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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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OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
Kazakh national research technical university
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## ГЕОЛОГИЯ ЖӘНЕ ТЕХНИКАЛЫҚ ҒЫЛЫМДАР СЕРИЯСЫ

♦

## СЕРИЯ ГЕОЛОГИИ И ТЕХНИЧЕСКИХ НАУК

♦

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# APPLICATION OF SYSTEMS APPROACH TO PROGNOSTICATION OF ORE FIELDS IN LOCAL AURIFEROUS NIDALSTRUCTURES (on the example of Vera-Char - Baladzhalnidal structure in West-Kalbinsk gold-bearing area of East Kazakhstan)

**Abstract.** Vera-Char - Baladzhalnidal structure (NS) of the rank of the ore site is identified by the author as a promising regional research level, the estimated gold resources in it are estimated at 574,361 kg. As a result of a detailed study, to which this article is devoted, the prospective areas are localized to the rank of ore fields and deposits.

Based on the paradigm of a systemic approach to the formation of gold deposits, the Vera-Char-Baladzhal focal structure was reconstructed, regularities in the location of deposits were established in its boundaries and three promising areas for the formation of large fields were identified: the Baladzhal predicted ore field, Vera-Char forecast ore field and the Marinovsko-Kyzyltas predicted ore field. Their total area is 37.5 $km^2$ or 5.8% of the area of predictive research.

**Keywords:** prognosis researches, gold deposits, nidal structure, magmatic formation, metasomatic changes, Western – Kalbinskgold-field.

The topicality of expanding raw material base of the gold mining industry of Kazakhstan is beyond doubt. Obviously, the solution to this problem is impossible without highly effective predictive studies. This article is devoted to the results of the use of the system approach in forecasting gold deposits in the West Kalbinsky gold-bearing area in the East Kazakhstan region, one of the oldest gold mining areas in the Republic.

The West Kalbinsky gold-bearing region, located on the northwestern flank of the West Kalba-Koksentau structural zone, is extended in the north-west direction by more than 300 km and a width of 80 to 150 km. The features of its geological structure are described by previous researchers [1, etc.]. Gold ore deposits have been studied by V.A. Narseyev and others [2]; B.A. Dyachkov and others [3]; M.S. Rafailovich [4], V.A. Globa [5, 6] and other specialists. According to their ideas, they belong to gold-arsenic-carbon type (Bakyrchik, Bolshevik); gold-sulfide-quartz vein type (Zhumba, Kulujun, etc.); complex gold-quartz-beresite (Baladzhal) types.

In the territory of the described region, forecasting studies were carried out by B.A. Dyachkov, A.A. Malygin, V.V. Potylitsyn, A.P. Sitnikov and others in the 1950s-1990s. Lithologic-stratigraphic, magmatic, metamorphic, structural-tectonic, mineralogical-geochemical and geophysical factors were considered as the main factors of the localization of gold mineralization.

In 2000, [1] the forecast of different types of gold ore deposits was carried out on the basis of bulk modeling methods by the staff of authors. The advantage of these studies is the development of typical models of ore-forming systems (ROS) of gold deposits. The main components of the ROS model are the magmatic focus, caused by its development of small intrusions and ore-bearing fluids that gravitate toward the above-intrusive zone. The developed geological and geophysical model of the Bakyrchik ore field [7], is similar. According to their ideas, the connection with magmatic-ore systems is characteristic for all gold ore objects of the West Kalbinsky region.

The presentations of these authors on the uniformity of ore control structures are consistent with the data [8, 9] that the local areas of the development of endogenous mineralization are controlled by similarly

imposed tectonic-magmatic structures of a focal character, which are fixed by the products of their activity - various magmatic, hydrothermal-metasomatic ( including ore) formations.

Such a combination of elements of the lithosphere in the modern sense is a magmatogene-ore system possessing the properties that do not follow from the sum of the properties of its parts, and therefore its reconstruction must be based on the methodology of system analysis, the principles of which are set forth in numerous works [10, 11].

The methodology for predictive research used by the author and based on the paradigm of system analysis and described earlier [12], includes the following successive procedures: reconstruction of the magmatogene-ore system on the basis of a quantitative evaluation of the structure of its elements development using the technique of S.V. Vasilev [13], the identification of structural and statistical regularities in the placement of "reference" gold ore objects in the system and the allocation of promising areas based on the identified regularities.

At the regional level of research, as a result of which the described Vera-Char-BaladzhalNS has been singled out, small intrusions of different composition and age are considered as ore-generating factor; as "traces" of exposure through magmatic fluids - different-scale gold ore objects; as ore-supplying elements - the zones of crushing, identified by cosmogeological data. The purpose of the detailed study, the results of which are described below, is the localization of promising areas to the size of ore fields and deposits

Vera-Char - BaladzhalNS is located on the southwestern side of the West-Kalbinsk gold-bearing area (figure 1). The forecast gold resources in it are estimated at 574,361 kg. The area covering the described structure with framing and estimated at the stage of the local forecast is 673.7 km$^2$.

