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FRACTIONAL STRUCTURE AND MINERALOGICAL FEATURES OF PSEPHYTIC DEPOSITS – POTENTIAL RESERVOIRS OF DIAMOND IN THE NORTH-WESTERN PART OF THE UKRAINIAN SHIELD. Part 2. USIVSKA AREA

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Geologists of Zhytomyrska Geological Exploration Expedition have allocated the Usivska area (48 m^2) in the headstream of the rivers Chervonka and Kovanka (the watershed part of the Ovrutska elevation). The area was designed to prospect the rocks of alkaline-ultrabasic composition. The reason for this are: (1) high contrast stray fluxes of pyrope (20–30 times greater than background); (2) a number of local low-magnetic anomalies of isometric and slightly elongated form; (3) presence of dykes of "post-Ovruch" age. Within the area, prospecting drilling was conducted and the series of prospecting holes was excavated with the sampling of lumps of rocks and large-volume samples. On the basis of comprehensive studies of rocks granulometric composition, their lithological peculiarities, composition of heavy fractions and typomorphic features of paragenetic diamond satellites it has been determined that in our case we are dealing with a material of non-diamond-bearing facies, which, in addition, has undergone a long transit route and repeated redeposition. Two different sizes mineral associations have been clearly identified for some lithological varieties of the rocks: coarse-grained staurolite–ilmenite–garnet and finer tourmaline–topaz–ilmenite–staurolite. Presented material indicates the arrival of individual clastogenic minerals from sources that had been located at different distances from the site of minerals burial. We did not find mineralogical signs of igneous sources of alkaline-ultrabasic composition, and rare grains of pyroxene, found in sedimentary deposits, are quite comparable to pyroxenes form the crystalline basement rocks.

Key words: diamond, paragenetic minerals-satellites, alkaline-ultrabasic rocks, terrigenous rocks, granulometric analysis, typomorphic features of minerals, Ovrutska elevation.

Usivskyi nose is the most raised in the present relief watershed part of the Ovrutska elevation. Here in the headstream of the rivers Chervonka and Kovanka, the geologists of Zhytomyrska Geological Exploration Expedition found during the search and survey works (1980-ies) high contrast stray fluxes of pyrope – 20–30 times greater than background. Within the nose in the square 48 km^2, the magnetic prospecting was completed (1:50 000). Thanks to them, a number of local low-magnetic anomalies of isometric and slightly elongated form was revealed, which can be interpreted as the bodies of basic and ultrabasic rocks. Restriction of pyrope to the headstream of the rivers, the presence of (1) geophysical anomalies of isometric form and (2) the dykes of "post-Ovruch" age – all this became the basis for the forecasting of alkaline-ultrabasic bodies in described region. Therefore, within the Usivska area, prospecting drilling was conducted and the series of prospecting holes was excavated with the sampling of lumps of rocks and large-volume samples.

The material of these samples (after appropriate processing and enrichment at enrichment plant of Rivnenska Geological Exploration Expedition) was the subject of our research. The purpose of research was to determine the genesis of rock and lithofacies features of diamond and its satellites localization for signs of alkaline ultrabasic magmatism.

Clay horizon of 18 m has been striped by one well and one pit in the southern part of Usivska area (within the geophysical anomaly N 9); it overlaps quartzite-sandstones of Tovkachivska suite. The lower part of the horizon has been studied mainly in the samples from the well, and the upper (up to 10.9 m) – in the large-volume samples collected in the pit.

Granulometric composition of the rocks from the well log is shown in Table 1. Two lithological varieties of the rocks have been distinguished – sands, sometimes poorly cemented into sandstone, and clays containing different amounts of gravel and pebble material (generally 10 %, sometimes up 30 %). Sands of the most upper and lower parts of the geological section belong to clay-aleuritic and aleurite-clayey varieties with small admixture of gravel and pebble material; at the depth of 13.5–14.0 m, the sands contain thin layer of psephytic rock. The middle part of the section is represented by aleuritic and high aleuritic clays which contain only 1–2 % of gravel material. All the rocks are high ferruginizated, and the degree of ferruginization increases with depth. There is a loam layer at the top of the section that has been defined in samples from the pits excavated within the territory of other magnetic anomalies.

