History of tectonic development of the southeastern part of the Turan plate

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Abstract. The history of the tectonic development of the territory of the Turan Plate in the pre-Jurassic and Lower-Middle Jurassic times is considered. The development of stages of rifting on the territory of the Amudarya syneclise is analyzed. The structural elements of the rift are examined. The tectonic development of the eastern part of the Turanian plate in Neogene-Anthropocene time is analyzed in more detail. Its large structural elements are substantiated with detailed descriptions of its characteristic features.

1 Introduction

The history of the tectonic development of the described territory was discussed by many researchers (A.A. Akramkhodzhaev, G.I. Amursky, A.A. Abidov, A.G. Babaev, T. Babadzhanov, A.A. Bakirov, R.G. Gavrilov, R.G. Garetsky, Sh. Peive, O.A. Ryzhkov, B.B. Sitdikov, B.B. Tal-Virsky, V.I. Troitsky, V.S. Shein, A.L. Yanshin, M.E. Egamberdyev, etc.).

The need to consider this issue arises from a number of reasons. Firstly, in recent years, new factual drilling and geophysical material has accumulated, significantly supplementing our knowledge of the paleotectonics of the region. Secondly, there are contradictory statements, for example, about the relationship between structural plans in the sedimentary cover and pre-Jurassic layers, etc.

The history of the tectonic development of the study area is relatively complete starting from pre-Jurassic deposits. Pre-Jurassic (preplate, intermediate or transitional complex) deposits on the territory of the Amudarya syneclise are confined mainly to the Khiva and Zaunguz (Izmail-Bagadzhinsky) grabens, delimited by the Central Amudarya horst. Here they are divided into Lower-Middle Carboniferous terrigenous-carbonate-volcanogenic, Upper Carboniferous-Lower Permian volcanogenic-sedimentary, Upper Permian-Lo-wer Triassic volcanogenic-terrigenous strata (according to A.M.Akramkhodzhaev, A.A.Bakirov, V.A.Bush, R.G. Garetsky, V.S.Knyazev, A.E.Starobinets, Kh.Uzakov and others.

The lower and middle formations are essentially marine, while the upper is continental. The latter forms an orogenic structural-tectonic stage, and the first two form a quasi-platform [6]

Within the Khiva graben, deposits of three formations are developed, up to 4-5 km thick. In the area of the Zaunguz graben, the thickness of pre-Jurassic rocks most often does not exceed 1-0.5 km. In the area of the Central Amudarya horst, pre-Jurassic layers are not recorded.

2 Methodology for analyzing tectonic development

The development of extension structures (grabens) along pre-Jurassic deposits, which were essentially filled with volcanics, indicates that a rift appeared on the territory of the Amudarya syneclise during Carboniferous - Early Triassic time. The rift was located southwest of the Chardzhou step that emerged later, within the eastern part of the Karakum microplate; extended submeridionally, had a length of about 350 km and a width in the middle part of up to 200 km, and had a wedge-shaped shape, expanding to the south (Fig. 1).

During the Northern Revolution, it most likely formed within the shelf located in the east of the Karakum microplate, where calcareous, clayey or volcanogenic formations accumulated, and in some places reefs and others formed.

The width of this coastal zone reached 200-250 km. In the east, the shelf ended with the Chardzhou geomorphologically and tectonically expressed fault (ledge) of a strike-slip type, behind which there was either a continental slope or an ocean (ocean crust). The shelf was structurally a system of megablocks, divided into macroblocks, articulated with each other and manifested with varying intensities. Intense volcanic activity has occurred here several times. The possibility of manifestation within the shelf of continental spreading (?), which was formed during the Riphean formation of the earth's crust and underwent spreading, cannot be ruled out. This conclusion arises from the fact that the volcano-plutonic complex reaches a thickness, at least in the northern part of the rift, where the Chardzhou,

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Bukhara, Elan and Central Ustyurt faults meet, of about or more than 1000 m.

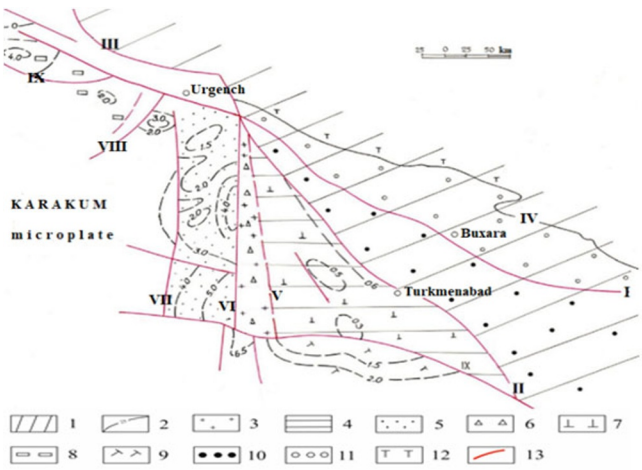

Fig 1. Amudarya rifts. (Ryzhkov O.A., Zakirov R.T., based on materials by A.Alan, G.E. Dikenshtein, K.N. Kravchenko, A.V.Peive, A.E. Starobintsev and others.)