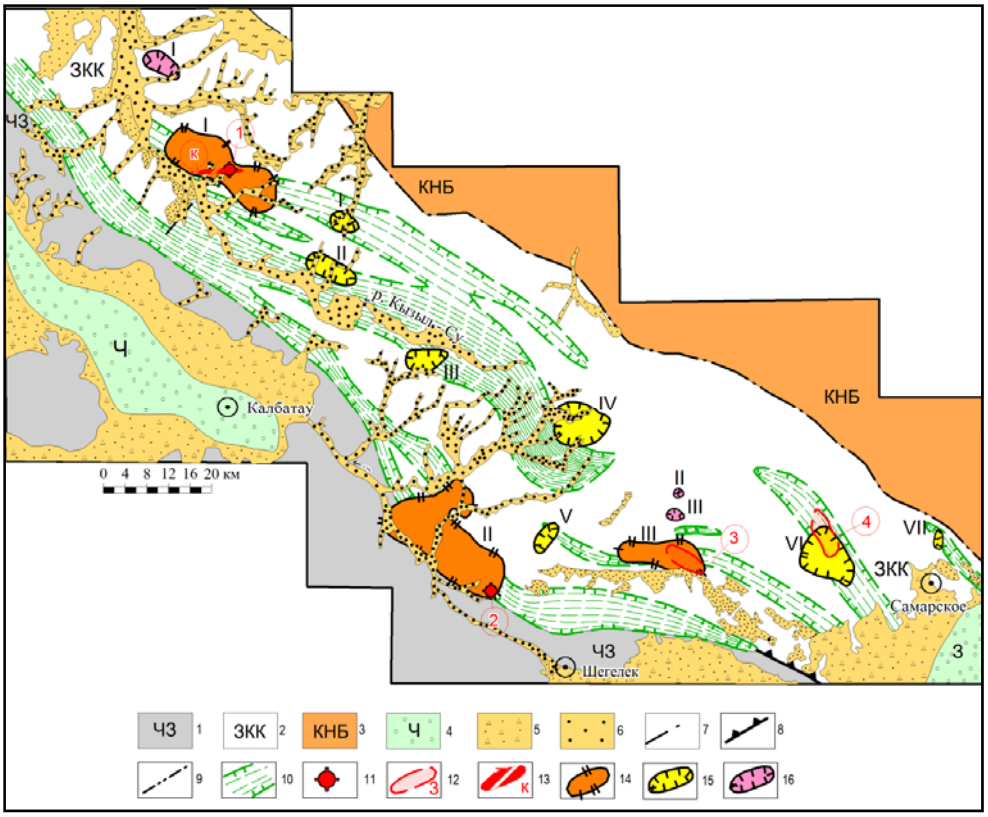


Figure 1 – The map of the location of prospective gold ore junctions on the area of the West-Kalbinsky district (a map of the forecast of gold content). Compiled by G. B. Orazbekova.

Legend: 1-3: structural zones - 1 Charsk-Zimunayskaya, 2 - West Kalba-Koksentau, 3 - Kalba-Narym-Burchumskaya; 4 - depressions of the inherited development (Ch - Charskaya, Z-Zaisanskaya); 5 - quaternary proluvial deposits of cones; 6 - neogene and quaternary deposits of valleys and intermontane depressions; 7, 8 - deep faults: 7 - Terektinsky, 8 - Charsk-Gornostaevsky; 9 - transverse fault; 10 - longitudinal crumple zones; 11 - reference gold deposits: 1 - Bakyrshik, 2 - Baladzhal; 12 - gold ore fields of reference deposits: 3 - Jumba, 4 - Kulujun; 13 - the Kyzylovskaya zone; 14 - 16: focal structures promising to find gold deposits 14 - bimodal, most promising: I - Bakyrchik, II - Vera-Char - Baladzhal, III - Jumba; 15 - unimodal, promising - I-Kanaika, II - Kazanchunchur, III - Zhanaminskaya, IV - Sentash, V - Opokoy, VI - Kulujun, VII - Lailinskaya; 16 - unimodal, least promising: I - Espinskaya, II, III - Northern Jumba.

Within its limits, the deposits of the Early Carbon are of the predominant development and the sediments of the Middle Devonian, composed of sandstones, siltstones and limestonesare developed on the southwestern flank (figure 2).

