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Research Article

STRUCTURAL AND TECTONIC STRUCTURE AND PROSPECTS OF OIL AND GAS BEARING CAPACITY OF CENOZOIC DEPOSITS OF THE UZBEK PART OF NORTHERN FERGANA ACCORDING TO 3D SEISMIC DATA

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ABSTRACT
The article deals with the results of MOGT-3D seismic surveys carried out in the Uzbek part of Northern Fergana. The deep geological structure of the area is studied, the identified promising objects for oil and gas are characterized, their parameters are given, on the example of three-dimensional model of Namangan area the geological structures of the Northern Fergana fields are shown, the methodological and geological recommendations for further works are given.

Keywords: *Fergana Depression, Seismic Survey, Mogt-3d, Oil And Gas Content, Structure, Tectonic Faults*

INTRODUCTION
One of the promising areas of the Fergana Basin for the discovery of new oil and gas fields is the Northern rim of the Fergana Basin, a significant part of which is located in the territory of the Uzbek and Tajik Republics.
Within the Uzbek part of this prospective area, a number of oil and gas fields were discovered in Cenozoic sediments, such as Shorbulak, Namangan, Kassansai and Tergachi. Moreover, in the process of prospecting and exploratory drilling for oil and gas, in many wells of prospecting and exploration areas from Paleogene and Neogene sediments oil and gas occurrences were noted (Chustpap well №6) or noncommercial hydrocarbon inflows (Yangikurgan well №2, Iskovat wells №2, 3, Isparan well №1). Despite such positive factors, the area under consideration has long remained poorly studied [Abdullaev *et al*., 2021].
For many years, searches for promising targets in Cenozoic sediments here have been conducted by MOGT-2D seismic surveys using explosive and non-explosive sources. Seismo-geological conditions of the area are complicated and characterized by the presence of numerous tectonic disturbances of different amplitude and direction. Complex surface and downhole seismo-geological conditions, which do not allow to obtain unambiguous conditioned information about the deep structure of oil-and-gas-bearing horizons.
With the introduction of MOGT seismic in 3D modifications, it became possible to obtain high-quality information on such complex areas as the North rim of the Fergana trough. The efficiency of 3D seismic surveys in other areas of the Fergana Basin has been covered in many publications [Babadjanov *et al*., 2004; Kirshin *et al*., 2011; Musagaliyev., 2008].
For the first time in Uzbekistan MOGT seismic survey in 3D modifications was introduced in 2000 in Fergana oil-gas bearing region at Mingbulak area in the Central submerged part of the depression. For the period of 2000-2022 these works covered the following areas: Mingbulak, East Mingbulak, Karajida, Varyk-II, Chinabad and Gumkhana, located in the Central Fergana megasyncline; Varyk-Achisui, Chimion-Kashkarkyr, Khankyz, Auwwal, South Gumkhana-Akbarabad and Andizhan-South Alamyshyk areas of the Southern stage of Fergana depression. During the mentioned period 32000 sq.km. of 3D

