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Қ. И. Сәтпаев атындағы Қазақ ұлттық техникалық зерттеу университеті

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ГЕОЛОГИЯ ЖӘНЕ ТЕХНИКАЛЫҚ ҒЫЛЫМДАР СЕРИЯСЫ

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НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

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THE BASIC REGULARITIES OF LOCALIZATION OF PALEOGENE-NEOGENIC KALBA PLACER DEPOSITS (Eastern Kazakhstan)

Abstract. Previously conducted works on the development of deposits were mainly focused on quaternary placers. However, placer deposits of the Paleogene and Neogene age are much more productive: in the West Kalbinskoye gold-bearing region, they contain more than 97% of the reserves and predicted resources of alluvial gold.

The main regularity is the presence of spatio-paragenetic connection of placers of various types and ages with indigenous sources. The structure of the location of indigenous sources is the main factor determining the location of placers in a particular area.

Local geomorphological patterns of localization of placers are less single-valued, as placers of different geological-geomorphological types are located in a diverse geomophological situation. At the same time, local geomorphologic zoning caused the presence of regularities in the location of placer-localizing elements of the relief - diverse types of modern and ancient valleys in geomorphological zones and, as a consequence, the presence of placer distribution patterns.

Forecast studies should be conducted in the following areas: isolation of ancient placer-localizing elements of the relief, retrospective reconstruction of the hydro-network and study of paleoclimatic and neotectonic conditions for the formation of ancient gold-bearing alluvium.

Keywords: West-Kalbinsky gold-bearing region, gold placers, Paleogene and Neogene placers, regularities, geomorphological zoning, forecast studies.

Introduction. At present, the Republic of Kazakhstan intends to intensify the work to increase the level of gold mining in order to strengthen the gold and foreign exchange reserves that determine the independence of sovereign Kazakhstan. This task determines the need for a comprehensive study of diverse gold deposits, including placer gold deposits.

Analysis of the gold-spruce activities carried out in different years on the territory of Kazakhstan shows that the overwhelming majority of them were directed to the study and development of quarternary placers lying at insignificant depths. At the same time, data on the productivity of differently aged placers show that placers of Paleogene and Neogene age are much more productive in the CIS and in the world [1]. Within the Trans-Ural peninsula [2], the Oligocene placers represent the main industrial value. In Northern Baikal region the most large-scale placers were formed in the Pliocene period [3]. Within the Amu-Zey Plateau, the Pliocene-Early Quaternary stage is the main stage in the formation of the most significant placers of the region [4]. In the Yano-Kolyma folded area [5] the Pliocene-Early Quaternary placers are most abundant. In the Anadyr-Koryak fold system [6], the placers of pliocene and early Quaternary age are most significant.

In the history of placer development in California (USA) [7, 8], the formation of unique placer reserves, of which 454 tons of gold was mined, occurred during the Oligocene and Miocene. In the state of Victoria (Australia), the richest placers are formed in the Pliocene [9].

The most significant productivity of placer deposits of the Paleogene-Neogene age is characteristic for the whole of Kazakhstan and for the described West Kalbinsk district in particular (table 1).

Table 1 – Reserves and forecasted gold resources of different age placers of the West Kalbinsk region (kg /%) [10]

Reserves and forecasted resources of gold of different age placers			Total
Pg_3-N_1	N_2^1	Q	
37925/14,5	216500/82,75	7196/2,75	261621/100

With a view to forecasting, we will determine the local regularities in the distribution of placer deposits of the Paleogene and Neogene age on the basis of available data [10].

Local patterns of placer distribution are determined by the dependence of their location relative to the indigenous sources and local geomorphological zones.

The regularity inherent in all gold-scraping regions is the presence of a spatio-paragenetic connection of placers of various types and ages with indigenous sources. The structure of the location of indigenous sources is the main factor determining the location of placers in a particular area.

In the area of the Western Kalbinsky region, gold deposits and manifestations are localized in the form of a single belt with a width of 10-12 to 60-70 km (figure 1).

