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Қ. И. Сәтпаев атындағы Қазақ ұлттық техникалық зерттеу университеті

# Х А Б А Р Л А Р Ы

## ИЗВЕСТИЯ

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РЕСПУБЛИКИ КАЗАХСТАН  
Казакский национальный исследовательский  
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## NEWS

OF THE ACADEMY OF SCIENCES  
OF THE REPUBLIC OF KAZAKHSTAN  
Kazakh national research technical university  
named after K. I. Satpayev

### ГЕОЛОГИЯ ЖӘНЕ ТЕХНИКАЛЫҚ ҒЫЛЫМДАР СЕРИЯСЫ



### СЕРИЯ ГЕОЛОГИИ И ТЕХНИЧЕСКИХ НАУК



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**FORECAST OF METALLIC MINERAL RESOURCE  
DEPOSITS BASED ON THE PRINCIPLES OF SHOCK-EXPLOSIVE  
TECTONICS AND USE OF THE EARTH REMOTE SENSING DATA**

**Abstract.** The authors propose a new technology for regional and local (large-scale) mineral deposit forecast based on the principles of shock-explosive tectonics (SET) and remote sensing data (RS).

The forecast of mineral deposits should be carried out using remote sensing data in conjunction with the huge amount of information on the location of known and proven mineral deposit fields in the geological space. Recent studies show that mineral deposit fields are often connected with ring structures, both endogenous and cosmogenic. Years of research has shown that the overwhelming majority of mineral deposit fields is confined to the concentric zones of the earth crust expansion-decompression, which accompanies cosmogenic ring structures of various sizes.

Blocks of mutual overlay of the earth's crust expansion-decompression, neighboring astroblems and giablems (giant astroblems), are spaces most promising for the localization of mineral deposits. The zones of the earth's crust expansion-decompression are separated by zones of compression that are devoid or almost devoid of accumulations of minerals.

The analysis of the solid minerals spatial allocation confirms this idea. On the basis of the proposed forecasting technology, new local prospective areas have been distinguished. Within these areas the discovery of deposits which are to fill the depleted ore base in the Zhezkazgan area is expected.

**Key words:** forecast of mineral deposits, ring cosmogenic structures, concentric zones of the earth crust expansion-decompression and compression.

Based on numerous long-term data obtained over 110 years concerning the spatial position of about 200 hydrocarbon fields in Kazakhstan, a method for predicting these fields was invented [1]. The method was patented in Moscow [2] and Almaty [3]. Academician Nadirov N. K. regards the invented method of predicting as a discovery [1].

**Forecast development for solid mineral deposits search.** In accordance with the fluid dynamic concept of mineral deposits formation, brought forward by Sokolov B. A. and Starostin V. I., [4], it can be assumed that the structural control established for hydrocarbon deposits should be manifested in the spatial allocation of both metallic and non-metallic deposits, somehow connected with hydrothermal activity or, that is, with fluid dynamic processes.

It is obvious that a significant number of deposits associated with fluid dynamic processes are hydrothermal deposits of metallic minerals. In a certain amount there are deposits of non-metals – piezooptical quartz, rock crystal, chalcedony (including colored chalcedony), agate, moss agate, agalmatolite, optical fluorite, turquoise, etc. The analysis of the territorial distribution of these deposits confirmed this idea.

It was logical to imagine that the most manifested ore-controlling role for the majority of deposits associated with fluid dynamic processes, can be "played" by the most ancient expansion-decompression zones, accompanying cosmogenic ring structures [5-13]. These expansion-decompression zones are subordinated to clearly manifested geological structures. Such geological structures are arcs of paleozoids

