Technical science and innovation

Volume 2021 | Issue 4 | Article 3

12-27-2021

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Recommended Citation
Zakirov, Azamjon; Zakirov, Ravshan; Khalismatov, Irmuxamat; Feruzaxon, Zakirova; and Victor, Borshov (2021) "THE HISTORY OF THE TECTONIC DEVELOPMENT OF THE SOUTH-EASTERN PART OF THE TURAN PLATE AND THE BESHKENT-KASHKADARYA FOOTHILL DEPRESSION OF THE MODERN TIEN SHAN," *Technical science and innovation*: Vol. 2021: Iss. 4, Article 3.
DOI: https://doi.org/10.51346/tstu-01.21.4-77-0144
Available at: https://btstu.researchcommons.org/journal/vol2021/iss4/3

THE HISTORY OF THE TECTONIC DEVELOPMENT OF THE SOUTH-EASTERN PART OF THE TURAN PLATE AND THE BESHKENT-KASHKADARYA FOOTHILL DEPRESSION OF THE MODERN TIEN SHAN

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***Abstract**. The article examines the history of the tectonic development of the southeastern part of the Turan Plate and the Beshkent-Kashkadarya foothill depression, which have been studied and discussed by many researchers. The history of the tectonic development of the research area is relatively complete since the Pre-Jurassic deposits. The pre-Jurassic deposits on the territory of the Amu Darya syneclise are confined mainly to the Khiva and Zaunguz grabens, delimited by the Central Amu Darya ridge.*

At the end of the Oligocene, tectonic activity increased sharply within the Turanian Plate, which included the research area. It flowed more intensively both from the northeast and to its southeast. Here and further to the east, the post-platform Tianshan orogen appeared on the plate. Within the greater part of the Chardzhou and Bukhara stages, a part of the Turan Plate continued to develop.

The foothill deflection is superimposed on a part of the Turanian plate involved in the deflection. It is relatively strongly divided into separate blocks characterized by a structure peculiar only to them, the capacities of the Cenozoic molasses and even sections of the Jurassic terrigenous formation.

In general, the foothill depression can be considered as a megablock, which in the southwest and northwest smoothly merges with the Turan plate, and in the northeast gradually articulates with the uplifting part of the orogen, the depression developed in the southeastern parts, previously manifested here by the Bukhara and Chardzhou stages.

***Keywords**: tectonics, plates, deflection, step, deposition, thickness, section, formation, syneclise, ridge, graben*

Introduction. The history of the tectonic development of the described territory has been discussed by many well-known domestic researchers, including A.A. Akramkhodzhaev, G.I. Amursky, A.A. Abidov, A.G. Babaev, T.L. Babajanov, A.A. Bakirov, R.G. Gavrilov, R.G. Garetsky, Sh.D. Davlyatov, G.H. Dickenstein, F.H. Zunnunov, S.I. Ilyin, N.A. Krylov, A.K. Maltseva, A.H. Nugmanov, A.V. Peive, O.A. Ryzhkov, B.B. Sitdikov, B.B. Talvirsky, V.I. Troitsky, V.S. Shein, M.E. Egamberdiyev, A.L. Yanshin, etc. [10, 14, 15].

Pre-Jurassic and Early Jurassic-Early Kellovian time. The history of the tectonic development of the research area is relatively complete since the Pre-Jurassic deposits. The pre-Jurassic (pre-lithic, intermediate or transitional complex) deposits on the territory of the Amu Darya syneclise are confined mainly to the Khiva and Zaunguz (Izmail-Bagajinsky) grabens, which are bordered by the Central Amu Darya ridge (Fig. 1). Here they are divided into Lower-Middle carboniferous terrigenous-carbonate-volcanogenic, Upper-Carboniferous-Lower Permian volcanogenic-sedimentary, Upper Permian-Lower Triassic volcanic-geno-terrigenous strata (according to A.M. Akramkhodzhaev, A.A. Bakirov, V.A. Bush, R.G. Garetsky, V.S. Knyazev, A.E. Starobinets, H. Uzakov, etc.).

