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Mineral Ophiolite Fossils Complexes Of South Tyan-Shan

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Abstract

The article discusses the prospects of ophiolite complexes of the South Tien Shan for the identification of deposits of ore and non-metallic minerals. Iron, chromite, copper-pyrite, platinum mineralizations are associated with the rocks of the ophiolite complexes of the Southern Tien Shan, which are a strategic mineral raw material in the economy of Uzbekistan. Most of them are of scientific interest, but some of them are not yet of industrial importance. Prospects for ore content of ophiolite complexes increase with their in-depth study. The analysis of geological materials indicates that in the South Tien Shan there are prospects for the discovery of new industrial deposits associated with ophiolite complexes.

Key words: ophiolites, accretionary complex, oceanic crust, magmatism, ultrabasic rocks, minerageny, ore content, minerals, chromites, iron, platinoids, Turkestan paleoocean, sutures, South Tien Shan, promising positions.

Introduction

The southern Tien Shan, which is a collisional structure (orogenic belt) of Paleozoic age, was formed on the site of the Turkestan paleobasin when it was closed. The basement of the orogen consists of fragments of pre-Paleozoic continental crust. Turkestan paleobasin, according to Academician T.N. Dalimov, existed from the Cambrian-Ordovician to the Upper Carboniferous-Lower Permian [5]. Yu.S. Biske believes that the paleoocean opened no later than 750 Ma, and its central part was in the middle of the Ordovician [4]. The processes that took place in it led to the formation of the structures of the Southern Tien Shan.

Ophiolite associations of the Southern Tien Shan are relics of the oceanic crust, consisting of igneous (diabase porphyrites and spilites up to quartz keratophyres) and intrusive (peridotites, serpentinites, diorites, quartz diorites) rocks.

The high relevance of the study of ophiolite associations in the South Tien Shan is motivated by the fact that, being a benchmark of global geological processes of the past, they trace suture zones, provide information on the geochemical specialization of products of oceanic magmatism, which are associated with strategically important types of ore and nonmetallic minerals - chromites, platinoids , asbestos, magnesian raw materials, etc.

Subduction processes within the Turkestan paleobasin took place at different times and in different parts (oceanic, continental-marginal and shelf). This led to the clustering of the upper levels of the absorbed crust with the formation of accretionary complexes.

In the stratigraphic section of the structure of the South Tien Shan, accretionary complexes have the following sequence: Caledonian accretionary complex (O-S1), carbonate deposits (D-C2), Hercynian accretionary complex (C2), molasse troughs (P1) [10].

A characteristic feature of the ophiolite associations of the Southern Tien Shan is that, as a result of nappe formation in the Middle and Upper Carboniferous (C2m-C3), they are lensed, displaced relative to each other, represent melange, underwent strong regional metamorphism and are found in various plates, scales and covers [9, 10].

Within Uzbekistan, complex structural relationships of various parts of intensively metamorphosed ancient and younger ophiolite sections of the Central Kyzylkum, Nurata, Zirabulak-Ziaetdin mountains determined the number of paleobasins, the age range of their existence, geodynamic settings and ore genesis processes [2].

Some parts of the accretion complexes have survived and were mapped during geological exploration and scientific-thematic works by Sh.R. Sabdyushev, R.R. Rustamov, P.A.Mukhin, Yu.S. Savchuk, R.Kh. Mirkamalov, and others. They contain ophiolites. The generated maps reflect geological and structural characteristics based only on "the study of stratigraphic columns and petrochemical data" [4]. In fig. 1 shows the paleogeodynamic scheme for the time C-P1.

Over the past 20 years, the regional geology of Uzbekistan has undergone fundamental changes associated with the modernization and technical re-equipment of the industry. This led to the formation of banks and databases of massive analytical data and isotope dating, which is associated with progress in scientific research in regional geology and in the study of ophiolites in particular [3, 10].

The reliably established ophiolite belts of the Southern Tien Shan - Bukantau-Besapan-Severo-Nurata, Nurata-Yuzhno-Fergana, Zirabulak-Karatyubinsky are characterized by linear distribution and are scattered. Most geologists regard these belts as sutures of extinct paleobasins [5, 8, 9].

