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TECTONIC PECULIARITIES OF THE ZHAILMA STRUCTURE FORMATION

Purpose. Studying the genesis and position of the Zhailma trough in the tectonic structures of Central Kazakhstan.

Methodology. Critical analysis of literature and stock materials, comparative analysis of geological, geophysical and morphological factors characteristic of continental rifts, features of the formation of volcanic graben synclines, analysis of the results of isotope dating of rocks.

Findings. The Zhailma graben-syncline is not an independent structure of the rift origin. The formation of Zhailma is associated with the general evolution of the Sarysu-Teniz segment of the Devonian volcano-plutonic belt. The formation of the Zhailma graben syncline is associated with subsidence after ejections of significant masses of felsic magmatic material.

Originality. The authors carried out a comparative analysis of the geological, geophysical and morphological data of the Zhailma structure with similar data characteristic of modern continental rifts. As a result of the analysis, it was established that the rift genesis of Zhailma remains controversial. This structure developed simultaneously with the Devonian volcanic-plutonic belt, and is genetically related to the processes of volcanism. The authors suggest that Zhailma is a volcanic graben-syncline.

Practical value. Over a long period of studying the structure, an opinion was formed about the futility of the Sarysu-Teniz segment of the Devonian volcano-plutonic belt for the identification of industrial deposits. An exception was the Zhailma trough, which is a unique Famennian-Carboniferous sedimentary structure in terms of ore saturation, containing significant reserves of iron-manganese, barite-polymetallic and barite proper ores. In this connection, the authors consider it practically important to study the existing graben-synclines in the area of the Devonian volcano-plutonic belt in order to identify industrial deposits of the Atasu type.

Keywords: *Volcanic graben syncline, isotopic analysis, Devonian volcano-plutonic belt, Atasu ore region, continental rifts*

Introduction. One of the most geologically interesting territories of Kazakhstan is its central part, whose industrial value is associated with the Atasu ore region. The main, large and ore-controlling structure covering almost the entire territory of the Atasu ore region, is the Zhailma graben-syncline that stretches from the Kartobay ore occurrence in the northwest to the Kentobe deposit in the east.

Zhailma is confined to the volcanogenic formations of the Devonian volcano-plutonic belt (DVPB), and from the east to the complexly dislocated Caledonian structures of the Atasu anticlinorium. Devonian volcanogenic-sedimentary formations from the west in the middle part of the trough overlie unconformably the Caledonian structures. Thus, from the east, the Famennian-Carboniferous sedimentary formations overlie directly on the Caledonides of the Atasu anticlinorium, and from the south, north, and west, on Devonian volcanic rocks that occur on the Caledonides of the Konsky synclinorium (basement complex).

The tectonic structure of entire Central Kazakhstan was dealt with by a large amount of time and work of Kazakh and Russian scientists. For a long period, the research teams of the IGS n.a. K. I. Satpaev, VSEGEI, Moscow State University, MSRI have worked at the problem. The results of the research are reflected on numerous tectonic maps: "Tectonic map of Kazakhstan", scale 1 : 1500000 (1971, editor-in-chief V. F. Bespalov), "Tectonic map of the Paleozoic folding region of Kazakhstan and adjacent territories", scale 1 : 1500000 (1976, editor-in-chief A. A. Abdulin, Yu. A. Zaitsev), "Tectonic map of Eastern Kazakhstan", scale 1 : 2500000 (1982, editor-in-chief A. V. Peive), and others. Modern ideas about the structures of Central Kazakhstan are reflected on the latest "Tectonic Map of Kazakhstan", scale 1 : 1000000 (2004, editor-in-chief B. S. Uzhkenov, V. Ya. Koshkin) [1]. However, since the tectonic zoning of entire Central Kazakhstan is interpreted differently, the question of Zhailma tectonic affiliation remains "open"to this day.

Analyzing the Zhailma structure genesis. At present, the hypothesis of the rift origin of the Zhailma structure is widely spread. It connects the Karagaily and Zhayrem deposits in a single rift zone, the basis for which was the presence of iron ores at the Kentyube deposit and barite-polymetallic ores at Karagaily.

The Atasu ore district includes about 60 deposits of iron-manganese, barite-polymetallic ores. Among these the largest ones are Karazhal, Ktai, Zhairem, Ushkatyn, Zhomart, Kamys, Keregetas, Bestobe, Kylysh, which are located along the Zhailma syncline (Fig. 1).

Comparative analysis of continental rifts features. To "support" one or another hypothesis of the origin of the Zhailma graben-syncline, the authors conducted a comparative review of this structure with modern rifts. The definitions of the terms "rift" and "ben" are given.