Analysis of the distribution of different-type and uneven-aged placers shows that placers of all geological-geomorphological types and age gravitate toward the inner parts of the range of development of indigenous sources. This pattern takes place both in the case when the indigenous sources are developed in the upper reaches of the basin (the basins of the Bylkyldak, Zhanama, and Bolshoy Chegelek rivers) and in the case when the valley crosses the area of their development transit (the sections of Middle Agynykatty, the lower reaches of the Bylkyldak River, lower course of the Bolshoy Chegelek River), etc. In these cases, the placers are confined to the interval of the intersection of the valley with the area of development of the indigenous sources. Outside the range of sustainable development of indigenous

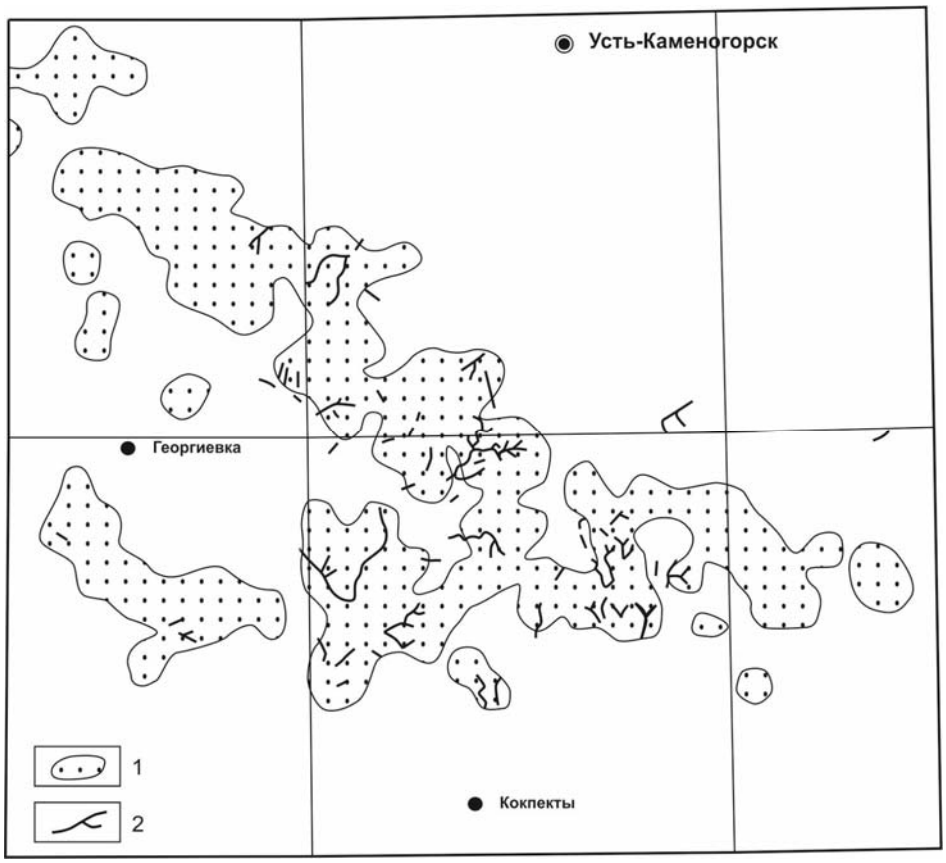

Figure 1 – Placer deposits of gold of different geological-genetic types and age relative to the structure of the indigenous sources in the Kalbinsky district. Scale about 1: 1000 000. Compiled by A.V. Tretyakov: 1 – area of development of indigenous sources; 2 – placers of gold

sources, single placers are located, and they are mostly removed from it by no more than 2-2.5 km, the upper reaches of the majority of their valleys are located within the range of development of indigenous sources.