Legend: 1.Paleotis: South Tien Shan geosynclinal region, pre-Jurassic (first generation) paleorift; 2.Isopachs of pre-Jurassic (Carboniferous - Lower Triassic sediments, in km); 3. Absence of pre-Jurassic deposits according to KMPV data; 4. The thickness of the Upper Paleozoic - Lower Triassic deposits is less than 0.5 km (up to their complete pinchout) - according to A.E. and M.E. Starbintsev; 5. Khiva graben; 6. Central - Amudarya horst; 7.Zaunguz (Izmail-Bagadzhinsky) graben; 8. Mangyshlak - Central Ustyurt rift zone; 9.Murgab rift; 10. Chardzhou shoulder; 11. Bukhara shoulder; 12. Kyzylkum uplift; 13. Faults (Flexural-fault zones): I – Chardzhou, II-Bukhara, III- Takhtakair-Sultanuizdag, IV-marginal Tien Shan orogen, V-Mergen, VI-Elan (Khorezm-Murghab), VII-Beurdeshik, VIII-Central Karakum, IX South Daryalyk.

Subsequently (R-T), the third stage, the stage of rift orogenesis, appeared. It is characterized by the formation of block mountains (mainly due to vertical movements of blocks), the manifestation of intense volcanism, moderate dissection of the relief, and the accumulation of relatively thick volcanic molasse.

The considered Amudarya rift of S-T time, corresponding to the rifting of the first generation in this area, went through three stages in its development: initiation, continental spreading (?) and rift orogenesis. The Amudarya rift of the first generation is located along the continental margin; its development was accompanied by active volcanic activity at all stages of its manifestation. It ceased its development at the end of the Late Permian-Early Triassic time. Its regional structures - the Beurdeshik shoulder, the Khiva and Zaunguz grabens and the Central Amudarya horst were revived and inherited continued to develop at the beginning of the Early-Middle Jurassic time; postumnian movements of the Central Amudarya horst are recorded even in the Jurassic and early Cretaceous times; then an inversion occurred, and the central part of the Amudarya syneclise began to form in this zone [4].

In the Early-Middle Jurassic (during the Cimmerian tectonic era), the second generation of the rift appeared on the territory of the Amudarya depression. It is associated with the general development of rifting at this time within the Eurasian continent [2]. If the first generation of the rift in the territory under consideration occurred on the eastern margin of the Karakum Plate, and this rift was replaced in the east by the Paleotethys, then its second generation appeared within the Eurasian continent. The Early-Middle Jurassic rift was formed not only on the territory of the first generation rift, but also significantly expanded to the east due to the involvement of adjacent parts of the continental crust of the Late Hercynian formation in its area; here the Chardzhou, Bukhara and Central Kyzylkum shoulders arose [5,7]. In the area of these rift shoulders, compression of the earth's crust sharply manifested itself in pre-Jurassic times. From the beginning of the Jurassic (possibly from the Late Triassic), it was replaced by extension, which led to the origin and development of these shoulders, as well as the formation of not only the slit-like Kimirek mesorift (O. Ryzhkov et al., 1985), but also the Zekrinsky one within the same Bukhara FRZ. In the Early and Middle Jurassic times, the Amudarya rift was filled with relatively thick, mainly terrigenous sediments - alternating gray, inequigranular, calcareous sandstones, gray siltstones, less often mudstones; tuffs were found among these rocks; interlayers of conglomerates and limestones are noted [6]. Volcanic rocks of alkaline composition are quite common in the Koshabulak region. Thus, the blocks of the Amudarya rift in the Cimmerian tectonic era were subjected to relatively intense spreading, penetration of the roots of deep faults into the “basalt” layer and, apparently, the upper mantle, from where volcanics came to the surface of the earth. This cycle of rifting began to degenerate by the end of the Middle Jurassic, as evidenced, firstly, by the cessation of activity of some of the previously manifested faults delimiting individual blocks (Beurdeshiksky, Mergensky), which indicates a weakening of the transverse movement, and secondly, the absence of the upper Jurassic terrigenous volcanic formations. The paleorift territory under consideration was located on the southern flank of the South Tien Shan uplift of the Eurasian continent.