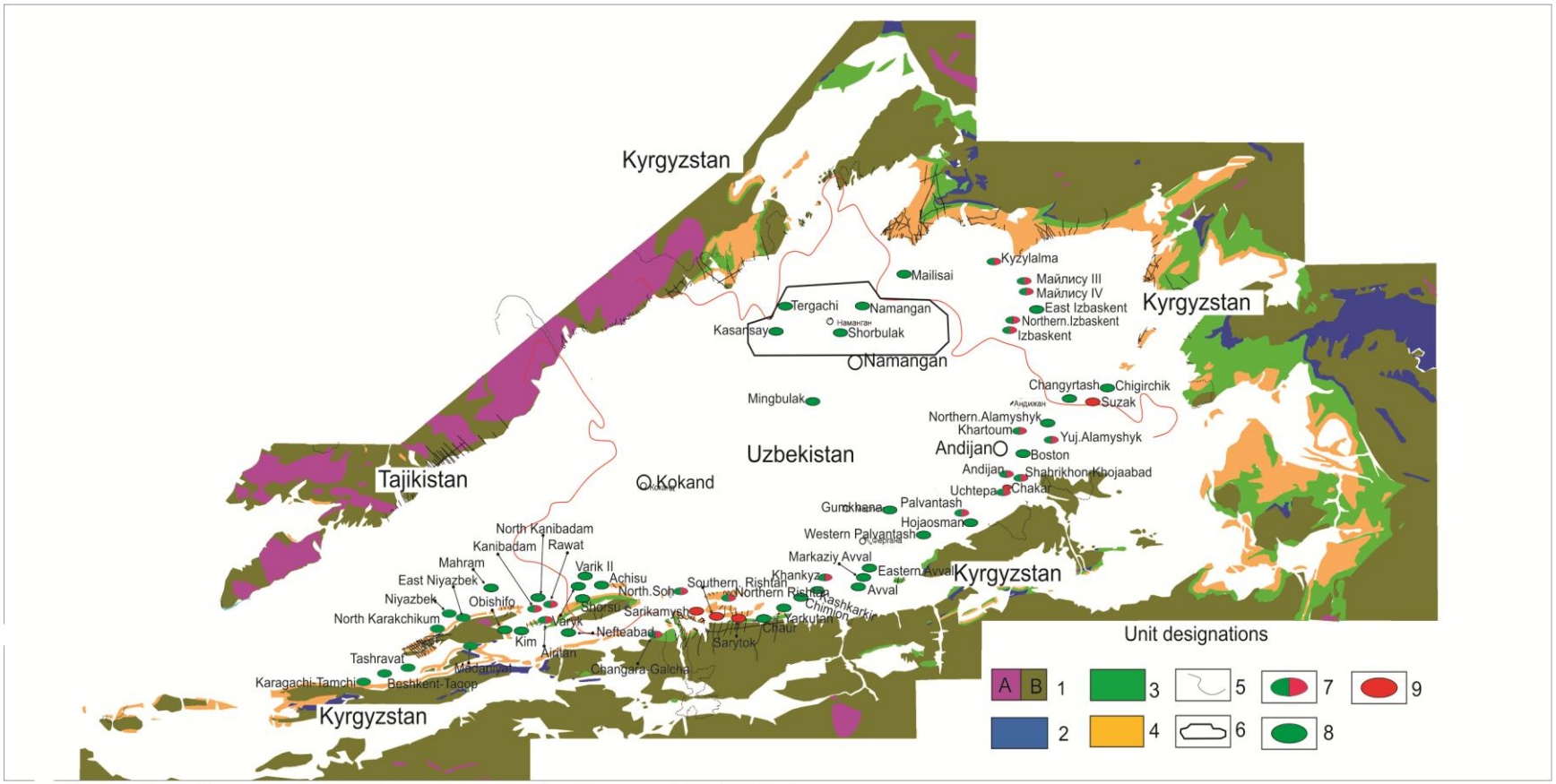

Figure1: Overview map of the work area (compiled by :Urmonov A.H., 2022). 1- *outcrops of the Paleozoik sediment complex;A -intrusive rocks, B-sedimentary rocks, 2-Jurassic outcrops, 3-outcrops of Cretaceous deposited, 4-outcrops of Paleogene deposits, 5-state border, 6-3D seismic exploration area, 7-oil and gas fields, 8-oil fields, 8-gas fields.*

seismic surveys were conducted in the Uzbek part of Fergana region. Including the South Gumkhana-Akbarabad area, 3D seismic survey with 505.35 sq. km. was carried out by Chinese company "BGP" CNPC.

MATERIALS AND METHODS

During 2016-2020, prospecting and exploration seismic works MOGT-3D were carried out at Shorbulak-Namangan and Kassansay-Tergachin areas of Mailisu-Karagunda uplift of Northern Fergana. The purpose of the works was to clarify geological and geophysical models of known oil and gas fields (Tergachi, Shorbulak, Namangan, Iskovat) in Cenozoic deposits, to optimize the laying of subsequent deep drilling wells on them and to search promising objects for oil and gas.

The seismic survey was carried out by a SERCEL "408 UL" telemetric seismic data acquisition system. Groups of 4 vibrators of NOMAD 65 type (France) were used as seismic sources.

The 3D field seismic materials were processed by the hardware-software complex GeoClacteur Plus and data interpretation by Integral Plus (France) at the computing center of Uzbekgeophysics Joint Stock Company.

As a result of the executed works on the reflecting horizon - T (P2), which is stratigraphically related to the roof of V-horizon of the Turkestan Paleogene layers, the structural map was composed at a scale of 1:50000 (Fig. 2). The three-dimensional structural model of the V horizon roof of Paleogene deposits for Shorbulak, Namangan, Tergachi and Isparan-Iskovat areas was compiled (Fig. 3).