Rifts are extended, limited by faults, elongated grabens, troughs. The term characterizes the process of rupture (stretching) of a previously continuous medium [2]. Under the rifts, the entire thickness of the lithosphere is reduced due to the stretching that occurs during the formation of these structures) (Sengor, Burke, 1978; Sengor, 1995).

Rifts are formed in almost all the tectonic settings (including over mantle plumes) and at all the stages of the Wilson cycle of ocean opening and closing (Burke, 1978). Sedimentary basins in rift zones retain a record of the tectonic settings of their origin and/or development much better than orogenic belt basins, although the range of tectonic settings that form in them is limited and contains much less diverse fauna and flora. The formation of rifts is usually accompanied by volcanic activity. The range of rock types in rift zones is poorer than in orogenic areas [2]. Metamorphism of rocks in rifts is much less pronounced compared to the metamorphism that accompanies orogenic processes (Burchfiel, et al., 1992; Davis, et al., 1996).

And the term "graben" is applicable to those structures that do not extend to the entire surface of the lithosphere. These are depressions or troughs in horizontal layers, which are much longer than wide. This concept is purely descriptive (Rosenfeld and Schickor, 1969). This term is applicable to those structures that do not pass through the lithosphere.

According to a number of scientists, the Central Kazakhstan paleorift is active, its rifting is caused by the rise of the mantle. However, in such settings, rifts form as a result of

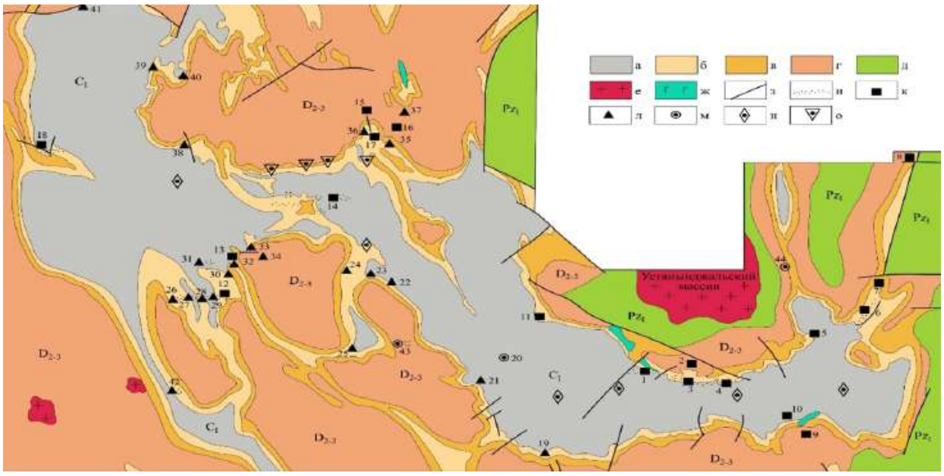

Fig. 1. Schematic structural-tectonic map of the Zhailma trough (according to A. A. Rozhnov):

a – sandy-argillite limestone sequences of the Lower Carboniferous; b – siliceous-carbonate ore-bearing strata of the Upper Nefamennian substage; c – limestones and calcareous siltstones of the Lower Famennian substage; d – volcanogenic complex of the Middle Devonian and Frasnian stage of the Upper Devonian; e-metamorphic strata of the Lower Paleozoic; e – varisian granitoids; f – small intrusions of the main composition of the Fameno-Tournaisian strata; h – tectonic faults; and - zones of development of ore-bearing deposits under younger strata; k – deposits and l – ore occurrences of the Atasu type; m – vein ore manifestations of ferromanganese and barite-polymetallic mineralization; n – magnetic anomalies of presumably ore nature; o – areas of manifestations of volcanic activity in the Upper Famennian. Deposits of the Atasuy type: 1 – Western Karazhal; 2 – Northern Karazhal; 3 – Eastern and Southern Karazhal; 4 – Far Eastern Karazhal; 5 – Ktay; 6 – Bestobe; 7 – Kentobe; 8 – Keregetas; 9 – Southern Kylysh; 10 – Northern Kylysh; 11 – Altyn-Shoko; 12 – Jomart; 13 – Tamara; 14 – Zhairem; 15 – Ushkatyn I; 16 – Ushkatyn III, Kamys. Ore occurrences of the Atasuy type: 19 – Bestau; 20 – Taskuduk; 21 – Karaoy; 22 – Ore-bearing; 23 – Akkuduk; 24 – Western Akkuduk; 25 – South-Western Akkuduk; 26 – Atayka; 27 – Intermediate I; 28 – Intermediate II; 29 – Western Zhomart; 30 – Tusbay; 31 – Buzgul; 32 – Bair-River; 33 – Mount Zhomart; 37 – Ushkatyn IV; 38 – Arap; 39 – Syurtysu; 40 – East Syurtysu; 41 – Kartobai; 42 – Kildzhir; 43 – Southern Akkuduk; 44 – Point No. 4

crustal extension (stretching of the outer arc of the concentric fold, i. e., on the stretching side of the neutral surface) caused by arching (Cloos, 1939). But fault formation is not enough to support large-scale rifting.

