gravitational, etc.) was calculated. As the response function of the system can take the magnetic susceptibility (magnetic survey), resistivity (electrical survey), the anomaly of gravitational acceleration (gravimetric), etc.

Findings. The formulas, which establish the connection between the measured quantities in geophysical exploration methods to the concentration of the useful component of a field of natural resources, were obtained. The formulas for predicted mineral deposits resources for a particular field and the formulas for quantifying the energy dispersion of refractory ores and minerals were obtained.

Originality. For the first time the methods of nonequilibrium quantum statistical thermodynamics were used for calculation of the measured values in geophysical methods of mineral exploration.

Practical value. The use of the suggested methods and formulas can significantly reduce the number of geological exploration (drilling, etc.), which dramatically reduces the cost of works associated with the assessment of the economic prospects for the development of a mineral deposit.

Keywords: *nonequilibrium statistical thermodynamics, elementary excitations, response function, geophysical methods of mineral exploration, estimated resources*

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PROSPECTS FOR DIAMOND CONTENT IN RAYGORODSKA STRATA OF THE UKRAINIAN SHIELD

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ПЕРСПЕКТИВИ АЛМАЗОНОСНОСТІ РАЙГОРОДСЬКОЇ ТОВЩІ УКРАЇНСЬКОГО ЩИТА

Purpose. To evaluate the prospects for diamond content in Raygorodska strata of the Ukrainian shield.

Methodology. A complex of field and laboratory tests was used to achieve the purpose of the research. Petrographic and mineragraphic studies, paleogeographic reconstruction and lithofacies analysis were carried out.

Findings. It has been found that the diamondiferous rock of Raygorodska strata refers to the marginal-marine type of sedimentary and pyroclastic group of rock. Diamondiferous bedrock processed by breaking waves and its alluvial migration from the continental surface can be considered as a possible source of incoming diamondiferous debris. Formation of marginal-marine diamond-bearing facie of Raygorodska strata is due to the peculiarities of paleogeography of the periphery of the Paleocene Sumy marine basin. Fluidized-explosive unit spatially related to Raygorodska strata has been discovered. This unit is similar in composition to diamondiferous mica-lamprophyre of Minette type from Parker Lake area, Canada, as well as to diamondiferous rovnenskits of the Ukrainian shield. The occurrence of diamonds set earlier in raygorodska strata is similar to pyroclastic kimberlites from the Fort à la Corne area (Saskatchewan, Canada) and to mineragenic type of pyroclastic kimberlite accumulated in shallow marine basins.

Originality. Fluidized-explosive unit and the peculiarities of lithofacies and stratigraphic position of raygorodska strata have been revealed. The potential diamond content of fluidized-explosive unit was substantiated. Mineragenic type of previously established occurrences of diamonds has been proved; the probable directions of transport and accumulation areas of diamond detritus of Raygorodska strata have been determined.

Practical value. New forecasting and prospecting criteria for diamond content in raygorodska strata have been formulated. These criteria allow extending the boundaries of the Kirovohrad area in the Central diamond prospective region and delineate potentially diamond placers.

Keywords: *volcanic-sedimentary rock, fluidized-explosive unit, pyroclastic kimberlites, mica-lamprophyres, diamond placers*

Introduction. Up to date, forecasting and prospecting works on assessing the prospects for diamond in Ukraine are mainly based on classical concepts about the formation of diamond associated with kimberlite and lamproite magmatism. However, the minerageny of diamond has accumulated a large amount of data, which require revising the theory of age, genetic types and regularities of diamond forming. For example, diamond occurrences have been found within the Central diamond prospective region in the Kirovohrad block of the Ukrainian shield (UkrSh), but their primary deposits have not been discovered yet, nor has their mineragenic type been substantiated. As a result of prospecting works (geological survey expedition No. 37 of State Enterprise (SE) "Ki-

rovgeologiya") diamonds of kimberlite genesis without any "signs of ageing" and their indicator minerals were found in the deposits of Phanerozoic cover, including rock of Raygorodska strata [1].

G.M. Yatsenko [2] suggested that known occurrences of diamond and accessory minerals in sand-clay sediments of buchakska suite are secondary collectors of placer diamonds, and the origin of placers is probably connected with the rocks of Raygorodska strata.