Table 1

Granulometric composition of the rocks from clayey horizon, %

Number of the sample	Depth of sampling, m	Size classes, mm					
		> 1.0	0.5–1.0	0.25–0.50	0.10–0.25	0.01–0.10	0.001–0.010
1	1.2	3.1	7.0	24.6	26.6	19.4	19.3
1*	8.0	3.4	1.7	24.3	17.8	39.6	19.0
2	9.5	1.9	0.3	1.9	4.6	23.4	67.9
3	11.0	0.3	0.3	1.7	4.6	40.1	53.0
3*	11.0	26.8**	1.1	1.3	6.3	64.4	15.0
4	13.5–14.0	3.8	1.8	7.8	20.7	18.4	24.4
4*	15.0	3.0	1.0	1.7	34.1	29.4	21.6
5	17.0	4.6	0.7	21.7	44.1	16.3	14.2
5*	19.0		1.2	12.2	38.3	22.9	14.4

*Results of V. Pohrebnyi (Dnipropetrovsk branch of the Institute of Mineral Resources, 1988).

**The distribution in the classes of gravel and pebble size, %: 10–20 mm – 9.1; 2–10 – 16.0; 1–2 – 1.7.

The capacity of all rocks varieties in different parts the Usivska areas varies, especially the clay layer: it is minimal in the eastern margin of the area – 3 m and in western direction increases from 6–7 to 9.7 m. The maximum capacity of loam (4.8 m) and sand (5.9 m) is in the southern part of Usivskyi nose.

U. Fenoshyna calculated (1989) such granulometric ratios according to the results of mentioned rocks granulometric analysis: (1) the average median particle size M_d; (2) coefficient of asymmetry K_a (if $K_a > 1$, the fine fraction dominates in sediment, if $K_a < 1$ – the coarse); (3) coefficient of sorting K_c ($K_c < 2.5$ – well sorted sands and aleurites, 2.5–4.5 – medium sorted, > 4.5 – poorly sorted); (4) the degree of sediments sorting H_r (0.0–0.1 – perfectly sorted sediment, 0.10–0.25 – well sorted, 0.25–0.50 – medium sorted, 0.50–0.75 – poorly sorted, 0.75–0.90 – unsorted, 0.9–1.0 – absolutely unsorted).

The following conclusions can be made on the basis of the results of granulometric analysis and calculated granulometric ratios. The sediments of upper and lower parts of the section have been formed in the environment with high dynamic activity of transporting flow. Such conditions were possible in the case of forming of the fluvial alluvium, which transformed in the floodplain alluvial facies and in proluvium sediments. High dynamic activity of sediment accumulation environment defines the participation in it of the material both near and distant sources of removal. Clay sediments of the middle part of the section have been formed apparently during the attenuation of the flow activity. All this leads to the following conclusion that mainly the material of nearby sources participated in the accumulation of sediments.

Lithological characteristics and composition of terrigenous rocks clastic component have been studied in more detail from the material of granulometric fractions isolated from the samples during their mechanical analysis.

The fraction > 1 mm is represented by the debris of intensively ferruginizated brown, brownish-yellow, ocherous-yellow sandstone and well-rounded grains of milky white and gray quartz. Acute or slightly rounded quartz grains, full of inclusions and covered with a thin skin of iron hydroxides, predominate in sand size grade and well-rounded isometric grains of colourless quartz and their fragments – in aleurite size grade. Occasionally there are quartz grains of irregular shape, gray, dark gray, gel-like, transparent, with dull surface, and intensively altered gray feldspar grains of rod-like shape. Coarse-grained material of clays and loams is represented by iron hydroxides, goethite and rare magnetite. Iron hydroxides are in the form of septarian nodules, which have different shades brown colour, irregularly sharply angled, oval, sometimes round shape and size to 3.5–4.0 mm.

