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Some aspects of field development Surkhandarya region, considering the generalization of the experience of their development

L. Z. Igamberdieva

Researcher of Hydrocarbon Field Development Design and Monitoring Department, of JSC «O'ZLITINEFTGAZ», Tashkent, Uzbekistan

ABSTRACT: The article provides a general overview and geological and production characteristics of the fields of the Surkhandarya region of the Republic of Uzbekistan. The systems of development of some deposits of the Surkhandarya region are considered and analyzed, taking into account the geological structure. Recommendations are given for further development and additional development of fields in the Surkhandarya region with an assessment of real residual geological reserves and the creation of energy-efficient, resource-saving technological schemes that provide a controlled impact on deposits with the displacement of oil from inter-well zones to the bottom of production wells. Based on the results of geophysical and hydrodynamic studies of new appraisal and production wells, qualitatively new permanent three-dimensional geological and hydrodynamic models of productive deposits should be built and the actual values of industrial geological reserves should be assessed.

KEYWORDS: oil, fields, production, oil recovery coefficient, technological indicators, viscosity, well grid density, extraction technologies, tectonic disturbances

I. INTRODUCTION

An important role in the formation and use of the raw material base of liquid hydrocarbons in Uzbekistan is played by the group of oil fields of the Surkhandarya oil-bearing region, which covers a large, complex depression structure (Surkhan or Surkhandarya megasyncline), bounded on the east by the Babatag zone of the Vakhsh-Kafirnigan meganticline, and on the west by the meganticline of the Southwestern Hissar. It is part of a vast gas-oil basin, known by various names (the South Tajik Depression, the Afghan-Tajik intermountain Depression, the Upper Amudarya Basin), but in recent years most often identified as the Afghan-Tajik gas-oil basin (Fig. 1).

In total, 14 fields were identified in the Surkhandarya oil and gas region, including one gas-oil field (Lyalmikar) and eleven oil fields (Haudag, Uchkyzil, Kokaity, Koshtar, Amu Darya, Mirshadi, South Mirshadi, Jalair, Jairankhana, Dasmanaga-Korsagly) and two heavy oil and natural bitumen fields (Aktau, Akjarsay) and one gas field (25 years of Independence).

Currently, 9 of them are being developed, the main part of them are at a late stage (Haudag, Uchkyzil, Kokaity, Koshtar, Amu Darya, Lyalmikar), including 2 are in conservation (Akzharsay and Aktau).

At the same time, it should be noted that due to the lack of technology for extracting heavy oil, some fields of Surkhandarya (Dasmanaga-Korsagly, Jalair, Jairankhana) have been in conservation for a long time, and the deposits of natural bitumen have not yet been fully explored.

A distinctive feature of the fields of the Surkhandarya region is that they are represented by multi-layer deposits of high-viscosity oil (more than 350 SDRs), lying mainly in the Bukhara layers of the Paleogene, represented by fractured, carbonate deposits with layers of dolomites and clays, the geological and commercial characteristics of which are given in Table 1.