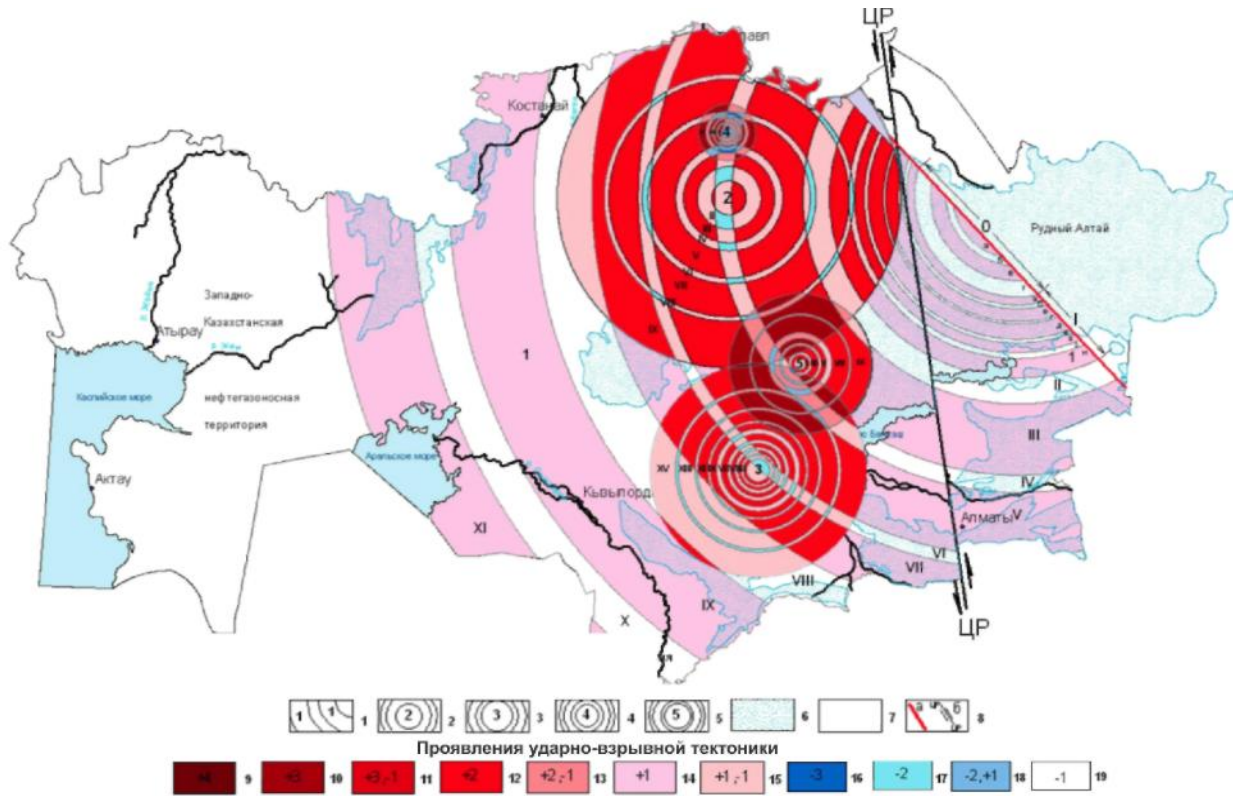


Figure 1 – Scheme of mutual overlay of concentric expansion and compression zones of the Kazakhstan giablen (covers the largest part of the territory, represented by arcs of the paleozoid of Kazakhstan), as well as the giablens – the Ishim (numeral 2 in the center of the structure), the Kaib-Shu (numeral 3 in the center of the structure), the Kiiksk-Bosaginsk (numeral 5 in the center of the structure) and the large Borovskaya astrobleme (numeral 4 in the center of the structure).

1 - expansion and compression zones of the Kazakhstan giablen (0-XI), the expansion and compression zones I and 0 are divided into zones of smaller width, denoted by alphabetic indices [15], 2 - expansion and compression zones of the Ishim giablen, 3 - expansion and compression zones of the Kaib-Shu giablen, 4 - expansion and compression zones of the large Borovskaya astrobleme, 5 - expansion and compression zones of the Kiiksk-Bosaginsk giablen, 6 - pre-Mesozoic formations, 7 - Mesozoic-Cenozoic formations, 8 - Shyngyz-Balkhash fault (a), Central Kazakhstan fault – shift (b), 9 - areas within the contour of the four-fold expansion zones, 10 - areas within the contour of the triple expansion zones, 11 - areas within the contour of the triple expansion and single compression zones, 12 - areas within the contour of the double expansion zones, 13 - areas within the contour of the double expansion and single compression zones, 14 - areas within the contour of the single expansion zones, 15 - areas within the contour of the single expansion and single compression zones, 16- areas within the contour of the triple compression zones, 17 - areas within the contour of the double compression zones, 18 - areas within the contour of the double compression and single expansion zones, 19 - areas within the contour of the single compression zones

of Kazakhstan, described by academician of the National Academy of Sciences of the Republic of Kazakhstan Shlygin E. D. [14] (figure 1).

These arcs are clearly imprinted in geological formations of any age on the majority of the territory of Kazakhstan. They are distinctively manifested in local gravity anomalies, in an anomalous magnetic field [7, 8] and, in our opinion, are the structural components of the Kazakhstan giant astrobleme-giablen, briefly described in [15].

The position of the Kazakhstan giablen geometric center located 40-50 km southwest from Semipalatinsk, as well as the spatial allocation of known metallic and a certain amount of non-metallic deposits, made it possible to carry out a new forecast method. On the entire vast area of Kazakhstan arched expansion and compression zones of the Kazakhstan giablen were schemed (Figure 1). At the same time, the West Kazakhstan oil and gas bearing territory and the territory of the Rudny Altay were excluded, because such scheming for them should be carried out separately.

The age of the Kazakhstan giant cosmogenic ring structure is at the boundary of the Ordovician and Silurian. To more accurately reproduce the expansion and compression zones, before their scheming, the geological space was reconstructed by displacing the eastern block of Kazakhstan along the Central

Kazakhstan fault-shift by 80-90 km to the north. This relatively young shift, which brakes the integrity of the arc ensemble of the paleozoid of Kazakhstan, in its northern part, was described in detail by Koshkin V. Ya. The shift is distinct both in its northern and southern parts on all regional maps of the anomalous magnetic field [6-8] and is provided in figure 1.

Earlier, in 1975 or 44 years ago, the Pre-Balkhash-Ili giant cosmogenic ring structure well marked in this field [6], and reconstructed from the data of the anomalous magnetic field of Kazakhstan, broken by this shift, was described in the journal "Reports of the USSR Academy of Sciences" by Smirnov V. I., an academician of the USSR Academy of Sciences.

For drawing of map of regional scale mineral deposit forecast there is a need of at least two or three stages of scheming based on large and giant cosmogenic structures, the diameters of which are measured from hundreds to one and a half (and more) thousand kilometers. As an example, in article [15], in accordance with the description of the invention [16], regional forecasts of the first and second stages on structures with similar diameters were made. As a result of the implemented forecast development, three-fold expansion blocks were distinguished, in the contour of which the world's largest rare-metal deposits are located – Upper Kayrakty and Koktenkol. Huge metal reserves in these deposits are given in [15].

The world's second most important province of ferromanganese deposits (Ushkatyn-3, etc.) tends to the same group of blocks. In similar blocks of triple expansion, there is a very large rare-metal deposit Karaobinsk (W, Bi, Mo (Sn)) and a large molybdenum deposit Shalgiya.

Local forecasting of metal mineral deposits based on the principles of shock-explosive tectonics and remote sensing data of the Earth for the planning of specific exploration works can and should be carried out within the boundaries of manifestation of much smaller scale cosmogenic ring structures. The diameters of these structures are measured from the first kilometers to tens of kilometers [13].

In particular, at the present time, in connection with the acute problem of raw material supply of the existing Production Association "Zhezkazgantsvetmet", "Kazakhmys Corporation" LLP, detailed exploration work carried out with the use the new technology is urgent, and should be carried out on the basis of a local forecast near this enterprise (figure 2).