Composition of ***pelitic fractions*** (< 0.01 mm) was determined by X-ray, thermal, chemical and other analysis. Note that a large number of fine-dispersive (X-ray-amorphous) hydroxides of iron in the samples significantly affect the clarity of the diffraction pattern that is why we treated the test material with the oxalic acid and then analyze it again. We discovered in the samples quartz, ferri-halloysite, pyrophyllite, Na-montmorillonite, mixed-layered phases and interlayer-deficient mica. Ferri-halloysite has been identified by the thermal analysis; Na-montmorillonite has been formed under the influence of oxalic acid, which led to the removal of calcium from the inter-packet layers. Exchange calcium in studied montmorillonite has been fixed on the thermogram of the acid-treated samples due to slight endothermic effect at temperature 220 °C. The degree of montmorillonite structure perfection decreases during formation of mixed-layered phases. The proportion of mentioned minerals varies in geological section. In particular, the content of quartz increases from bottom to top, and the content of ferri-halloysite decreases; pyrophyllite is only in the lower part of the section and in the upper sand layer. Montmorillonite is confined to the lower part of the section, and up for the section instead of it mixed-layered phases of kaolinite-montmoryllonite composition and X-ray-amorphous (gel-like) ferri-halloysite appear. Interlayer-deficient mica has been found in the top layer of sand.

Most likely these minerals are the material of redeposited crust of weathering. This crust of weathering has been formed of the basic rocks enriched with Ca, Al and Fe (hence the presence of montmorillonite, ferri-halloysite and abundant iron hydroxides). Interlayer-deficient mica and pyrophyllite are, probably, of allothigene origin, and changes of their ratio in the geological section have been caused by the composition of rocks which have been eroded within the drainage system area.

It is known [3] that due to certain geochemical parameters – the ratio of individual oxides (Al_2O_3/Na_2O, K_2O/Na_2O, Al_2O_3/TiO_2) – it is possible to determine the physical and chemical (climatic) conditions of weathering and to evaluate the intensity of chemical weathering on the continent. The results of chemical analysis of clay rocks pelitic fraction showed that the Al_2O_3 content ranges in them from 18.34 to 28.88 wt % and TiO_2 – from 0.60 to 0.90 wt %, moreover the content of both oxide increases with depth. The quantity of K_2O sharply decreases with depth – from 1.69 to 0.30 wt %. The content of MnO (0.05–0.08 wt %), MgO (0.20–0.60), CaO (1.12–1.40) and Na_2O (0.26–0.33 wt %) is approximately the same, and in the distribution of Fe_2O_3 and FeO (0.23–0.71 and 5.81–12.55 wt %, respectively), no laws have been found. Obtained according to chemical analysis values of geochemical parameters are somewhat contradictory. In particular, the value of Al_2O_3/Na_2O = 56–96 indicates a medium and a high degree of clay substance chemical differentiation and value of K_2O/Na_2O – up to 5 – a low one. The value of the ratio Al_2O_3/TiO_2 – from 24.9 to 32.1 – is typical for the alkalescent conditions of sediments accumulation environment and the climate transition from humid to arid.

Material composition and factional structure of the heavy fraction of the clay horizon rocks we studied in eight mineralogical samples taken from well and 17 large-volume samples from pits. Material of mineralogical samples heavy fraction was divided by size into four classes, which made it possible, firstly, to characterize the composition and fractional structure of all lithological varieties of the rocks, and, secondly, – to find out the features of changes of different-sized heavy minerals in all the section of exposed sediments.

Heavy fraction of the size of 0.2–0.5 mm has been isolated from large-volume samples and separately – electromagnetic fraction from jigging concentrates of the size of 0.5–1.0 mm. Mineralogical studies have been performed only for the material 0.25–1.00 mm – the most informative for investigative purpose.

The content of the heavy fraction in rocks is extremely uneven: at the bottoms of the section – the smallest (130 g/t), higher (to a depth of 8 m) increases almost twice (240–260), even higher increases almost six times (up to 782 g/t) and in the top meter layer of sand reaches 4 kg/t. Granulometric composition of heavy fraction also varies: the content of gravel and coarse-grained material at the bottom of the section is about 25 %; higher (to a depth of 8 m), it abruptly rises to 45 % and in the upper part of the section – crushingly low – 5 %.