RESULTS AND DISCUSSION

The drawn structural map shows in detail the deep geological structure of Namangan-Tergachin area, Northern side of Fergana depression. Paleogene deposits in this area from south-west (absolute marks -2100-2300) to north-east (abs. marks -4900-4950) are regionally dipping complicated by numerous tectonic disturbances of different lengths, directions and amplitudes.

The study area in terms of geological and tectonic structure can be conditionally divided into three structural-tectonic blocks, complicated by anticlinal and tectonically screened structures, and separated from each other by coulically arranged sublatitudinal tectonic disturbances. The main sublatitudinal faults are complicated by numerous outcropping, short, local faults of different orientations.

In the southern part there is Shorbulak - Namangan structural-tectonic block, bounded from the north by local non-extended tectonic disturbances of sublatitudinal orientation. Within this block the Shorbulak and Namangan fields have been studied in detail. In addition to the above-mentioned fields, a number of objects such as Kukumbay, Zap. Shorbulak, South Shorbulak, East Shorbulak, South-West Shorbulak, South-West Namangan, North Namangan and others have been studied in detail here.

The tectonically shielded two-dome Kukumbay fold is confined to the northwestern wing of the Shorbulak structure and is separated from the latter by a tectonic disturbance with an amplitude of about 300 meters. The West Shorbulak structure is a tectonically orcanated block and is confined to the northwestern dip of the Shorbulak field. In the southeastern dip of the Shorbulak field, the tectonically orcanated East Shorbulak block is identified.

Within the interstructural zone, i.e. in the zone of junction of Shorbulak and Namangan fields, the previously identified West Namangan structure and identified objects South-West Namangan and South Namangan have been studied in detail.

The South-West Namangan structure, bounded from the north by a tectonic fracture with an amplitude of about 100 m, adjoins the West Namangan structure from the south. Further, in the southern dip of the Shorbulak - Namangan uplift a tectonically screened fold - South Namangan - has been revealed. In the western end of the considered structural zone the Namangan field is located, in its northeastern dip the