In the article, **detailed forecast development** in Zhezkazgan district is undertaken and offered as a **specific example** in two variants:

**1. Basing on ring structures manifested in relief that suggests they are of relatively young age.**

**On the basis of the ring structures captured in space images, but not manifested in relief, that indicates their older age, combined with one of the structures manifested in the relief, but the morphological elements of which clearly contain and control all deposits of the Zhezkazgan ore district.**

At the same time, it is necessary to pay attention to the proposals expressed by the late Satpayeva M. K., who devoted many years to the exploration of the Zhezkazgan ore deposits and outlined the Zhezkazgan-Aynak Copper Belt.

She pointed out the manifestation of a number of ring structures with a diameter of 80-120 km, complicated by faults and small rings, in the Zhezkazgan ore region. Satpayeva M. K. considered the areas connected with the newly discovered ring structures, promising to search for concealed deposits, as deserving further study. Satpayeva M. K. regarded the need to use gravity survey data in addition to RS data on ring structures, as the primary step to further studies.

**The first variant of the forecast is based on ring structures manifested in relief.**

In the Zhezkazgan ore region and its vicinity, schemed from the data of the radar satellite survey, 6 ring structures are distinctly manifested in the relief (Fig. 2, A, B). **All structures are superposed on a heterogeneous geological situation, which indicates their exogenous (cosmogenic, impact) nature** (Figure 2, B). Within the contours of impact wave influence zones of these ring structures, there are 12 known deposits, including the largest of them – Zhezkazgan (Figure 2, Г, Д).

Taking into account the distinguished ring structures, basing on the spatial allocation of known deposits, the zones of expansion and compression of three ring structures were drawn – Zhezkazgan, Northern as the most significant in size which is cometary, without craters, and South-Eastern which is asteroidal with a crater (figure 2, Д). The mutual overlay of expansion and compression zones made it possible to distinguish double expansion blocks and 8 triple expansion blocks that cover the most promising areas located in the eastern and southeastern parts of the Zhezkazgan ore district (figure 2, Д, E).

Thereafter, prospecting works should be carried out within all 8 blocks of triple expansion.



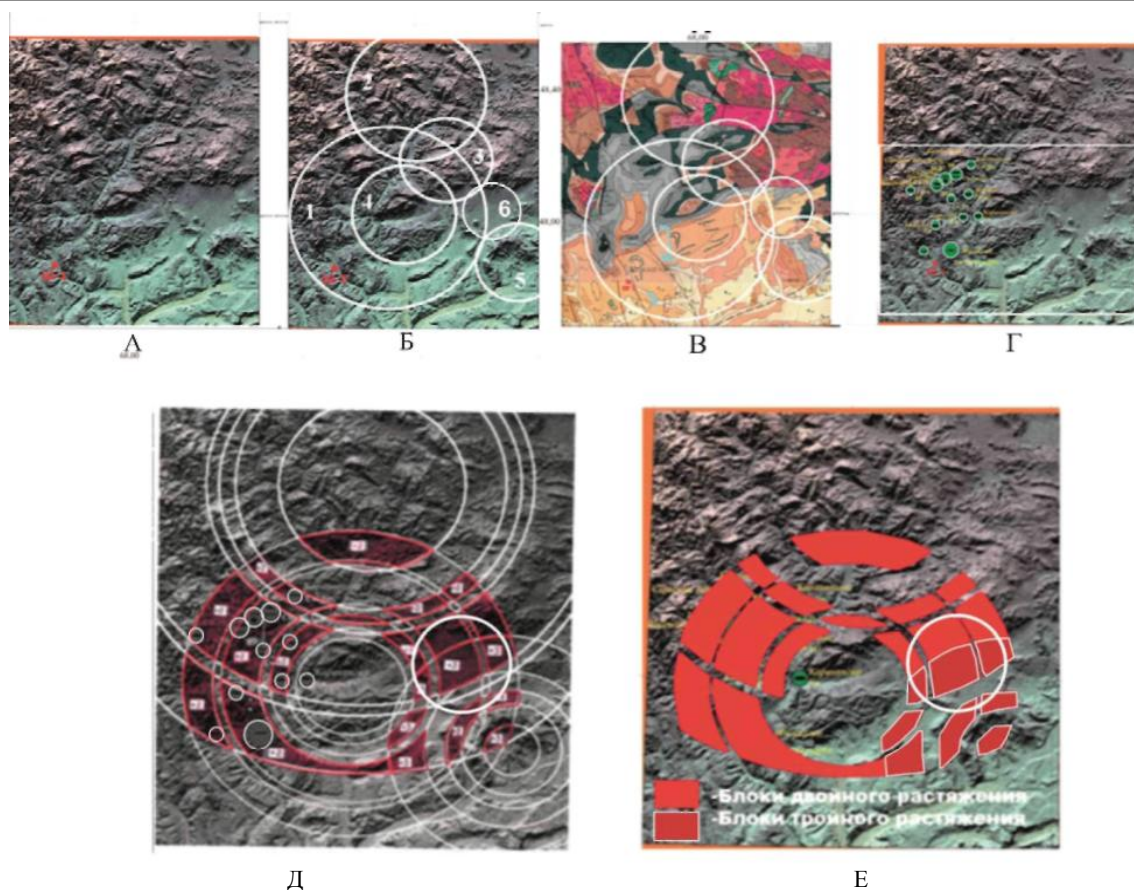


Figure 2 – Forecast development in the Zhezkazgan ore district.

А - the relief drawn from the data of the radar satellite survey in the Zhezkazgan ore district and in its vicinity; Б - contours of the ring structures distinctly manifested in the relief of: 1 – Zhezkazgan, 2 – Northern, 3 – Middle, 4 – Karakengir, 5 – South-Eastern, 6 – Terekty; В - contours of the ring structures on the Geological map of Kazakhstan at a scale of 1:1000000; Г - the Zhezkazgan ore region deposits (contoured by a white rectangle), plotted on the relief according to the data of the Kazakhstan Mineral Map 1: 1000000 – 12 small circles, the largest of them is the Zhezkazgan deposit; Д - concentric zones of expansion and compression of the three ring structures: Zhezkazgan, Northern, South-Eastern, drawn considering the spatial position of the twelve known deposits. Thick contour of the Terekty ring structure; Е - blocks of double and triple expansion in places of mutual overlay of Zhezkazgan, Northern and South-Eastern ring structures

As we can see, these schemes do not take into account all the ring structures allocated in the relief. In addition to the unaccounted Middle (structure 3), Karakengir (structure 4) and Terekty (structure 6) structures, ring structures, the centers of which are outside the territory covered by the provided figures, are marked in the southern and southeastern parts of the region as arcuate valleys of temporary streams.

