in the studied area, the specific gravity of the drilling fluid should not exceed 1.05-1.06 g/cm^3. Considering that the above-mentioned wells were drilled with a drilling fluid with a specific gravity of 1.18-1.20 g/cm^3, the authors believe that a good gas inflow can be obtained from the terrigenous horizons of these deposits in the studied region, such as North Syzma and Khakkul.

The XIX horizon is represented by interbedded dark gray, greenish-gray, variegated, clayey sandstones and layers of gray, dark gray, almost black aleurolites and clays.

The permeable XIX horizon lies in the Bayosky layer directly below the sandy-clay layer of the Tangiduvalskaya suite, and the XX horizon lies in the Aalensky layer directly below the sandy-clay layer of the Degibadamskaya suite.[11]

It combines a group of permeable layers of sandstones, clays, and siltstones, and there is a regional lithological thinning from the west, east, north to the central part. In the studied area, more than 20 layers of sandy-siltstone collectors have been identified from the XIX and XX horizons, which can contain hydrocarbon deposits, and each layer has a thin clay cover. As a result of testing, industrial inflow of hydrocarbons was obtained from ten layers, while the remaining ten layers were not studied.

The XVIII horizon is represented by the interlayering of sandstones and aleurolites. The aleurolites are gray, dark gray, and have varying grain sizes with abundant organic matter content. The sandstones are gray, dark gray, fine to medium-grained, aleurolitic, polymictic with clayey-carbonate cement. The rock is composed of 70-80% clastic material and 20-25% cementing material, with quartz comprising 1% of the clastic material.

In the investigated region of the XVIII horizon, seven potential reservoir layers were identified with

