



THE GEOLOGY AND RESERVOIR CHARACTERISTICS OF THE KUMKOL OIL FIELD, KAZAKHSTAN

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ABSTRACT

The Kumkol field is located in the Kyzylorda area, 200 kilometers from the town of Kyzylorda. Recoverable hydrocarbon reserves are about 55 million tons. Production in 2012 was 2.14 million tons of oil (LUKOIL's share was 1.07 million tons) and 222 million cubic meters of gas (LUKOIL's share was 111 million cubic meters). LUKOIL's share in investment from the start of the project has exceeded \$ 600 million. The total number of employees is 675, 100% of whom are Kazakhstan nationals. LUKOIL plans to invest upto \$ 190 million in development of the project till 2020¹.

Key words: Kumkol oil field, Reservoir, Karaganda, Geological structure.

INTRODUCTION

East Kumkol administratively is located in the district of Karaganda region of Kazakhstan. Geographically field is located in the southern lowlands and Turgay limited geographical coordinates 46⁰30' - 46⁰34' N and 65⁰35' - 65⁰43'E. The nearest settlements are railway stations Zhalagash (150 Km), Zhusaly (210 Km), Karsakpai (180 Km). Distance to regional centers, Kyzylorda and Zhezkazgan are respectively 160 and 290 Km. Oil is transported through a pipeline to Karakoin Kumkol-trunk pipeline Pavlodar-Shymkent. Kumkol oil field is connected to the regional center of Kyzylorda asphalt road.

The climate is sharply continental, with large seasonal and daily fluctuations in air temperature, humidity, and its deficit low rainfall. Maximum temperatures in the summer of +30⁰ - 35⁰C, the minimum winter -38- 40⁰C. Annual rainfall of 150 mm, falling mainly in winter and spring. Characterized by constant winds of the south- east direction in the winter-blizzards and snowstorms. Waterways on the area of work available².

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Geological and geophysical characteristics of the field

Raising East Kumkol as a complication of the structure Kumkol first identified and detailed search CDP seismic profiling in 1983-1985 year. Exploration drilling on the area started in 1985 drilling an exploratory well 3c, in which the oil flows from the Upper Jurassic sediments (productive horizon SE -I). In 1986 exploration wells were drilled 34 and 36 (on the west raised block), 37 (on the eastern block is lowered) and 26, 28 (on the structural ledge southeast of the uplift). Well established 34 oil-bearing Upper Jurassic and wells 28, 36, 37 were unproductive³.

In 2001, the continued study of the oil-bearing lifting East Kumkol exploration drilling. Along the strike of the structure were drilled three exploration wells: 5, 6, 7. the well established, as the productivity of the Upper Jurassic (productive horizons SE -I, SE -II), and oil-bearing horizon Arysium in the Lower Cretaceous (productive horizon M -I). In the future, the field has drilled two exploration wells 9 and 12, study materials which have been used to clarify the geological structure. In the same year on the area of East Kumkol forces "Azimuth Energie Service" conducted 3D seismic exploration work.

These studies have revealed the structural mismatch plans for Jurassic and Cretaceous. So the eastern and western blocks East Kumkol are separate deposits on Jurassic horizons, while for Cretaceous independent can only lift the Eastern bloc in the area of wells 5 and 6, and the deposit of the Western bloc is a continuation of M -I horizon Kumkol field. Are confirming and re-drilled wells in 1074 and 1059, which are Cretaceous in the territory of "structural nose" Kumkol elongated in the direction of East Kumkol. Oil-saturated formations in these wells by M -I opened up the horizon of absolute marks -981.8 -981.2 m and m, respectively, which is within the mark OWC received Kumkol M -I on the horizon in this region (-986 m - 988 m). In Jurassic deposits wells in 1059 and 1074 are located in the western block of East Kumkol (District wells 3c). Oil obtained in these wells to a level -1169.7 -1181.6 m, respectively, which confirms the oil-water contact, previously adopted by the well 3c (-1178.0 m). Kumkol OWC Ju -I horizon in this area is -1196 m -1200 m³.