The lower and middle formations are essentially marine, while the upper one is continental. The latter forms an orogenic structural-tectonic floor, and the first two are quasi-platform [1].

Within the limits of the Khiva graben, deposits of three formations with a thickness of up to 4-5 km are developed. On the area of the Zaunguz graben, the thickness of pre-Jurassic rocks most often does not exceed 1-0.5 km (Fig. 1). The pre-Jurassic layers are not fixed on the area of the Central Amu Darya Mountain.

The development of stretching structures (grabens) along the Pre-Jurassic sediments, which were filled significantly with volcanites, indicates that a rift was manifested on the territory of the Amu Darya syneclise during the Carboniferous – Early Triassic time. The rift was located southwest of the later Chardzhou stage, within the eastern part of the Karakum microplate; it extended submeridionally, had a length of about 350 km and a width, in the middle part, up to 200 km, had a wedge-shaped shape that expanded to the south (Fig. 1). During the S-R, it was formed most likely within the shelf located in the east of the Karakum microplate, where calcareous, clay or volcanogenic formations accumulated, reefs formed in places, etc. [11].

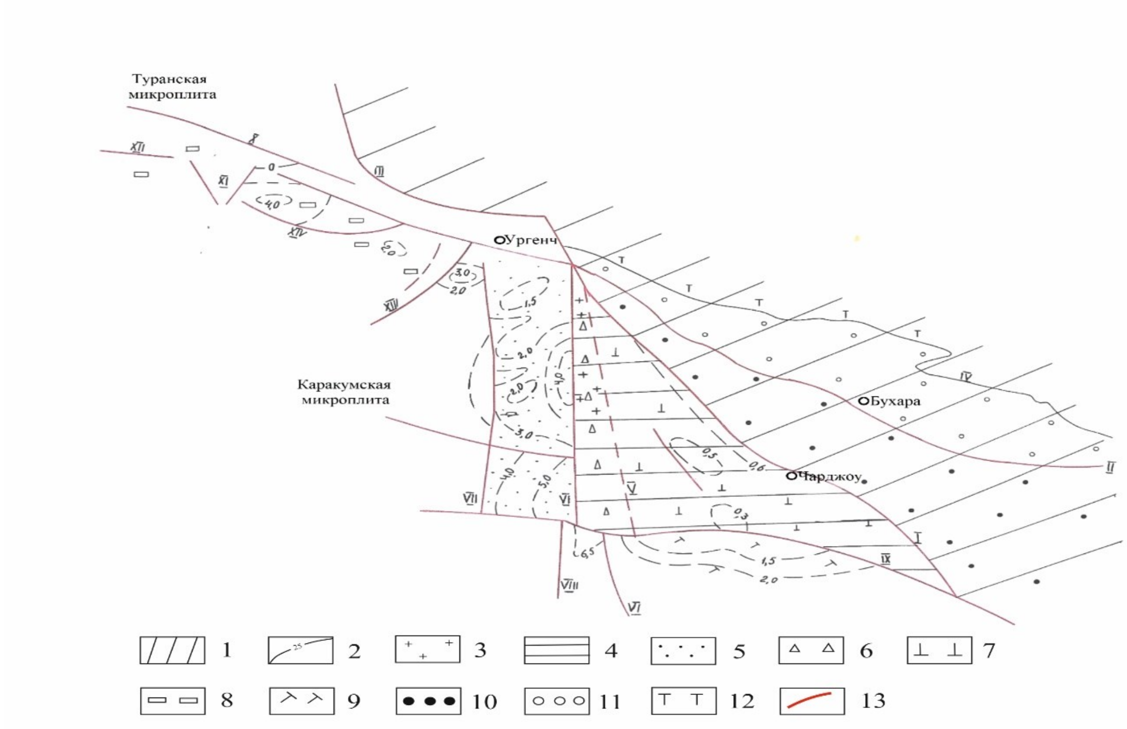

Figure. 1. Amu Darya rifts. (Ryzhkov O.A., Zakirov R.T., Khalismatov I. based on the materials of A. Alan, G.E. Dickenstein, K.N. Kravchenko, A.V. Peive, A.E. Starobinets, etc.)