The mineral composition of heavy fraction is quite uniform. In size fraction > 0.5 mm, ilmenite, garnet, tourmaline, staurolite and hydroxides of iron have been diagnosed; sometimes there are pyrite, leucoxene and rock fragments. Iron hydroxides appear from the depth of 1 m, and in the interval 11–13 m they represent 94 % of the weight of the heavy fraction 0.5–1.0 mm. In smaller fractions along with mentioned minerals, there are topaz, kyanite, rutile and zircon; moreover topaz and kyanite dominate in the fraction 0.25–0.50 mm and rutile, zircon, leucoxene – in the fraction 0.10–0.25 mm.

To study the distribution of minerals in the sequence we used a method of N. Hrabetskaia [4, 5]. We determined the distribution by particle size classes of the amount of stable minerals and each mineral alone. It turned out that it's different in the upper, middle and lower parts of the section. There are three groups of stable minerals that clearly differ in size and genetic affiliation: (1) inequigranular (from 1.0 to 0.5 mm) minerals – garnet, ilmenite, tourmaline, staurolite, leucoxene; (2) medium- and fine-grained (0.5–0.1 mm) – topaz and kyanite; (3) fine- and close-grained (0.25–0.05 mm) – zircon and rutile. Four mineral associations have been allocated (if the mineral content over 5 %) by the character of mineral distribution in the section: (1) medium-grained garnet–staurolite–topaz–leucoxene–rutile–zircon–ilmenite – at the bottom of the section; (2) fine- and close-grained ilmenite–zircon – in the middle of the section; (3) inequigranular topaz–leucoxene–rutile–tourmaline–staurolite–zircon–ilmenite – at the top of the section; (4) inequigranular topaz–staurolite–zircon–ilmenite–garnet – in the top layer of sand.

According to [5], the most informative indicators for determining the genetic affinity of sediments is the character of distribution of the persistent minerals amount by size and the gravitational accumulation coefficient (GAC). In particular, a sharp increase in the content of resistant minerals from large to small (as defined for the studied rocks) is characteristic of coastal-marine sediments, etc. Consequently, the different character of the distribution of the stable minerals amount by size and GAC in the samples of the upper, middle and lower parts of the section indicates that the deposition of the material in each part has been occurred under slightly different dynamic conditions.

The results of the study of large-volume samples showed the following. The content of heavy fraction in the size of 0.2–1.0 mm varies greatly both in the section of the same rocks and in the area of their development, that is within the limits of individual magnetic anomalies. In particular, the maximum content 410.86 g/t was defined in loams of one anomaly at a depth of 8.4–10.9 m, as well as in the sands of the upper strata of another anomaly (402.5 g/t at a depth of 2.0–3.5 m). However, in the same loams, the average yield of a heavy fraction, although the highest (in comparison with other rocks), but very variable in area – decreases to 70.55 and 65.07 g/t. In the actual clays, the content of heavy fraction is generally low – varies in the area from 18.0 to 74.3 g/t, but in some places it increases to 114.0 and even 277.5 g/t. Characteristically, that the content of heavy fraction in the clays decreases with the depth, for example, within one anomaly – from 57.8 (4.9–8.0 m) to 18.0 g/t (8.0–9.5 m), within the limits of the other one – from 41.9 (5.8–8.8 m) to 27.8 g/t (8.8–11.8 m). And one more regularity is that in the heavy fraction of all lithological varieties of rocks, prevailing (50–70 %) material has the size of 0.20–0.25 mm.