Ophiolites in open areas can be observed on various maps, and in closed areas they can be traced according to drilling data and Earth remote sensing (ERS) materials. So, in the Cambrian, the formation of an ophiolite complex is fixed by pyroxenites and gabbro overlying them in the form of a "layer", with lenses of plagiogranites, with a series of parallel dikes of diabases, diorites and quartz diorites in the top of the "layer", (Teskuduk-Chengeldinsky intrusive massif, Central Kyzylkum)

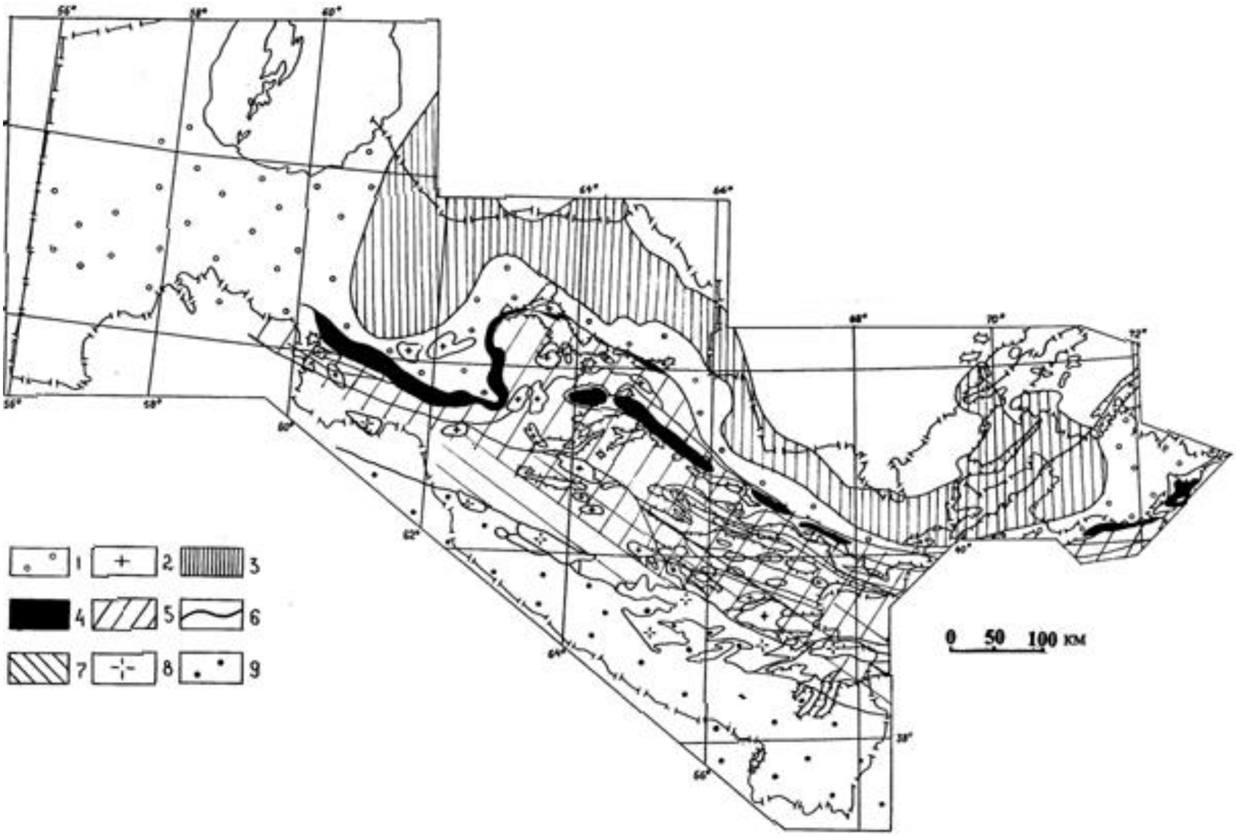

Figure: 1. Paleogeodynamic scheme for the time C-P1. Collision of Kazakh with Ustyurt and Turkestan micro-continents: 1 – intercity basin C_1-P_1; 2 – South Tien Shan collisional granitoid belt C_3-P_1; 3 – Mid-Tien Shan volcanoplutonic arc of the active margin C_1-C_3; 4 – relics of ophiolites of the Turkestan paleobasin Є-C_2b; 5 – South Tien Shan accretionary prism (scales of island-arc, continental margin and shelf sections); 6 - main pillowcases. Collision of the Turkestan and Tajik microcontinents: 7 - Gissar accretionary prism (continental foot, ophiolites and island arc of the Gissar paleobasin C_1-C_2); 8 – Gissar collisional granitoid belt C_3; 9 – back-arc basin of the Tajik microcontinent C_2-C_3 [15].

The metallogeny of the oceanic stage of the geodynamic evolution of the Southern Tien Shan has been insufficiently studied.