Symbols: 1. Paleotis: The South Tien Shan geosynclinal region of the Pre-Jurassic (first generation) paleorift; 2. Isopachites of Pre-Jurassic (Carboniferous-Lower Triassic deposits, km); 3. Absence of Pre-Jurassic deposits according to the KMPV; 4. Thickness of Upper Paleozoic-Lower Triassic deposits less than 0.5 km (up to their complete wedging) – according to A.E. and M.E. Starobinets; 5. Khiva graben; 6. Central Amu Darya ridge; 7. Zaunguz (Izmail-Bagajinsky) graben; 8. Mangyshlak-Central Ustyurt rift zone; 9. Murgab rift; 10. Chardzhou shoulder; 11. Bukhara shoulder; 12. Kyzylkum uplift; 13. Faults (Flexural-discontinuous zones): I – Chardzhou, II – Bukhara, III – Takhtakair-Sultanuizdag, IV – marginal Tien Shan newest orogen, V – Mergen, VI – Elan (Khorezm-Murgab), VII – Beurdeshik, VIII – Serakh, IX – Yerbent-Donguzsyrt, X – Northern-Mangyshlak-Ustyurt, XI – East and West Shurshinsky, XII – North-Shakhpakhtinsky (South Ustyurt), XIII – Central Karakum, XIV – South Daryalyksky.

The width of this coastal zone reached 200-250 km. In the east, the shelf ended with the Chardzhou geomorphologically and tectonically pronounced fault (ledge) of the shear type, behind which there was either a continental slope or an ocean (oceanic crust). The shelf was structurally a system of megablocks, divided into macroblocks, articulated with each other and manifested with varying intensity. Intense volcanic activity has repeatedly taken place here [6, 8]. The possibility of the manifestation of continental spreading (?) within the shelf, which was laid down at the Riphean formation of the Earth's crust, which was subjected to spreading, is not excluded. This conclusion suggests itself from the fact that the volcanic-plutonic complex reaches power, at least in the northern part of the rift, where the Chardzhou, Bukhara, Elan and Central Ustyurt faults join, about or more than 1000 m.

Subsequently, the third stage, the stage of rift orogeny, appeared (P-T). It is characterized by the formation of blocky mountains (mainly due to vertical movements of blocks), the manifestation of intense volcanism, moderate dismemberment of the relief, accumulation of relatively powerful volcanic molasses.

The considered Amu Darya rift of C-T time, corresponding to the riftogenesis of the first generation in this area, has passed three stages in its development: laying, continental spreading (?) and rift orogeny. The Amu Darya rift of the first generation is located on the outskirts of the continent; 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 Amu Darya Ridge were revived and continued to develop inherently at the beginning of the Early-Middle Jurassic time; posthumous movements of the Central Amu Darya Ridge are recorded even in the Jurassic and Early Cretaceous time; then an inversion occurred, and the central part of the Amu Darya syneclise began to form in this zone [2].