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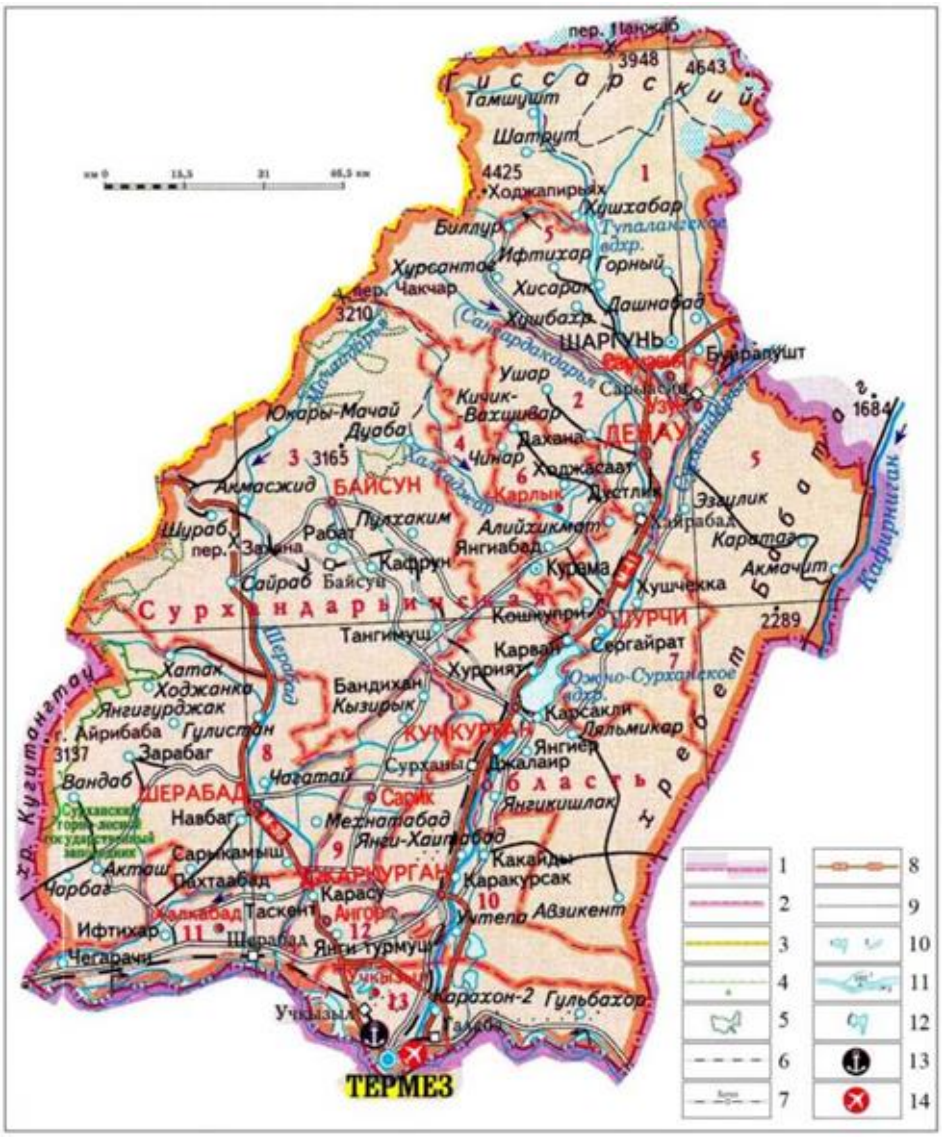

Fig. 1. Overview map of the Surkhandarya region

1 - state border of the Republic of Uzbekistan, 2 - borders of regions, 3 - borders of districts, 4 - borders of state reserves, national natural parks, 5 - forests, 6 - railways, 7 - railway stations, crossings and their names, 8 - highways of international importance and their numbers, 9 - highways of republican importance on the territory of Uzbekistan and the main ones in foreign territory, 10 - coastline of the sea, lakes and reservoirs (1 - constant and definite; 2 - variable and uncertain), 11 - constant rivers (1 - water edges and their marks; 2 - arrows of the direction of river flow), 12 - dams, 13 - port, 14 - international airport.

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Table 1. Geological and commercial characteristics of the deposits of the Surkhandarya region

Deposits	Type of deposit	Year of commissioning	Depth of occurrence of horizons, m	Capacity of productive horizons, m		Current KIN, fractions of units.
				total cost	effective	
Haudag	Oil	1934	130-200	28	10	0,34
Uchkyzyl	Oil	1935				
Kokoity	Oil	1939	1200-1300	26	16,5	0,28
Amu Darya	Oil	1965	1150-1250	55-65	30	0,12
Nightmare	Oil	1967	1200-1350	35	23	0,12
Mershadi	Oil	1984	1180-1350	55-70	34,5	0,19
Jalair	Oil	1989	358-470	36-45	8.6	
Jairanhana	Oil	1989		50-25	1,6	
South Mershadi	Oil	2007	1460-1850			
Acdjar	Oil	2013	2500	200	3,5	
Lyalmikar	oil and gas		980-1300	168,8-192,3	60-66,2	0,20
Aktau	Bitumen	1964	1200	10		
Dasmanaga-Korsagly	Bitumen	1958		3,2-8,4		
Gadzhak	gas	1974		85	62-77	

According to the hydrodynamic characteristics, the field development mode is elastic – water-pressure (the exception is the Mirshadi field, which has a pronounced rigid elastic-water-pressure mode) and belong to the formation-arch type of the deposit.