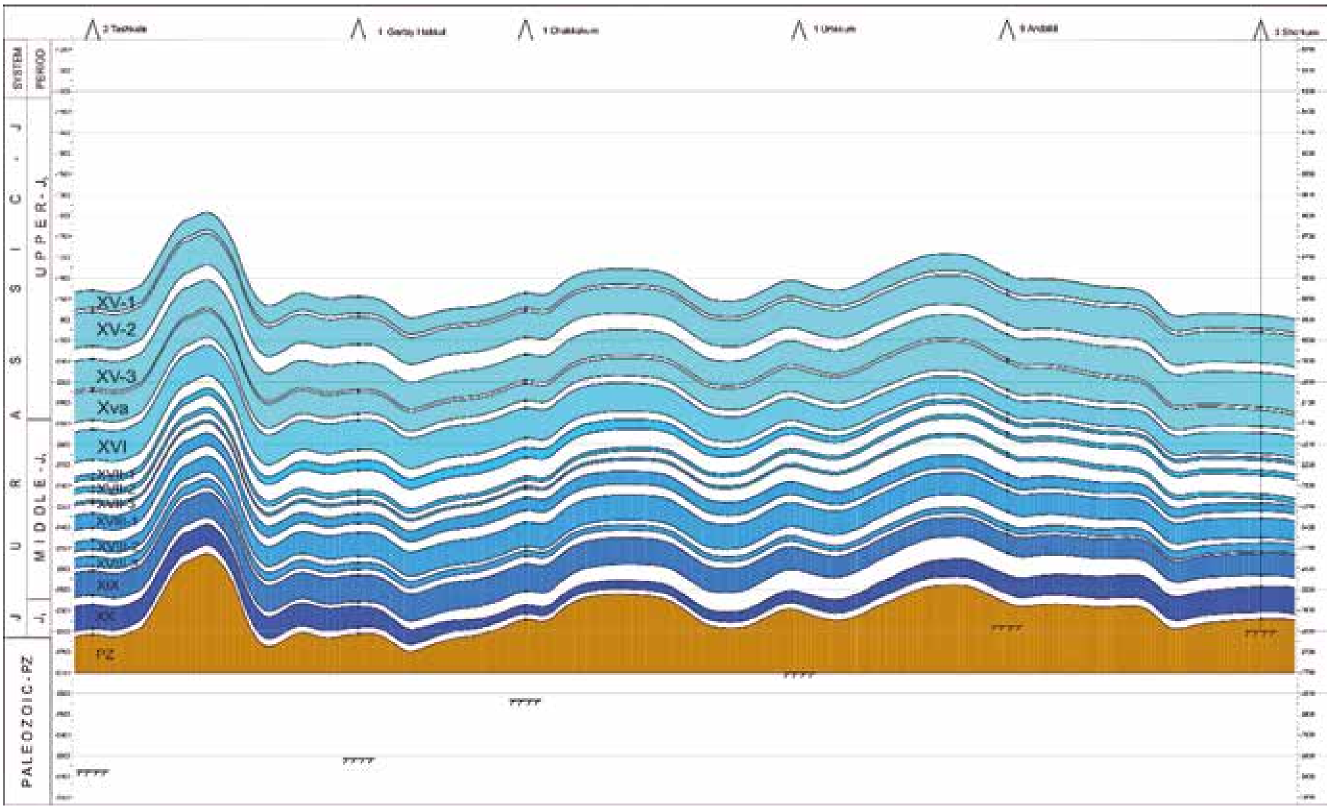

Fig. 3 – Well Line Profile (Scale: 1:10000). Toshkala 2 – Garbiy Khakkul 1 – Urtakum 1 – Andakli 9 – Shorkum 3.

the potential to harbor hydrocarbon deposits. Each layer is thinly coated with clay. Hydrocarbon inflow was confirmed in three of these layers, while the remaining four remain unstudied.

The XVII horizon consists of an interlayering of clays, aleurolites and sandstones. The aleurolites are gray, dark gray, have varying grain sizes and interbedded clay layers. The sandstones are polymictic, fine-grained, aleurolitic, clayey carbonate cemented, dolomitic, silicified, and pyritized.

Overall, Jurassic terrigenous reservoirs can be classified as non-carbonate, aleurolitic, quartzitic, clayey sandstones with dispersed clay content.

3. Conclusion

Taking into account the results of the correlation scheme, it can be concluded that the prospectivity of the XVII and XVIII horizons on the studied area is associated with anticlinal (structural-stratigraphic) traps, while the prospectivity of the XIX horizon is associated with non-anticlinal (lithologically shielded) traps. The possible prospectivity of the Jurassic terrigenous formation is determined from south to north (Fig. 3).

The GIS correlation scheme along the I-I line passes through well n. 2 Toshkala, n. 1 Garbiy Hakkul, n. 1 Chakkakum, n. 1 Urtakum, n. 9 Andakli, n. 1 Shorkum.

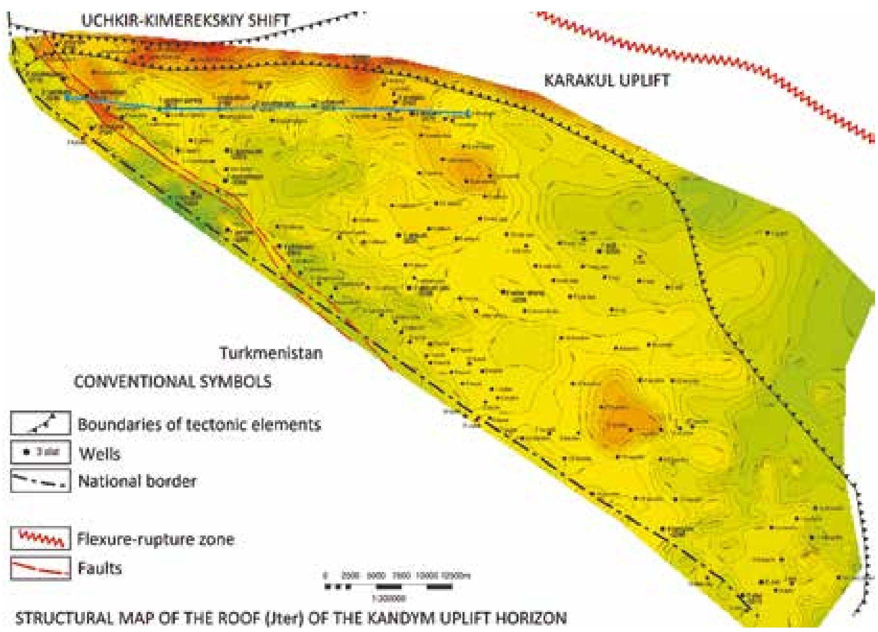

Fig. 4 – Structural map of the roof (Jter) of the Kandym uplift HarizonGIS Correlation Scheme along Line I-I.

Along this line (in a south-north direction), the authors studied the distribution of the Jurassic terrigenous formation (Fig. 4).