In the Early-Middle Jurassic period (in the Cimmerian Tectonic epoch), the second generation of the rift appeared on the territory of the Amu Darya Depression. It is connected with the general development of riftogenesis within the Eurasian continent at that time [3]. 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 Paleothesis, then its second generation manifested itself within the Eurasian continent. The Early-Middle Jurassic rift was formed not only on the territory of the rift of the first generation, but also significantly expanded to the east due to the involvement of adjacent parts of the continental crust of the Late Hercynian formation into its area; its Chardzhou, Bukhara and Central Kyzylkum shoulders appeared here [4]. In the area of these shoulders of the rift in the pre-Jurassic period, the compression of the Earth's crust was sharply manifested. From the beginning of Jurassic time (possibly from the late Triassic) it was replaced by stretching, which led to the origin and development of these shoulders, as well as the formation of not only the slit-shaped Kimirek mesorift (O. Ryzhkov et al., 1985), but also the Zekrin one within the same Bukhara flexural-discontinuous zone (FDZ). In the Early and Middle Jurassic, the Amu Darya Rift was filled with relatively powerful, mainly terrigenous deposits – alternating gray sandstones, multi-grained, calcareous, gray siltstones, less often mudstones, tuffs were found among these rocks; Interlayers of conglomerates and limestones are noted [5]. Volcanites of alkaline composition are quite common in the Koshabulak district. Thus, the blocks of the Amu Darya rift in the Cimmerian tectonic epoch underwent relatively intensive spreading, penetration of the roots of deep faults into the "basalt" layer and, apparently, the upper mantle, from where volcanites came to the earth's surface. This cycle of rifting began to degenerate by the end of the Middle Jurassic time, as evidenced, firstly, by the cessation of the activity of some of the previously manifested faults that delimit individual blocks (Beurdeshik, Mergen), which indicates a weakening of the transverse expansion, and secondly, the absence of volcanites in the upper Jurassic terrigenous formation. The paleorift area under consideration was located on the southern wing of the South Tien Shan Uplift of the Eurasian continent [9].

Neogene-anthropogenic time. At the end of the Oligocene, tectonic activity increased sharply within the Turanian Plate, which included the territory of our research. It flowed more intensively both from the northeast and to its southeast. As you know, here and further to the east, the post-platform Tien Shan orogen appeared on the plate. A part of the Turan Plate continued to develop in most of the Chardzhou and Bukhara stages. In the area under consideration, the orogen was manifested by the uplift – the southwestern immersion of the Hissar meganticline and the immersion – the foothill (marginal) Beshkent-Kashkadarya depression, which is an element of the foothill of the Newest Tien Shan [4, 7]; the depression is also considered as a megablock. The southeastern limit of the depression is the Lyangarsko-Karailskaya FDZ, the northwestern one is the isopachite of Neogene-anthropogenic layers of 500 m for the reason that the thickness of the deposits under consideration gradually decreases to the northwest of it, and then fluctuates within 100-200 m, while to the southeast of the isopachite of 500 m it increases relatively rapidly, reaching up to 2000 m or more in individual blocks (Fig. 2).

The foothill deflection is superimposed on a part of the Turanian plate involved in the deflection (Fig. 2). It is relatively strongly divided into separate blocks characterized by a structure peculiar only to them, the capacities of the Cenozoic molasses and even sections of the Jurassic terrigenous formation. Discontinuous tectonics manifested itself more often in the form of overflows, less often discharges (mainly in the north-western part of it); the blocks developing here have a hinge joint.

In general, the foothill depression can be considered as a megablock, which in the southwest and northwest smoothly merges with the Turan plate, and in the northeast gradually articulates with the uplifting part of the orogen; the depression developed in the southeastern parts of the Bukhara and Chardzhou stages that were previously manifested here [14].