Prospects for ore content of ophiolite complexes increase with their in-depth study. An analysis of cartographic, published materials and reports on the results of geological exploration shows that in the South Tien Shan there are prospects for the discovery of new industrial deposits associated with ophiolite complexes.

Methodology. To study ophiolite complexes, an analysis of literary and fund sources on oceanic magmatism, minerals of the Southern Tien Shan, was carried out. The materials on the geochemical specialization of the products of oceanic magmatism, data on the determination of the absolute age were studied. When analyzing the materials, the formation analysis and the principle of actualism were used. The ore-formational classification of the types of oceanic magmatism of the Southern Tien Shan has been carried out to determine the prospects for ophiolite complexes of the region for various types of minerals.

Results and discussion. Iron, chromite, copper-pyrite, platinum mineralizations are associated with the rocks of the ophiolite complexes of the Southern Tien Shan, which are a strategic mineral raw material in the economy of Uzbekistan. Almost all of them are still of scientific interest and are not included in the state mineral resource base of deposits that have an industrially significant status.

Iron. In the state balance of reserves of the Republic of Uzbekistan, one Tebinbulak iron deposit, located in ophiolites, and the second iron deposit, Temirkan, have been registered.

The Tebinbulak deposit is located in the eastern part of the Sultanuvays mountains in a small (2 × 4 km) allochthonous massif composed of gabbro, gabbro-diorite, pyroxenite, hornblendite.

In fig. 2 shows the geological scheme and section of the Tebinbulak field [1].