Unsolved aspects of the problem. Since the study of diamond content in sedimentary cover within that area has hardly been carried out, it was proposed to develop prospecting works for diamonds focusing on the search of Phanerozoic placers, which can be both of value and help to identify the primary sources [2]. Thus, new wells were drilled with the purpose of studying the material composition of primary potential enclosing rock of major diamond indicator minerals, which are Buchaksk sediments and brecciated Raygorodska strata [3]. Yu.I. Fedorishin et al. [4] detected autoliths, pisoliths, lapilli and xenotuff breccia of kimberlite (lamproite) composition with very uneven distribution of rock-forming components and a high degree of substitution with secondary minerals in the rocks of Raygorodska strata. Currently, rock strata are regarded as the petrological indicator of basic and ultrabasic dykes and can be the enclosing rock for kimberlite pipes that were formed in the Cretaceous-Paleogene (on the analogy of the Yakutian kimberlite province).

Objectives. To achieve the purpose of the study a number of problems were solved. The study included:

- Systematization and analysis of the collected data on geology and diamond content of Raygorodska strata.
- Research on the material composition and structure of Raygorodska strata, updating of stratigraphic position.
- Paleogeographic studies of the Paleocene formations in the Kirovohrad block of the UkrSh.
- Substantiation of genesis and mineragenic type of indicated diamond occurrences within Raygorodska strata.
- Development of forecasting and prospecting criteria and delineation of potentially diamond placer bearing areas.

Methodology. Drilling new wells gave the opportunity to get additional data for the study. The authors have carried out the comprehensive study of Raygorodska strata to substantiate their prospects for diamonds and to identify new forecasting and prospecting criteria that will allow searching diamond deposits effectively.

According to geologists of SE "Centrukrgeologiya", the rock of Raygorodska strata occurs in river valleys mainly and other depressions of the crystalline basement, filling Kirovohrad-Novomirgorodska, Sazonovska, Lebedyno-Balakleevska, Tyasminska, Novomirgorod-Rotmistrovska, Vyskovska, Chigirinska paleovalleys and Rotmistrovska, Zelena, Adamovska, Ositnyazhska basin. The largest areas of continuous rock are extant to the west and north, within the sheet M-36-XXVI (Smila) in the basin of the river Tyasmin, as well as to the south – in the upper Ingul river, sheets M-36-XXXII, XXXIII (Znamenka, Kirovohrad). On most of the area raygorodsky sediments occur directly on the surface of crystalline basement and its crust of weathering. Raygorodska strata are deposited at the Burimska suite of the Lower and Upper Cretaceous within Sazonovska, Lebedyno-Balakleevska, Tyasminska, Novomirgorod-Rotmistrovska paleovalleys. In Rotmistrovska depression raygorodsky rocks occur on carbonate of chalk of Turonian age, to the west of it they are found on Smelyanska layers of the Lower Cretaceous, in the north-east, on the watershed between the r. Tyasmin and Kremenchug reservoir the rocks occur on the deposits of the Orelska suite of the Middle Jurassic and on the Dronovska suite of the Lower Triassic.

Sediments of the Eocene (sand and carbonaceous units of Buchakska series, marl and marly sands of the Kievska suite, aleurolite and glauconite-quartz sands of the Obukhovska suite) transgressively superpose the rock of Raygorodska strata, with traces of explicit washout. In the bottom layer of Buchakska series there often occurs boulder-gravel layer, the material of which corresponds to the composition of crystalline rock fragments underlying Raygorodska strata. The Quaternary sandy-loamy sediments superpose the rock of strata in the valleys.

Established facial differences in raygorodsky units in the area of their distribution allow dividing the research territory into two areas – the Smelyanska area (the northern part of continuous Raygorodska strata near villages Lebedevka, Luzanovka, Yarovoye, Kapeychana, and Raygorod) and the Kirovohradska area (the southern part of continuous Raygorodska strata near villages Gruzskoye and Lesnoye).

Main research. The study of core-samples from wells drilled at villages Gruzskoye and Lesnoye revealed the volcanogenic-sedimentary rock in Raygorodska strata. Almost all Raygorodska strata have an abundance of organic remains represented by nuclei, detritus and debris of marine benthic invertebrates and rare fragments of carbonized flora. The survival rate of mesofauna varies from indeterminate nuclei and their fragments to the representative debris clams in fair preservation. The structure of strata is divided into two bands: the lower one has a thickness of 11–16 m and the upper one is 42–54 m thick. According to textural and structural features, these bands are lithified mixed sediments of treated and untreated tephra and resurgent material (sharp-edged and slightly rounded debris with zones of roasting and without it, boulders of crystalline and sedimentary rock).

Regarding the quantitative ratio of volcanic and sedimentary constituents (from 75 to 20%), sedimentary and pyroclastic deposits are distinguished. In their internal and external characteristics, rocks of Raygorodska strata refer to the genetic group of marginal-marine sediments.