Analysis of morphological data. On the example of the Baikal and East African rift systems, elements of the morphology of rift valleys were considered. Studying the relief of rifts reveals important differences and similarities between individual rift structures. Morphological features of continental rifting are the result of deep processes. All the continental rifts tend to have similar geological characteristics. Dome structures and depressions separating them are clearly expressed in the relief [3].

The planned location of the rift basins has certain patterns, among them the first one is the asymmetric transverse profile of the zones, which is maintained at considerable distances, determines the different height and morphology of the ridges on both sides of the rift basin, the frequent asymmetry of each rift valley, and the second one is the constancy of the width rift basins is the most important common feature of continental rifts [4].

The Zhailma structure has an arcuate shape, it is oriented from southeast to northwest, along an azimuth of 300°, with the total length of about 165 km. It branches along the strike, and has a width of 10 to 45 km, which somewhat does not coincide with the above regularities [5].

Analysis of geophysical data. According to the geophysical data, the thickness of the crust under the continental rifts decreases and a corresponding uplift of the Mohorovichic surface takes place [8]. The thickness of the crust under the Baikal rift decreases to 30–35 km, under the Rhine up to 22–25 km, under the Kenya up to 20 km, and to the north, along the Afar valley, it reaches 13 km, and then an ocean appears under the axial part of the valley bark [6].

If to consider similar parameters of deflections of the Mohorovichich surfaces in the Central Kazakhstan paleorift system: Agadyr-Vishnevsky – 50 km and Kenkuduk-Karagailinsky 47.5 km, then the thickness of the crust under the rift is significantly greater than in modern rifts. In the mantle ledge under the rift, the rocks are loosened (the velocities of longitudinal waves vary in the range of 7.2–7.8 km/s (Kenyan), and for the central Kazakhstan paleorift, a wide range of changes in the velocity of longitudinal waves passage is characteristic: from 7.8 up to 8.2 km/s [7] (Fig. 2).

Within the boundaries of Zhailma, the presence of zones with gravity maxima in the marginal parts of the continents, as well as gravity anomalies, are interpreted in the "favor" of the rift, since this is inherent in modern active continental margins.

However, a similar phenomenon is also observed in the structures of volcanic belts. Given that in all cases the volcanic belts are associated with structures such as graben-synclines, it can be assumed that the Zhailma graben-syncline is a volcanic graben.

Analysis of tectonic conditions of the structure formation. In tectonic systems, graben-synclines are expressed by linear troughs but with any morphology variations, the width of graben-synclines always corresponds to the width of frontal uplifts adjacent to them. In this, as well as in their general confinement, graben-synclines sharply differ from grabens of the normal type. Graben-synclines have an inherited superimposed character. In most cases, they inherit the position of intense subsidence, which, often, are volcanic belts of the corresponding time. Partially, they cross them at an angle and are superimposed on complexes of the Mesozoic or older age [8].

The foundation composed of rocks is sharply lowered in them and, as a rule, is lower than the modern erosive incision of the hydraulic network or the coastline of the sea. The amplitude of subsidence varies from hundreds to 1,000 m, and the total range of motion relative to adjacent mountain systems reaches 1,500–3,000 m [9]. These structures have a sharply asymmetric shape, reflecting their flexural position on the limb of the main fault. Large-amplitude faults are noted in the front part of the graben-synclines facing the trench, corresponding to their junction with the adjacent frontal zone of the geosynclinal uplift. An example is the fault of the eastern boundary of the Central Kamchatka depression, the fault of Kainga-roa in the eastern part of the Taupo volcanic zone, etc.