Local geomorphological patterns of localization of placers are less unambiguous, since placers of various geological-geomorphological types are located in a diverse geomophological situation. At the same time, local geomorphologic zoning caused the presence of patterns of location of placer-localizing elements of the relief - various types of modern and ancient valleys in geomorphological zones and, as a consequence, the presence of placer distribution patterns.

Local geomorphologic zonation in the general case is expressed in the centripetal change in the hilly-steep, low-mountain, mid-mountain and high-mountainous terrain, the increase in absolute marks and the depth of erosion dismemberment. Within the Kalbinsky area, located within the boundaries of the Altai elevation, A.V. Tretyakov (2009) identified three geomorphological zones (table 2).

Table 2 – Distribution of ancient valleys of different types and gold placers in the local geomorphological zones of the Kalbinsky District

Geomor-phological zones	Predominant types of exogenous and endogenous relief	The inherent types of palaeovalley	Typical geological-geomorphological types of placers
Intense uplifts	Erosion-tectonogenic intensely dissected steepened, rel. excess of up to 500 - 600 m; fragments of PIIB on abs. heights from 1000 to 1560 m.	Inherited development, developing in intrastive mode	1. Quaternary riverbed; 2. Quaternary spoon.
Transitional	Erosion-tectonogenic intensively dissected steep (up to 300 m elevation); erosion-no-tectonogenic dissected shallow-billed steep (elevated up to 150 m); denudation-tectonogenic oblique (relative excess not more than 100 m); fragments of PIIB on abs. heights from 600 to 1225 m.	1. The dead and raised; 2. Dead and died in intermountain and graben-like depressions; 3. Inherited development: 3.1. Developing in the perstrative mode: a) made by Neogene deposits, b) with a dug out bottom; 3.2. Developing in an intrastive mode: a) in a moderate, b) in an intensive one; 3.3. Log of the ancient hydrosystem	1. Large-volume (Pg-N) with MTZ; 2. Buried (Pg-N) in paleovalleys, including the dead; 3. Buried (Pg-N) in ancient logs; 4. Spoonfuls in ancient logs with a dug out bottom 5. Quaternary channel; 6. Quaternary spoon; 7. Quaternary terrace; 8. Terrace and spoon 9. Eluvial-deluvial-proluvial on fragments of PIIB and gentle slopes.
Weak and moderate uplifts	Denudation-tectonogenic oblique (relative excess not more than 80 m); small hills; fragments of PIIB on abs. heights of 500 - 600 m, in some areas up to 800 m.	1. The valleys and logs of the inherited development, developing in the perstrative mode: a) made by Neogene deposits, b) with a dug out bottom	1. Buried in the ancient valleys (Pg-N); 2. Buried in ancient logs (Pg-N); 3. Spoonfuls in ancient logs with a dug out bottom; 4. Quaternary channel 5. Eluvial-deluvial-proluvial on fragments of PIIB and gentle slopes.

The zone of intensive uplifts, characterized by the development of steeply dissected intensively dissected erosion-tectonogenic relief, covers the axial part of the Kalbinskii upland (figure 2). Fragments of the PIIB are located on the abs. heights from 1200 to 1560 m. They are largely transformed as a result of erosion. River valleys develop in an intensive mode of operation. Their bottoms are narrow, the depth of the erosive cut reaches 500 m.

The transitional geomorphological zone occupying the most significant area in the central part of the region is characterized by a combination of all types of erosion-tectonogenic and denudation-tectonic relief in the combination with the accumulative relief of the intramountain basins. Fragments of PIIB here in various degrees are dissected by erosion processes and are located mainly on the abs. altitudes from 600 to 1000 m. This zone is characterized by the development of various types of paleodine (dead raised and buried in intermountain and graben-like depressions, inherited development, developing in the perstrastative and moderate instasive regimes), intermountain and graben-like depressions.