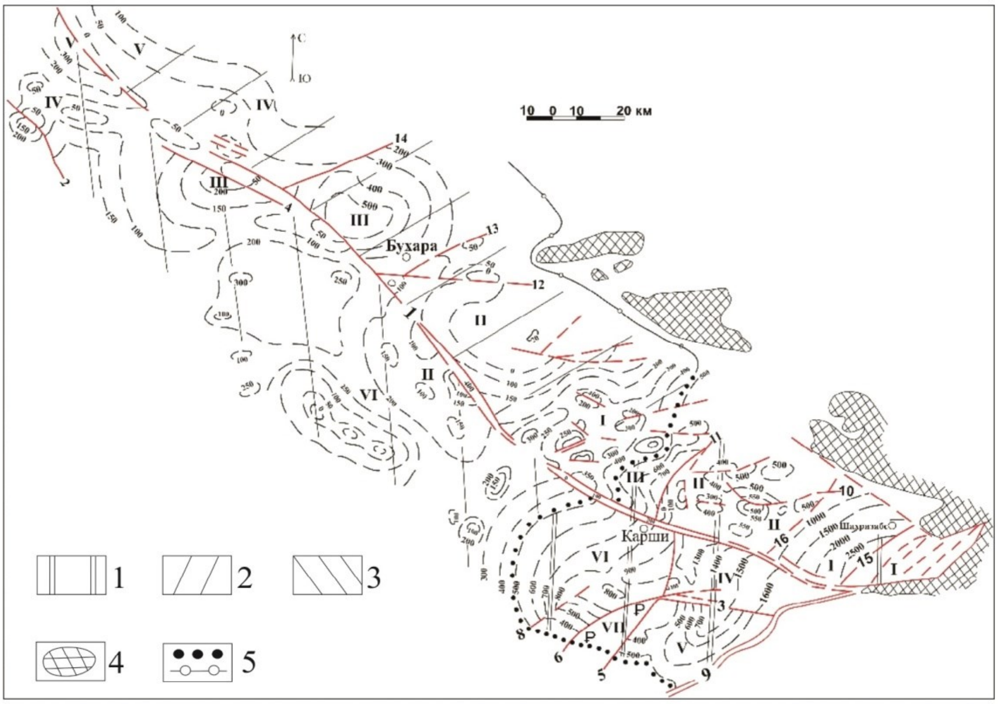

Figure. 2. Paleotectonic scheme of the Neogene-anthropogenic soles by the time of completion of their accumulation. (Ryzhkov O.A., Zakirov R.T., Khalismatov I.)

Symbols: 1. Beshkent-Kashkadarya foothill depression: I. Shakhrizyabz mesoblock, II. Tashly-Vidisky mesoblock, III. Bayburak-Rudaksai mesoblock, IV. Zafar mesoblock, V. Shurtan mesoblock, VI. Yangikent mesoblock, VII. The Alyaudin-Ilim mesoblock. 2. Bukhara stage: I.

Mubarek monocline slope, II. Kagan macro-elevation, III. Rometan macro-bend, IV. Gazlinsky structural nose, V. Tuzko monocline slope. 3. Chardzhou degree: I. Dengizkul macro-elevation, II. Ispanly-Chandyr macro-elevation, III. South Kimire prirazlomny deflection, IV. Khojikazgan uplift V. Northeast Gugurtlinsky prirazlomny deflection, VI. Kushabsky deflection. 4. Exits to the daytime surface of Paleozoic sediments. 5. The border of the most important Tyanyshan orogen with the Turanian. Major regional faults: 1. Bukhara FDZ, 2.Chardzhou FDZ. Intra - stage faults:3. North-Shurtan, 4. South-Kimirek, 5. Kuruksai-Mangit, 6. Alyaudinsky, 7. Beshkent-Kamashinsky, 8. Nishansky, 9. Lyangarsko-Karailsky, 10. Uvadinsky-Sarychinsky. 11. Andabazar-Karaktai. 12. Proletarabadsky, 13. Kuyumazarsky, 14. Atbakarsky, 15. Yakkasaraysky, 16. Chirakchinsky.

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

The Shakhrizyabz-Tashlyk macroblock consists of three mesoblocks (from the southeast to the northwest) of Kashkadarya, Tashly-Uvadinsky and Bayburak-Rudaksay. The second structure is a handful complicated by folds. Within the Kashkadarya structure, the maximum capacities of the rocks under consideration of the entire deflection have accumulated – up to 2000 m or more. The Baiburak-Rudaksai mesoblock is characterized by a decrease in the accumulation capacity to the northwest. It is also complicated by local folds and fractures.

The middle part of the megablock is formed by the Zafar macroblock. It is enclosed between the Bukhara FDZ in the north and the North-Shurtan FDZ in the south, the northern part of the Kuruksai-Mangit fault in the west [12, 13].

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

The southern macroblock at least consists of the Shurtan, Yangikent mesoblocks and the Alyaudin-Ilim wedge-shaped ridge.

The Shurtan mesoblock relative to the Zafar macroblock is raised in places up to 1000 m. Regionally, it is a Prirazlomnaya hemisicline with a maximum thickness of the deposits under consideration of more than 700 m. In the south-west of it, the prirazlomnoye uplift is distinguished, which is replaced to the west by the Alyaudinsky-Ilim mountain, where these deposits are absent.