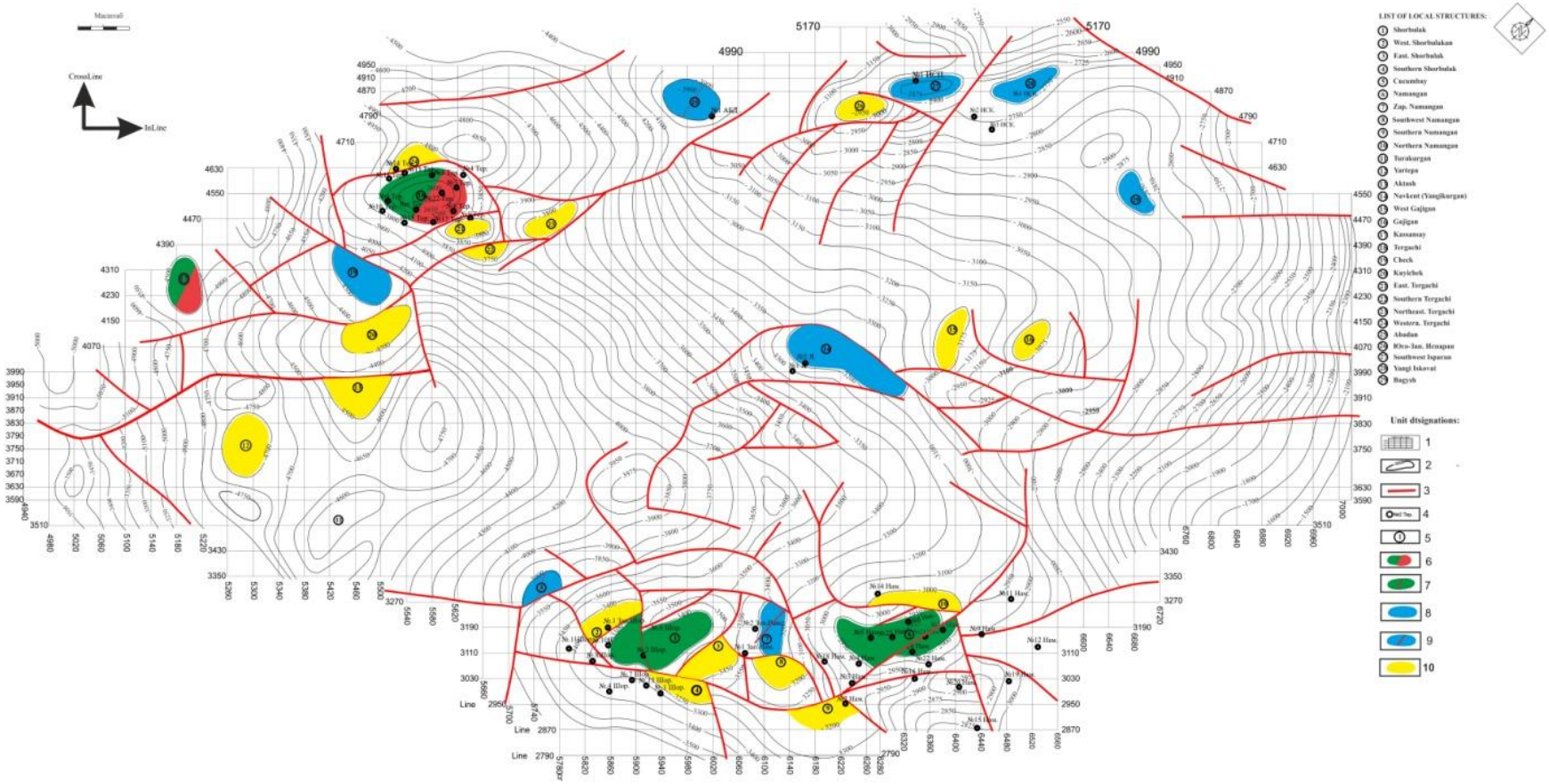

Figure 2. Structural map along the reference reflecting horizon (P2trk) confined to the top of the V layer of the Turkestan layers of the Paleogene (compiled by: Urmonov A.H., 2022). 1- *MOGT-3D profiles, 2-isohypses on the reference reflecting horizon P2, timedto the top of the Turkestan deposits of the Paleogene, 3-tectonic disturbances, 4-deep drilling wells, 5-local Structures, 6-oil and gas fields, 7-oil fields, 8-structures prepared for drilling, 9-structures derived from drilling, 10-revealed structures.*

North Namangan fold is revealed, which in Paleogene sediments is a tectonically screened hemi-anticlinal.

Parameters of the structure on the considered block are: dimensions 2.5-3.5 x 0.5-2.6 km; amplitude from 50-100 m, depth to the maximum closed isohypsis from -3000m to-3900m.

Structural and tectonic block is distinguished in the central part of the area: Yartepa-Turakurgan-Yangikurgan-Zap.Hajigan, broken by numerous tectonic faults into small blocks and structures. Paleogene deposits within this block, according to structural drawings, first dip from West to East from "-3500m" to "-5000m" (Fig.1). After that, they stabilize at -4770m-4750m in the eastern direction, and the same values of depths of reference horizon are observed in the area of anticlines: Yartepa, Tyurakurgan and Kuyichek. Further, from structure Kuyichek in east direction, there is monotonous rise from absolute mark "-4750 m" to "-1500-2100 m", and at the background of general rise to the east in sediments of Paleogene there are structures: Yangikurgan, West Hajigan and East Hajigan complicated with set of breakings (fig.2).

The Yartepa structure, represented by a submeridional strike-slip anticlinal fold, has been studied in the western dip of the block in question.

To the southeast of the latter feature is the terrace-shaped Turakurgan anticlinal fold, previously prepared for deep drilling. To the north of the latter is a tectonically screened, possibly, Aktash trap. To the east of these structures, the Yangikurgan structure has been studied in detail and presented in a new version. In the Paleogene sediments, it is a two-dome structure of northwestern southeastern strike-slip and, practically, unites the previously known Yangikurgan and Gaisan structures (Fig. 2).

Both structures were prepared and put into drilling where a total of five wells were drilled, three in the Gaisan structure and two at Yangikurgan. Despite receiving signs of oil and gas, the structures were not unambiguously interpreted and exploratory drilling was abandoned. According to the surveys carried out, the wells were not drilled in optimal conditions. The Navkent structure has been prepared according to the new construction here and it is recommended to resume drilling.