Staurolite in the studied rocks is represented by several varieties. Subrounded transparent clear brilliant bright orange, yellow-, dark-, brownish-orange grains occur in variable quantity throughout the section, and in smaller fractions they are more than in large ones. Optical characteristics: $n_g' = 1.750$; $n_p' = 1.740$, pleochroism is from clear-yellow to honey-yellow. Less commonly there are angularly-irregular subrounded grains of brown to almost black colour (due to the abundance of another mineral black inclusions); $n_g' = 1.758$; $n_p' = 1.748$; pleochroism is not visible; element cell parameters, nm: $a = 0{,}7878 \pm 0{,}0007$, $b = 1{,}6682 \pm 0{,}0026$, $c = 0{,}5654 \pm 0{,}0005$. Much less often, but throughout the section, there are translucent grains of dark gray-brown, gray-orange, greenish-brown colour with greasy lustre. Grain surface is uneven, sometimes sugary, pitted. Such staurolite is more in a fraction with a density of < 3.60 g/cm^3. It contains Th, La (up to $3 \cdot 10^{-3}$ %), Hf, Pb, Sn, which are not detected in transparent staurolite. Optical characteristics: $n_g' = 1.752–1.754$; $n_p' = 1.740$, pleochroism is from grayish-brown to dark brown; element cell parameters, nm: $a = 0.7856 \pm 0.0011$, $b = 1.6568 \pm 0.0016$, $c = 0.5623 \pm 0.0015$. It is characteristic that staurolite is the most quantitatively variable mineral in the section: its content increases from bottom to top; the maximum content (48 g/t) is in the loams of the northern and southern parts of the studied territory.

Garnets are represented by grains of pink, pale-, orange-, reddish-pink, pinkish-orange, orange, orange-red, red, lilac and purple colour. The degree of roundness is different: larger grains are angular, smaller ones – subrounded and rounded. The mineral is unevenly distributed in rocks, but in the sands that crowned the section its content is substantially increased.

The following results are based on the study of about 8,000 pyrope grains (U. Fenoshyna took an active part in the studies). Grains are distributed in size as follows: there is no pyrope in the fraction > 1 mm; 0.7–0.5 mm – 1 % (most of it in loams), 0.50–0.25 – 65 % (characteristic for clays and prevails in the sands of the section upper part), 0.25–0.20 mm – 34 % (characteristic for loams, “top” clays and sandstones of Tovkachivska suite).

Pink grains predominate over the colour, especially in the fraction 0.25–0.50 mm. The refractive index of pink pyrope *n* fluctuates within 1.745–1.755, very rarely – 1.760; for purple pyrope the predominant value of *n* is 1.745–1.750, occasionally increasing to 1.765, moreover the grains have the effect of dichroism. The bulk of orange pyrope grains have *n* in the range of 1.751–1.755, and the red one is 1.761–1.765. The most colourful pyrope has been found in the sands of the section upper part, but in general pink varieties dominate in all the rocks.

The shape of pyrope grains is irregular, irregularly-rounded, somewhat flattened or elongated, sometimes isometric; more rare, are the grains in the form of triangular subrounded fragments. The grains are usually whole, monolithic, the degree of roundness varies – there are poorly rounded, sub- and well-rounded and angular grains. The surface is shiny, smooth, polished and matte, less rough, sometimes with a silky chatoyancy. Mechanical potholes or hilly or dug-like sculpture of chemical origin are noticeable. Some grains are cracked, and the cracks are only visible under a microscope. Black point inclusions are rare.

Thus, among studied pyrope grains, small grains (< 0.5 mm) predominate, which, moreover, have traces of intensive mechanical influence (high degree of roundness and smooth polished surface). Therefore, it is most likely that the bulk of the pyrope has been deposited in the clay horizon of the Usivska area or after prolonged transport from the primary sources, or after repeated redeposition from older intermediate collectors.

The results of partial micro-X-ray spectral analysis* of purple pyrope grains and the diagram of Cr_2O_3–CaO (see Figure) show that by composition the studied pyrope correspond to pyrope of lherzolite paragenesis.

Spinelids are represented by spinels and chrome-spinellids, which occur throughout the section in all size fractions. *Spinel* is available in the form of rounded grains of gray, blue, pink, lilac colour and matte surface. *Chrome-spinellids* in all lithological varieties of rocks are contained in the weight range of 0.2–0.4 g/t, but their content grows from the bottom up to the section: their maximum concentration (1.2 g/t) is in the sands of the upper part. Most of the grains are well rounded; they have round, irregularly round, slightly flattened and oval shape. Separate grains of a size > 0.5 mm have elements of crystallographic faceting – relicts of faces and habit of the octahedron, the fins and vertices of which are smoothed. The surface of the grains is smooth, thin-rough, with individual potholes and dents, occasionally finely-tufted. The colour is black, chatoyancy is or dull, or resinous, the lustre on the fracture planes is strong metalline.