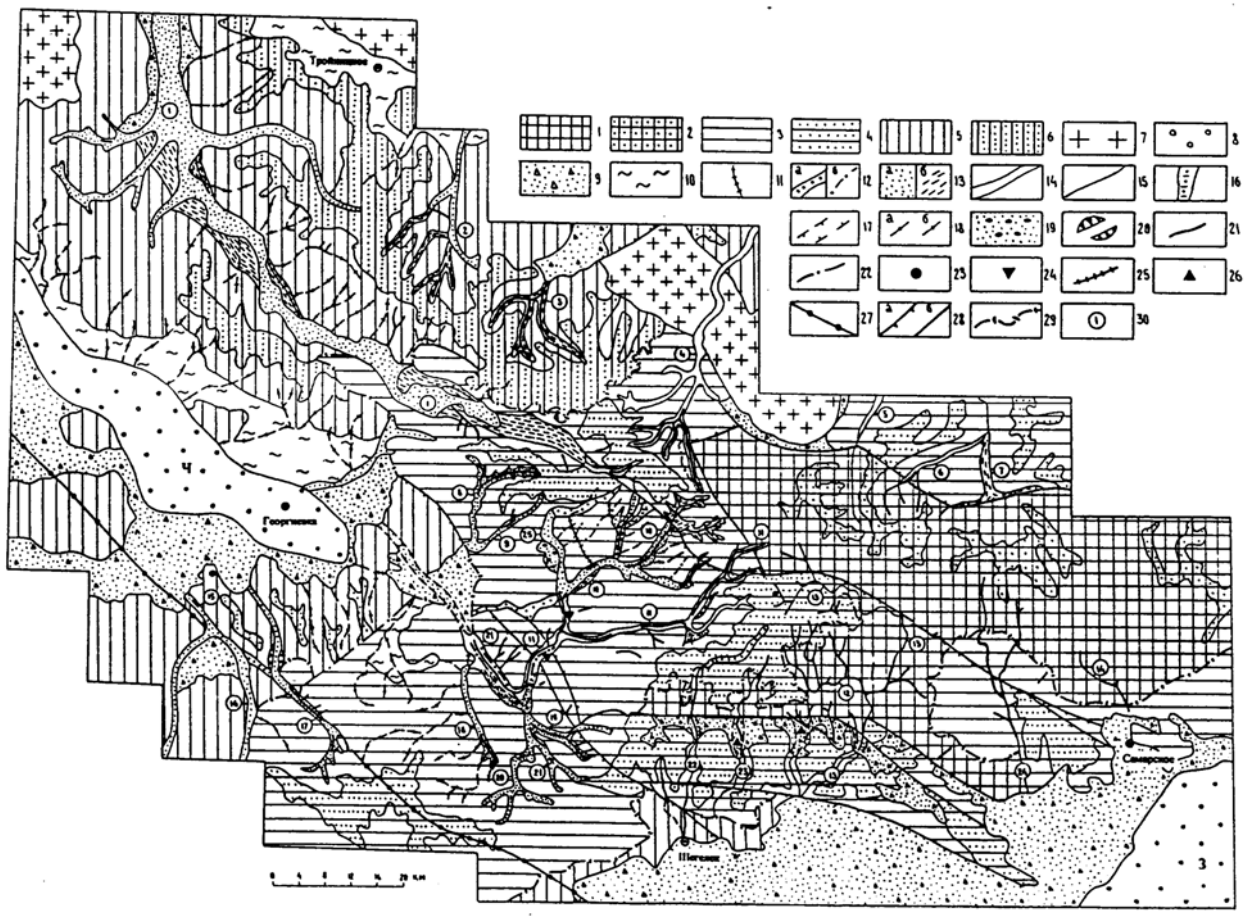

Figure 2 – Geomorphological zoning and distribution of diverse river valleys and gold placers of southeast flank of the Kalbinsky district in geomorphological zones (compiled by A.V. Tretyakov, 2009).