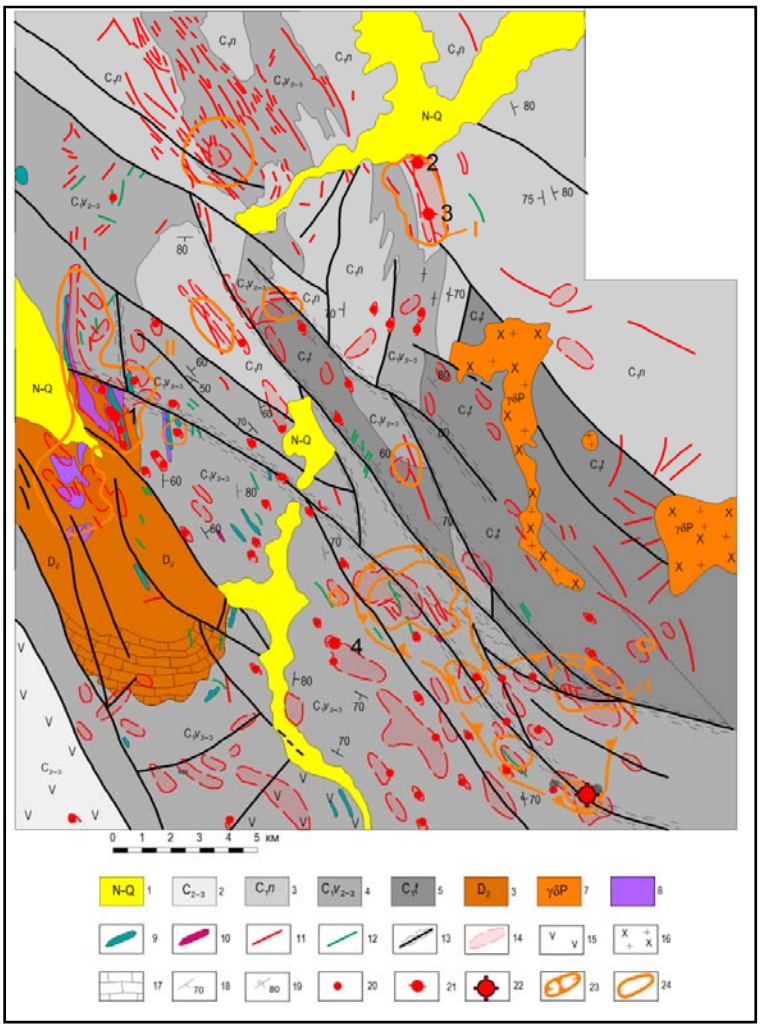


Figure 2 – Schematic geological map of Vera-Char - Baladzhal NS with elements of the forecast (compiled using materials PGO "Vostkazgeologiya").

Legend: 1 - Neogene and Quaternary deposits are undivided; 2 - medium - upper carboniferous (andesite porphyrites, tuffs, sandstones); 3 - Lower Carboniferous, Namurian Stage (tuffites, siltstones, clay shists, sandstones); 4 - Lower Carboniferous, Visean Stage, Middle-Upper Substage (siliceous siltstones, sandstones, porphyrites, tuffs, limestones); 5 - Lower Carboniferous, Turney Stage (sandstones, tuff sandstones with interlayers of siltstones); 6 - Middle Devonian (sandstones, siltstones, limestones, schists, quartz porphyries and their tuffs); 7 - granodiorites of Permian age, post-ore; 8 - hyperbasites of conventionally early-carboniferous age (peridotites, pyroxenites, serpentinites and gabbro-diabases, 9 - small intrusions of medium and basic composition undivided, 10 - small intrusions of acidic composition undivided, 11 - dykes of acid composition, 12 - dykes of medium-basic composition, 13 - faults and near fracture zones, 14 - development zones of hydrothermal-metasomatic formations, 15 - andesites, 16 - granodiorites, 17 - limestones, 18 - inclined rocks, 19 - inverted rocks, 20 - points of gold mineralization, 21 - ash ore deposits and ore occurrences (1 - Vera-Char, 2 - Marinovskoye, 3 - Kyzyl-Tas, 4 - Jupiter), 22 - Baladzhal reference deposit, 23, 24 - predicted construction results: 23 - predicted Balazhalsky gold ore subunit, 24 - areas, promising for the identification of gold deposits (I - Marino-Kyzyltasskaya, II - Vera-Charskaya).

Intrusive formations are diverse in composition and age. The most ancient are Early Carboniferous intrusions of hyperbasites - peridotites, pyroxenites, serpentinitesand gabbro-diabases, developed on the western flank. Dyke-like and stock-shaped bodies of medium-basic composition (diabase, diabaseporphyrites, gabbro-diabase, gabbro-norites, andesite porphyrites, diorite porphyrites, quartz diorites) are not numerous. According to the views of previous researchers (O.V. Navozovand etc., 2009), their formation occurred in four stages: Early Carboniferous, Middle Carboniferous, Middle-Late Carboniferous and Permian time.

Dyke-like and stock-shaped bodies of the acid composition are formed in the late Carboniferous time. Among them are granite-porphyry, granodiorite-porphyry, syenite-porphyry, plagiogranite-porphyry, and rarely quartz porphyry. The youngest are large stock-shaped and lacollitose bodies of granodiorites of Permian age, developed on the eastern flank of the structure.

The prevalence of small intrusions and dikes in the described structure is greatest on the north-western flank and insignificant on the rest of the area. Hydrothermal-metasomatic formations are represented by quartz veins, fouling (oxidized areas of sulfidization), lystenitization and birbiritization.

Stratified deposits are crushed into strained linear folds (with incidence angles to vertical ones) of the northwestern strike in the southwestern and central parts and submeridional on the northeastern flank, and are broken by numerous faults of the general northwest orientation, the conformal strike of the Charsk-Gornostayev crumpling zone.

Within the described structure, there is a "reference" Baladzhal deposit, as well as the Vera-Char deposit and the ore occurrences of Marinovskoe and Kyzyl-Tas.