If necessary, these structures can also be taken into account in more detailed forecast development.

**We consider it is very important to use gravimetric data in these forecast developments. It was emphasized above that Satpayeva M. K., having paid attention to the control of the Zhezkazgan ore deposits by ring structures of various diameters, pointed out the need for using gravimetric survey data. The authors share this point of view.**

Analysis of the deposits location on the gravimetric map, specifically on the map of the residual anomalies *Ag of 1: 500 000 scale*, shows that the Zhezkazgan ore fields (a very large deposit) and Zhaman-Aybata (a large deposit) are within the contours of relative gravity maxima. In this regard, the gravity maxima of this region deserve careful attention.

In figure 3, six gravity maxima are contoured. The Zhezkazgan (very large) deposit and two small deposits of **Taskuduk** and **Zhezdy** are located in the maximum contour **West**. In addition, five more maxima, closest to Zhezkazgan, are contoured. They were given names and numbers: gravity maximum – 1 (**Close**), gravity maximum – 2 (**Middle**), gravity maximum – 3 (**Far**), gravity maximum – 4 (**South-Eastern**).

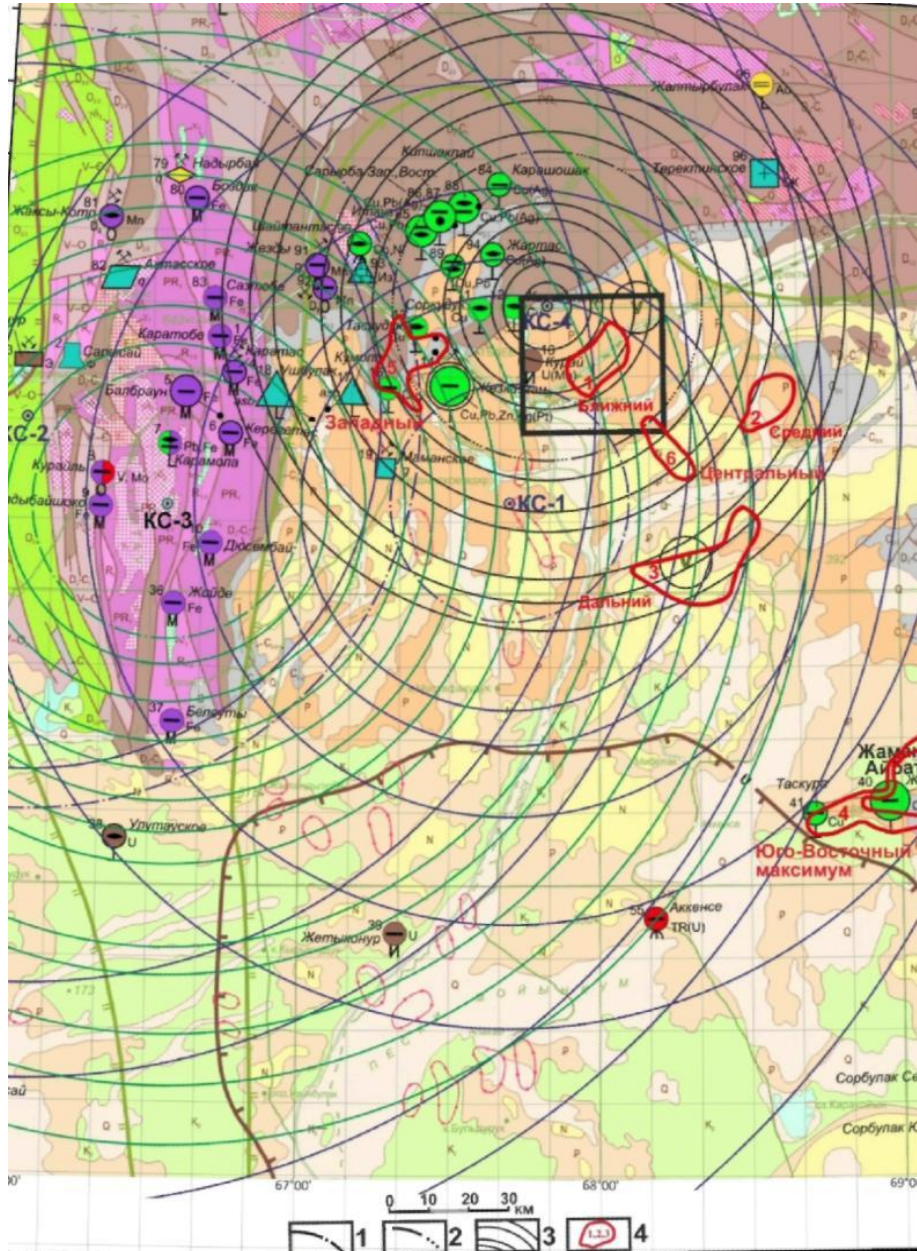


Figure 3 – Fragment of the Kazakhstan minerals Map of 1:1 000 000 scale (Uzhkenov B. S., 2003).

1 – contours of ring structures (KC-1, KC-2 and KC-3), taken from the cosmogeological map of the USSR [32], 2 – contour of the Zhezkazgan ring structure (KC-4), clearly manifested in the relief, 3 – concentric zones of expansion and compression, marked with the same color as the contour of each of these ring structures, 4 – contours of relative gravity maxima – 1, 2, 3, 4, 5, 6, within the contour of which detailed exploration works and exploration drilling were carried out. In the black square – the gravity maximum – 1 (Close), which, at this stage of research, deserves the most careful attention of all.