The stratigraphic section of the field

This record held previously adopted stratigraphic section supplemented from drilling operational data. Incision East Kumkol deposits represented Mesozoic- Cenozoic, resting on a weathered surface Proterozoic basement. Studying the folded basement opened all wells, except wells 34. Basement rocks in the upper part (weathering crust) stacked massive gray-green hydromica kaolinite clay, gradually turning into weathered gneiss quartz-biotite-plagioclase composition. The maximum thickness of 81 m foundation opened in well 5. Sedimentary complex is represented by two structural levels⁴:

- Bottom - Jurassic rift system;
- Top - platform Cretaceous,

Paleogene and Neogene- Quaternary systems .Jurassic system is represented by the top Division (J3) as part of Kumkol and akshabulakskoy suites and most fully represented in the well section 34 on the northern East Kumkol periklinali structure and on its western (well 3c) and eastern wings (well 12). In the context of these wells revealed water-saturated reservoirs productive horizon Yu -IV. On the area of East Kumkol finds a reduction of the total thickness of the Jurassic deposits compared to Kumkol. Kumkol formation (J3 Km) on the deposit area is divided into middle and upper member. Middle Kumkol formation (J3 Km 2) thickness up to 48 m in the lower part is composed of sand and silt cut rocks interbedded with clay differences above dark gray clay. Upper Kumkol formation (J3 Km 3) is composed of clay and sand deposits with a predominance of sands, sandstones and siltstones. Formations thickness varies from 33-36 m (wells 5, 6, 7) in the arched portion of the structure to 43-45 m (wells 34, 12) on the wings. In

Upper Kumkol formation contains two productive horizons SE -I and SE -II, separated sustained throughout the area of a layer of clay and clay silt. Akshabu Lak formation (J3a) occurs according to sediment Kumkol suites and presented variegated clays, argillaceous siltstone with interbreed and lenses of sandy rocks. Formation thickness due to erosion of its roof varies from 50 m (well 6) to 73 m (well 26). In the field area Akshabu Lak formation is confining beds separating productive horizons Upper Kumkol formation Upper Jurassic and Aryskum horizon at the base of the Lower Cretaceous. Cretaceous system (K) lies with the regional erosion and angular unconformity on deposits Akshabu Lak suites and is subdivided into the lower part of the submitted daulskoy Neocomian nadyarusa entourage, entourage karachetauskoy Aptian-middle Albian, kyzylkiinskoy retinue Albian-Cenomanian upper and upper section, which includes undivided Turonian deposits-Senonian⁴.

Daulskaya Formation (K_{1nc}) is divided into two subseries: lower and upper. Nizhnedaulskaya formation (K_{1nc_1}) contains two horizons: the lower - and upper Aryskum. Aryskum horizon (K_{1nc_1ar}) on East Kumkol sediments overlain by Upper Jurassic and submitted sands and sandstones with beds of brown clays and silts. Horizon is divided into three members: the lower and upper silty sand- and medium - clay. The lower member in the base is composed of gray-brown clay and clay- calcareous grits. In the top part of the pack developed sandstones are collectors, which are correlated with cuts Kumkol field stand out at the horizon M -II - water saturated area on the East Kumkol. Upper sand pack in the top part contains the oil-bearing horizon is M -I. Aryskum horizon thickness 90-107 m. The upper horizon of the Lower daulskoy formations ($K_{1nc_1}^2$) complex clayey and calcareous

siltstones and clays 110-130 m thick and is a regional confining beds over Aryskum productive horizon.

Upper Daulskaya formation (K_{1nc_2}) is presented in the lower and middle parts of the section packs bed of sand and clay red rocks, and at the top-clays. Thickness of 242 m formation up to 250 m. Aptian-Albian sediments (K_{1a-al_2}) combined in karachetauskuyu retinue and lie on the erosion of the underlying sediments. Section is represented by gray-colored unconsolidated sand thickness interbedded with grits at the bottom and the top of the clay formation. Thickness of 264-298 m. Albian-Cenomanian deposits are highlighted in kyzylkiinskuyu retinue (K_{1-2al_3-s}), folded variegated shales and siltstones with interbedded sands and sandstones. Formation thickness 103-125 m. Upper cretaceous turonian composed Senonian (K_{2t-sn}) closed at the bottom of the sea gray-colored sands, silts and clays, and the upper part-variegated continental sandstones, siltstones and shales with a thickness of 286 to 304 m Paleogene sediments of (P) with erosion occur at different levels of the Upper Cretaceous and presented dark gray clay with plant detritus and interbedded quartz-glaucanite sands. Fat thickness reaches 68 m Neogene- Quaternary sediments (NQ) as loam, sandy loam, sand have a thickness of no more than 10 m and occur on the eroded sediments of the Paleogene⁵.