II. RESEARCH METHODOLOGY

For the fields of the region under consideration, the achieved oil recovery is on average 23% with an average well grid density of 23.5 ha/sle. The relatively low oil recovery for the main fields that are at the late (final) stage of development (Amu Darya, Haudag, Mirshady, Kokaity, Lyalmikar, Koshtar) - at the level of 26%, determines the need for additional exploration to increase production opportunities. The main reason for the low oil recovery of the region's fields is the high viscosity of the reservoir oil, numerous tectonic disturbances that divide the fields into separate hydrodynamic blocks and create complications during drilling and further development of the fields [1].

For example, in the Jalair field, wells No. 5 and 18 were placed in a separate tectonically disturbed block (such as a dump) due to a tectonic disturbance, and the main oil production of the field is carried out from well No. 5 (Fig. 2). As shown in [2], the flow of liquid into the well is due to gravity forces. A similar situation is observed in the Mirshady field (Fig. 3) [3].

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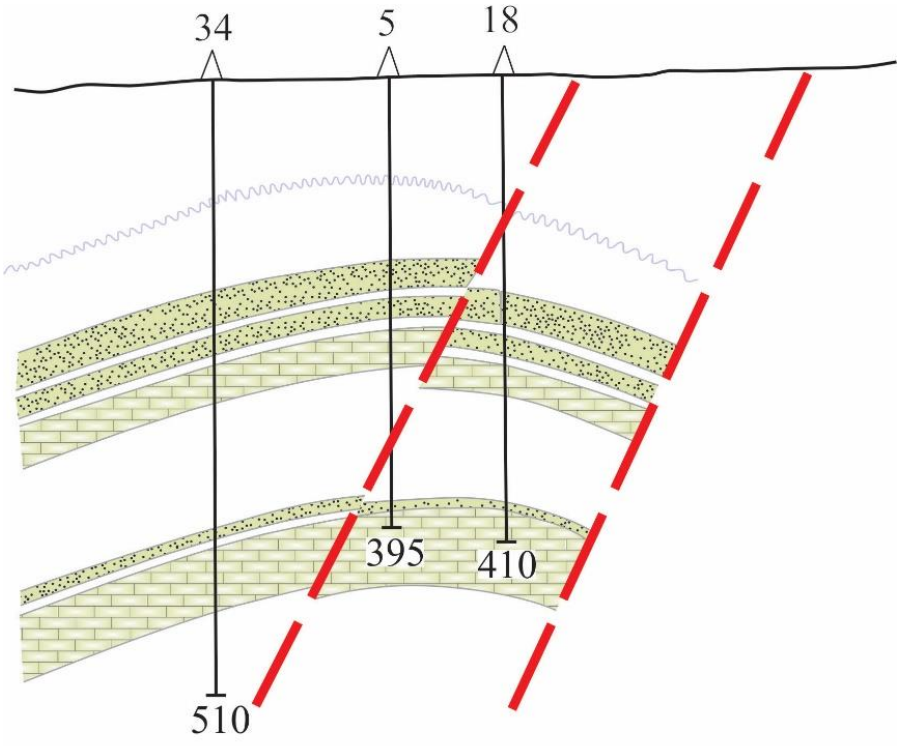

Fig. 2. Geological profile along the line of wells No. 34, 5, 18 of the Jalair field