Mixing of sedimentary, volcanic and biogenic deposits of different age often occurred simultaneously on land and sea due to repeated regressions of paleobasin. As a result, interbedded sedimentary and pyroclastic facies were formed. More significant regression led to dewatering of paleobays on the research territory and made conditions for dividing Raygorodska strata into two bands. It is confirmed by interstratified layers of kaolin in the superfaces of the upper and lower bands of Raygorodska strata.

The section of Raygorodska strata within the Smelyanska area in the artificial outcrop on the right bank of the r. Suhoy Tashlyk (outskirts of the village of Lebedevka, Kamensky district, Cherkasy region) differs from other sections of strata studied. Brecciated rocks represented by

fragments of crystalline rock and cemented by fine-grained rose-gray material with a brown tinge are found in the outcrop. It is distinguished that the section is complicated by vein-like formations. According to the external features, branching veins show similarities with feeders of fluidized-explosive units which are filled with light grey material with a bluish tinge identical to those identified in the Devonian sediments [5] on the bank outcrop of the river Rassolna in the northern Ural.

Almost complete similarity between vein rock and fluidized-explosive units in sedimentary complexes of Russia, Belarus and China was established by petrographic and X-ray diffraction analyses. These complexes were studied in detail by K.E. Jacobson et al.

Mineral composition of the studied rock is similar to mica-lamprophyres of Minett type and kersantites. The main rock-forming minerals include biotite in two generations, potassium feldspar such as orthoclase and microcline, as well as aggregates of pseudoleucite. There are also relics of amphibole and pyroxene; occurrence of apatite (it confirms the input of volatiles), leucoxene, quartz and ore mineral is also observed.

Due to stratiform diamond occurrences in the Kirovohrad area, which were revealed in the Raygorodsky sediments, biostratigraphic studies of Raygorodska strata and overlying deposits were carried out in collaboration with. Stefanskiy V.L (Dnipropetrovsk National University). Previously, in press Raygorodsky units were considered a part of the subface of Luzanovsky key section of the Paleocene. On the one hand, on the basis of findings of the Cenomanian and Maastricht fauna raygorodsky sediments or their upper part refer to the Cretaceous formations (Cenomanian–Maastrichtian); on the other hand these deposits are dated as Paleocene and even Miocene [2].

Many organic residues of marine benthic invertebrates of the Paleocene were revealed in the matrix of Raygorodska volcanic-sedimentary strata in the Kirovohrad area during the core studies, Raygorodsky sediments of Tyasminska depression did not reveal any remains of fossil.

Conducted malacological studies of gastropods (defined by V.L. Stefanskiy) from the rock of Raygorodska strata agree with data of E.I. Nikolaevskaya & M.V. Yartseva about the Paleocene fauna of zonal species *Cibicides lectus* in these strata.

Studying of nannoplankton from Raygorodska basic (matrix) mass rock in the Smelyanskaya area (carried out by G.P. Kalinichenko) showed the Late Maastrichtian age in the volume of *Nephrolithus frequens* zone. Our studies of overlying Luzanovsky sediments also agree with conclusions regarding the Late Cretaceous age of Raygorodska strata in the Smelyanskaya area of the research territory.

Thus, forming of Raygorodska strata occurred during the Late Maastrichtian – Early Paleocene. These conclusions were drawn based on the study of the history of geological evolution and results of the paleontological study of the research territory, as well as the stratigraphic position of Raygorodska strata.

Paleogeographic maps of the USSR, Ukraine and Moldova, the schematic paleogeographic map of the territory of Ukraine of the Paleocene age (D.E. Makarenko) were used to reconstruct forming conditions of Raygorodska strata. The schematic paleogeographic map of the Lower Paleocene for the research territory was constructed according to the results of the study of basement hypsometry.

The water of the North Sea from the north and the Tethys from the south penetrated the Ukrainian Shield through deeply incised shallow bays. The offshore area has been changing its shape during its lifetime. During Raygorodsky age, the sea was more deeply incised into the territory of the UkrSh, namely, into its southern part – in the area of Kirovohrad, and in the north-eastern part the sea covered a small part of the UkrSh's slope; as for the north and the central part, the research territory was dry land.

According to the geological data obtained by SE "Kirovgeologiya", single diamonds and minerals-indicators were detected within Gruzsky, Lesnoy and Ositnyazhsky diamond prospective regions in the Kirovohrad area. Earlier it was revealed that Raygorodska strata contained Xenotuff breccia of kimberlites (lamproites). There are negative gravity anomalies controlling explosive structures of the Mesozoic-Cenozoic phase of tectonic activation in this territory (Fig. 1).