Analysis and reinterpretation of the GIS materials show that in the central part of the Kandym uplift (Fig. 5), the thickness of the XVII and XVIII horizons is reduced and distributed almost equally. In the eastern part, the distribution of the XVII, XVIII, and XIX horizons

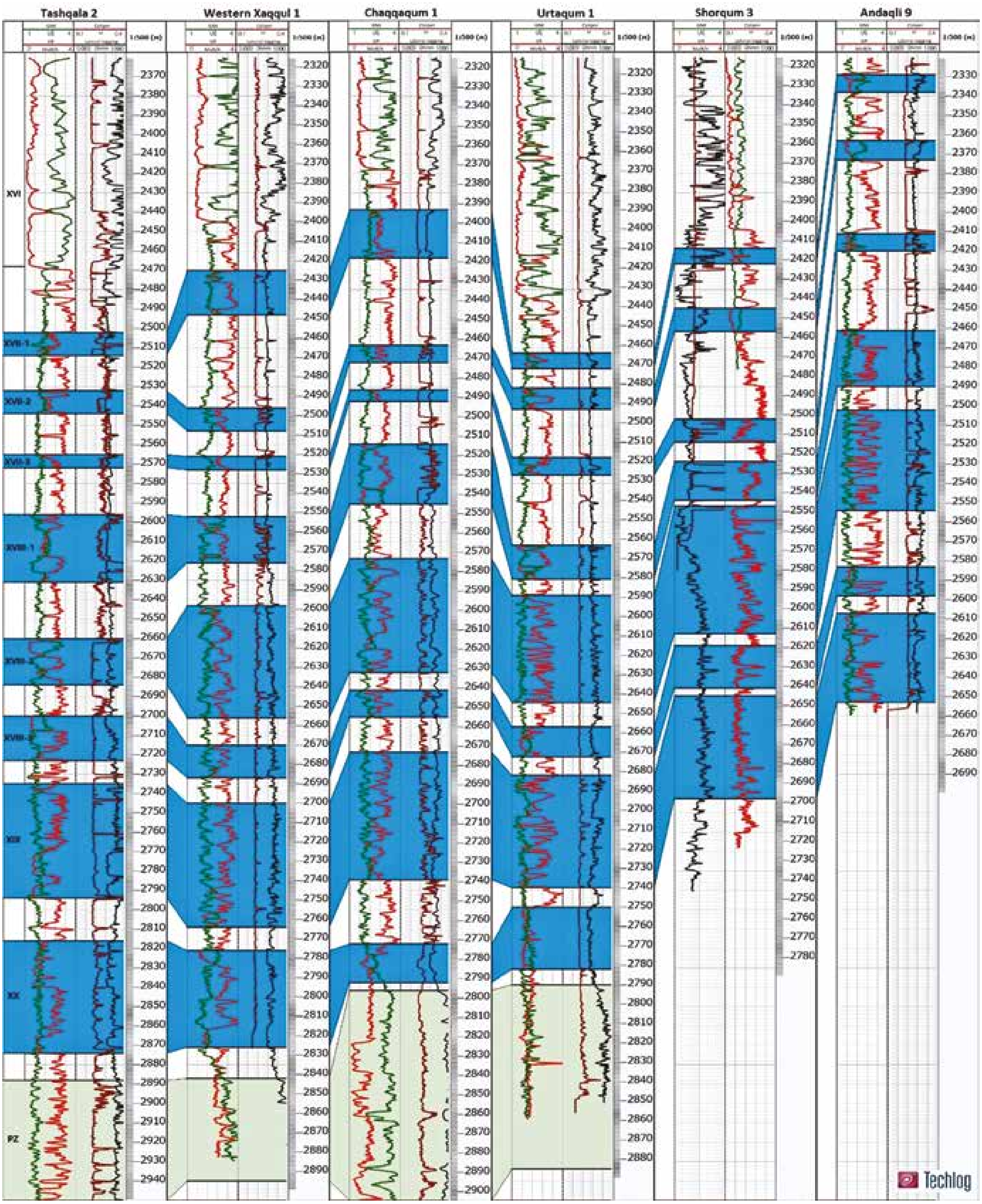

Fig. 5 – GIS Correlation Scheme along Line I-I.

is observed, while in the western part, the distribution of the XVII, XVIII, XIX, and XX horizons is observed.

Thus, throughout the Kandym Uplift, the prospectivity of the XVII and XVIII horizons is associated with anticlinal (structural-stratigraphic) traps, while in the eastern and northern parts, the prospectivity of the XIX horizon is associated with non-anticlinal (lithologically shielded) traps, and in the western part, the prospectivity of the XIX and XX horizons is also associated with non-anticlinal traps.

The results of the comprehensive interpretation of GIS data in Jurassic terrigenous sediments show that the main productive reservoirs of the XVII and XVIII horizons have 8-13% porosity and all reservoirs are enriched to some extent with clay material. The average clay content in productive reservoirs of the XVII horizon is 4-6% higher than in reservoirs of the XVIII and XX horizons.