Volcanic belts of island arcs are localized along those deep faults (perhaps they are associated with an inflection of the M surface), along which horizontal displacements of the deep shear type are noted. Since individual volcanoes are located

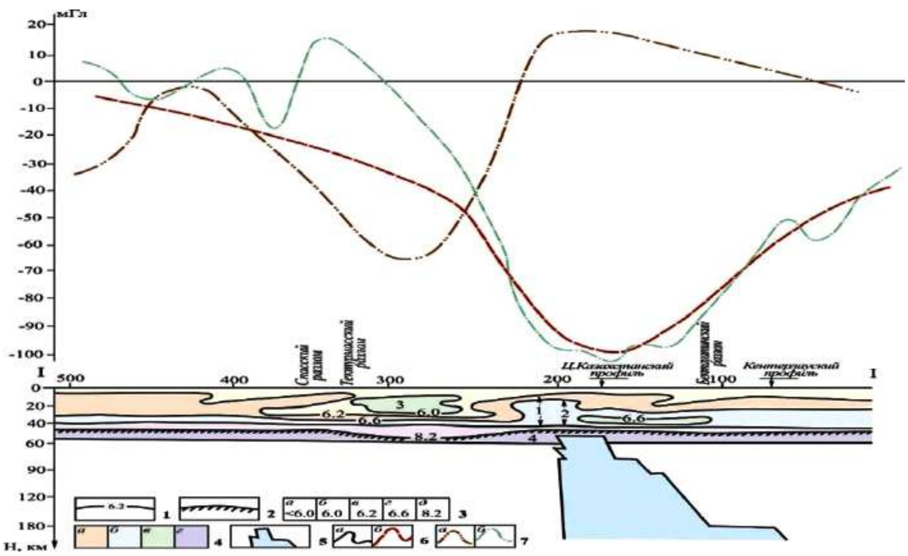

Fig. 2. Physical model of the lithosphere structure of the Central Kazakhstan paleorift system (according to L. V. Shabalina):

1 – lines of equal speeds, km/s; 2 – the surface of Mohorovichich (8.2 km/s); 3 – correlation of velocity and density (g/cm^3): 2.57 – a; 2.70 – b; 2.75 – in; 2.85 – g; 3.10 – d; 4 – excess densities of the considered bodies: 1 – (+0.05), 2 – (+0.10), 3 – (–0.05), 4 – (+0.40); 5 – an anomalous body in the mantle, established on the basis of complex data (+0.063); 6–7 – Graphs of anomalies of the gravitational field (Δg, mGl): 6 – observed initial in Bouguer reduction – a, total calculated – b; 7 – total calculated from the influence of bodies 1 + 4 – a; residual uncompensated by inhomogeneities of the upper layers of the lithosphere, reflecting the influence of inhomogeneities in the mantle – b

not on the line of the main fault, but along the fissure zones feathering it, the volcanic belt is adjacent to such a fault, but the volcanoes are always moved away from it.

On the example of the volcanic belts of Japan, New Zealand, Kamchatka, the Kuriles, it can be seen that the types of the gravity field are practically the same everywhere. Weakly negative or small positive gravity anomalies are common, much less intense positive anomalies typical of adjacent zones of nonvolcanic geoanticlinal belts [10]. The reduced values of gravity in volcanic belts are interpreted by many authors as a result of the deconsolidation of the material of the upper mantle within them (Eiby, 1964; Pakiser, 1960).

The eastern volcanic belt of Kamchatka adjoins the line of high gravity gradients.

Zhailma is divided by numerous discontinuities into tectonic blocks, whose boundaries are often accompanied by zones of high gradients of the gravimetric field (a positive anomaly characterizes the eastern half of the trough, fixes the hidden part of the Atasu uplift, and a negative one: restites of deep chambers of palingenic granite formation and granite intrusions of the Devonian age) [11].

Deep regional faults manifest themselves in gravitational and magnetic fields in the form of regional zones of large gradients, extended boundaries of changes in the nature of fields, linearly located local anomalies, and isolated narrow local zones of negative anomalies (Fig. 3).

Uplifts or uplifted large blocks of the earth's crust in the Atasu region are, as a rule, characterized by an increased gravitational field and often a lowered or tending to decrease magnetic field (Fig. 3).

Chains of local anomalies are caused by intrusive, volcanic or subvolcanic bodies that have filled fault cavities [12].

The time of initiation of many of them belongs to the Devonian period, characterized by tectonic-magmatic activation, the manifestation of intense volcanism and blocky deformations of the Caledonian base, as well as the formation of consedimentary horst-anticlines and graben-synclines, one of which, possibly, is the Zhailma graben-syncline, which is not an independent structure. Its formation is associated with the general evolution of the Sarysu-Teniz segment of the Devonian volcano-plutonic belt.