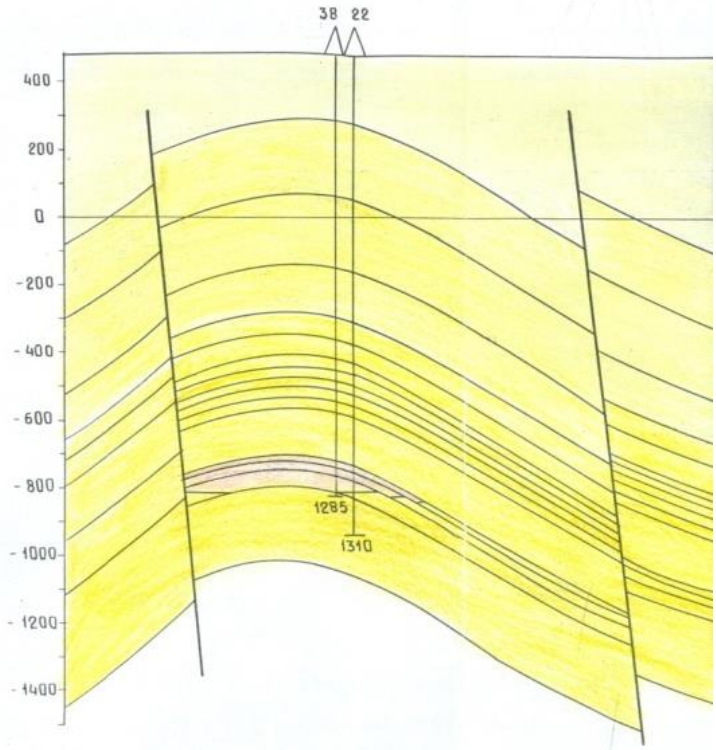

Fig. 3. Map of the total effective oil-saturated thicknesses along the horizons I, II and III of the Mirshadi field

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All the fields of the Surkhandarya region are multi-layer deposits and were put into development with the integration of all productive layers into a single object of operation, and the placement of wells within the oil-bearing area was carried out on a triangular grid.

As shown by the experience of the development of multi-layer fields and studies conducted in recent years, when several layers are jointly developed by a single well grid, i.e. when they are combined into a single object, it leads to significant oil losses in the reservoir.

A similar situation is observed in the fields of the Surkhandarya region. For example, at the Lyalmikar field, well No. 135 was put into operation on 01.01.1969 for the purpose of operating horizon II with a flow rate of 5 t / day. Since 01.12.2011, Horizon I has been put into development and joint development of horizons I-II has begun. After their merger, the water content of the produced products in this well increased to 90%, and the share of oil produced decreased sharply to 0.1 t / day. In addition, the well operation coefficient decreased from 0.96 to 0.46, due to periodically conducted series of cattle. After that, the well was stopped and the well was re-commissioned in November 2015 for the purpose of operating Horizon II. To date, the well operates Horizon II, and the accumulated oil production from the well is 38.3 thousand tons.

In the current situation, for the further development of deposits in the Surkhandarya region, a joint-separate development system is proposed with the combination of two layers into one operational object, while producing wells are equipped with installations for simultaneous-separate operation, and injection wells with installations for simultaneous – separate water injection.

It should be noted that the high viscosity of oil creates significant complications in the development of any mode and especially complicates the application of methods for maintaining reservoir pressure. In practice, these conditions lead to a high water cut of the extracted products at very low current values of the oil recovery coefficient. The most characteristic feature of the mechanism of displacement of high-viscosity oils is the instability of the front, that is, the formation of narrow "tongues"of flooding, between which there are tseliki oil. Also, the uniformity of displacement is affected by the manifestation of non-Newtonian properties of oil, for which high oil recovery coefficients can be achieved with simultaneous compaction of the well grid and high rates of fluid extraction [1].

For example, during the period 2007-2008, an additional 43 wells were drilled at the Haudag field, and oil production doubled, including 20 units. wells were drilled in the southern fold of the field and exploited horizon I. The remaining wells were drilled in the northern fold of the field and operated independently drained horizons I and II. In 2008, the annual oil production at the field reached 21.4 thousand tons, but the new wells were quickly flooded (within 1 to 3 months) and were transferred to the control and injection funds.

Of the total fund of newly drilled wells in the Haudag field, as of 01.01.2020, oil production is carried out only from 18 wells, which is 48.6 % of the total number of new wells. The remaining number of new wells is currently in the injection and control funds. The initial and current oil production rates of new wells (weighted average for accumulated oil production) were 4.5 t/day and 1.5 t/day, respectively (Fig. 4) [4].