Results of partial micro-X-ray spectral analysis of five spinellid grains (Table 2) showed that they differ significantly in chemical composition. According to the binary diagrams Cr_2O_3–TiO_2 and Cr_2O_3–Al_2O_3, the figurative points of the studied grains fall into the fields of different genetic type spinellids: chromite of stratiform ultrabasic rocks, alumochromite from inclusions in the Yakut kimberlite pipes, alumomagnetite and hercinite.

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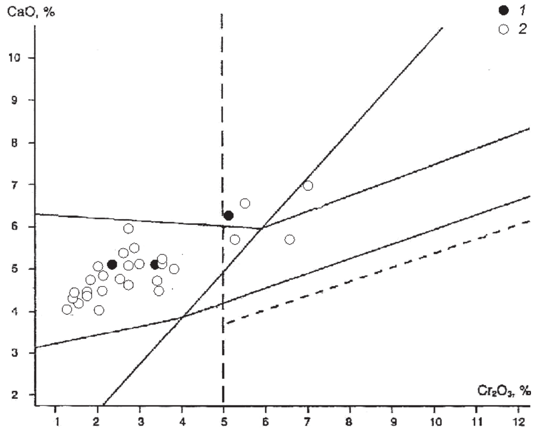
*These and other micro-X-ray spectral analyzes used in the article have been performed at the Institute of Geology of the Yakut Branch of the Siberian Branch of the RAS, Yakutsk.



The position of figurative points of the composition of Cr-containing pyrope from the Usivska area rocks in the diagram Cr_2O_3–CaO:
1 – our data; *2* – data of S. Tsymbal (pyrope grains have been selected from the heavy fraction of two large-volume samples, 1989).

Table 2
The results of partial microprobe analysis of spinellids from clay horizon of Usivska area

Number of the analysis	Content, mass %		
	Al_2O_3	Cr_2O_3	TiO_2
122/3-10	13.35	51.58	0.48
122/3-11	28.92	0.20	0.49
152-12	12.49	30.68	3.70
152-14	19.73	40.35	1.49
152-15	49.72	0.21	0.63

Consequently, chrome-spinellid grains from the clay horizon rocks of Usivska area not only externally but also in composition are similar to the grains that we have found in the deposits of other areas and in the rocks of the Bilokorovytska structure [5–7, etc.].

Ilmenite in the studied rocks is represented by four varieties. *Ilmenite-1* (the so-called rounded), unevenly distributed in the deposits, is in the form of rounded and subrounded grains of oval, round form; larger grains are less rounded and have the relics of angular habit. The colour is iron-black, gray-black, luster is metalline; grains with traces of leucoxenization are black and brown. The surface of grains is smooth or slightly rough, often in pits and potholes. *Ilmenite-2* (“fragmented”), also unevenly distributed – there are non-rounded or poorly rounded angular, acute-angled fragments of iron-black, gray-black, more rarely gray-brown colour and conchoidal fracture. Leucoxenization is manifested less than in ilmenite-1. *Ilmenite-3* (“shiny”) is sporadically found in the variable amount; it is represented by subrounded and rounded grains of a thick-tabular or lamellar shape and with a distinctive parting by basal plane. The colour is iron-black, the lustre is strong metallic. The mineral is not leucoxenized at all. *Ilmenite-4* (“leached”) is available in subrounded, rarely rounded grains with a porous, as if leached surface, often leucoxenizated. The colour is gray-black, iron-black; the lustre is metalline, chatoyancy – dull. Such ilmenite occurs only in the rocks of the section upper part – in sands and loams, and its content decreases from larger sized fractions to smaller ones.