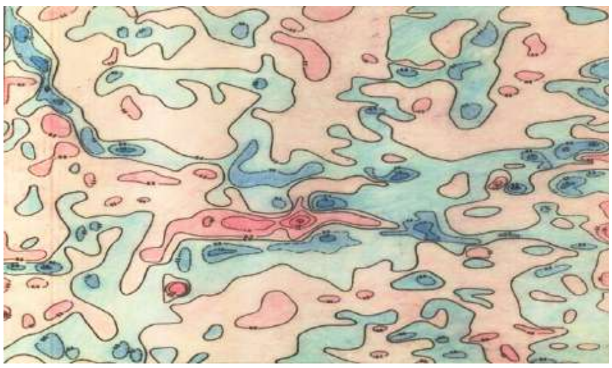

Fig. 3. The map of residual anomalies Δg. Scale 1:50000. Sheet L-42-10-A (S. A. Akylbekova)

Isotopic analysis of absolute dating of rocks. The scientific team of the Azimut Geology (Karaganda, Kazakhstan) in the framework of cooperation with the Institute of Geology and Mineralogy of the Siberian Branch of the Russian Academy of Sciences n.a. V. S. Sobolev (Novosibirsk, Russia) carried out an analysis to determine the absolute age of rocks (moderately alkaline leucogranite, granodiorite, quartz diorite, rhyodacite, trachirhyolite) of works on the topic: "Search for deposits of the Atasuy type and other deposits in limit of the southeastern part of the Sarysu-Teniz uplift". Surface samples were taken for analysis (Fig. 4). The measurements were carried out on a Thermo Scientific Element XR high-resolution inductively coupled plasma mass spectrometer connected to an Analyte Excite laser ablation system (Teledyne Cetac) equipped with a two-chamber HelEx II cell. The measurement parameters of the mass spectrometer were optimized to obtain the maximum intensity of the ^{208}Pb signal at the minimum value of ^{248}ThO$^+$ ^{232}Th$'^+$ (less than 2 %) using the NIST SRM612 standard. All measurements were performed by the masses of ^{202}Hg, ^{204}(Pb + Hg), ^{206}Pb, ^{207}Pb, ^{208}Pb, ^{232}Th, ^{238}U. The shooting was carried out in the E-scan mode. Signals were detected in the counting mode for all the isotopes, except for ^{238}U and ^{232}Th (the triple mode).

The isolation of zircons was carried out by standard methods using magnetic separation and bromoform. Separate zir-

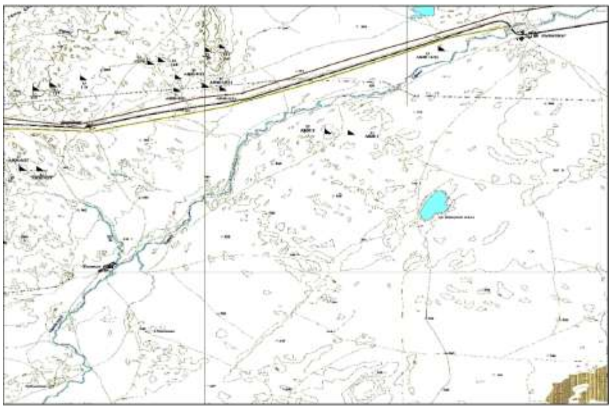

Fig. 4. Scheme of the sampling area location intended for isotope study

con grains were manually selected under a binocular, then fixed in an epoxy resin preparation (diameter 25 mm, height 5 mm). The zircon grains were ground and polished to about half their thickness. Cathode luminescence (CL) images were used to select sites (points) for dating on the surface of grains. Cathodoluminescent images of zircon grains were obtained on a MIRA 3LMU scanning electron microscope with a JSM 6510 LV cathode-luminescence unit at the Institute of Geology and Mineralogy of RAS SB.

There were analyzed from 40 to 45 zircons in each sample. According to isotope dating, the majority of points in almost all the samples (40 analyzes) fit into one range, according to which the weighted average age was obtained from 409 ± 2 to 415 ± 2 Ma.

Volcanic graben-synclines. Taking into account that graben-synclines have an inherited superimposed character and in most cases they inherit the position of intense sagging [13] that are often volcanic belts of the corresponding time, it should be noted that the Zhailma graben-syncline also has an inherited superimposed character. It is expressed by intense subsidence, the time of its initiation belongs to the Devonian period, similar to the Devonian volcano-plutonic belt.

The Zhailma trough has a very complex mosaic structure surrounding the Ustanynzhal massif. It is caused by the development of a system of plicative and disjunctive dislocations developed along deep foundation faults. Within its limits, a series of brachifolds is established, less often linear with dips on the wings from 30 to 80–900, complicated by flexures, normal faults, strike-slips, thrusts, interformation failures, brecciation zones (Fig. 5) [14].