**Western** gravity maximum was assigned with number 5. It is most well studied for the present day. In the center of the triangle formed by the three gravity maxima of **Close**, **Middle** and **Far** there is another gravity maximum called **Central**, which assigned with number 6. This maximum also deserves attention, although it is somewhat of an inferior intensity comparing with the three maxima mentioned.

**A large gravity maximum, the central part of which is located 20-22 km to the east of the city of Zhezkazgan, and 50 km away from the central part of the Western gravity maximum, which contains the deposits of Zhezkazgan and the deposits of Taskuduk and Zhezdy, deserves careful attention. This gravity maximum is under number 1 (Close) (figures 3, 4). Its center is located at 47°52'N and 68°00'E. The area covered by the maximum is ~ 200 km<sup>2</sup>.**

The gravitational situation that we can see here allows to hope for the discovery of a large ore object (**the second Zhezkazgan?**), but the one that lies at a depth. This maximum, according to its intensity figures, exceeds the maximum **5 (Western)**, in the contour of which a very large Zhezkazgan deposit and small deposits of Taskuduk and Zhezdy are located, and a maximum **4 (South-Eastern)**, to which the large Zhaman-Aybat deposit and a small deposit of Taskura are confined to. It is known that ore bodies at Zhaman-Aybat lie at 400-700 m depths.

It should be emphasized that the center of the gravity maximum **1 (Close)** is at the shortest distance from the city of Zhezkazgan – only 20-22 km, and the railway passes through it. This is a very significant technical and economic factor.

Gravimetry data record requires careful attention towards the gravitational maximum **3 (Far)**. This is the area of the field, named **Tabyлга**, which has long ago been nominated a highly promising for a new ore site detection [17]. However, the Yu-6 prospecting well of 280 m depth was drilled on this site by DGEE in 1962-1968, i.e. half a century ago. The ore object was not detected, apparently due to insufficient depth of drilling. At present time, this object should be considered a promising one. It deserves an exploration well boring control, but with wells of greater depth.

The local gravity maximum **2 (Middle)** deserves additional deep well boring control. The prospecting well was also drilled there, but much later, in 1995-1996, and, apparently, the well was of insufficient depth, too.

On limited in size areas, distinguished with the help of the proposed innovative forecast method, it is necessary to conduct research with the use of modern geophysical and geochemical methods. In particular, on these areas it is necessary to plan and carry out a "deep" form of geochemical exploration – geochemistry of the mobile form method – MFM, etc.

Ring structures are accompanied by concentric zones of expansion-decompression (denoted by odd Roman numerals) and compression (denoted by even Roman numerals). All the deposits of the area are shown. The contours show gravity maximum – **1 (Close)**, gravity maximum – **2 (Middle)**, gravity maximum – **6 (Central)**, gravity maximum – **3 (Far)**, and gravity maximum, containing the deposits of Zhezkazgan, Taskuduk and Zhezdy (**Western** gravity maximum 5).

Basic methods of geochemistry have proven effective in the recent years – the North Shandun gold province with several industrial gold deposits with reserves of more than 10-20 tons in China, the Bendigo-Balarat gold province in Australia, as well as the provinces in Canada, the United States, India, Russia and Kazakhstan (Rudny Altay) were distinguished.

Since, as previously noted, the Zhezkazgan ore fields (a very large deposit) and Zhaman-Aybata (a large deposit) are located within the contours of relative gravity maxima, then it was natural to analyze the spatial position of all deposits in the Zhezkazgan ore region within the gravitational field. The entire area is located in a gravitational field with an intensity from -36 mGal to +8 mGal.

A very large deposit of Zhezkazgan is located in a distinctively manifested relative gravity maximum **Western** named above. A small deposit of Taskuduk is located within the contour of this same maximum. Both these deposits are located in the northeastern part of this significantly large gravity maximum territory, contoured by an isoline of -4 mGal. Zhezkazgan itself is located on a relatively small area within this maximum, the area is contoured by an isoline of -2 mGal. In a similar situation, i.e. next to a small-area maximum, with the same intensity of -2 mGal, there is a small deposit of Zhezdy, located to southwest of the Zhezkazgan deposit. All three deposits (Zhezkazgan, Taskuduk and Zhezdy) are located within the contour of a single gravity maximum, contoured by an isoline of -4 mGal (figure 4).

Small deposits of Karakengir (on the -6 mGal isoline), Sorkuduk and Zhartas (between the isolines of -8 mGal, and -10 mGal), small Shaytantis deposit (on the -14 mGal isoline), small Saryoba East deposit (between the isolines of -18 mGal, and -20 mGal), small Karashoshak deposit (between the isolines of -16 mGal and -18 mGal) are located within the relative gravity maxima, but of inferior intensity. Three medium deposits – Itauz, Saryoba East and Kipshakpay are located in the gravitational field between the isolines from -18 mGal to -20 mGal.

Since, as noted, the lowest value of the gravitational field intensity in the region is -36 mGal, it can be assumed that all these deposits, as noted, are in the contours of relative gravity maxima of different intensity. In addition, the **Zhaman-Aybat** deposit, as mentioned above, as well as the **Taskura** deposit, are also located in the gravity maximum contour with an intensity from -6 mGal to -12 mGal.