It is widely known that as one descends from the Earth's surface towards its core, both temperature and pressure consistently increase. This phenomenon leads to the compaction of sedimentary deposits with increasing depth and alters their composition through metamorphism. According to this principle, the open porosity of the reservoirs in the XVII horizon, located higher up, should be greater than the porosity of reservoirs in the XVIII and XIX horizons located below. However, the conducted analysis revealed the opposite. In the study area, the open porosity of the XVII horizon reservoirs is significantly lower than that of the XVIII and XIX horizon reservoirs.

In the Jurassic terrigenous horizons, the amount of clay inclusions in sandy reservoirs decreases with increasing depth. This, in turn, improves the effective thickness and reservoir properties of the sandy beds.

To enhance the efficiency of geological exploration in the field of scientific research, it is advisable to focus on two principal aspects. The first aspects involves preparing for deep drilling of Jurassic terrigenous horizon reservoirs with excellent reservoir properties and substantial clay caps. During drilling, it is essential to monitor the specific gravity of the drilling fluid. The second aspect is the retesting of promising terrigenous beds left untested or perforation operations in wells drilled with high-density drilling fluids, resulting in a weak gas influx.

References

Abdullaev, G.S., Evseeva, G.B., (2014). Lithofacial features, geological structure and prospects of oil and gas potential of the Jurassic terrigenous formation in the northwestern part of the Chardzhou Steppe // Uzbek Journal of Oil and Gas. Tashkent, No. 1. pp. 18-19.

Abdullaev, G.S., Bogdanov, A.N., Ivonina, I.E. History, (2015). current state, and prospects of the development of the oil and gas industry in Uzbekistan in the field of exploration and development of hydrocarbon deposits // Uzbek Journal of Oil and Gas. Special issue. Tashkent, pp. 103-110.

Abdullaev, G.S., Dolgopolov, F.G., (2016). Geodynamics and oil and gas potential of the lithosphere of Uzbekistan. Tashkent: Voris Print, 2016. 360 p.

Abdullaev, G.S., Bogdanov, A.N., Eidelnant, N.K., (2019). Oil and gas fields of the Republic of Uzbekistan Tashkent. "Zamin Nashr".

Abidov, A.A., Tal-Virsky, B.B., (1996), Development of a scheme for tectonic zoning of oil and gas regions of Uzbekistan based on geodynamic principles. Research Report (conclusion). Tashkent: GGF, pp. 32-60.

Alexeev, V.P., Troitsky, A.V., Safonov, B.K., Pavlov, V.A., (1991). Application of seismic stratigraphy principles in studying sections of the Jurassic terrigenous formation of Western Uzbekistan. Bulletin of MOIP. Issue No. 3. Geological series. Moscow: Nauka, pp. 40-44.

Akramkhojaev, A.M., Egamberdiev, M.E., Mirkamalov, Kh.Kh., *et al.*, (1971). Lithology, stratigraphy, and oil and gas potential of Southern and Southwestern Uzbekistan. Tashkent: Fan, pp. 170-176.

Akramkhojaev, A.M., (1971).Features of lithological composition, stratigraphy, and prospects of oil and gas content of Mesozoic and Paleogene deposits in Southern and Southwestern Uzbekistan. Tashkent: Fan. pp. 200-202.

Babaev, A.G., Gabrielyan, R.A., Salyamova, S.K., (1977). Terrigenous formation of Jurassic age of the Bukhara-Khiva region and the Southwestern Hissar and its oil and gas potential. Moscow: Nedra, 158 p.

Babadzhanov, T.L., Kunin, N.Ya., Luk-Zilberman, V.I., (1986). Structure and oil and gas potential of deep-seated complexes of Central Asia based on geophysical data, Tashkent: Fan, 186 p.

Babadzhanov ,T.L., Cherkashina, L.G., Rubo, V.V., (1988). New data on the prospects of gas content of terrigenous Jurassic deposits of Western Uzbekistan, Geology of Oil and Gas. Tashkent, No. 2. pp. 21-24.

Comprehensive reinterpretation of geological and geophysical materials on the deposits of the Bukhara-Khiva oil and gas region with the identification of promising areas for seismic exploration. Research Report (conclusion). Tashkent: GGF, (2014), pp. 191-200.

Davlyatov, Sh.D., (1971). Tectonics of oil and gas regions of Western Uzbekistan. Tashkent: Fan, 176 p.

Gabrielyan, R.A, (1988). About the exploration status of the terrigenous formation of Jurassic age of the Bukhara-Khiva oil and gas region // Tashkent: SAIGIMS, Issue 66/VIII, pp. 75-80.

Gabrielyan, R.A., (2004). Geodynamic factors of the formation of Lower and Middle Jurassic deposits of Western Uzbekistan for the purpose of predicting their oil and gas potential. Research Report (conclusion). Tashkent: GGF, pp. 91-96.