3 Analysis of the tectonic development of the territory in Neogene-Anthropogenic times

At the end of the Oligocene, tectonic activity sharply intensified within the Turanian plate, which included the territory of our research. It flowed more intensely both from the northeast and to the southeast. As is known, the post-platform Tien Shan orogen arose here and further east on the plate. Within most of the Chardzhou and Bukhara steps, part of the Turan plate continued to develop. In the area under consideration, the orogen was manifested by an uplift - the southwestern subsidence of the Gissar meganticline and subsidence - by the foothill (marginal) Beshkent-Kashkadarya depression, which is an element of the foothills of the Newest Tien Shan [5,8]; the depression is also considered as a megablock. The south-eastern limit of the depression is the Lyangara-Karail FRZ, the north-western limit is the isopach of Neogene-anthropogenic layers of 500 m due

to the fact that to the north-west of it the thickness of the sediments in question gradually decreases, and then fluctuates between 100-200 m, while as to the southeast of the 500m isopach it increases relatively quickly, reaching up to 2000m or more in individual blocks (Fig. 2).

The foothill trough is superimposed on the part of the Turanian plate involved in the subsidence (Fig. 2). It is relatively strongly divided into separate blocks, characterized by their own unique structure, the thickness of the Cenozoic molasse, and even the sections of the Jurassic terrigenous formation. Fault tectonics manifested itself more often in the form of reverse faults, less often faults (mainly in its northwestern part); The blocks developing here are articulated.

In general, the foothill basin can be considered as a megablock, which smoothly merges with the Turanian plate in the southwest and northwest, and gradually articulates with the uplifting part of the orogen in the northeast; the depression developed in the southeastern parts of the Bukhara and Chardzhou steps that had previously appeared here.

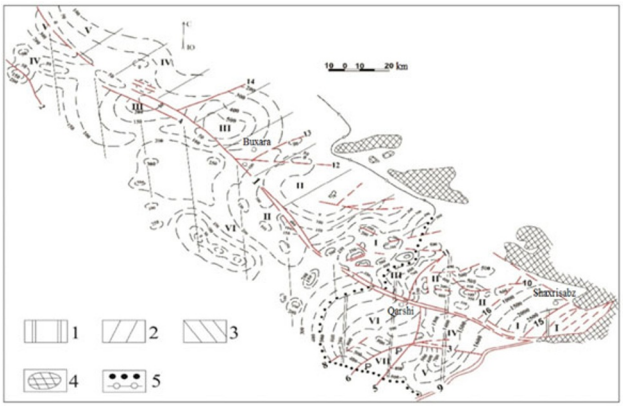

Fig. 2. Paleotectonic diagram along the base of the Neogene-Anthropogen at the time of completion of their accumulation. (Ryzhkov O.A., Zakirov R.T., Khalismatov I.)

Legend: 1. Beshkent-Kashkadarya foothill depression: I. Shakhrizyab mesoblock, II. Tashly-Uvidi mesoblock, III. Bayburak-Rudaksai mesoblock, IV. Zafar mesoblock, V. Shurtan mesoblock, VI. Yangikent mesoblock, VII. Alyaudinsky-Ilimsky mesoblock 2. Bukhara stage: I. Mubarek monoclinal slope, II. Kagan macrouplift, III. Rometan macrotrough, IV. Gazli structural nose, V. Tuzkoy monoclinal slope. 3. Chardzhou degree: I. Dengizkul macro-uplift, II. Ispanly-Chandyr macro-uplift, III. South Kimire fault trough, IV. Khodzhikazgan uplift V. North - Eastern Gugurtlinsky fault trough, VI. Kushabsky trough. 4. Outcrops of Paleozoic sediments on the surface. 5. Boundary of the latest Tianyshan orogen with Turan. Main regional faults: 1. Bukhara FRZ, 2. Chardzhou FRZ. Intrastage faults: 3. North-Shurtansky, 4. South-Kimireksky, 5. Kuruksai-Mangitsky, 6. Alyaudinsky, 7. Beshkent-Kamashinsky, 8. Nishansky, 9. Lyangara-Karailsky, 10. Uvadinsky-Sarychinsky.11 .Andabazar-Karaktai. 12. Proletar-Abad, 13. Kuyumazar, 14. Atbakar, 15. Yakkasaray, 16. Chirakchin.

The megablock, mainly by a system of faults that caused a sharp change in the thickness of the newest accumulations within them, is divided into three macroblocks: northern (Shakhrizyab-Tashlyk), central (Zafar) and southern (Shurtan-Yangikent) (Fig. 2).

The Shakhrizyab-Tashlyk macroblock consists of three mesoblocks (from southeast to northwest) Kashkadarya, Tashly-Uvadinsky and Baiburak-Rudaksay. The second structure is a horst complicated by folds. Within the Kashka-Darya structure, the maximum thicknesses of the rocks under consideration throughout the entire trough have accumulated - up to 2000 m or more. The Baiburak-Rudaksai mesoblock is characterized by a decrease in the thickness of accumulations to the northwest. It is also complicated by local folds and faults (Fig. 2).