East Kumkol confined to the southern part of Aschisayskoy horst-anticline by rifting floor and to the central part of the trough, Platform Aryskum floor. Field associated with the same name and structure located east of Kumkol separated from his saddle and tectonic disturbances in the form of relief. As a result of seismic 3D space on East Kumkol been mapped structural surface reflecting horizons IIar (roof Aryskum horizon K_{1nc1ar}), III1 (roof Kumkol suite J3km) and PZ (roof base).

Structural plans reflecting horizons IIar and III 1 were the basis for the construction of maps roof productive horizons M -I, SE -I and SE -II. By reflecting horizon III 1 (roof productive horizon SE -I) East Kumkol structure is an elongated anticline northwest-trending, separated by faults along the strike of the structure on the eastern and western blocks. Eastern Bloc (District 5 wells) - is at a higher hypsometric level and size of a closed contour line elevation 1167 m is 6.25 x 1.25 Km at an amplitude of 37 m north- east wing of the structure is limited to two tectonic disturbances with amplitude from 5 m to 10 m, which occurs dive Jurassic sediments. In the west, a few lowered unit (district wells 3c), there is a small set of dimensions 3.75 x 1.0 Km and an amplitude of 30 m M on the roof -I production horizon mapped brachy anticline northwest trending. Its size is 2.75 x 1.25 Km at amplitude of more than 10 m along the closed contour line minus 986 m in the north- western part of the structure is complicated prisvodovoy tectonic disturbance amplitude of 5 m⁵.

Characteristic thickness, reservoir properties of productive horizons and their heterogeneity

East Kumkol is commercial oil and gas deposits of the Lower and Upper Neocomian. In Lower Neocomian sediments composed Aryskum horizon stands productive horizon M -I. Collectors horizon M -II, which is productive at Kumkol on East Kumkol fully saturated with water. In the Upper Jurassic deposits (Kumkol Formation) contains two productive horizons SE -I and SE -II. Water-saturated reservoirs productive horizons Yu-III and -IV SE opened in wells on the structure periklinal East Kumkol (wells 3c, 36, 34, 12). Compared with Kumkol Jurassic horizons have smaller thickness as by reducing the thickness of the reservoir, so by wedging clay "pinches" separating these horizons.

At East Kumkol due wedging clay interface between productive horizons SE -II and -III SE in the crest of the structure (well 6), these horizons are combined into one productive horizon SE -II. Horizon M -I. Productive horizon M -I are confined to the top part of Aryskum horizon and distributed across the entire field. Tire for him are the top of the sediments nizhnedaulskoy subseries.

The thickness varies from the horizon 27.6 m (37 wells) to 31.7 m (well 12) and an average of 29.3 m Horizon M -I contains two reservoir developed over the whole area. The upper reservoir is presented in the form of two streaks separated by thick layers of clay to 1 m with upper reservoir bed connected oil reservoir. The lower the reservoir stands up to 5 inter layers and it is fully water-saturated. Gross ratio of the horizon is 0.61, the coefficient compartmentalization averages 7.4 (Table 1). Based on the results of testing and interpretation of GIS OWC adopted at an altitude of -986 m Net pay thickness of the collector is equal to 6.8 m in the borehole 5 and 5.8 m in the hole 6. By type of deposit is the natural reservoir formation, the crest, tectonically screened from the northeast representation of the heterogeneity of productive interval are shown in Table 1.