Generalization and data analysis on the composition, structure and paleogeography of the rock of Raygorodska strata allow drawing a conclusion that the diamonds are of kimberlite genesis and have octahedral habitus without any "signs of ageing", which indicates the proximity to primary kimberlite (lamproite?) sources of diamonds; the minerals-indicators found in Raygorodsky sediments are of marginal-marine origin.

In this regard, it can be assumed that primary sources of detected diamonds are the explosive structures of the Mesozoic-Cenozoic stage of tectonic activity. These sources were apparently located in the shallow coastal area of marine paleobasin, but due to hydrodynamic processes, differentiation and accumulation of diamond material in the littoral zone, diamond placer occurrences formed in Raygorodska strata of the Paleocene (Fig. 1).

Subsequently, there was hydrodynamic processing of diamondiferous material applied due to the alluvial activity of the main rivers in this area resulting in redeposition of diamonds in the rock of Buchakska series.

Thus, we can assume that the following can be considered the source of placer minerals coming to the littoral zone of Raygorodska strata. They are diamondiferous bedrock directly processed by breaking waves and localized within the shoreline of the Paleocene shallow marine, as well as alluvial migration of potential diamondiferous material from the continental surface of the research territory. Based on the findings of diamonds and their accessory minerals in Buchaksky sediments, the rock of Raygorodska strata can be considered as intermediate collectors to diamond placer occurrences, which formed later.

To justify the mineragenic type of diamond occurrences in Raygorodska strata we have drawn the data [3, 4] which described the material composition of core-samples, i.e. xenotuff breccia of kimberlite (lamproite) composition with a very uneven distribution of rock-forming components and a high degree of substitution of secondary minerals in the rock of Raygorodska strata.

We have found that these kimberlite rocks having a number of certain features (Table) are similar to diamondiferous volcaniclastic kimberlites in marine sediments of Fort à la Corne in East Central Saskatchewan, Canada [6]. In that territory P. Nixon and K. Leahy [6] exposed the off-crater volcaniclastic sediments represented by two facies – pyroclastic kimberlite (PK) and processed pyroclastic kimberlite (PPK).