The middle part of the megablock is formed by the Zafar macroblock. It is enclosed between the Bukhara FRF in the north and the North Shurtan fault in the south, and the northern part of the Kuruksai-Mangit fault in the west.

The macroblock is a graben inclined in an easterly direction (Fig. 2). The southwestern part of the macroblock is broken by several faults of local importance, forming the North Shurtan tectonic wedge - graben.

The southern macroblock at least consists of the Shurtan, Yangikent mesoblocks and the Alyaudinsky-Ilimsky wedge-shaped horst.

The Shurtan mesoblock relative to the Zafar macroblock is elevated in places by up to 1000 m. In regional terms, it is a near-fault hemicycline with a maximum thickness of the deposits in question more than 700 m. In the southwest it is distinguished by a near-fault uplift, which to the west is replaced by the Alyaudinsky-Ilimsky horst, where these deposits are absent.

The Yangikent mesoblock is located south of the Bukhara FRZ, west of the northern part of the Kuruksai-Mangitsky and west of the Alyaudinsky faults. Regionally, it is expressed by two near-fault hemisynclines with a sediment thickness of up to and more than 900 m. To the west of them, the thickness of the deposits in question gradually decreases.

Thus, the considered foothill depression was paleostructurally connected by Lower Jurassic-Lower Callovian deposits with the Shurtan near-fault macrotrough, the Kultak-Zafar macroblock, the Shakhrizyab and Azlyartepa troughs; for Kimmeridgian-Tithonian deposits - with the Shurtan, Nishan, Beshkent-Kamashin and eastern part of the Urtabulak-Aizavat mesoblocks and the southeastern part of the Bukhara stage; along the Cretaceous deposits - with the Shurtan mesoblock, the Kultak-Zafar macroblock and the Alyaudin-Ilim graben and the southeastern part of the Bukhara step.

All this indicates a serious reworking of the structure of the earth's crust here during the accumulation of sedimentary cover, especially in recent times, when independent blocks of various sizes and structures arose, articulated with each other. The foothill trough originated at the base of the Tien Shan orogenic uplift and thus developed on platform pre-Neogene structures.

North-west of the Shakhrizyab-Tashlyk macroblock, on the area of the Turan plate, the Mubarek monoclinal slope stands out. Within the uplift, numerous folds are outlined, broken by faults, mainly of north-eastern strike. The thickness of the rocks in question in the raised wings is 150-200m. North-west of the Mubarek uplift is the Kagan macrouplift. The uplift from the northwest is

limited by the Proletarabad fault. To the north-west, between the Kuyumazar and Atbakor faults, the Rometan trough is located. In the central part, the thickness of these deposits is more than 500 m. Even further to the north-west there is a weakly expressed Gazli structural nose and the Tuzkoy monocline.

On the territory of the Chardzhou stage, based on Neogene-Anthropocene deposits, the Dengizkul uplift is distinguished with the absence of these deposits on the arches of the folds complicating it; also the Ispanly-Chandyr fault uplift. North-west of the Dengizkul and Ispanly-Chandyr uplifts, the Karakul trough is distinguished; the Kushab trough is also recorded between the Dengizkul and Ispanly-Chandyr uplifts. The South Kimirek near-fault trough, the folds of the Gugurtlinsky macro-uplift and the northeast located near-fault trough are well identified. In the area of the Khadzhikazgan uplift, the southwestern wing of the Chardzhou FRZ is lowered by approximately 100 - 150 m, forming a near-fault trough, as in the layers of the terrigenous Jurassic, and in the Cretaceous, this wing was raised by 400 m compared to the northeastern one.

The Bukhara FRZ is fixed by its previously described elements: the Prigugurtlinsky-Yangikazgan - near-fault trough, the Pritaikyrsky - elevated southern wing, the Zekrinsky-Kassantausky - graben or stepped faults, the Kassantausky - Kanallinsky - horst or large-amplitude step.

4 Conclusion

Based on the results of tectonic analysis, the following were identified:

1. The study of the modern structure and paleotectonics of the region indicates the development within its boundaries of both folded and discontinuous (block) structures, which manifested themselves in different places with unequal severity. The modern structure of the study area includes the Beshkent-Kashkadarya, Bukhara and Chardzhou megablocks and the Bukhara flexural fault zone.

2. As a result of paleotectonic analysis, Lower-Middle Jurassic rifting was revealed and it was expressed in the territory by the Bukhara slot-like mesorift, Chardzhou and Bukhara shoulders.

3. It has been established that tectonics affects both reserves and the distribution of oil and gas deposits in section and area. In this case, the intensity of manifestation, regional distribution, and the depth of active faults are of particular importance.

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