Table 1: Options heterogeneity productive interval

Level	Distribution factor	Dissection factor	Arenaceous factor
1	1.0	7.4	0.61
2	0.67	2.8	0.20
3	1.0	3.6	0.49

Horizon SE -I. Productive horizons of the Jurassic and Cretaceous strata are clay akshabulakskoy suites from 50 m (well 6) to 73 m (well 26), is a regional confining beds for productive Jurassic horizons. Horizon thickness SE -I varies from 9 m (hole 7) to 19.4 m

(well 34) and an average of 11.7 m. Productive horizon Yu-I includes 1-2 reservoir. Reservoirs are developed over the entire area except for the absence of zones in the collector region 5 and the holes 9. Prevalence rate is 0.67 layers (Table 1). Gross ratio of the horizon is an average of 0.20, 2.8 coefficient compartmentalization.

Reservoir is a reservoir, the crest, tectonically screened from the south- east and north-west. In the isolated, tectonically disturbed vault Western block, according to GIS downhole 3c OWC was adopted at an altitude of -1178.4 m, which is confirmed by obtaining oil during testing up to the mark - 1178 m of water-saturated reservoir roof in this well opened at a depth of 1300.6 m, which corresponds to an altitude of -1181.5 m. In the newly drilled wells in 1059 and 1074, located on the western block East Kumkol (District wells 3c) isolated on GIS reservoirs are characterized as productive to absolute elevations - 1169.7 -1181.6 m and m, respectively⁶.

Roof water-saturated reservoir opened in 1059 in the well at a depth of 1303.7 m, which corresponds to an altitude of -1183 m Well 1074 is in the inner loop oil content, and open to the soles of the producing formation. Thus, the oil-water contact on the results of the GIS can be conditionally accepted at an altitude of -1181.5 m, 3 m below the previously accepted position. Horizon distributed within the entire block. Net pay thickness varies from 2.2 m (hole 1059) to 5.5 m (well 1074). Reservoir is a reservoir, the crest, tectonically screened from the north- west and south-east. Horizon SE -II, Productive horizons SE -I and SE -II are sustained throughout the area of clay "constriction "thickness from 2 m to 8 m productive horizon Yu-II distributed across the entire field. Horizon thickness averages 26.2 m. Productive horizon Yu-II contains four reservoirs. The upper reservoir is not widely distributed (not highlighted in the borehole 9). Middle and lower reservoirs present in all wells. Prevalence rate of this horizon is 1. Gross ratio of the horizon averages 0.49, the coefficient of compartmentalization - 3.6 (Table 1). OWC on deposits Yu-II adopted the horizon at around -1167 m total net pay thickness reservoirs productive horizon Yu-II varies from 1.8 m (hole 7) to 10.4 m (hole 6). Reservoir type is deposit formation, crest, tectonically screened from the south- east and north-west. With certainty, the degree of scrutiny of the existing defined breeds - from core collectors determined that the reservoir rocks M -I horizon represented by sandstones and medium- grained, coarse-grained siltstone and salty. Species poorly sorted, polymictic mineralogical composition, with a layered texture caused sub parallel orientation of elongated debris. Montmorillonite clay-cement hydromica composition, pore, basal pore, calcite sgustkovy porous. Reservoir rocks SE -I horizon represented by siltstones and fine grained, quartz-feldspar, moderately sorted, with a layered texture. Montmorillonite clay-cement hydromica composition sgustkovy porous. Reservoir rocks SE -II horizon characterized by sandstones and fine- medium-grained, quartz-feldspar, moderately sorted siltstones and fine- and coarse-grained, sandy, quartz-

feldspar, Stratus. Throughout the productive interval in the rocks present on (to 1%) of iron hydroxides, in the context of M -I horizon marked (30%) assorted calcite, in SE -I, SE -II horizons - the presence of carbonaceous matter⁶.

CONCLUSION

Kumkol administratively is located in the district of Karaganda region of Kazakhstan. Exploration drilling on the area started in 1985 drilling an exploratory well 3c, in which the oil flows from the Upper Jurassic sediments (productive horizon SE -I).

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In this article that studding geological and physical characteristics of the deposit and characteristics of the geological structure and characteristics thicknesses of reservoir properties of productive horizons and their heterogeneity of the field.

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