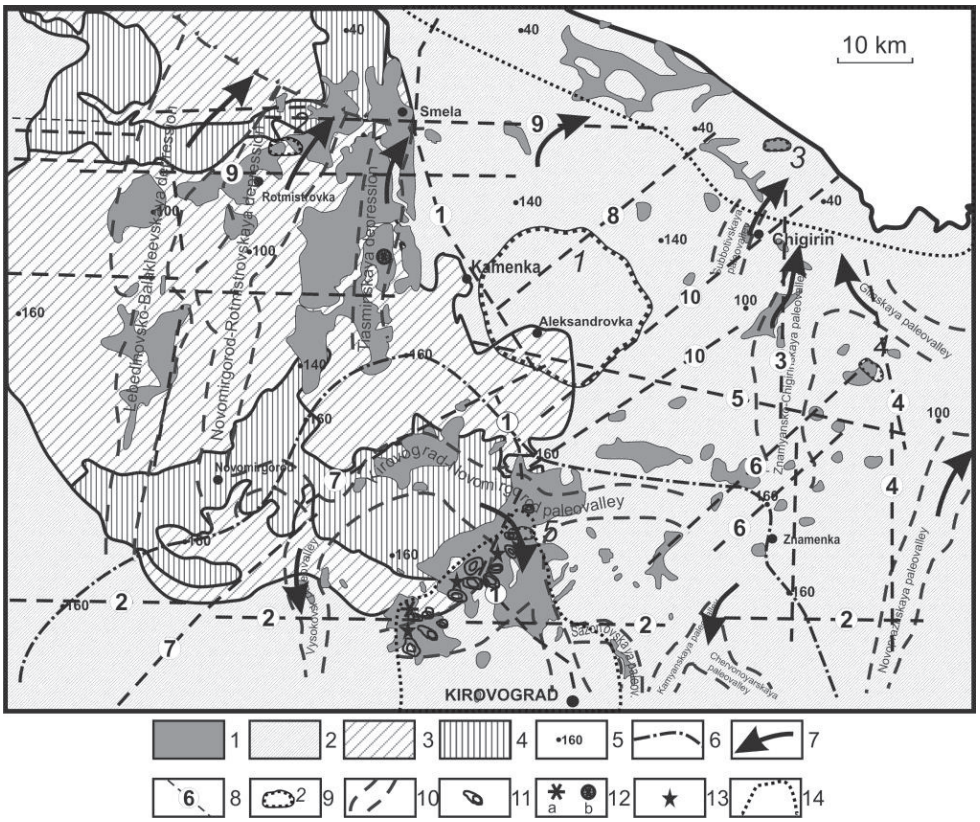

Fig. 1. The scheme of the geological background and the direction of clastic material transport in the area of Raygorodska strata distribution: 1 – Raygorodska strata, 2 – Kirovohrad granites of Novoukrainsky massif; rock of Korsun-Novomirgorod complex: 3 – rapakivi granites, 4 – gabbro and gabbro-anorthosites; 5 – elevation of the basement relief, 6 – the aged watershed, 7 – direction of clastic material transport, 8 – faults of various orders of magnitude (1 – Kirovohradsky, 2 – Subbotsko-Moshorinsky, 3 – Znamyansky, 4 – Ivanovsky, 5 – Tsybulivsky, 6 – Marevsky, 7 – Glodossky, 8 – Kosarsko-Pogorelovsky, 9 – Timoshivsko-Galeschinsky, 10 – Chigirinsky) 9 – explosive structures (1 – Boltyshska, 2 – Rotmistrovska, 3 – Adamovska, 4 – Zelenogayska, 5 – Ositnyazhska), 10 – boundaries of paleovalleys and paleodepressions; 11 – contours of negative gravity anomalies controlling explosive structure of the Meso-Cenozoic stage of tectonic activity; 12 – places of findings in Raygorodsky sediments: a – kimberlites (vil. Gruzskoe, Lesnoye, Ositnyazhka) , b – fluidized-explosive units (vil. Lebedevka) 13 – occurrences of endogenous diamonds, 14 – the inferred limits of sea basin

Petrographic composition of pyroclastic kimberlite are presented with angular and euhedral grains of serpentized olivine, kimberlite lapilli, mantle and crustal xenoliths and products of their destruction, i.e. xenocrysts, including diamonds distributed in the mass of serpentized olivine. Pyroclastic kimberlites are coarse-graded, subfissile, and rarely massive. PK changes into PPK through massive, graded and stratified pyroclastic sands. PPK is characterized by low angle bedding and alternation of aleurolite and coarse-grained interlayers, which are similar to the studied Raygorodska strata.

Processed pyroclastic kimberlites from the Fort à la Corne area contain a variety of tuffaceous clastic similar to kimberlite tuffs in Raygorodska strata.

According to [7], pyroclastic kimberlites and processed pyroclastic kimberlites most probably derive from several volcanic edifices located within a few hundred meters from the described volcaniclastic sediments.

Arenaceous, sand-and-gravel, sand-and-silt tuffs Established in the central part of the Kirovohrad block along with autolithic breccias also allow slight movement of volcanic material, close proximity and minor corrasion of volcanic edifices.

Many craters of the Cretaceous age were revealed in the area Fort à la Corne covered by volcaniclastic kimberlites. According to [7], these pyroclastic kimberlites are the distal volcanic ashy products accumulated in shallow basins not too far from the source. Such volcanic pyroclastic products of coastal and shallow facies are found in core-samples of Raygorodska strata in the Kirovohrad area.

Parageneses of secondary minerals in kimberlites from the Central district of the Kirovohrad block of the UkrSh are presented by the assemblage of serpentine + saponite + vermiculite (as a result of the phlogopite transformation), and

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according to N.N. Zinchuk [8] show a slight level of erosional truncation of kimberlite bodies. An admitted fact is that tuffaceous units confine to upper horizons of tubes, while breccias and massive kimberlites confine to middle and lower horizons of kimberlite pipes correspondingly.

As for the origin of volcaniclastic kimberlites, it is currently thought that pyroclastic kimberlite in marine sediments is a special type of diamond-bearing units the genesis of which is at the interface between the primary kimberlites and redeposited placers [7].