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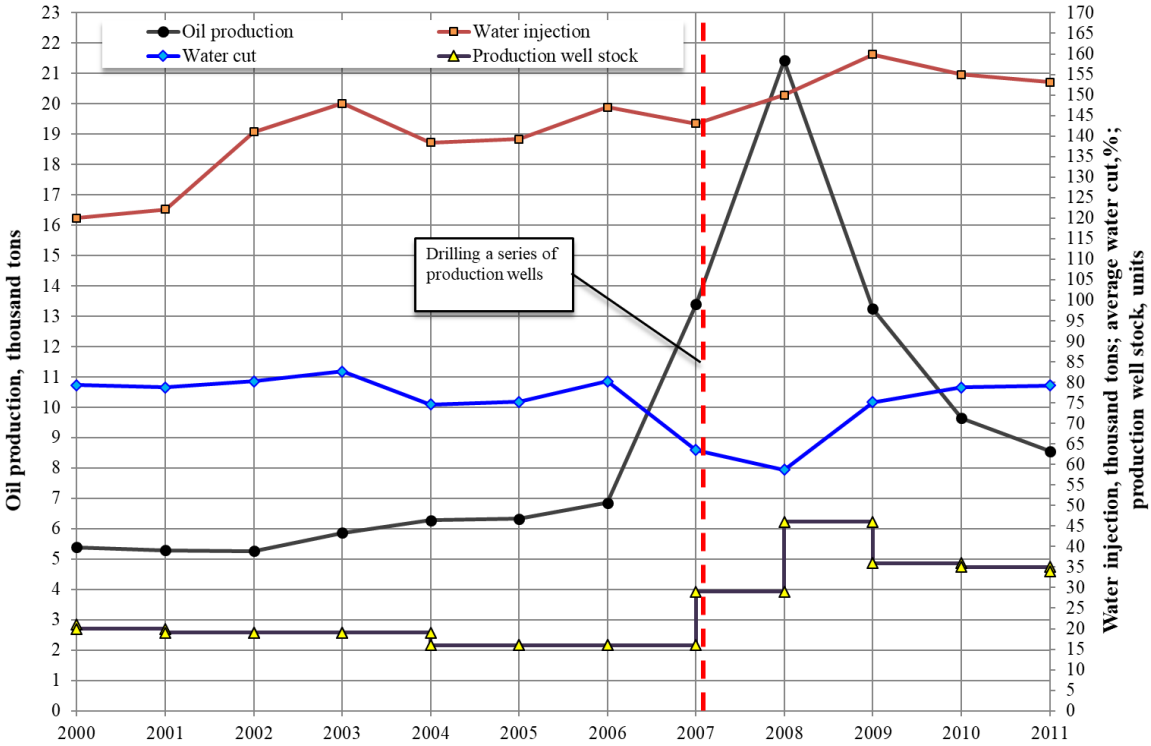

Fig. 4. Dynamics of the increase in oil production after drilling production wells since 2007

Due to the drilling of new production wells, as of 01.01.2020, an additional 94.8 thousand tons of oil were produced, while the KIN increased by about 2 %.

Taking into account the duration of the development of the Surkhandarya region fields, it should be noted that the main fund of producing wells is operated for 30-50 years, and oil production is carried out in a mechanized way. However, in recent years, when developing high-viscosity oil fields, foreign oil companies have often used screw pumps in the production of high-viscosity oils.

For example, for the first time, screw pumps of the company "Petroleum Tools Services" were installed for pilot work at well No. 37 of the Karsagli field, which gave positive results. With continuous operation of the pump for 16 days, the oil flow rate increased from 0.8 to 1.8 m3 / day. Then this unit was replaced with a more powerful one, which ensured uninterrupted oil production of up to 3 m3 / day of pure oil.

From November 2015 to June 2020, 4667.2 tons of oil were produced in the Karsagli field as a whole (Fig. 5) from 6 screw pumps installed, as of 01.01.2020, only 3 wells are operating, for which the average daily oil production is 0.5 tons of commercial oil.