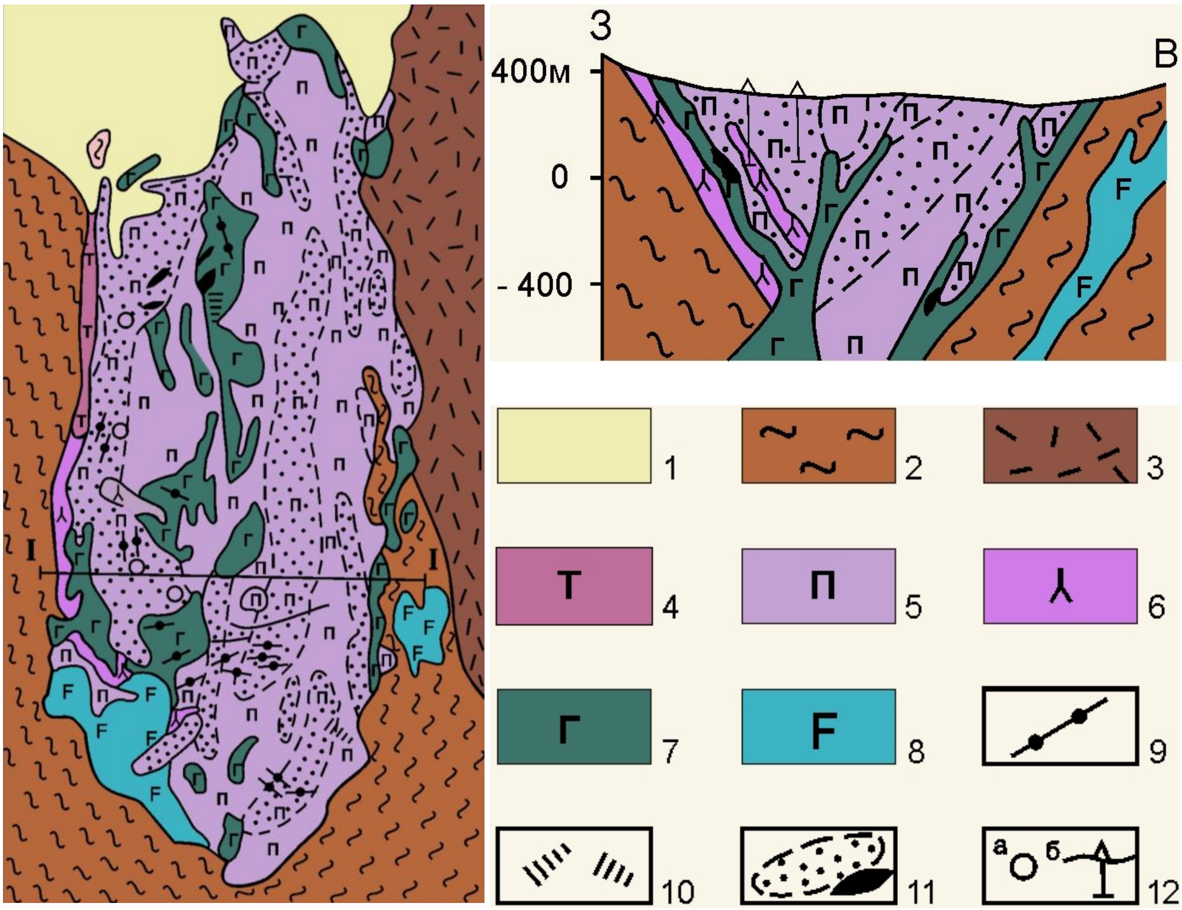

Figure: 2. Geological scheme and section of the Tebinbulak deposit.1 – quaternary deposits; 2 - beshmazar suite (D_1): sandstones, siltstones, marbles; 3 - Jamansay suite (D_1): effusive rocks, slates, marbles; 4 - peridotites; 5 - pyroxenites; 6 - hornblendites; 7 - gabbro; 8 - gabbro-syenite; 9 - albite, syenite veins; 10 - quartz-carbonate veins; 11 - zones of vein-disseminated mineralization; 12 - boreholes on the plan (a), in the section (b).

Iron deposit Tebinbulak according to the geological and industrial classification of I.M. Golovanov, B.A. Isakhodzhaeva et al. Belongs to the titanomagnetite type in ultrabasites [15]. The ore-bearing structure is an ophiolite cover. The host rocks are pyroxenites, peridotites, hornblendites D_2-C_1. The industrial type of ores is ilmenite-titanomagnetite with martite. The main ore mineral is titanomagnetite, which consists of magnetite with thin lamellar ilmenite intergrowths. Hematite is also present. The ores are disseminated (97%), massive (about 3%). About 5% of the iron is in the non-recoverable aluminosilicate form.

Morphology of ore bodies - mineralized zones, deposits.

The main useful components: Fe – 16,2%, TiO_2 – 2,0%. Associated useful components: V_2O_5 – 0,15%, MnO – 0,22%, Pt – 0,02%.

In terms of the average content of the main components (iron - 16.2%, titanium dioxide - 2.0%, vanadium pentoxide - 0.15%), the ores of the Tebinbulak deposit are similar to the ores of the Kachkanar deposits and the Gusevogorsk Urals (Russia). The difference is that at the Tebinbulak deposit the titanium dioxide content is 1.5 times higher. In addition, Tebinbulak ores contain platinum, traces of gold, silver, palladium [7].

The intrusive massif by the type of magmatism belongs to the peridotite-pyroxenite-gabbro formation (Tebinbulak peridotite-pyroxenite-gabbro complex). The rocks of the formation were formed in the following sequence: y1 - fine- and medium-grained peridotites, pyroxenites, tebinites, hornblendites; y2 - pyroxene, pyroxene-amphibole gabbro and gabbro-syenite [5].

According to petrological data, a wide manifestation of crystallization differentiation processes of the initial gabbro melt is established in the massif, which caused the appearance of ultramafic rocks (lherzolites, wehrlites, and other peridotites) [3, 11]. The petrofund of the formation is dominated by gabbroids. Peridotites form small lenticular bodies 5 × 10 and 10 × 50 m in size; they are found among pyroxenites and gabbroids, with which they have mutual transitions. They are composed of olivine (chrysolite-hyalosiderite) and pyroxene. By the ratio of amphibole to pyroxene, shrisheimites, wehrlites, and pyroxene-amphibole peridotites are distinguished.

There are 2 types of pyroxenites: 1) monomineral, consisting of pyroxenes, hornblende, magnetite, titanomagnetite, olivine, vermiculite; 2) enriched with apatite, plagioclase. In addition, differentiates of ultrabasic hornblendites are widespread.

Gabbroids are widespread in the central and southwestern parts of the massif and are represented by hornblende and saussurite gabbros.

In terms of chemistry, ultrabasic varieties of rocks have a tholeiitic evolutionary trend, while gabbroids and hornblendites have a calc-alkaline trend [7].

The table shows the average values of the chemical composition of the rocks of the peridotite-pyroxenite-gabbro formation. They have a relatively high potassium alkalinity (K2O = 0.85-1.1% and titanium content (TiO_2 = 1,2- 2,0%).