These features distinguish graben-synclines from normal rift zones formed at the crest of a growing uplift. The formation of graben-synclines of volcanic belts is associated with subsidence after ejections of significant masses of acidic magmatic material (Bemmelen, 1963; Westerveld, 1952). If linear rows of stratovolcanoes are located in the graben-syncline, the subsidence is slight. If, on the other hand, centers of mass ejecta of acidic pyroclastic material or mass eruptions of basalts are concentrated in a certain section of the structure, the subsidence amplitude reaches its maximum values.

Localization of mass volcanic manifestations in graben-synclines causes the complication of these structures: if in their original form they are a reflection of a lagging uplift in the rear part of the system of paired structures, then the accumulation of thick volcanogenic strata here leads to their additional compensatory subsidence [15].

Almost until the mid-80s of the last century, an opinion was formed about the futility of the Sarysu-Teniz segment of the marginal Devonian volcano-plutonic belt for the discovery of industrial deposits. An exception was the Zhailma trough, which is a unique Famennian-Carboniferous sedimentary structure in terms of ore saturation, which contained significant reserves of iron-manganese, barite-polymetallic and proper barite ores. In this connection, for more than 90 years of study, scientists have attached features of exclusivity, uniqueness of regional metallogenic factors of the structure. This, in particular, concerns the issues of structural and tectonic position, genesis and influence of volcanism on the formation of industrial mineralization.

The Devonian volcano-plutonic belt served as the boundary zone of the Caledonian and Hercynian consolidation systems, which was first identified by A. A. Bogdanov (Fig. 6) [16].

An extensive literature is devoted to this belt (Bogdanov, 1959, 1965; Bogdanov, et al., 1963; Shcherbakova, 1963; Markova, 1964; Nikitina, Aksamentova, 1965; Aksamentova, et al., 1966; Chetverikova, 1966, 1970; Shuzhanov, 1967, 1968; Mossakovsky, 1968; Nikitina and Shuzhanov, 1969, 1974; Aksamentova, 1970, 1972; Geology of the USSR, 1972; Azbel, et al., 1973; Tikhomirov, 1975; Geology..., 1977; and others).

According to E. Yu. Seitmuratova, Zh. K. Arshamov, the DVPB is a thick permeability zone marked by an active manifestation of magmatism and connected by a system of large deep faults. The belt is characterized by significant heterogeneity of its individual segments [17].

Kurchavov A. M., Malchenko E. G. determined the petrochemical zonation of the belt and its segmentation (Figs. 6, 7) [18].

The Devonian volcano-plutonic belt as a morphologically positive structure developed on the edge of the Caledonian continent from the early Devonian to the Frasnian inclusive. Deep into the Caledonian continent, the intensity of volcanism weakens, and volcanic-sedimentary, volcanomictic, and terrigenous formations predominate here. They perform superimposed depressions. The general evolution of magmatism within

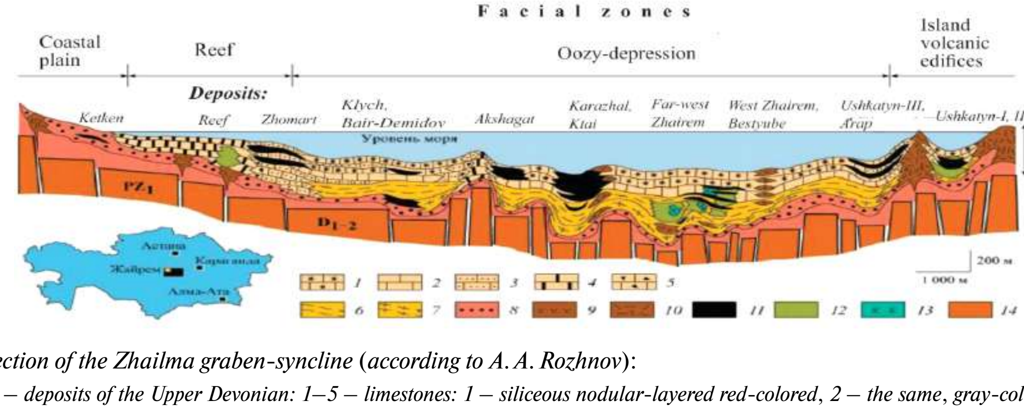

Fig. 5. Section of the Zhailma graben-syncline (*according to A. A. Rozhnov*):

1–13 — deposits of the Upper Devonian: 1–5 — limestones: 1 — siliceous nodular-layered red-colored, 2 — the same, gray-colored, 3 — organogenic-detrital, 4 — reef organogenic-algal, 5 — breccia sedimentation; 6, 7 — clay-siliceous-carbonate rocks: 6 — flyschoid, 7 — lenticular-layered; 8 — conglomerates, sandstones, siltstones; 9,10 — volcanics: 9 — basalts and trachybasalts, 10 — trachyrhyolites; 11–13 — ores: 11 — iron-manganese, 12 — lead-zinc, 13 — barite and barite-lead; 14 — terrigenous-volcanogenic deposits of the Lower-Middle Devonian and metamorphosed volcanogenic-terrigenous strata of the Lower Paleozoic with granite intrusions [2, 3, 11]