We have studied 2,946 ilmenite grains, which were selected from the heavy fractions (0.5–1.0 mm) of large-volume samples, by the method of thermoelectric power: 1,022 grains have different meanings of thermoelectric power, in the remaining grains the conductivity is "zero". Only in 40 grains, we have recorded the minimum (±100 mV/°C) negative and positive (36 grains) values of thermoelectric power, typical for picroilmenite. Most of these grains belong to ilmenite-4 ("leached") confined to the loams and clays of the Usivska area eastern outskirts.

It is known that for the knowledge and genetic interpretation of the peculiarities of terrigenous minerals distribution in sedimentary strata, it is important to identify the statistical laws of the correlation between the individual minerals [2]. Therefore, we performed a statistical processing of available mineralogical results on materials of large-volume sampling. The results showed that for $r_{0.05} = 0.45$ ($n = 19$), significant correlations are between topaz and kyanite ($r = 0.65$), between two varieties of staurolite (0.63) and garnet and pyrope (up to 0.5 mm) and weaker correlations – between topaz and pyrope (> 0.5 mm) ($r = 0.47$). Strong isolation of each mineral is revealed by the distribution of signs in the fields of factors F_1–F_2; depending on the influence of individual factors, minerals are grouped into two such associations: kyanite–tourmaline–pyrope +0.5 mm and staurolite-1–staurolite-2 (in the field of F_1 positive values) and topaz–ilmenite-2 ("fragmented")–pyrope +0.5 mm (in the field of F_2 positive values). In the fields of factors F_1–F_3, the distribution of the contents of the studied variables is due to the influence of the factors F_1 and F_3: the samples have been grouped, mainly, according to the granulometric composition of the studied rocks (factor F_1) and differ according to the belonging to anomalies of the eastern and western parts of the Usivska area (factor F_3). All these associations belong to the fifth heavy concentrate-mineralogical type (according to V. Afanasiev [1]), which corresponds to unpromising prospecting conditions.

Thus, the study of the typomorphic features of paragenetic diamond satellites on the territory under study showed that in our case we are dealing with a material of non-diamond-bearing facies, which, in addition, has undergone a long transit route and, apparently, a repeated redeposition. Two different sizes mineral associations have been clearly identified for some lithological varieties of the rocks: coarse-grained staurolite–ilmenite–garnet and finer tourmaline–topaz–ilmenite–staurolite. Presented material indicates the arrival of individual clastogenic minerals from sources that had been located at different distances from the site of minerals burial. We did not find mineralogical signs of igneous sources of alkaline-ultrabasic composition, and rare grains of pyroxene, found in sedimentary deposits, are quite comparable to pyroxenes form the crystalline basement rocks.

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ФРАКЦІЙНА СТРУКТУРА І МІНЕРАЛОГІЧНІ ОСОБЛИВОСТІ ГРУБОУЛАМКОВИХ ВІДКЛАДІВ – МОЖЛИВИХ КОЛЕКТОРІВ АЛМАЗУ У ПІВНІЧНО-ЗАХІДНІЙ ЧАСТИНІ УКРАЇНСЬКОГО ЩИТА. Ч. 2. УСІВСЬКА ДІЛЯНКА

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Усівську ділянку площею 48 км^2 виділили у верхів'ях рік Червонка й Кованка (вододільна частина Овруцької височини) геологи Житомирської ГРЕ для розшуків порід лужно-ультраосновного складу. Підставою для цього стали виявлені висококонтрастні потоки розсіяння піропу (у 20–30 разів більші від фонових) і наявність локальних слабко магнітних аномалій ізометричної, ледь витягнутої форми та "післяовруцьких" дайок. У межах ділянки виконано розшукове буріння з відбиранням штуфних проб, а також пройдено низку шурфів з відбиранням великооб'ємних проб.