Average values of the chemical composition of the rocks of the peridotite-pyroxenite-gabbro formation of the Tebinbulak complex (based on materials by V.V. Baranov, G.G. Likhoidov)

Component	Peridotites (3)	Ore pyroxenites (8)	pyroxenites (8)	Ore tebinities	tebinities (4)	Hornblendities	Gabbro (All)	Melanocratic ore gabbro (10)	Gabbro hornblende	Gabbro diorite	Gabbro syenit	Albitities (5)
SiO_2	42,68	39,70	48,64	36,46	42,08	39,2	42,42	40,38	47,51	47,49	54,59	59,17
TiO_2	0,37	1,74	(Ш	2,16	1,43	1,86	1,37	1,44	1,20	1,13	0,93	0,13
Al_2O_3	2,55	8,78	4,24	9,39	10,30	11,2	17,92	17,32	19,43	17,19	17,29	23,88
Fe_2O_3	6,39	10,07	4,22	11,80	5,96	7,47	6,28	6.72	5,19	4,83	3,16	1,99
FeO	4,91	9,34	4,60	10,63	8,76	9,93	6,37	7,10	4,55	5,74	4,15	0,43
MnO	0,16	0,17	0,13	0,16	0,18	0,18	0,17	0,17	0,17	0,19	0,14	0,008
MgO	26,97	10,66	14.86	10,97	11,65	11,35	5,89	6,96	3,21	4,97	3,08	0,49
CaO	8,96	16,15	19,60	13,24	15,14	13,3	13,23	14,05	11,18	10,19	7.32	1,31
Na_2O	0,27	1,19	0,90	1,41	1,49	1,64	2,65	1,97	4,36	3,43	3,95	5,86
K_2O	0,11	0,44	0,21	0,88	1,03	1,07	0,75	0,71	0,85	1,48	2,89	3,79
ПШ	6,41	1,36	1,58	1,93	1,46	2,28	2,31	2,54	1,71	2,6	1,78	1,77
H_2O	0,29	0,12	0,23	0,11	0,125	0,17	0,19	0,24	0,05	0,19	0.118	0,37
P_2O_5	0,04	0,31	0,06	0,47	0,1265	0,36	0,50	0,51	0,4 S	0,4 S	0,32	0,01
CO_2	0,13	0,14	0,31	0,24	0,21	0,27	0,33	0,34	0,28	0,50	0,17	0,09

SO_3	0,0*	0,07	0,03	0,10	<0,10	0,1	0,09	0,10	0,055	0,06	0.14	0,04
Cr_2O_3	0,061	0,018	0.026	0,0012	0,017	0,015	0,037	0,051	0,002	0,01	-	0,004
NiO	0,007	0,005	0.003	0,005	0,005	0,0014	0,012	0,02	-	0,0005	-	-
CoO	0,001	0,0008	0,002	0,0035	0,003	0,0016	0,002	0,002	0,002	0,002	0,005	-
CпO	-	-	-	-	-	0,003	0,005	0,008	-	0,005	-	-
V_2O_5	0,017	0,05	0,0125	0,127	0,06	0,09	0,02	0,024	0,012	0,005	-	0,004

The monograph gives the absolute age of the rocks of the massif according to K-Ar dates: from 306 ± 5 to 378 Ma (amphibole), ie, early Carboniferous age [5].

Both ores and barren pyroxenites with pyrite-chalcopyrite mineralization contain native gold and platinum, as well as gold tellurides, platinum sulfides and arsenides [7].

The authors share the point of view of most geologists, who believe that the Tebinbulak iron mineralization was formed in the process of prolonged cooling of the ultrabasic magmatic melt, differentiation of magma and squeezing out those fractions where valuable mineral compounds are concentrated into weakened zones along deep faults.

Geophysical studies carried out in recent years make it possible to predict new mineralized zones with industrial mineralization to the north and south of the intrusive.

Banded magnetite schists are promising for titanomagnetite mineralization in the Sangruntau mountains, and ferruginous quartzites with lenses of banded and massive garnet-hematite rocks have been identified in Northern Nuratau.

Chromites. In the ophiolite complex of the western part of the Northern Tamdytau (serpentinites, pyroxenites, peridotites and other ultrabasic, as well as gabbro-basic series) in the Teskuduk-Chengeldinsky, Uchkuduk-Tyumenbaysky, Azhriktinsky and other massifs, chromite mineralization is widely developed.

Complex nickel-graphite mineralization in the Kuldzhuktau mountains is associated with endo- and exo-contact zones of layered intrusions of the Late Carboniferous peridotite-norite-gabbro complex. Three massifs are known in the region - Beltau, Taushansky. Shaydarazsky. An industrial deposit was discovered only in the first one. This is the Taskazgan graphite deposit. There are more than 20 mineralized points and ore occurrences with copper-nickel mineralization, the industrial significance of which has not yet been established.