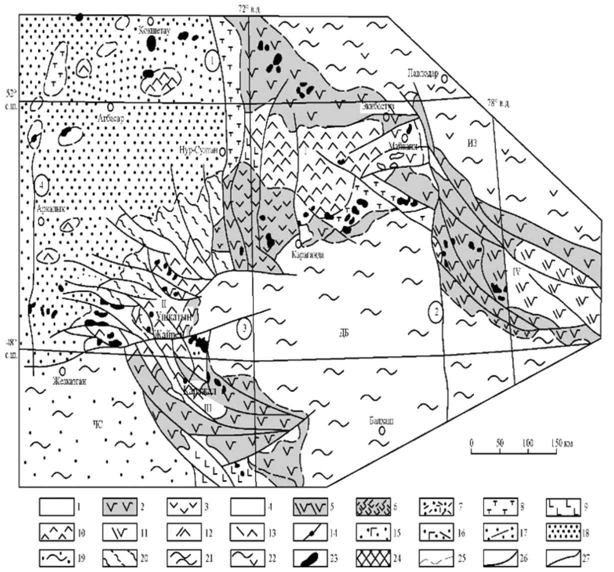

Fig. 6. Present day distribution of early orogenic formations (lower Devonian) of the Devonian volcano-plutonic belt of Central and Northern Kazakhstan (according to A. M. Kurchavov):

1–7 – calc-alkaline with subordinate tholeiite varieties: 1 – basalt – basaltic andesite, 2 – basalt-basalt-andesite-andesitic, 3 – basalt-andesite-andesite-andesite with dacites and rhyodacites, 4 – contrasting basaltic andesite-silicic, 5 – andesite-dacite-rhyolite, 6 – rhyodaci-rhyolitic, 7 – terrigenous with subordinate rhyodacites and rhyolites; 8–17 – mainly calc-alkaline high potassium and shoshonitic: 8 –trachybasalt-trachyandesite-basalt-trachyandesite-trachytic with subordinate basalts and andesite-basalts, 9 – trachybasalt-basalt, 10 – trachybasalt-trachyandesitebasalt trachyandesite with subordinate basalts, andesite-basalts and andesite-basalts trachyandesite-trachydacite-trachyrhyolitic, 12 – trachyandesite-trachydacite-trachyrhyolitic with dacites and rhyolites, 13 – contrast trachyandesite-salt-trachyrhyolitic, 14 – trachyrhyodacite-trachyrhyolitic, 15–17 – predominantly terrigenous: 15 – with trachybasalts trachyandesite basalts, 16 – trachybasalts, trachyandesite basalts and trachyrhyodacites, 17 – with trachyrhyodacites and trachyrhyolites; 18 – terrigenous molasse; 19 – terrigenous continental and, possibly, coastal-marine sediments; 20–23 – formations: 20 – subaqueous terrigenous, 21, 22 – Devonian marine: 21 – predominantly terrigenous, 22 – terrigenous and volcanogenic; 23 – intrusive; 24 – outcrops of the Precambrian basement in the marginal part of the Dzungar-Balkhash region (only in Fig. 4); 25 – distribution boundaries of rock associations; 26, 27 – faults: 26 – regional faults (numbers in circles: 1 – Tselinograd, 2 – Central Kazakhstan, 3 – Uspensky, 4 – Ulutau), 27 – other faults. The letters indicate: ChS – Chu-Sarysu depression; DB – Dzhungaro-Balkhash and IZ – Irtysh-Zaisan mobile regions. Roman numerals denote the segments: I – North-Eastern, II – Sarysu-Tengiz, III – Betpakdala, IV – Chingiz. The distribution of predominantly calc-alkaline associations of low potassium content is highlighted in dark tone, and the distribution of associations of the high-potassium branch of the calc-alkaline series, shoshonite series, and continental molasse is shown in light tone

the belt, covering the time interval from 400 to 367 Ma, is determined by the change in predominantly basic derivatives by more silicic ones, and then formations of contrasting silica [19].

In the Devonian volcanic-plutonic belt, petrochemical zoning is disturbed, which was the result of the movement of individual blocks that limit the superimposed basins on the structures of the Devonian volcanic belt, composed of the same sediments as the Zhailma basin, which, unfortunately, are poorly studied by drilling. Some of them contain polymetals and iron-manganese ores similar to the Atasu genetic type [20].