To the east of the Naukent structure, the West Hajigan structure is detailed through a tectonic disturbance and is represented in Paleogene sediments by an anticline of submeridional strike, complicated in the periclines by a tectonic disturbance.

Parameters of the structure in the central block are: dimensions 1.8-4.2 x 0.8-2.0 km; amplitude from about 50 m, depth to the limiting closed isohypsis from -3075 m to 4700 m.

In the north of the reporting area from west to east along the Cassansay-Tergachi-Abadan-Isparan-Iskavat structure line, a northern structural-tectonic block is developed, within which the absolute marks of Paleogene deposits change within "-5100 m" to "-2700 m". (Fig.2). Against the background of a general regional uplift of Paleogene deposits from west to east, 3D seismic surveys reporting detailed a number of structures, such as: Chek, KuyiChek, Tergachi, South Tergachi, East Tergachi, Northeast Tergachi, West Tergachi, Abadan, Southwest Isparan, Isparan, Iskavat and Bagysh.

Considered structural-tectonic block, according to depth of occurrence of Paleogene deposits is divided into two zones: deep-western part with absolute marks "-3600-5000 m" (Kassansay-Tergachi group of structures) and eastern-elevated, with absolute marks "-2500-3100 m" (Isparan-Iskavatskaya group of structures). Within the Kassansai-Tergachi group of structures are located from west to east: Kassansai, Tergachi, Chek structure, prepared for deep drilling, East Tergachi, South Tergachi, Southeast Tergachi, West Tergachi fields.

The Kassansai site, located at the westernmost end of the area under consideration, is not completely covered by 3D seismic surveys due to the proximity of the state border with the Republic of Kyrgyzstan. Its northern periclinal dip remained unexplored.

To the east of this structure through the sublatitudinal disturbance, adjacent to the Chek structure from the south, the Kuyichek object is mapped. It is represented by an anticline of southwestern-northeastern strike. The northwestern wing is cut off by a sublatitudinal tectonic disturbance, which separates it from the Chek structure.

To the northeast of Kujicek, against the background of the southern dip, a previously identified structure, the Eastern Tergachi, is confirmed and detailed. It is represented by a sublatitudinally striking anticline, bounded on all sides by tectonic faults.
To the east of the latter, the Northeastern Tergachi structure, represented by a sublatitudinally striking anticline, is identified through a fault with meridional strike. The southern wing is cut off by a tectonic disturbance of northeastern strike.
To the south, the tectonically screened South Tergachigeomianticline adjoins the above-mentioned structures. It is bounded to the north by a fault with an amplitude of about 100 m.
In the far northeastern dip of the Tergachi field is the previously prepared Abadan structure for deep drilling. The northern and northeastern wings of the structure were not captured by work due to its location in the border zone, and as a result remained underexplored.
The northeastern end of the investigated area includes the Isparan-Iskavat group of structures. The Isparan, Iskavat and newly discovered Southwest Isparan structures have been studied in detail here.
Newly identified South-West Isparan structure in Paleogene sediments is represented by sublatitudinally striking anticline.
A detailed Bagysh structure is located in the eastern dip of the Iskovat structure.
Parameters of the structure in the northern block are: dimensions 2.0-3.0 x 1.0-2.0 km; amplitude from 50 to 100 m, depth to the extreme closed isohypsis from -1900 m to-4500 m.
As it is known, investigation of promising areas by making three-dimensional models according to 3D seismic data leads to increase of efficiency of carried out works [Musagaliyev., 2008; Urmonov AH *and* Yuldashev TYu., 2016**].** Detailed geological structure of oil and gas fields of the Northern part of the depression will be considered on the example of three-dimensional structural model of Namangan field, on the roof of V horizon of Paleogene sediments. (Fig. 3).
The Namangan deposit, according to the results of the study, is represented by an anticline of sublatitudinal strike, divided by differently directed tectonic disturbances into several blocks. The amplitude of the faults varies from 25 m to 300 m. The central vaulted block, which is a sublatitudinally striking anticline, isohypseous at 2950 m, measuring 4.5x1.5 km. Both wings of the fold are cut off by a fault of the same direction; the northwestern periclinal of the fold is flat and longer than the northeastern periclinal, which is bounded by a tectonic fault (Fig. 3).
The southern wing of the fold is divided into three blocks: the upper tectonically screened block, adjoining the fold vault from the south, with wells Nos. 24, 23, 21 and 22 located at isohypsis -2925 m, has dimensions of 3.6 x 1.6 km.
The lower block is bounded by tectonic faults on all sides and drilled by wells Nos. 2, 16 and 20 at isohypsis -2900 m has dimensions of 2.5 x 1.3 km (Fig.3).
The tectonically screened block to the east of the latter through the meridional fracture, studied by well № 19: on isohypsis -2950 m, has dimensions 3.0 x 1.8 km.
In the south-west dip of the Namangan field from south-east to north-west two objects were identified: South Namangan and South-West Namangan. West Namangan block was identified in the north-west continuation, which was previously studied by drilling two wells: Namangan West No. 1 and 2.
The South Namangan object, according to the limiting closed isohypse - 3250 m, has dimensions of 4.5 x 2.0 km. South-western Namangan structure by isohypsis-3200m, has dimensions of 2.5 x 1.8km. The area of these objects is 9.0 sq km and 3.4 sq km respectively.
The western - Namangan tectonically screened block is of no practical interest due to negative results obtained by wells 1 and 2.
The central arch of Namangan field is adjacent to the North Namangan hemiantiklinal, bounded from the south by a tectonic disturbance of sublatitudinal strike. It has dimensions of 3.5 x 0.6 km according to limiting closed isohypse-3000 m. The results show that, in contrast to earlier views, the fields of the northern part of the depression are complicated by multiple tectonic faults, and consist of a set of separate tectonic blocks.