In the most studied Teskuduk-Chengeldinsky massif, chromium is found in the form of chromium spinels, scattered phenocrysts or nests of magma-chromopicotite. In areas of chromite mineralization, sporadic contents of platinum up to 2 g / t, palladium up to 0.4 g / t, as well as ruthenium, rhodium and iridium have been established. Sulphide mineralization (pyrrhotite, pentlandite, pyrite, chalcopyrite) also develops along ultrabasites.

Chromite dissemination is often established in the metabasites of the basement of the Uchkuduktau Formation.

Platinoids. No own deposits of platinum metals have been found in Uzbekistan. However, palladium is extracted from the ores of the Muruntau gold deposit.

The largest commercial reserves of platinum group metals (PGM) are found in deposits associated with basic and ultrabasic igneous rocks of five countries: South Africa, USA, Zimbabwe, Canada and Russia.

Diagram 1 shows the distribution of world PGM reserves in geological formations.

About 89% of the world's PGM reserves are contained in platinoid deposits proper, located in layered intrusive massifs of basic-ultrabasic rocks.

Less than 11% of PGM reserves are associated with complex ores of copper-nickel deposits. An insignificant amount of PGM is contained in porphyry copper, less often in pyrite, copper-vanadium and copper-titanomagnetite ores. About 0.2% of the world's reserves of platinoids (almost exclusively platinum) are associated with placers. CM. Zhmodik et al. Found that the ophiolite complex rocks are the sources of platinum minerals in placers [6].

Chromites and copper-nickel ores are traditionally considered platinum-bearing.

There are mineralogical and geochemical prerequisites for the discovery of complex gold-platinoid mineralization in apohyperbasic and apobasic metasomatites associated with ophiolites. Native metals, as well as sulphide nickel-cobalt mineralization, are found in serpentinites.

With the ophiolite complex of the western part of the Northern Tamdytau (serpentinites, pyroxenites, peridotites and other ultrabasic, as well as gabbro-basic series) in the Teskuduk-Chengeldinsky, Uchkuduk-Tyumenbaysky, Azhriktinsky and other massifs, chromite and platinoid mineralizations are widely developed [7, 12].

In the Teskuduk-Chengeldinsky massif, in areas of chromite mineralization, sporadic contents of platinum up to 2 g / t, palladium up to 0.4 g / t, as well as ruthenium, rhodium and iridium have been established. Sulphide mineralization (pyrrhotite, pentlandite, pyrite, chalcopyrite) also develops along ultrabasites.

A map of the location of occurrences and promising positions of platinoid mineralization in the Kyzylkum region was compiled on a scale of 1: 200,000 [14]. The Sultanuvais "mafic-ultramafic belt", the West-Tamdyn mafite-ultramafic intrusive massif, the Sentyab outcrops of ultramafic rocks, and the Kuldzhuktau gabbroid massif are promising for minerals of the platinoid group. In addition, promising sills and sill-like dikes of the Malguzar complex, widely developed within the Malguzar mountains of Northern Nuratau and the Turkestan ridge [12, 13].

Copper mineralization. In the northern spreading zone of the Turkestan paleooceanic basin, siliceous-carbonate-shale deposits (sedimentary layer of the oceanic crust) accumulated. They, together with the underlying basaltoids, have been intensively metamorphosed. In them, in the siliceous-shale rocks of the Taskazgan Formation of the Riphean of the Kokpatassky ore field (Central Kyzylkum), small bedded and intersecting ore bodies with copper (0.5-4.0%), vanadium (up to 2.7%), molybdenum (0.001-0.05%), uranium (0.01-0.1%). They are assigned to the stratiform-metamorphogenic copper-molybdenum-uranium-vanadium ore formation [15].

In the prazinite of the Uchkuduktau V-Є (?) Formation of the Northern Tamdytau, manifestations of copper mineralization are known in the form of lenticular nests and dissemination of sulfides.

Conclusions. The analysis of the geological features of the formation of deposits associated with the ophiolites of the Southern Tien Shan is carried out. It is concluded that the metallogenic features of the Southern Tien Shan for chromite, titanomagnetite, copper-pyrite with gold and zinc-copper-pyrite orederation are due to the processes of oceanic magmatism in a spreading environment.

The products of oceanic magmatism of the Southern Tien Shan are promising for the discovery of industrial deposits of iron, chromites and platinum group metals.

The established facts of the occurrence of ore mineralization in geological formations of oceanic magmatism require study.

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