Метою наших досліджень було визначення генезису порід і літолого-фаціальних особливостей локалізації алмазу та його супутників для виявлення ознак лужно-ультраосновного магматизму. Вивчали головно утворення глинистого горизонту потужністю 18 м, який залягає над кварцито-пісковиками товкачівської світи у південній частині Усівської ділянки. Гранулометричний аналіз порід (піски, місцями слабко зцементовані до пісковиків, та глини, що містять різну кількість гравійно-галькового матеріалу) засвідчив, що відклади верхів і низів розрізу формувалися за умов високої динамічної активності транспортувального потоку, а такі умови вірогідні в разі формування руслового алювію з переходом до заплавних алювіальних фацій і/або пролювіальних утворень. Висока динамічна активність середовища осадонагромадження зумовила участь у ньому матеріалу як ближніх, так і дальніх джерел знесення. Глинисті осади середньої частини розрізу формувалися, вочевидь, під час загасання активності потоку, отже, у нагромадженні осадів брав участь головно матеріал джерел, розташованих поблизу.

Вміст важкої фракції у вивчених породах украй нерівномірний: у низах розрізу – найменший (130 г/т), до глибини 8 м – 240–260, ще вище – до 782 г/т, а у верхньому метровому шарі піску досягає 4 кг/т. Різниться і гранулометричний склад важкої фракції: вміст гравійного і крупнозернистого матеріалу в низах розрізу становить ~ 25 %, до глибини 8 м він стрибкоподібно зростає до 45 %, а у верхах розрізу нищівно малий – до 5 %. За результатами вивчення великооб'ємних проб визначено, що вміст важкої фракції розміром 0,2–1,0 мм сильно варіює як за розрізом однойменних порід, так і за площею їхнього розвитку, тобто в межах окремих магнітних аномалій. У всіх літологічних відмінах порід важкі фракції на 50–70 % складені матеріалом, що має розмір 0,20–0,25 мм.

Мінеральний склад важкої фракції достатньо одноманітний: у фракції > 0,5 мм це, головно, ільменіт, гранат, турмалін, ставроліт, гідроксиди заліза, трапляються пірит, лейкоксен і уламки порід. З глибини 1 м з'являються гідроксиди заліза, а в інтервалі 11–13 м вони становлять 94 % від маси важкої фракції класу 0,5–1,0 мм. У дрібніших класах виявлено також топаз, кіаніт, рутил і циркон. Серед вивчених зерен піропу переважають дрібні (–0,5 мм) зерна зі слідами інтенсивного механічного впливу. Тому найвірогідніше, що основна маса піропу надійшла у відклади глинистого горизонту Усівської ділянки або після тривалого транспортування з первинних джерел, або після неодноразового перевідкладення з давніших проміжних колекторів. За складом піроп відповідає мінералу лерцолітового парагенезису. Досліджені шпінеліди зіставні з хромітом стратиформних ультрабазитів, алюмохромітом із включень у кімберлітових трубках Якутії, алюмомагнетитом і герцинітом.

Різний характер розподілу за класами крупності суми стійких мінералів і коефіцієнта гравітаційного нагромадження у пробах верхньої, середньої і нижньої частин розрізу свідчить про те, що відкладання матеріалу в кожній із частин відбувалося за дещо різних динамічних умов середовища осадонагромадження. Для окремих літологічних відмін порід чітко визначено дві різнорозмірні мінеральні асоціації: крупнозернисту ставроліт-ільменіт-гранатову та дрібнішу турмалін-топаз-ільменіт-ставролітову. Статистичне опрацювання наявних мінералогічних результатів за матеріалами великооб'ємного опробування засвідчило, що всі виділені мінеральні асоціації належать до так званого п'ятого шліхомінералогічного типу (за В. Афанасьєвим), який відповідає малоперспективним розшуковим умовам. На підставі комплексного вивчення типоморфних особливостей парагенетичних супутників алмазу з'ясовано, що в нашому випадку наявний матеріал неалмазоносної фації, який зазнав тривалого транспортування й неодноразового перевідкладання. Зроблено висновок про надходження окремих кластогенних мінералів із джерел, по-різному віддалених від місця їхнього захоронення. Мінералогічних ознак магматичних джерел лужно-ультраосновного складу не виявлено, а наявні в осадових відкладах рідкісні зерна піроксену зіставні з піроксенами порід кристалічної основи.

Ключові слова: алмаз, парагенетичні мінерали-супутники, лужно-ультраосновні породи, теригенні породи, гранулометричний склад, типоморфні особливості мінералів, Овруцька височина.