Table

Comparative characteristics of the compositions of processed and primary pyroclastic kimberlites in Fort à la Corne, East Central Saskatchewan, Canada, and the volcanic-sedimentary rock of Raygorodska strata in the Kirovohrad area

Pyroclastic units in Raygorodska strata of the Ukrainian Shield	**Pyroclastic kimberlites in the Fort à la Corne area, Canada**
Xenotuff breccias of kimberlite (lamproite) composition are presented by insular distribution of secondary smectite material, and include autoliths, pisoliths and lapilli. They are composed of vermiculite, chlorite, serpentine, and saponite	Pyroclastic kimberlites are composed of coarse-grained and lapilli tuff with fragments of olivine, mantle and crustal xenoliths, kimberlite lapilli. Coarse-grained crystals of authigenic vermicular antigorite in the matrix are often found
Volcaniclastic rocks are comprised of tuffaceous marine sediments varying from aleurolite to coarse-grained ones. The matrix includes up to 80% of the particles of erupted origin, such as crystalloclasts. Colour varies from light green to brown tinge. Thickness of lithological varieties is unsteady (from 10–20 cm to 20 m). There are fragments of wood and marine molluscs found. Zircon, apatite, carbonate, ilmenite, garnet and ore minerals also occur	Processed pyroclastic kimberlites are presented by sediments varying from silt to coarse-grained, arenaceous ones, from loose sediments to cemented deposits which contain up to 90% of tuffaceous clastic material accumulated in a marine environment. Colour varies from pale green to blue. There are fragments of shale and needles. Thickness of horizons is from 20 cm to 2 m. Features of normal sedimentary rocks are observed. Ilmenite, garnet, carbonates and magnetite occur

A schematic forecast map in the area of Raygorodska strata in the Kirovohrad block of the Ukrainian Shield (Fig. 2) has been compiled on the basis of our research and compilation of previously obtained data.

The research resulted in summarizing of forecasting and prospecting criteria for diamond content in Raygorodska strata of the central district in the UkrSh. The fundamental regional forecasting and prospecting criteria for diamond content in Raygorodska strata are as follows:

Petrological criteria. The presence of kimberlite and lamproite in the research territory should be considered as the main petrological criterion determining diamond prospects of any territory. It should be noted that the occurrence of explosive kimberlite facies in the bottom of Raygorodska strata is an extremely important feature.

Fluidized-explosive units within the rock of Raygorodska strata were found by authors in the northern part of the Kirovohrad block during the study of the outcrop near the village of Lebedevka. As a result of petrographic and X-ray diffraction studies, it was established that vein-rock is similar to the fluidized-explosive unit in sedimentary complexes.

Regarding the mineralogical composition, these rocks are also similar to the rovnenskits described by G.M. Yatsenko within Novoukrainsky massif of trachytoid granite in the central part of the Ukrainian shield [2]. As well as rovnenskits, the studied mica-lamprophyre consists essentially of biotite with specific zonal colour, relics of hornblende and pyroxene, feldspar, pseudoleucite, and apatite. Macroscopical habitus of the rock is fluidized and brecciated. The rovnenskits formation was distinguished and referred to the fluidized-explosive group of diamond-bearing formations. The authors have exposed the petrographic analogy between mica-lamprophyres and rovnenskits of Novoukrainsky massif, which suggests the potential diamond content of these rocks.

In recent years, a number of new types of diamondiferous rocks have been established such as minett dykes in the area of Parker Lake in the Northwest Territories of Canada [7]. The main minerals of diamondiferous minett include microcline containing intergrowths of biotite, apatite, and epidote. Accessory minerals consist of sphene, zircon and ore minerals. Dykes contain diamond and xeno-flakes of abyssal paragenesis.

Structural and tectonic criteria. The most common regional criteria that determine the capability to detect diamondiferous kimberlites, is the confinedness of these units to the platforms with the aged Precambrian basement. Within the platforms the occurrences of kimberlite magmatism are confined to deep faults and their intersections. The presence of feathering faults is the local criterion.

According to [3] kimberlite bodies within the Kirovohrad megablock are correlated to the north-west, north-east and sublatitudinal faults and their intersections in the Kirovohrad megablock (Fig. 2). Endogenous alkaline ultrabasic magmatism have been exposed within the Kirovohrad global knot of the intersections of first-order faults with trend azimuths of 0º, 270º, 332º, 347º, 305º, 315º and Zelenogaysky deep fault (35º), what was the basis for priority detailed research concerning potential diamond content in the territory [1].

In the north-western part of the central district of the Kirovohrad block, the fluid-explosive units identified by the authorsas well as previously established kimberlites in Lelekovsky and Schorsovsky areas are spatially confined to the deep fault zone of Lelekovsky NW-trending fault (315º) and are prospective for diamond content.

Magmatic criteria are conditioned upon development of alkaline-ultrabasic magmatism within potentially diamondiferous areas. According to the research of SE "Kirovgeologiya" in the Kirovohrad diamondiferous region, shows of mul-tistage alkaline-ultrabasic magmatism in the form of dyke facies (Kirovohrad knot) and xenotuff breccias with lamproite impurities within Zelenogayska structure were distinguished.