Conventional notation. Geomorphological zones: 1 - zone of intensive neotectonic uplifts; 2 - fragments of PIIB within its limits; 3 - transition zone; 4 - fragments of PIIB within its limits; 5 - zone of weakly intensive neotectonic uplifts; 6 - fragments of PIIB within its limits; 7 - zone of erosion-tectonogenic intensively dissected relief on the granitoids of the Kalbinsky complex. Areas of development of the accumulative relief: 8 - depressions of long-term development (Z - Zaysanskaya, Ch-Charskaya) 9 - surfaces composed of Quaternary alluvial and proluvial deposits; 10 - the surface composed of lake sediments of the Pavlodar suite. River valleys: 11 - Quaternary newly formed zones; 12 - the ancient dead raised valleys; 13 - ancient valleys of the inherited development, developing in the perstrastative mode, made by Cenozoic deposits - a, with a dug out bottom - b; 14 - ancient valleys of the inherited development, developing in the moderate instrasive mode; 15 - ancient valleys of the inherited development, developing in an intensive instrasive mode; 16 - ancient valleys developing in inversion mode; 17 - ancient dead buried valleys; 18 - the logs of the ancient hydrosystem, developing in the perstrastative mode, made by Cenozoic deposits - a, with a dug out bottom - b; 19 - surfaces of socle and accumulative terraces of the Lower Pliocene age, composed of "sarybulak" pebbles; 20 - antecedent segments of the ancient hydrosystem. Known gold placers: 21 - Quaternary channel and spoon; 22 - terraces; 23 - eluvial-deluvial-proluvial; 24 - residual on high socle terraces; 25 - buried in the ancient valleys of the inherited development (combined in a single valley with Quaternary channel placers); 26 - buried in the hollows. Rifts: 27 - Bayguzin-Bulak boundary deep; 28 - active at neotectonic stage: discharges - a, others involved in relief formation - b. Other notations: 29 - non-tectonic boundaries of geomorphological regions; 30 - the main rivers of the region: 1 - Kyzylsu, 2 - Kanayka, 3 - Ulanka, 4 - Sibinka, 5 - Targyn, 6 - Shibyndy, 7 - Tainty, 8 - Zhanama, 9 - Tokpak, 10 - Bylkyldak, 11 - Agynkutty, 12 - Zhumba, 13 - Bolshaya Bukon, 14 - Layly, 15 - Zhinishke, 16 - Tamdy, 17 - Boko, 18 - Daubai, 19 - Balazhal, 20 - Ashaly, 21 - Char, 22 - Bolshoy Chegelek, 23 - Malaya Bukon , 24 - Kulujun, 25 - Batpak-Bulak.

The zone of weak and moderate uplifts, characterized by the development of the shallow hills and the oblong-sloping denudation-tectonogenic relief is located on the flanks of the district. Fragments of PIIB here are located on the abs. altitudes of 500-600 m, less often - up to 800 m. They are poorly dissected by erosion, in some areas are covered by tertiary sediments. In the Kiinsu-Troinitsky trough, linear and area weathering crusts are locally developed on them, which allows considering them as a relic of the original peneplain (V.S. Yrofeev, [11]). Within this zone, the ancient hydraulic piping developed in the perestrotic regime, the logs of ancient deposits, made by the Pliocene deposits, are of considerable development.

The above-described local geomorphologic zonation caused the presence of regularities in the location of diverse types of modern and ancient valleys in geomorphological zones and, as a consequence, the presence of regularities in the location of various types of placers in geomorphological zones. On the example of the Kalbinsky District (figure 2, table 2), it is evident that the most diverse and, in connection with this, prospects for placer gold content, is characterized by a transition zone, to which all known and predicted placers of large-scale types gravitate. The spectrum of geological-geomorphological types of placers in the zone of weak and moderate uplifts is much less significant. Finally, the diversity of placers in the area of intensive new uplifts is the least significant.

Especially we will focus on the local geological and geomorphological laws of placement of large-volume placers with fine and fine gold (MTZ). Data analysis by SG. Zhelnina [12]] according to the conditions of placer Bolshaya Kuranakh, NG. Patyk-Kara [13], etc. on the Nagyminskaya and Petrovskaya placers, A.I. Sadovsky, Yu.G. Tolpegin [14] on placer Malaya Stolbovaya river shows that these placers are characterized by the following geological-geomorphological conditions of localization.