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

Results. Thus, the considered foothill depression was paleostructurally connected by the Lower Jurassic-Lower Kellovian deposits with the Shurtan prirazlomny macroblock, the Kultak-Zafar macroblock, the Shakhrizyabz and Azlyartepinsky deflections; by the Kimeridzh-Titon deposits – with the Shurtan, Nishan, Beshkent-Kamashinsky and the eastern part of the Urtabulak-Aizawat 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 stage.

Conclusions. All this indicates a serious processing 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 that articulate with each other appeared. The foothill deflection originated at the foot of the Tien Shan orogenic uplift and thus developed on platform pre-Geogene structures.

Northwest of the Shakhrizyabz-Tashlyk macroblock, the Mubarek monocline slope stands out on the Turan Plate area. Within the uplift, numerous folds are outlined, disturbed by discontinuous disturbances, mainly of the north-eastern prostration. The thickness of the rocks in question in the raised wings is 150-200 m. Northwest of the Mubarek uplift is the Kagan macro-uplift. The uplift from the northwest is limited by the Proletarabad fault. To the northwest, the Rometan trough is located between the Kuyumazarsky and Atbakorsky faults. In the central part of it, the thickness of these deposits is more than 500 m. Further north-west there is a weakly pronounced Gazli structural nose and Tuzkoy monocline.

On the territory of the Chardzhou stage, the Dengizkul uplift is distinguished by Neogene-Anthropogenic deposits with the absence of these deposits on the arches of the folds complicating it; also the Ispanly-Chandyr prirazlomnoe uplift. The Karakul trough is located northwest of the Dengizkul and Ispanly-Chandyr uplifts, and the Kushab trough is also recorded between the Dengizkul and Ispanly-Chandyr uplifts. The South-Kimirek prirazlomny deflection, the folds of the Gugurtli macro-uplift and the north-easterly located prirazlomny deflection are well fixed. In the area of the Khadzhikazgan uplift, the southwestern wing of the Chardzhou FDZ is lowered by about 100-150 m, forming a fault deflection as in the layers of the terrigenous Jurassic, and in Cretaceous time this wing was raised by 400 m compared to the northeastern one.

The Bukhara FDZ is fixed by its previously described elements: the Prigurtlinsky-Yangikazgan – prirazlomny deflection, the Pritaikyrsky – raised southern wing, the Zekrinsko-Kassantau graben or stepped discharges, the Kassantau-Kanalinsky – ridge or large-amplitude step.

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INDUSTRIAL TESTS OF THE CONSTRUCTION OF A PYRAMIDAL-STRAIGHT LOG CABIN WITH COMPENSATING HOLES

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Abstract. *Straight log cabins are created by a set of holes drilled perpendicular to the face plane. Therefore, their parameters depend on the size of the cross-section of the workings. The designs of straight log cabins are very diverse. Of these, the most effective is the prismatic one, consisting of a central hole and three to five holes' parallel to the central one surrounding it. In the practice of tunneling, there may be cases when all the holes have the same diameter, as well as when the average hole has a larger diameter.*

The rational distances between them will be different. The leading branch of the mining industry at the moment can be called the explosive business. The constant growth of the demand for various kinds of minerals requires an increase in the volume of extraction of mineral raw materials, which, in turn, determines the growth of mining operations. In this regard, it is important to improve the technology of sinking both at existing and projected mines. The analysis of the research results of various authors shows that the overwhelming volume of tunneling operations at underground mines is carried out using drilling and blasting operations (DBO), and in the near future this method remains the main technology for horizontal mining. In recent years, research has been actively conducted to develop new theories and methods for calculating the optimal parameters of drilling and blasting operations and improving their structural elements. The most important element of the explosive destruction of rocks during mining is the formation of a cut-in cavity.

The effective operation of the log cabin largely determines the effectiveness of the explosion as a whole. Since the cutting cavity is the most important component of the entire passport of drilling and blasting operations, which largely determines the main qualitative characteristics of the explosion produced – the step of moving the face per cycle, the required collapse of the rock