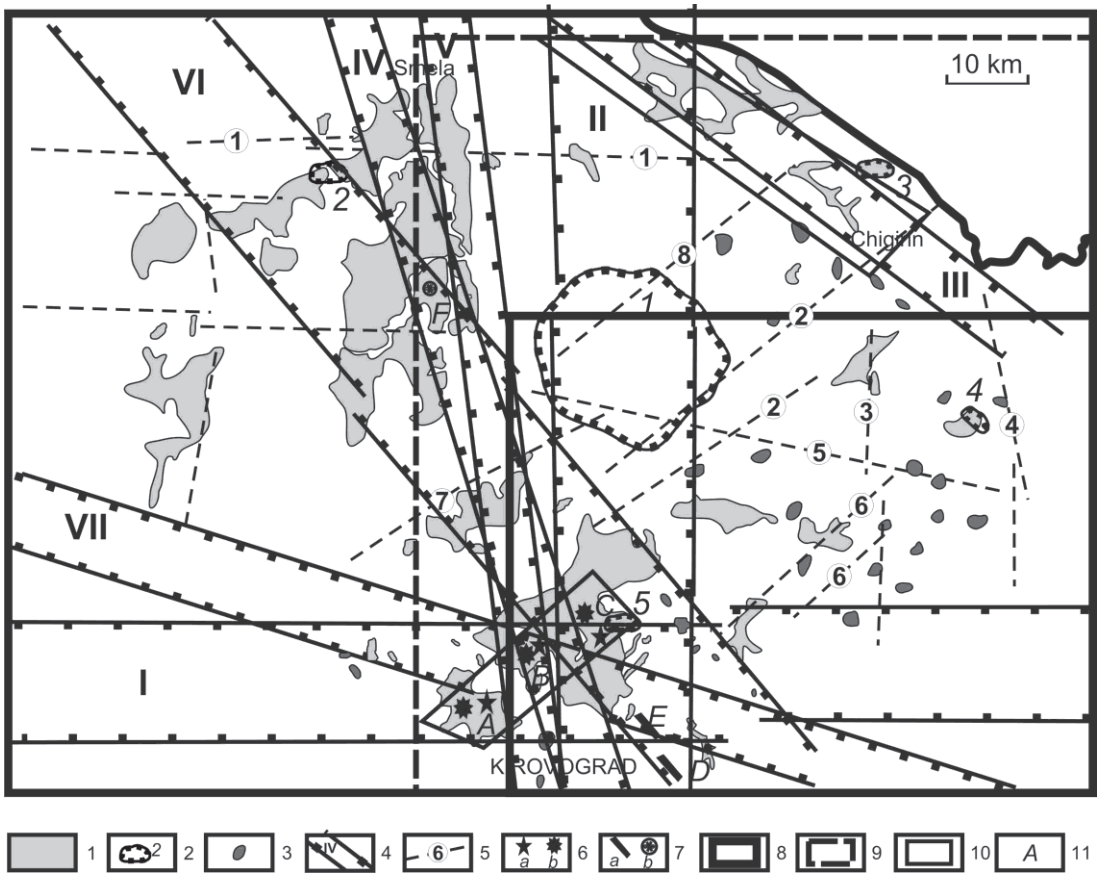

Fig. 2. Forecast schematic map of the research territory: 1 – raygorodsky sediments; 2 – explosive structures (1 – Boltyshskaya, 2 – Rotmistrovskaya, 3 – Adamovskaya, 4 – Zelenogaiskaya, 5 – Ositnyazhskaya); 3 – small explosion craters filled with raygorodsky sediments; 4 – proposed boundaries of faults of the first order (I – Subbotsky-Moshorinsky (270°), II – Kirovohradsky (0°), III – Tyasminsky (305°), IV – Severinsky (332 °), V – East (347°), VI – Lelekovsky (315°), VII – Znamenovsky (287°)); 5 – regional faults (1 – Timoshivsko-Galeschinsky, 2 – Chigirinsky, 3 – Znamyansky, 4 – Ivanovsky, 5 – Tsybulivsky, 6 – Marevsky, 7 – Glodossky, 8 – Kosarsko-Pogorelovsky); 6 – findings of diamonds (a), minerals-satellites (b); 7 – findings of kimberlites (a), alkaline lamprophyres (b); 8 – boundary of the Kirovohrad diamond-prospective area; 9 – proposed boundaries of the Kirovohrad diamond-prospective area, 10 –potential areas prospective for placer diamonds in Raygorodsky rock of marginal-marine facies, 11 – diamond-prospective areas: A – Gruzsky; B – Lesnoy, C – Ositnyazhsky, D – Schorskovsky, E – Lelekovsky, F – Lebedevsky

Mineralogical criteria and features are the most important because they have both regional and local significance and are used in forecasting both placer deposits and endogenous diamond deposits. The main criterion is the discovery of diamonds in the Quaternary and pre-Quaternary sediments and the presence of accessory minerals of diamonds.