Holmuradov, I.Z., Khojiyev, B.I., (2022), Filtration-capacity properties of productive reservoirs of Jurassic deposits of the Kandym Uplift. Journal "VESTNIK NUUz" Tashkent, 3/1/1, 303 p.

Holmuradov, I.Z., Muratova, S.F., Mekhmonov, Sh.M., (2021). Efficiency of identification of terrigenous reservoirs in the northwestern part of the Chardzhou Steppe (on the example of the gas condensate fields of Andakli). Journal "VESTNIK NUUz" Tashkent, 3/2/1, 186 p.

Holmuradov, I.Z., Zhumaev, A.D., (2022). Oil and gas potential of Jurassic terrigenous deposits in the northwestern part of the Chardzhou Steppe (on the example of the gas condensate fields of Shortak). Journal "VESTNIK NUUz" Tashkent. 3/2, pp. 338-342.

Itenberg, S.S., (1967). Study of oil and gas-bearing strata by industrial-geophysical and geological methods. Moscow. Nedra, 191 p.

Karshiev, O.A., Abbasova, S.A., (2016). Prospects for improving the efficiency of geological exploration in the area of development of lagoon deposits of the Bukhara-Khiva region // Uzbek Journal of Oil and Gas. Tashkent, No.1, pp. 8-12.

Khalmuradov, I.Z., Muratova, S.F., Mekhmonov, Sh.M., (2021). Efficiency of Identifying Terrigenous Collectors in the Northwest Part of the Chardjouskaya Steppe (on the Example of the Gas Condensate Field Andakli). Journal "Bulletin of NUUz" Tashkent, 3/2/1, pp. 185-187.

Khayitov, N.Sh., Holmuradov, I.Z., Zhumaev, A.D., (2022). Assessment of the oil and gas potential of the terrigenous Cretaceous deposits of the Istiklol-25 field. Journal "GFU" Tashkent. 1/2, 34 p.

Khojiyev, B.I., (2017) .Prospects of Jurassic terrigenous deposits of the Kandym Uplift for the discovery of lithological oil and gas deposits. Uzbek Journal of Oil and Gas. Tashkent, No. 1, 23 p.

Khojiyev, B.I., (2019). Features of the geological structure and prospects of oil and gas potential of the terrigenous formation of the Jurassic of the Kandym Uplift"Tashkent 2019. PhD thesis in geological sciences. Tashkent, 92 p.

Khojiyev, B.I., (2019). Paleotectonics, processes of formation of the structure and productivity of the Jurassic terrigenous formation of the Kandym Uplift (Uzbekistan). Journal "Oil and Gas Geology. Theory and Practice", St. Petersburg, 10 p.

Nugmanov, A.K., (2009). Prospects for oil and gas content of Western Uzbekistan and priority directions of geological exploration. "Uzbek Journal of Oil and Gas" Tashkent, No. 3, pp. 24-27.

Nugmanov, A.K., (2010). Laws of trap and reservoir formation of oil and gas and prospects of oil and gas content of the northern edge of the Amudarya syncline. Doctoral dissertation in geological and mineralogical sciences (DSc). Tashkent, Fan.

Pak, S.A., Mizik, A.I., (2000). Calculation of Gas and Condensate Reserves of the Uchburgan Field with Recalculation of the Khodjikazgan Field. "Uzbekgeofizika" Scientific Journal, Research Report (Conclusion). Tashkent: IHIRMGI, pp. 24-78.

Sadykov, Yu.M., Sultanova, D.B., (2016). Comprehensive analysis of seismic survey and deep drilling results within the northwestern part of the Chardzhou steppe to identify promising objects in the volume of Jurassic carbonate and Lower Cretaceous deposits. Research Report (conclusion). Tashkent: IGIRNIGM, 121 p.

Sitdikov, B.B., Khayitov, N.Sh., (2012). On the issue of discovering new deposits with large and medium reserves of hydrocarbon raw materials in Uzbekistan. Uzbek Journal of Oil and Gas. Tashkent, No.4, pp. 10-12.

Turunova, T.M., (2013). Project for the Exploration of Oil and Gas Deposits in the Garbiy Khakkul Area Research Report (Conclusion). Tashkent: IHIRMGI, pp. 12-55.

Volkov, V.P., (2019). Industrial Recalculation of Hydrocarbon Reserves and FEED for KIK/KIG Deposits of the Kandym Group as of January 01, within the Akkum-Parsankul Deposit" Lukoil, LLC TING, Research Report (Conclusion). Tashkent: IHIRMGI, pp. 81-97.