***The reconstruction of the magmatogene-ore system.*** At the first stage of this procedure, a meaningful analysis of the initial geological data is carried out (figure 2). As can be seen, the prevalence of dykes and small intrusions is negligible, while the bodies of medium-basic and acidic composition are spatially separated, and therefore do not form a joint multiplicative structure even near the Baladzhal reference deposit. This may indicate either a low intensity of the magmatic process or an excessive generalization in the mapping of the area.

In this connection, an additive picture of their development is used to quantify the structure of dike location and small intrusions of medium-base and acidic composition related to coal-mining igneous complexes; in the analysis granitoids of Permian age do not participate, which are post-ore according to existing concepts [1]. A similar decision was made as a result of the analysis of the arrangement of quartz veins and metasomatic formations that are developed in numerous but local nodes - at the stage of reconstruction of the structure of their placement they are considered as a single factor.

The structure of the location of dikes and small intrusions of a variegated composition and of various ages is illustrated in figure 3. As can be seen, it has a nodal character, and in the placement of nodes, traces of a linear (on the north-western flank) and concentric organization are traced. This is probably due to the peculiarities of the deep structure that controls the location of magma chambers. On the south-eastern flank, the magmatic control of the linear discontinuities of the north-north-western orientation is very clearly manifested in the location of magmatic formations.

The most stable (with values of measure up to 9) the described process is manifested on the north-western flank of the OS, at the junction of linearly and concentrically oriented elements. On the remaining area, the maximum values of the measure in local nodes are predominantly 7-8, only 9 reach 9.

The distribution of gold objects in the structure of magmatic formations has a clearly expressed regularity: both the reference Balajal deposit and other potentially significant objects (Vera-Char, Marinovskoye, Kyzyl-Tas) gravitate towards local nodes of sustainable development of the magmatic process (figure 3).

The statistical regularity of the confinement of gold ore objects to certain intervals of the measure's values is not observed (table 1): the distribution of gold deposits covers the values of the measure from 2 (the Baladzhal deposit) to 8 (the Vera-Char deposit). The total area of these intervals is 235 $km^2$, which is 35% of the study area (673.3 $km^2$).

According to the author of this work, the presence of structural control of mineralization (confinement of gold ore objects to local nodes of sustainable development of magmatic process) indicates the existence of a paragenetic connection between these processes and is a structural regularity.

The structure of the distribution of hydrothermal-metasomatic formations (HMF) has a nodal character (figure 4), and the distribution of local nodes is subordinated to a multi-level hierarchical concentric organization. Two levels of structures are distinguished: the structure of the first level of the organization is developed in the northern part of the area, it is characterized by toroidal placement of nodes of sustainable development of HMFs in the external concentrator (the Marinovskoe, Kyzyltas, Vera-Char objects are connected with these nodes), the distribution of HMFnodes is controlled by linear structures in the central part. The structures of the second level are of lesser dimensions and gravitate toward the periphery of the previously described one. Within their limits, the placement of HMFnodes is also subject to linear structures.

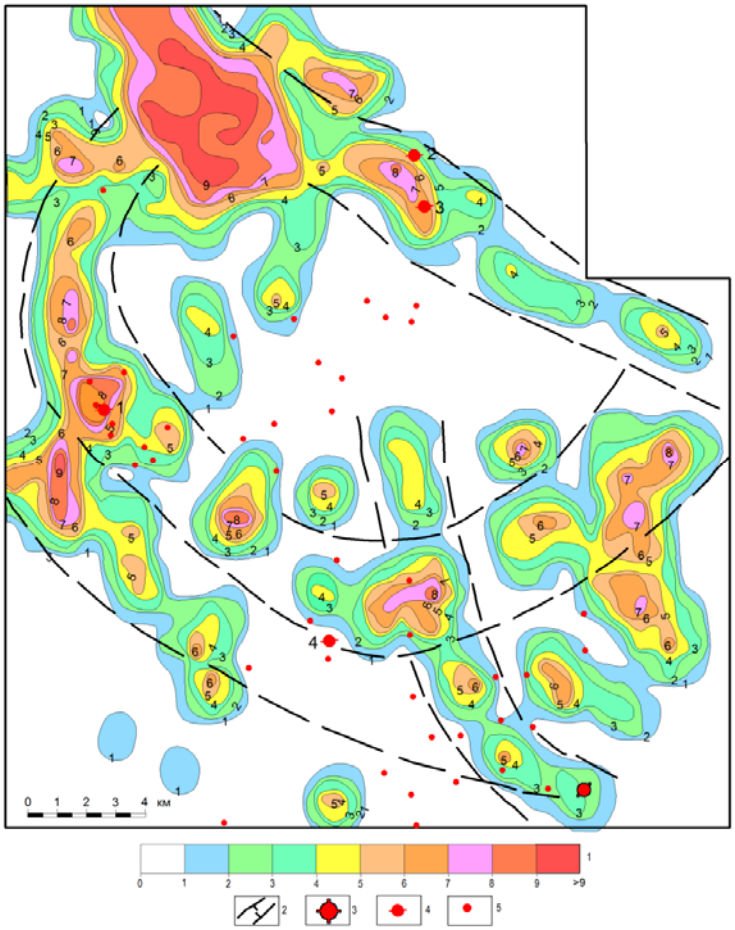


Figure 3 – The structure of the location of dykes and small intrusions of various composition in the area of Vera-Char - BaladzhalNS and the position of gold ore deposits in it (Compiled by G. B. Orazbekova).