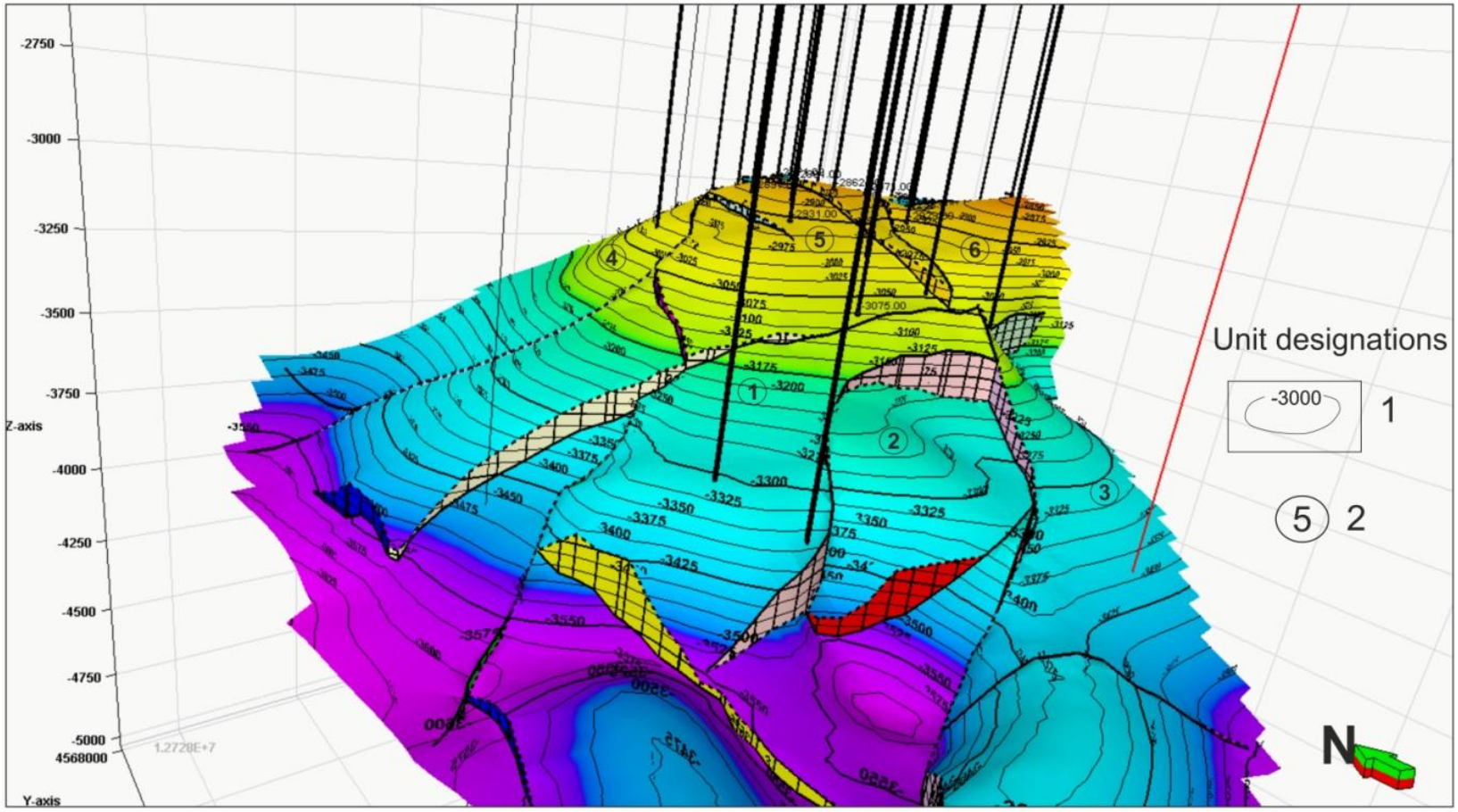

Figure 3: Namangan oil fields. Three-dimensional structural model along the topof the V-horizon of Paleogene deposits (compiled by: Urmonov A.H. 2022). 1- *isohypses on the reference reflecting horizon P2, timed to the top of the Turkestan deposits of the Paleogene, local structures: 1-West Namangan, 2-South Namangan, 3-South west Namangan, 4-North Namangan, 5-Namangan, 6-upper tectonically shielded block of Namangan.*

CONCLUSIONS AND RECOMMENDATIONS

Thus, the results of completed MOGT-3D seismic surveys allow us to conclude that the geological and tectonic structure of the central part of the northern side of the Fergana Depression has been studied in detail. The following promising oil and gas structures have been prepared for prospect drilling: Navkent and Chek in Cenozoic and Tergachi in Cretaceous sediments. New promising structures were identified: East and South Shorbulak, South-West and South Namangan, North-East, South and West Tergachi, South-West Isparan, GarbiyGajigan and others: the following structures were recommended for retraining and drilling: Isparan, YangiIskovat in Cenozoic and Shorbulak in Cretaceous sediments.

The structural map on the reference reflecting horizon (Ꝑ2trk) confined to the roof of the V layer of Turkestan Paleogene layers of the Shorbulak-Namangan-Tergachi-Iskovat area was made at a scale of 1:25000 and 1:50000.

To improve the quality and efficiency of the conducted works, the following is recommended: to provide the survey areas with uniform multiplicity by means of operational planning by the complex of MESA programs and GPS satellite system; to optimize the 3D survey