They are located on the flanks of gold ore nodes, which were the main sources of alluvial gold, both in ordinary alluvial placers of valleys, through which the debris of gold-bearing material was transported, and in placer deposits.

They are confined to the areas of abrupt change in the hydrodynamic regime of the watercourses and are localized in the parts of the perstrastative and constrative regime, which is reflected in the lithological features of the enclosing strata.

According to the ideas of V.P. Polevanova [9] and R.A. Amosov [15] for the formation of large placers with fine and thin gold, the most favorable conditions for gold, together with its loose material, to move as little as possible under the conditions of cones of removal, proluvial-diluvial plume, alluvium and lacustrine-alluvial sediments.

The results of previous studies [16,10] indicate that in the West Kalbinsky region, highly productive placer deposits of the Paleogene-Neogene age are confined to ancient valleys and valleys that have been changed to varying degrees as a result of subsequent neotectonic processes. Expanding the prospects for placer deposits of the Paleogene-Neogene age makes it evident that it is necessary to isolate and study the placer-localizing elements of the ancient relief.

In the West Kalbinsky region placers of Pliocene age are most productive (table 1), which are localized in alluvial sediments isolated by VS. Yerofeev [11] under the name "Sarybulak layers", lying under the red-colored lake clays of the Pavlodar suite. Their formation is associated with the tarbagatai phase of tectogenesis in the Upper Miocene - the Lower Pliocene, which led to the formation of low mountains and elevated plains in the Kalba and the intensification of erosional activity of rivers.

Deposits of the Sarybulak beds are well-rounded alluvial boulder-pebbles with sandy-orange-yellow, yellow-gray aggregate. Quartz (up to 20-30%), as well as sandstones and siltstones, are present in the composition of a well-rounded clastic material. Boulders and pebbles, composed of terrigenous rocks, are clarified and weathered almost to a loose state. On the southern slopes of the Kalbinskiy range, the thickness of the "sarybul" pebbles, which fixes the movement of powerful water currents, is developed in the basins of the rivers Bylkyldak, Agynykatti and Shar. The pagodeolines, according to which the movement of the water flows of the Pliocene period occurred, are divided into three types according to the views of the previous researchers [17, 10]:

a - developing inherited and used by modern waterways throughout their entire length;

b - raised dead, intersected by younger erosive cuts with active watercourses;

c - buried dead in intermountain and graben-like depressions.

In the inherited mode, the majority of the river valleys of the region develop, in which the Sarybulak pebbles are covered with a clay of the Pavlodar suite and are opened with a few search lines that established their gold content.

The dead elevated paleohydrosystem is developed on the right side of the Bylkyldak river basin. The dead raised valleys only on separate unextended areas are inherited by waterways, usually belonging to the basin of younger, often newly formed valleys.

The dead buried hydrosystem is developed fragmentarily within intermountain and graben-like depressions. In the Nizhne-Charskaya intermountain valley in the left side of the valleys of the rivers Char

and Agynykatta, an ancient thalweg buried to a depth of 30 m, separated from the modern channel by a ledge of Paleozoic rocks, was drilled.

The second element of the ancient relief, which requires study from the standpoint of assessing prospects from gold content, is the intermontane depressions formed at the stage of vaulted upwelling of the area and made by Neogene deposits of the Sarybulak beds. In the basin of the river. Bylkyldak favorable for placer formation are sites Batpak-Bulak, Middle Bylkyldak, Nizhne-Charsky - Agynykatty [19].

The material presented in this article shows that the main direction of work on the study of Paleogene-Neogene placers in the West Kalbinsk region is the isolation of ancient placer-localizing elements of the relief (dead raised valleys and intramountain depressions), retrospective reconstruction of the hydrosystem and study of paleoclimatic and neotectonic conditions for the formation of the ancient gold-bearing alluvium.