Legend: 1 - the intervals of the stability measure of the placement of dikes and small intrusions of different composition; 2 - structural elements of the internal structure of the OS; 3 - the reference Baladzhal deposit; 4 - gold ore occurrences and deposits (1 - Vera-Char, 2 - Marinovskoe, 3 - Kyzyl-Tas, 4 - Jupiter); 5 - points of gold mineralization.

Table 1 – The distribution of values of the intervals of the stability measure for the development of dykes and small intrusions of different composition in the area of the Vera-Char - Balajal OS and the distribution of gold objects in them

| Meaning of measure | Area | | Position of deposits and ore manifestations | | | | | Perspective plots (area, km$^2$/%) from the area of the local forecast |
|---|---|---|---|---|---|---|---|---|
| | km$^2$ | % | Baladzhal | Vera-Char | Marinovskoe | Kysyltas | Jupiter* | |
| 1 | 64,75 | 20,9 | | | | | | |
| 2 | 64,75 | 20,9 | | | | | | 235/35 |
| 33 | 52,5 | 16,9 | | | | | | |
| 44 | 43,75 | 14,1 | | | | | | |
| 55 | 28 | 9,04 | | | | | | |
| 66 | 20,25 | 6,5 | | | | | | |
| 77 | 13,75 | 4,44 | | | | | | |
| 88 | 12,25 | 4,11 | | | | | | |
| 99 | 9,75 | 3,11 | | | | | | |
| Total | 309,75 | 100 | | | | | | 235/35 |
| *The occurrence of Jupiter is located outside the range of sustainable development of dykes and small intrusions. | | | | | | | | |

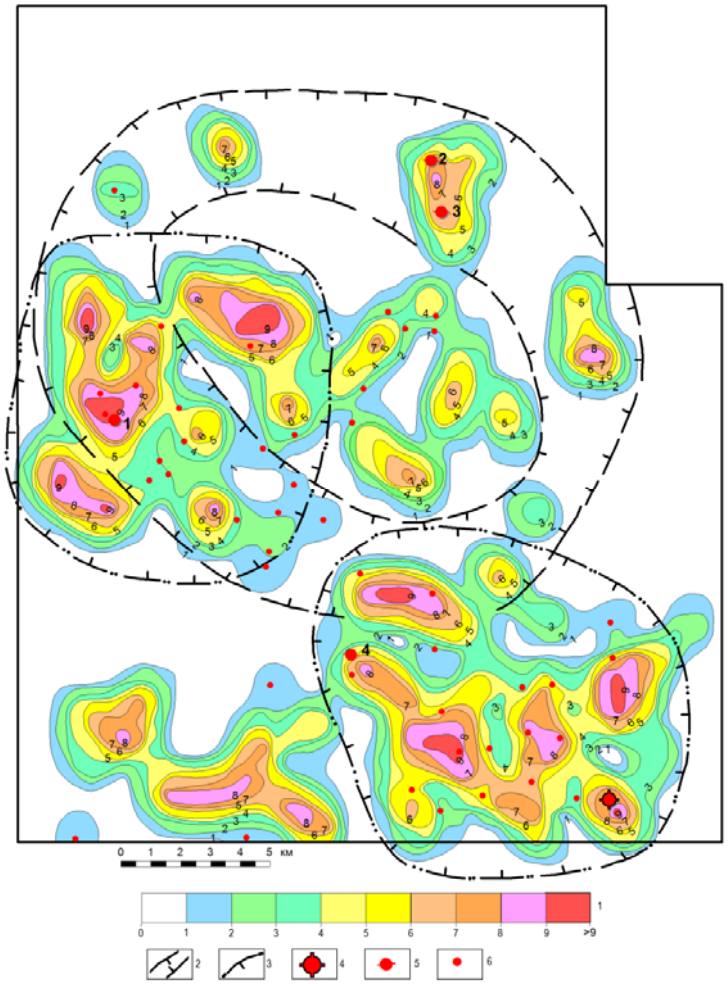


Figure 4 – The structure of the distribution of hydrothermal-metasomatic formations in the area of Vera-Char - BaladzhalNS and gold ore objects placement in it (Compiled by G. B. Orazbekova).

Legend: 1 - intervals of the stability measure of development of hydrothermal-metasomatic formations; 2, 3 - structural elements of the internal structure of the NS; 4 - the reference Balajal deposit; 5 - gold ore occurrences and deposits (1 - Vera-Char, 2 - Marinovskoe, 3 - Kyzyl-Tas, 4 - Jupiter); 6 - points of gold mineralization.

Analysis of the location of deposits in the structure of the HMFshows that they gravitate toward local nodes of the stable development of the factor located in the external concentration of the first-order structure, and the Baladzhal and Vera-Char deposits are located in local nodes located in the inner parts of structures of higher order. The outlined proposal testifies to the presence of structural regularities in the location of deposits in the structure of hydrothermal-metasomatic formations.