area, providing simultaneous registration of both steep-dipping horizons of the instrumental zone with deep occurrence and in the elevated zone of the Northern part of the Fergana depression; in conditions of adyrs and in the area of development of gravel-cone cone-bearing deposits, to study in detail the upper parts of the section.

The introduction of the obtained results into production, undoubtedly, leads to the discovery of new oil and gas deposits, and an increase in hydrocarbon production in the Northern part of the Fergana Basin.

REFERENCES

Abdullaev GS, Bogdanov AN, Eidelnant NK (2021). Current state and development prospects of oil and gas exploration in the Fergana region of the Republic of Uzbekistan. Oil and Gas Geology. Theory and Practice. 2021-T.16-№2.-http://ngtp.ru/rub/2021/15_2021.html.-26p.

Babadjanov TL, ZunununovFKh, Mametov KM (2004). Volumetric seismic survey in Uzbekistan // Geology and Mineral Resources. **5**. c.35-40.

Kirshin AV, Mukhutdinov NU, Yuldashev NI, Devyatov RR (2011). Efficiency of volumetric seismic survey in Uzbekistan in solving structural-tectonic problems // Uzbek Journal of Oil and Gas, **1**. 12-14.

Musagaliyev MZ (2008). Efficiency of 3D seismic survey in searching for oil and gas deposits // Moscow, Gubkin Russian State University of Oil and Gas, Oil and Gas**. 1.** 47-53.

Urmonov AH, Yuldashev TYu (2016). Ways to increase hydrocarbon production in the Khankyz field according to 3D seismic and GIS data // Materials of the Republican scientific-practical conference "Modern forecast of hydrocarbon potential of the bowels and progressive technologies of prospecting and exploration for oil and gas". Tashkent, 238-240.