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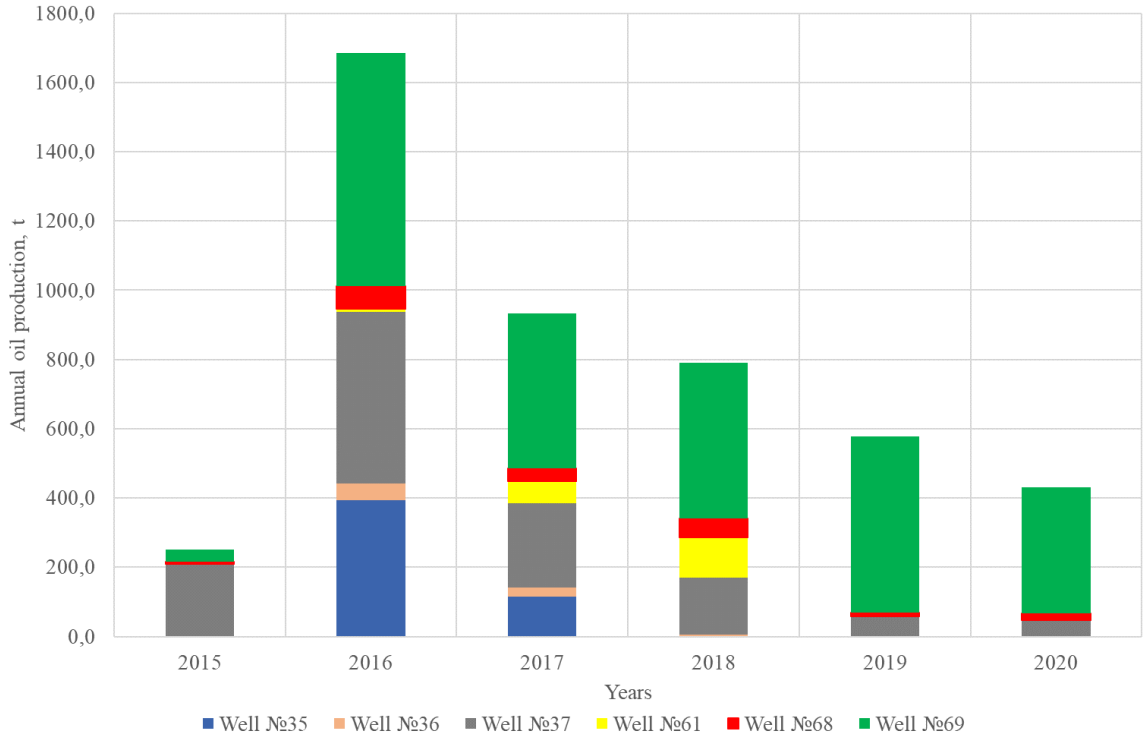

Fig. 5. Dynamics of oil production in the Karsagli field

It should be noted that the maintenance of annual oil production volumes is associated with the revaluation of the geological reserves of the fields. As a result of their additional exploration, it would allow for the design and application of foreign innovative and technological solutions aimed at achieving high rates of oil extraction from fields and increasing oil recovery.

At the same time, design decisions should be aimed at developing a strategy for additional exploration work on deposits, providing for the use of modern equipment and methodological techniques, systems for interpreting geological and geophysical information with high resolution, which should clarify the geological models of deposits built with a high risk factor.

For example, at the Yuzhny Mirshady field, it was planned to drill evaluation and production wells No. 11 OE, 12 OE and 13 OE along the fold axis in zone c of the C1 reserve category. From these three wells, industrial oil inflows were obtained from the wells No. 11 OE, 12 OE.

After the laying of well No. 13 OE, it was found (when drawing up a structural map based on the coordinates of all wells) that the fold axis passes along the profile of well No. 11 OE and exploration well No. 6. Because of this, further drilling of well No. 13 OE continued in an oblique-directional way. However, due to the large (400-450 m) slope of the borehole due to the lack of necessary technological equipment, it was not possible to conduct geophysical studies in the bottom hole. Therefore, the intervals of the productive horizon are determined by the sludge, and the development of the well by the reference point did not give a positive result. The determination of the direction of the axis of the narrow-line deposit of the South Mirshadi field remains open. In order to determine the direction of the axis, the production well No. 15 was drilled at a distance of 125 m to the southwest of the well No. 10 OE (Fig. 6).