Conclusions. Taking into account that all the continental rifts have, as a rule, similar geological, geophysical and morphological characteristics, as a result of a comparative review of the Zhailma "paleorift" with modern structures: Baikal,

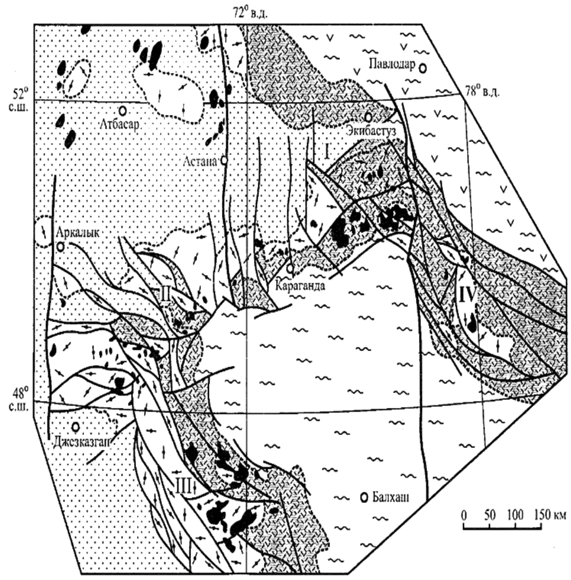

Fig. 7. Present day distribution of medium orogenic formations (upper Lower Devonian-Eifelian) of the Devonian volcano-plutonic belt of Central and Northern Kazakhstan (A. M. Kurchavov). Symbols according to Fig. 6.

Afar, Kenya, Ethiopian and Red Sea rifts, there is a sufficient number of discrepancies in the rift genesis of Zhailma.

The identical composition of the Zhailma sedimentation with the DVPB, the presence of volcanic rocks on the territories of almost all deposits confined to the Zhailma syncline, the presence of a high gradient band corresponding to the Zhailma axis, the formation scheme of which "corresponds" to volcanic graben synclines allow us to conclude that the "best" similarity of Zhailma not with rifts of the modern type, but with grabens of volcanic origin, namely, genetically associated with the development of the DVPB. The formation of the Zhailma graben-syncline is associated with subsidence after ejections of significant masses of acidic magmatic material.

On this basis, it is possible to make a prediction about the possibility of finding deposits of the Atasu type in graben-synclines throughout the entire area of the belt. Zhailma is a prominent representative of such structures.

The validity of this forecast is fully confirmed by the discovery of such industrial deposits as Karaadyr, Bogach and Tur in the northern part of the Aydagarly graben-syncline.

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Тектонічні особливості утворення Жаільмінської структури

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Мета. Вивчення генезису й положення Жаільмінської мульди в тектонічних структурах Центрального Казахстану.

Методика. Критичний аналіз літературних і фондових матеріалів, порівняльний аналіз геологічних, геофізичних і морфологічних факторів, характерних для континентальних рифтів, особливостей формування вулканічних грабен-синкліналей, аналіз результатів ізотопного датування гірських порід.

Результати. Жаільмінска грабен-синкліналь не є самостійною структурою рифтового походження. Формування Жаільми пов'язане із загальною еволюцією Сарису-Тенізського сегмента девонського вулкано-плутонічного поясу. Формування Жаільмінської грабен-синкліналі пов'язане з просіданням після викидів значних мас кислого магматичного матеріалу.

Наукова новизна. Авторами був проведений порівняльний аналіз геологічних, геофізичних і морфологічних даних Жаільмінської структури з аналогічними даними, характерними для сучасних континентальних рифтів. У результаті аналізу встановлено, що рифтовий генезис Жаільми залишається спірним. Дана структура розвивалась одночасно з Девонським вулкано-плутонічним поясом, і генетично пов'язана з процесами вулканізму. Автори припускають, що Жаільма є вулканічною грабен-сінкліналлю.

Практична значимість. За довгий період дослідження структури сформувалася думка про безперспективність Сарису-Тенизського сегменту крайового девонського вулкано-плутонічного поясу на виявлення промислових родовищ. Виняток представляла Жаільмінська мульда, що є унікальною за рудонасиченістю фаменкам'яновугільною осадовою структурою, яка включала в собі значні запаси залізо-марганцевих, барит-поліметалічних і власне баритових руд. У зв'язку з чим, вважаємо практично важливим вивчити наявні грабен-синкліналі на площі девонського вулкано-плутонічного поясу для виявлення промислових родовищ атасуйського типу.

Ключові слова: *вулканічна грабен-синкліналь, ізотопний аналіз, Девонський вулкано-плутонічний пояс, Атасуйський рудний район, континентальні рифти*

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