The statistical analysis of the location of gold ore objects in the structure of HMFs (table 2) shows that the area of their development covers intervals of values of the measure from 4 to 8 with a total area of 119.7 km$^2$, which is 17.8% of the area of the local forecast.

In accordance with the research paradigm, the reconstruction of the synergistic effect area was carried out by evaluating the joint sustainable development of the system elements described above: dykes and small intrusions of basic, medium and acidic (combined into a single additive element) and hydrothermal-metasomatic formations (figure 5). As can be seen, the joint manifestation of these processes is of a nodal nature, and two tendencies are clearly seen in the distribution of nodes: a focal character with the placement of nodes in the outer concentrator in the central part of the area and a linear type on the southwestern flank.

The placement of the Baladzhal reference deposit, as well as Vera-Char, Marinovskoye and Kyzyl-Tas deposits in the described structure are clearly natural: they gravitate towards the nodes of stable joint development of magmatic and hydrothermal-metasomatic processes.

Table 2 – Distribution of the intervals of the stability measure for the development of hydrothermal-metasomatic formations in the area of the Vera-Char - BaladzhalNS and the distribution of gold objects in them

| Meaning of measure | Area | | Position of deposits and ore manifestations | | | | | Perspective plots (area, km$^2$/%) from the area of the local forecast |
|---|---|---|---|---|---|---|---|---|
| | km$^2$ | % | Baladzhal | Vera-Char | Marinovskoe | Kysyltas | Jupiter* | |
| 1 | 58,25 | 20,37 | | | | | | |
| 2 | 58,25 | 20,37 | | | | | | |
| 3 | 43,75 | 15,3 | | | | | | |
| 4 | 38,0 | 13,3 | | | | | ..... | 119,7/17,8 |
| 5 | 30,75 | 10,75 | | | | | | |
| 6 | 21,25 | 7,43 | | | | ..... | | |
| 7 | 15,75 | 5,5 | ..... | | ..... | | | |
| 8 | 13,95 | 4,88 | | ..... | | | | |
| 9 | 6,0 | 2,1 | | | | | | |
| Total | 285,95 | 100 | | | | | | 119,7/17,8 |

Statistical characteristics also show the presence of regularities in the location of objects relative to the described structure (table 3): all promising deposits and ore occurrences (Baladzhal, Vera-Char, Marinovskoye and Kyzyl-Tas) are concentrated in the intervals of measure from 20-30 to 70-80 with a total area of 37.5 km$^2$, which is 5.8% of the investigated area.

This indicates the uniqueness of the geological situation of these intervals and the possibility of their isolation as favorable for the formation of gold mineralization in this OS.

***Analysis of forecasting results.*** The carried out researches allowed tosingle out local areas promising for the formation of gold deposits within the limits of the Vera-Bar-Baladzhal MRS (figure 2).The Baladzhal forecasted ore sub-cluster is located on the southeastern flank of the OS and covers five promising areas (figure 2), one of which is connected with the "reference" Baladzhal deposit. It is extended in the northwestern direction by 11 km and a width of 1.5 to 5 km, conformally to the Charsk-Gornostaevka crushing zone. The previous researchers pointed out (Navozov OV et al., 2009) within its limits 6 points of gold mineralization and numerous primary and secondary halos of arsenic, silver, as well as shingle haloes and placer gold, were isolated. Here, the formation of gold ore deposits is likely both in terrigenous strata (such as Zhumba, Kulujun, etc.), and in stocks and dykes.

Table 3 – The distribution of the values of intervals of the stability measure of the joint development of metasomatic formations and intrusive bodies in the area of Vera-Char - Baladzhal OS and distribution of gold ore objects in them

| Interval of measure values | Area | | Position of deposits and ore manifestations | | | | | Perspective plots (area, km$^2$/%) from the area of the local forecast |
|---|---|---|---|---|---|---|---|---|
| | km$^2$ | % | Baladzhal | Vera-Char | Marinovskoe | Kysyltas | Jupiter* | |
| 1-10 | 81,25 | 51,7 | | | | | | |
| 10-20 | 37,5 | 23,8 | | | | | | |
| 20-30 | 15 | 9,53 | ..... | | ..... | | | 37,5/5,8 |
| 30-40 | 7,5 | 4,76 | | | | | | |
| 40-50 | 8,75 | 5,36 | | | | ..... | | |
| 50-60 | 4,75 | 3,12 | | | | | | |
| 70-80 | 1,5 | 0,95 | | ..... | | | | |
| More 80 | 1,25 | 0,79 | | | | | | |
| Total | 157,5 | 100 | | | | | | |