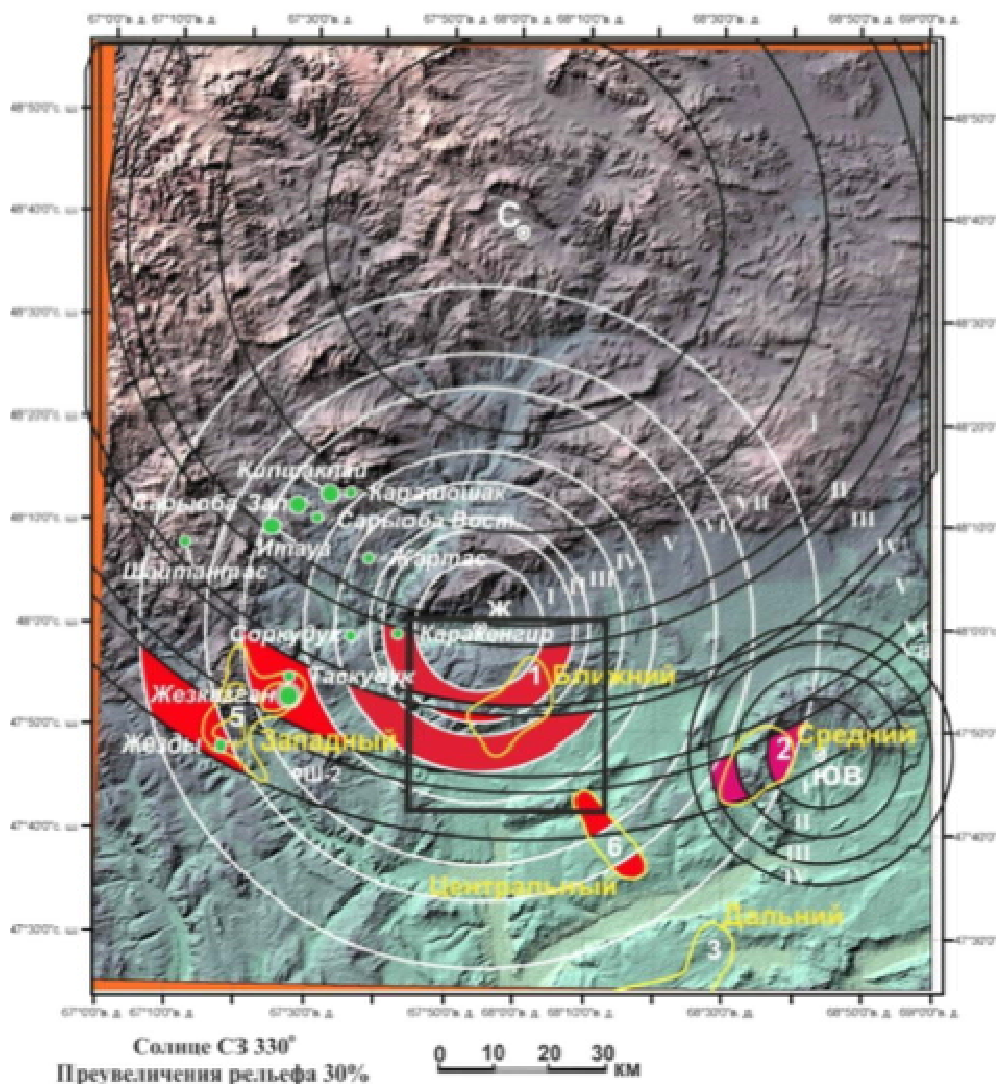


Figure 4 – Ring structures manifested in the relief mapped from the radar satellite survey data – Zhezkazgan (center – Zh), Northern (center – C) and South-Eastern (center – SE)

It is clear that the provided data should be considered as an important search characteristic.

Thus, the gravity maximum – **1 (Close)**, the central part of which is located at a distance of 20-22 km from the city of Zhezkazgan, and 50 km to the east from the central part of **Western** gravity maximum, which contains the deposits of Zhezkazgan, Taskuduk and Zhezdy, is currently of the greatest interest.

The scheming of concentric expansion and compression zones of the Zhezkazgan and Northern ring structures considering the spatial allocation of all known copper ore deposits in the Zhezkazgan ore region, allows us to distinguish the blocks of double expansion. They are clearly visible in Figure 4. Their total area is about 80 km<sup>2</sup>. In other words, we can see that double-expansion blocks cover about half the area of a given gravity maximum.

Thus, the geologic data resulting from the spatial allocation of known deposits, in conjunction with geophysical data on the connection of the region's deposits with geophysical anomalies, underline the high prospectivity of the area which is located within the contours of this gravity maximum. It is important to understand that the area of the modern ore field of the Zhezkazgan deposit itself (a very large deposit) is 62 km<sup>2</sup>.

We note that the central, inner part of this maximum is promising, due to being confined to the maximum. This part is intersected by narrow compression zones of the Zhezkazgan and Northern ring structures. At the point of their mutual overlay, a relatively small block of double compression is allocated.

However, a similar picture is typical for **Western** gravity maximum, which contains the deposits of Zhezkazgan, Taskuduk and Zhezdy (Figure 4). This again underlines the high prospectivity of the territory enclosed in the contour of the gravity maximum **Close**.

It is obvious that detailed modern geochemical and geophysical exploration works should be carried out within the entire territory of Close gravity maximum with the use of the MFM and other methods, i.e. basic methods of geochemistry and geophysics should be applied. The complex of planned detailed geophysical and geochemical works should be carefully thought out, prepared and carried out. After this, drilling of exploration wells should be carried out. Drilling should come along with a detailed geophysical study of the near-wellbore area, since ore bodies are relatively narrow ribbons. The probability of a "miss" in this situation is very significant.

Gravity maximum – 2 (**Middle**), located within the contour of the South-Eastern ring structure, is likewise characterized in the same way (Figure 4). Eastern and western parts of this gravity maximum are within the boundaries of triple expansion blocks. At the same time, double expansion blocks, which lie on this maximum, are drawn up considering all known copper ore deposits in the region. However, the third expansion is based on the concentric expansion and compression zones of the South-Eastern KC, drawn up on the basis of relief features, but without data on the spatial position of known deposits, which makes this expansion less obvious. This point should be taken into account.

The clear manifestation of all these ring structures in the relief allows one to assume that they are of relatively young, perhaps **Mesozoic-Cenozoic age**, which makes their ore-controlling role **for Paleozoic** ore objects controversial.

In this connection, an idea about similar forecast developments based on older ring structures, manifested in space images, but not manifested in relief arose.