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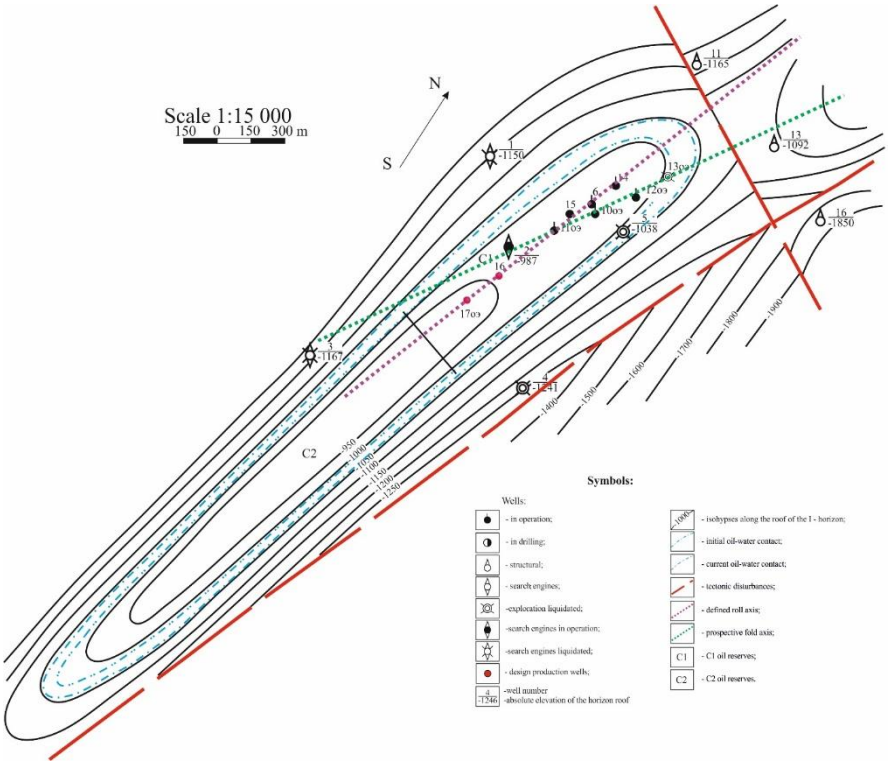

Fig. 6. Structural map of the South Mirshadi field

Also, in order to accurately determine the direction of the axis of the southern part of the fold, it was proposed to drill well No. 16 OE along the axis of the fold of the field at a distance of 300 m to the southwest of the search well No. 2 of the South Mirshady field. The results of the drilled well No. 16 OE confirmed the direction axis of the South Mirshadi field [5].

III. CONCLUSION

Summarizing the above, it should be noted that at the present stage, the main task is to design modern systems for the development and further development of oil fields in the Surkhandarya region, to assess the actual residual geological reserves and to create energy-efficient, resource-saving technological schemes that provide a controlled impact on the deposits with the displacement of oil from the inter-well zones to the bottom of production wells.
As noted above, the fund of oil producing wells in the Surkhandarya region, more than 70% is operated for 30-50 years at very low operating coefficients.

It should be noted that attempts to reinterpret outdated geological materials without conducting additional exploration work did not allow us to confirm or refute the previously accepted geological parameters of individual oil deposits with the greatest accuracy. This circumstance is also a justifying factor for the need for additional exploration work in the fields with the drilling of new wells, on a large scale.

Based on the results of geophysical and hydrodynamic studies of new evaluation and production wells, qualitatively new permanent three-dimensional geological and hydrodynamic models of productive deposits should be built and the real values of industrial geological reserves estimated, which will allow us to direct work to the design of new scientific and technological solutions that ensure the extraction of geological reserves from the subsurface, up to 50% and above.

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AUTHOR'S BIOGRAPHY

Igamberdieva Lobar Zoirovna – Researcher of the Department of Design and Monitoring of Development of Hydrocarbon Fields of O'ZLITINEFTGAZ JSC.
Direction of activity - issues of increasing the effective development of oil and oil and gas fields, the use of modern technologies to enhance oil recovery of oil and gas fields. Has more than 50 scientific publications in republican and foreign scientific and technical journals and conferences, 12 teaching aids for students.