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ҚАЛБА ПАЛЕОГЕН-НЕОГЕН ШАШЫРАНДЫЛАРЫН ОҚШАУЛАУДЫҢ НЕГІЗГІ ЗАҢДЫЛЫҚТАРЫ (Шығыс Қазақстан)

Аннотация. Шашырандыларды игеру бойынша бұрынғы жүргізілген жұмыстар көбіне төрттік шашырандыларға бағытталған. Алайда, палеоген және неоген кезеңіндегі шашырандылар анағұрлым өнімді: Батыс-Қалба алтынды ауданында шашыранды алтын қорының 97% және болжамды ресурстары осы шашырандыларда шоғырланған.

Басты заңдылығы әртүрлі типтегі және әртүрлі жастағы шашырандылардың негізгі түпнұсқалармен кеңістікті-парагенетикалық байланысы болып табылады. Негізгі түпнұсқалардың орналасу құрылымы нақты аудандағы шашырандылардың орналасуын анықтайтын басты фактор болып табылады.

Шашырандыларды оқшаулаудың жергілікті геоморфологиялық заңдылықтарының маңыздылығы аз, өйткені әртүрлі геологиялық-геоморфологиялық типтегі шашырандылар әркелкі геоморфологиялық жағдайда орналасады. Сонымен қатар, жергілікті геоморфологиялық зоналау бедердің шашыранды оқшаулау элементтерінің орналасу заңдылықтарының бар болуына себепші болды – геоморфологиялық аймақтарда әртүрлі қазіргі заманғы және ежелгі алқаптардың бар болуына және, соның нәтижесінде – шашырандылардың орналасу заңдылықтарының бар болуына.

Болжамды зерттеулерді келесі бағыттар бойынша жүргізген дұрыс: бедердің ежелгі шашыранды оқшаулау элементтерін анықтау, гидрожүйелерді ретроперспективті қайта құру және ежелгі алтынды аллювидің қалыптасуының палеоклиматтық және неотектоникалық жағдайларын зерттеу.

Түйін сөздер: Батыс-Қалба алтынды ауданы, алтын шашырандылары, палеоген-неоген шашырандылары, заңдылықтары, геоморфологиялық зоналау, болжамды зерттеулер.

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ОСНОВНЫЕ ЗАКОНОМЕРНОСТИ ЛОКАЛИЗАЦИИ ПАЛЕОГЕН-НЕОГЕНОВЫХ РОССЫПЕЙ КАЛБЫ (Восточный Казахстан)

Аннотация. Ранее проведенные работы по освоению россыпей преимущественно были ориентированы на четвертичные россыпи. Однако, гораздо более продуктивны россыпи палеогенового и неогенового возраста: в Западно-Калбинском золотоносном районе в них заключено более 97% запасов и прогнозных ресурсов россыпного золота.

Основной закономерностью является наличие пространственно-парагентической связи россыпей различного типа и возраста с коренными источниками. Структура размещения коренных источников является основным фактором, определяющим размещение россыпей в конкретном районе.

Локальные геоморфологические закономерности локализации россыпей менее однозначны, поскольку россыпи различных геолого-геоморфологических типов располагаются в разнообразной геомофологической обстановке. Вместе с тем, локальная геоморфологическая зональность обусловила наличие закономерностей размещения россыпелокализующих элементов рельефа - разнотипных современных и древних долин в геоморфологических зонах и, как следствие - наличие закономерности размещения россыпей.

Прогнозные исследования следует вести по следующим направлениям: выделение древних россыпелокализующих элементов рельефа, ретроспективная реконструкция гидросети и изучение палеоклиматических и неотектонических условий формирования древнего золотоносного аллювия.

Ключевые слова: Западно-Калбинский золотоносный район, россыпи золота, палеоген-неогеновые россыпи, закономерности, геоморфологическая зональность, прогнозные исследования.

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