**The second variant of the forecast is based on ring structures captured in space images, but not manifested in relief, which suggests their older age, combined with a structure that manifested in the relief, but clearly containing all deposits of the Zhezkazgan ore district.**

The older age of the ring structures suggests their considerable erosion damage and, therefore, levelling process, disappearance of their occurrence and manifestation in the relief. At the same time, erosion damage, by removing superficial, clearly pronounced morphological features of these structures, inevitably outcrops their depth zones, represented by arcuate and radial faults, which are accompanied by powerful flooded zones of crush, accompanying these faults. These faults and zones of crush are emphasized by vegetation and, therefore, are clearly manifested in cosmic images, without being manifested or being slightly manifested in relief. **For such structures, the hypothesis about their Paleozoic age, "consonant" to the Paleozoic age of the ore objects of this region, is more acceptable.**

Three structures like the ones mentioned above were taken from the Cosmogeological Map of the USSR [18]. These three structures are shown at the Map of Minerals of Kazakhstan and are designated as KC-1, KC-2 and KC-3. KC-4 as the fourth structure is involved in forecasting. This is the Zhezkazgan structure. Although it is clearly manifested in the relief (Figures 3, 4), which was emphasized above, we admit the possibility to use it, since all ore objects are located inside it, close to its center. This suggests the feasibility of their genetic relation (figures 3, 4).

In terms of the forecasting, as was noted above, all mentioned relative gravity maxima (**Close, Middle, Far and Central**) are of great interest. In this second variant of the forecast, like in its first variant, the relative gravity maximum, located closer than others to Zhezkazgan is the most interesting. This is maximum – 1 (**Close**).

Basing on the spatial allocation of all the copper ore deposits in the Zhezkazgan region and taking into account the spatial allocation of the centers of the four ring structures listed above, concentric expansion and compression zones were mapped for each of them (Figure 3). On the basis of mutual overlay of concentric zones of expansion and compression of all four ring structures, blocks of the highest, medium and lowest expansion-decompression and compression are determined. Figure 5 shows the differentiation of such blocks in the contour of the gravity maximum 1 - (**Close**) in this variant of the forecast. As we can see, the gravity maximum 1 - (**Close**) in both of the provided variants of the forecast is of definite interest.

Gravity maximum 2 - (**Middle**) is also of considerable interest. It is limited by the -8 mGal isoline. This maximum is almost entirely located in the block of four-fold expansion. Gravity maximum 3 (**Far** –

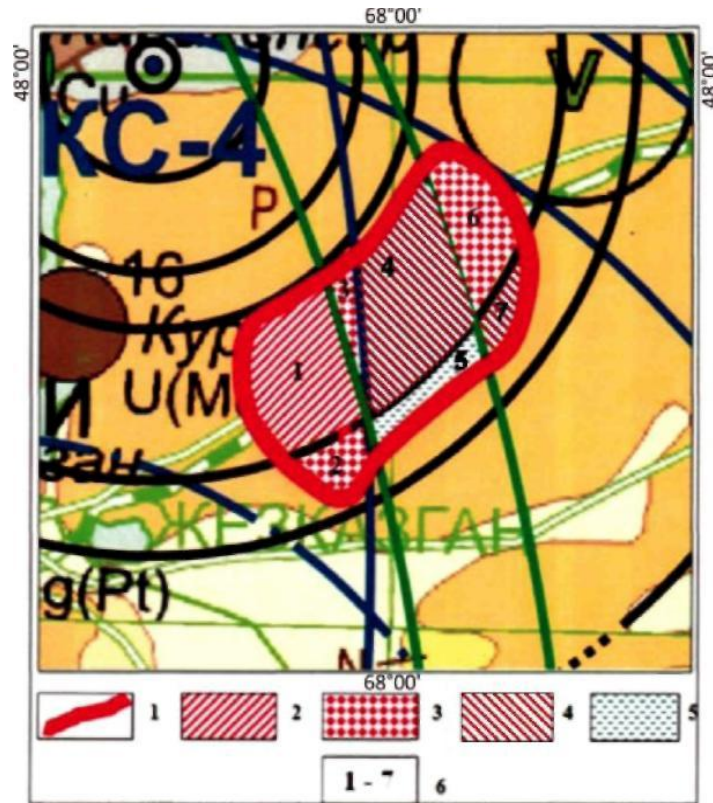


Figure 5 –Fragment of the Mineral Map of Kazakhstan, outlined as a black square in figures 3, 4.

1 - contour of the gravity maximum - 1 (Close); 2 - block of four-fold expansion, 3 - blocks of three-fold expansion and single compression, 4 - blocks of double expansion and double compression, 5 - block of triple compression and single expansion, 6 - block numbers inside the gravity maximum contour

**Tabylga**) is also subdivided into blocks of different degree of expansion and compression. **All four maxima (taking into account the Central maximum), by analogy with the spatial position of Zhezkazgan and Zhaman-Aybat, are high-potential territories.**

Special attention should be paid to the fact that in the contour of the gravity maximum **1 - (Close)**, according to both variants of the forecast, there are areas of mutual overlay and overlap of the areas of expansion of the geological environment. These limited in size, conterminating areas according to the two variants of the forecast are in the north-north-east and south-south-west parts of this gravity maximum.

In addition to the gravity maxima mentioned above, the area of the Terekty ring structure (**structure 6 in figure 2B**) deserves attention, as well. The Terekty ring structure is a depression filled with Early Quaternary loose sediments that play the role of an overlapping mantle (therefore, the structure is underlined) for potential ore objects hidden at some depth.

The gravitational field in the contours of depression is characterized by values of -12 mGal and -16 mGal, and its contours allow us to outline a certain similarity of a separate gravity maximum. If you take into account that three medium deposits: Itauz, Saryoba West and Kipshakpay are located in the gravitational field between the isolines from -18 mGal to -20 mGal, this object undoubtedly deserves careful attention!