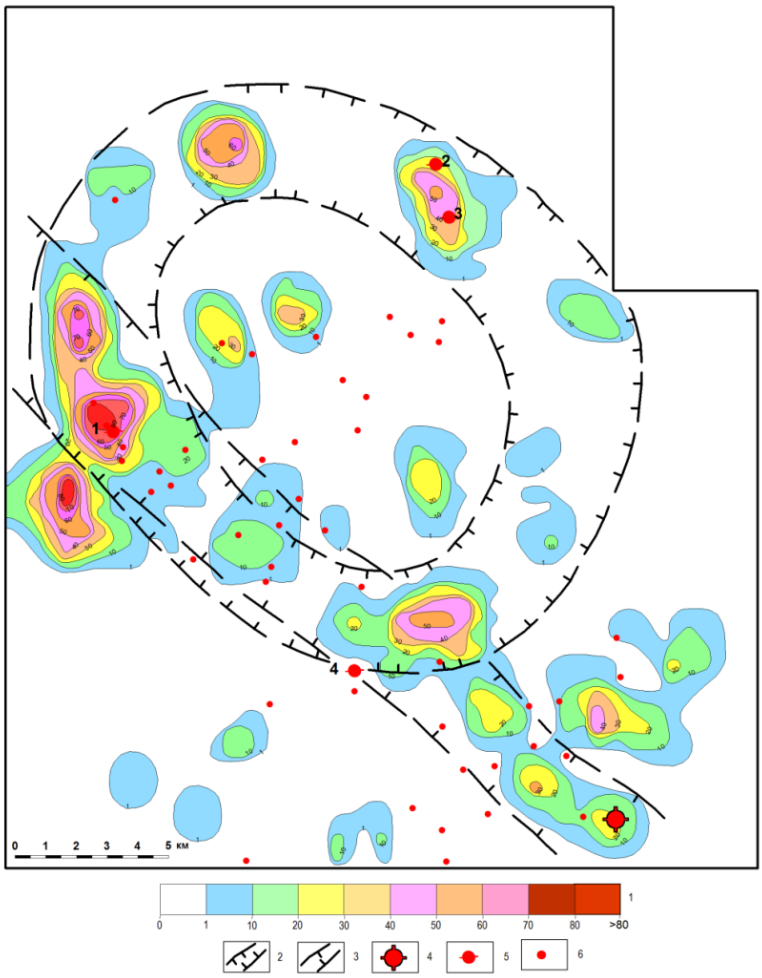


Figure 5 – The structure of the joint sustainable development of hydrothermal-metasomatic and intrusive formations in the Vera-Char-BaladzhalNS area and the position of gold ore objects in it. (Compiled by G. B. Orazbekova).

Legend: 1 - intervals of the stability measure of the joint sustainable development of hydrothermal metasomatic and intrusive formations 2,3 - structural elements of the internal structure of the NS; 4 - the reference Balajal deposit; 5 - gold ore occurrences and deposits (1 - Vera-Char, 2 - Marinovskoe, 3 - Kyzyl-Tas, 4 - Jupiter); 6 - points of gold mineralization.

No less, if not more significant, are the prospects of the Vera-Charsky predicted ore field, the northern part of which is located at the intersection of concentric and linear structurally-structuring elements of the MRS (figure 2). Within its boundaries is the well-known deposit Vera-Char, as well as a number of manifestations: Razdolny, Dmitri, Yekaterine. The previous researchers (O.V. Navozovand etc, 2009) have identified numerous points of mineralization and secondary geochemical aureoles of silver, arsenic, copper, as well as gold and arsenopyrite ingots.

The Marinovsko-Kyzyltas predicted ore field is located in the outer concentration of the OC (figure 2) and includes two gold ore occurrences - Marinovskoe and Kyzyltas. On the Marinovskoeoccurence gold-bearing bodies are brown iron minerals and secondary quartzites, penetrated by a network of quartz veins. The thickness of the zone is from 1-2 to 3-5 meters. The gold content in quartz is from 1.0 to 5 g/t, sometimes up to 20 g/t. In secondary quartzites increased concentrations of nickel, cobalt, arsenic, molybdenumwere noted. More interesting is the manifestation of Kyzyltas, where gold mineralization is associated with zones of fouled hydrothermally altered rocks bearing a rich impregnation of pyrite, less often arsenopyrite. Petrified zones can be traced at 1000-1500 m, their thickness is 5-10 meters with blowing up to 50 m, dip steep (80-90 °) with submeridional extension. The gold content in the Kyzyltas zone reaches 18.4 g/t. Gold is contained both in quartz and in altered pyritized rocks. The content from the surface to the depths of 8-10 m is 0.1-1.0 g/t (according to the galleries), in the pits 0.3-3 g/t, the highest concentrations are confined to the areas of maximum development of pyritization.

Thus, the reconstruction of the magmatic ore system of the Vera-CharkBaladzhal OS at a local level of study has made it possible to identify promising areas of ore-field rank, the total area of which is 37.5 km$^2$ or 5.8% of the area of predictive research.

A meaningful analysis of the results of forecasting confirms the prospects of the selected sites with the available search data.

The results of the predictive studies outlined in the article can be used to justify the direction of prospecting exploration.

**REFERENCES**

[1] Shcherba G.N., Bespayev Kh.A., Dyachkov B.A. Bolshoi Altai (geology and metallogeny). Book 2: Metallogeny. Almaty: RIO WAC RK, 2000. 400 p.

[2] Narseyev V.A., Gostev Yu.V., Zakharov A.V. Bakyrchik (geology, geochemistry, mineralization). M.: TsNIGRI, 2001. 174 p.

[3] Dyachkov B.A., Chernenko Z.I., Mayorova N.P. Geological conditions for the formation and location of gold-bearing deposits of the apocarbonate type of East Kazakhstan. Ust-Kamenogorsk: VKTGU, 2011. 136 p.