The depression is largely overlapped by Early Quaternary loose deposits shown on the Geological Map of Kazakhstan of 1: 1,000,000 scale (Bekzhanov G. R., 1996) (see figure 2, B) and the Kazakhstan Mineral Map of 1: 1,000,000 scale (Uzhkenov B. S., 2003). The depression, most likely, is, as well as the ring structure 5, a meteorite crater. Three blocks of triple expansion fall on the depression (figure 2-E). Inside the depression there is the Terekty railway station, located 85 km to the east of the Zhezkazgan deposit.

Fragmentation of rock, which is a specific of crater funnels, contributing to the localization of hydrothermal processes, is an additional favorable ore-localizing factor that draws attention to this promising

closed territory. This fragmentation should be considered as an addition to the three episodes of expansion-decompression, which influenced this section of the ore-bearing region.

The area adjacent to the **Sh-2 well**, drilled to the south of the Zhezkazgan deposit deserves serious attention. It also reveals a thick layer of pyritized gray sandstones (the well is shown in figure 2A, Б, В, Г and figure 4).

In accordance with the suggested research methodology, based on the forecast developments of 2002-2003, that is, 10-11 years ago, the **Sh-2 well** was set to the south of the Zhezkazgan deposit ore field. **The well had a depth of 1500 m.**

**At a depth from 1300 m to 1395 m, it passed along fine-grained gray sandstones with pyrite nodules on plant remains.** The nodules of pyrite are strongly marked signs of hydrothermal activity in the rock of the ore-bearing Tuskuduk suite. **This is a highly informative positive exploration sign.** Taking into account the sequence of the thicknesses in the section of the Tuskuduk ore-bearing formation in the Zhezkazgan ore region is in the range of 200-350 m, and, at the same time, gray sandstone with and without ore is alternating with red sandstone, argillite and siltstone, then **the section of a thick – 95 m – layer of fine-grained gray sandstone with pyrite in the general section of the Tuskuduk suite with a thickness of 205 m, crossed by a well, should attract the closest attention.** It is significant that the most **important highly informative sign is gray sandstone with pyrite**, and in a layer of considerable thickness, were found at a fairly large distance of 11 km from the ore field of the Zhezkazgan deposit. This shows that the area, located to the south of the Zhezkazgan deposit still remains prospective. It should be emphasized that the range of metallization age in the region can be traced from the Lower Carboniferous (Itauz deposit) to the Lower Permian (Taskura deposit).

**Thus, it is necessary to note the following: 1. The forecast of mineral deposits with the use of the proposed new technology can be carried out without difficulties. As we can see, it is based on the principles of shock-explosive tectonics (SET) and the extensive use of the up-to-date space information, in the form of remote sensing data (RS), considering the spatial location of known deposits. The proposed new technology opens vast prospects to the exploration of solid mineral deposits. The new technology allows to carry out regional and local forecast within the areas overlapped by a mantle of young loose sediments, and within the vast marine areas, as well.**

**Regional and detailed works on the forecast of solid mineral deposits can be carried out in any areas [5-13, 15-17, 19].**

**As for detailed works on solid minerals, concrete forecast development for the Zhezkazgan ore region are provided as an example. Here the problem of the raw material base is very acute and requires an immediate solution.**

The results of the conducted studies allow us to map the following objects in the Zhezkazgan ore district for carrying out detailed exploration works that are of **high priority for the present day:**

1. The area of gravity maximum **1 (Close)**, located close to the city of Zhezkazgan (the center of this area, as noted above, is only 20-22 km away from it) and connected with it by the railway. It is regarded as the most promising.

2. The area of gravity maximum **2 (Middle)**,

3. The area of gravity maximum **3 (Far – Tabyлга)**,

4. The area of gravity maximum **6 (Central)**,

5. Closer attention should be paid to the **area**, overlaid by a loose sediment cover and located **inside the Terekty ring structure**, as well as **the area adjacent to the Sh-2 well**, drilled to the south of the Zhezkazgan deposit, and **revealed a thick layer of pyrite gray sandstone at depth.**

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**ПРОГНОЗИРОВАНИЕ МЕСТОРОЖДЕНИЙ МЕТАЛЛИЧЕСКИХ ПОЛЕЗНЫХ ИСКОПАЕМЫХ НА ОСНОВЕ ПРИНЦИПОВ УДАРНО-ВЗРЫВНОЙ ТЕКТОНИКИ И ИСПОЛЬЗОВАНИИ ДАННЫХ ДИСТАНЦИОННОГО ЗОНДИРОВАНИЯ ЗЕМЛИ**

**Аннотация.** Авторы предлагают новую технологию регионального и локального (крупномасштабного) прогнозирования месторождений полезных ископаемых на основе принципов ударно-взрывной тектоники (УВТ) и данных дистанционного зондирования (ДЗЗ). Прогноз месторождений полезных ископаемых следует осуществлять, используя данные ДЗЗ в совокупности с огромной информацией о размещении в геологическом пространстве известных и разведанных месторождений полезных ископаемых. Исследования последних лет показывают, что месторождения полезных ископаемых часто связаны с кольцевыми структурами, как эндогенными, так и космогенными. Подавляющая масса месторождений полезных ископаемых, как показывают многолетние исследования, приурочена к концентрическим зонам растяжения-разуплотнения земной коры, сопровождающим космогенные кольцевые структуры различных размеров. Блоки взаимного наложения зон растяжения-разуплотнения земной коры, соседствующих астроблем и гиаблем (гигантских астроблем), представляют собою пространства, наиболее перспективные для локализации месторождений полезных ископаемых. Зоны растяжения-разуплотнения земной коры разделяются зонами сжатия, лишенными или почти лишенными скоплений полезных ископаемых. Анализ пространственного размещения твердых полезных ископаемых подтверждает эту мысль. На основе предлагаемой технологии прогноза выделены новые локальные перспективные площади, в пределах которых предполагается обнаружение месторождений, запасы которых должны восполнить истощенную рудную базу в районе Жезказгана.

**Ключевые слова:** прогноз месторождений полезных ископаемых, кольцевые космогенные структуры, концентрические зоны растяжения-разуплотнения и сжатия земной коры

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