[4] Rafailovich M.S. Gold of the bowels of Kazakhstan: geology, metallogeny, forecasting and searching models. Almaty: KazGeo, 2004. 304 p.

[5] Globa V.A. The development of gold-telluride deposits will be a new stage in the history of Kazakhstan's gold mining // Mineral Resources of Kazakhstan. 1999. N 1. P. 13-17.

[6] Globa V.A. Gold ore formations of regions of mobile-belt activation of Kazakhstan // Izv. NAS RK. Ser. geol. 2004. N 3-4. P. 110-114.

[7] Bespaev H.A., Lyubetskiy V.N., Lyubetskaya L.D., Uzhkenov B.S. Gold ore belts of Kazakhstan (deep structure, geodynamics of development, deep factors of localization of mineralization). Almaty, 2008. 284 p.

[8] Thomson I.N. Metallogeny of ore regions. M.: Nedra, 1988. 215 p.

[9] Marakushev A.A. Nature and metallogenic significance of deep fluids // Metallogeny of the Ural-Mongolian fold belt: Tez. doc. X All-Union metallogenic meeting. Alma-Ata: Science, 1983. Vol. 1. P. 32-40.

[10] Letnikov F.A. Synergetics of geological systems. N.: Nauka, 1992. 230 p.

[11] Khlobustov A.A. A systematic approach to geological research // Methodology of geological research. Vladivostok: FENC of the USSR Academy of Sciences, 1976. P. 129-133.

[12] Orazbekova G.B. Application of methods of system analysis in forecasting large and unique gold ore deposits in East Kazakhstan // Proceedings of the VIII International Scientific and Practical Conference: "Natural-scientific research, national economy, modern technologies and technological progress". Voronezh, 2015. P. 24-34.

[13] Vasiliev S.V. Forecasting based on the system-information approach // Computer forecast of mineral deposits. M.: Nedra, 1990. P. 208-225.

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## ҚОЛДАНУ ЖҮЙЕЛІ КӨЗҚАРАС БОЛЖАУ КЕЗІНДЕ КЕНДІ АЛАҢДАР, ЖЕРГІЛІКТІ АЛТЫН ОШАҚТЫ ҚҰРЫЛЫМДАРДА (мысалы, Вера-Чар - Баладжал ошақтық құрылымдар Шығыс Қазақстан облысының Батыс-Қалбақ алтынды ауданы)

**Аннотация.** Вера Чар - Балажал ошақтық құрылымы (OS) руда бірлігі бөлінген атағы реттегішті - AW перспективалық өңірлі конда 574.361 кг-ға дейін бағаланады болжамды ресурстары алтын зерттейді ретінде. Егжей-тегжейлі зерттеу нәтижесінде, осы баптың тақырыбы, перспективалық бағыттары кен және кенорындарына тағы орналасқан.

Вера Чарқайта алтын кен қалыптастыруға жүйелі тәсілді парадигмасынан егізделген - депозиттерді орналастыру оның алдын ала орнатылған істер заңдарына Балажал ошақты құрылымы мен кенді ірі кенорындарын қалыптастыру үшін перспективалы үш бөлінген учаскесі атағы өрістер: Балажалдын, Вера-кенболжамды Шар кенболжамды және Мариновты-Кызылтофты кенболжаған. Олардың жалпы ауданы 37,5 км$^2$ немесе болжамдық зерттеулер аумағының 5,8% құрайды.

**Түйін сөздер:** болжамды зерттеулер, алтын кенорындары, фокалды құрылымы, магматикалық білім беру, метасомалдық өзгерістер, Батыс-Қалба алтын ауданы.

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# ПРИМЕНЕНИЕ СИСТЕМНОГО ПОДХОДА ПРИ ПРОГНОЗИРОВАНИИ РУДНЫХ ПОЛЕЙ В ЛОКАЛЬНЫХ ЗОЛОТОНОСНЫХ ОЧАГОВЫХ СТРУКТУРАХ (на примере Вера-Чар - Баладжальской очаговой структуры в Западно-Калбинском золотоносном районе Восточного Казахстана)

**Аннотация.** Вера-Чар - Баладжальская очаговая структура (ОС) ранга рудного узла выделена автором в качестве перспективной на региональном уровне исследований, прогнозные ресурсы золота в ней оценены в 574 361 кг. В результате детального изучения, которому посвящена данная статья, перспективные площади локализованы до ранга рудных полей и месторождений.

На основе парадигмы системного подхода к формированию золоторудных месторождений произведена реконструкция Вера-Чар - Баладжальской очаговой структуры, в ее пределах установлены закономерности размещения месторождений и выделено три перспективных для формирования крупных месторождений участка ранга рудных полей: *Баладжальское прогнозное рудное поле,Вера-Чарское прогнозное рудное поле и Мариновско-Кызылтасское прогнозное рудное поле.* Их общая площадь которых составляет 37,5 км$^2$ или 5,8% от площади прогнозных исследований.

**Ключевые слова:** прогнозные исследования, золоторудные месторождения, очаговые структуры, магматические образования, метасоматические изменения, Западно-Калбинский золотоносный район.

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