Within the Kirovohrad megablock, direct mineralogical indicators of diamond content in studied Raygorodska strata are:

– Identification of natural diamonds in tuffaceous units of the deeper section of brecciated Raygorodska strata of the Lower Paleocene in the Lesnoy, Gruzsky and Ositnyazhsky areas.

– Occurrence of indicator minerals for diamond, such as chromespinelide, chrome-diopside and pyrope in xenotuff breccias of Raygorodska strata.

It should be noted that when forecasting diamond placers (as opposed to primary deposits), the most reliable criterion is the occurrence of diamond itself, as accessory minerals are less stable than diamond to processes of erosion and chemical weathering. Accessory minerals are associated with diamonds only during the first ten kilometres of dislocation in coeval deposits and at the initial stages of redeposition when erosion of aged reservoir rocks occurs.

In this case, they may indirectly indicate the possibility of placer formation of near migration. In this regard, it is interesting to discover ilmenite and garnet in the composition of heavy residue of kimberlite xenotuff breccias and postmagmatic minerals of kimberlite, i.e. serpentine, saponite and vermiculite. It allows suggesting a slight dislocation of the rock-forming material.

Lithological criteria. Among the fundamental lithologic criteria for determining the potential prospect for diamond placers, the following should be included. They are coarse-grained composition of sedimentary units, the presence of polymictic strata and the occurrence of debris of primary and secondary diamondiferous rock. Polymictic tuff gravelstone

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and tuff sandstone with coarse-grained explosive material, blocks and boulders, were revealed in the composition of Raygorodska strata.

Paleogeographic criteria. The fundamental criterion is the presence of marginal-marine facies in Raygorodska strata. The occurrence of interbedded secondary kaolin associated with regression of paleobasin from the research territory conditioned vertical and areal zonality of diamond placers accumulation in diamondiferous Raygorodska strata.

According to the type of primary source, potentially diamondiferous units found in Raygorodska strata within the Kirovohrad area are likely to belong to the volcaniclastic kimberlites defined as distal ashy volcanic products accumulated in shallow basins not too far from the source [7]. Regarding the origin of volcaniclastic kimberlite, it is currently assumed that pyroclastic kimberlites in marine sediments are the special type of diamond-bearing units, the genesis of which is at the interface between the primary kimberlites and redeposited placers.

Occurrence of autoliths in xenotuff breccias of Raygorodska strata gives possible evidence of multiphase intrusion of magmatic melt.

Moreover, in the northern part of the Central area of the Kirovohrad block mica-lamprophyres found within Raygorodska strata are similar to the potential diamond-bearing rovnenskits (leucocratic units of kimberlite-lamproite formational series). This allows suggesting the presence of fluid-explosive units here. The fluidized-explosive units revealed within Raygorodska strata are an intermediate part of endogenous and exogenous series: endogenous formation → formation of weathering crusts → placer formation. In this regard, enclosing rocks of Raygorodska strata can be considered the intermediate reservoir of diamond placers.

Conclusions. The prospect for diamond content in Raygorodska strata is conditioned by the following data:

– Identification of diamonds as the part of clastic units within Raygorodska strata in the Lesnoy, Gruzsky and Ositnyazhsky areas.

– Identification of indicator minerals for diamond such as pyrope, ilmenite, chrome-diopside, and chromespinelide among the clastic units of Raygorodska strata.

– Discovery of kimberlite xenotuff breccias containing lapilli, pisoliths and autoliths and similar to volcaniclastic kimberlite in the Fort à la Corne area (Saskatchewan, Canada) and to kimberlite in the Yakutian diamondiferous province.

– Serpentine + saponite paragenesis in the composition of kimberlite xenotuff breccias found in Raygorodska strata and specific to the rock of crater facies kimberlite.

– Detection of potential diamond-bearing fluid-explosive units within Raygorodska strata.

– Discovery of diamonds without any “signs of ageing”, which indicates their shot distance of dislocation.

The research resulted in new forecasting and prospecting criteria for diamond content in Raygorodska strata being formulated. These criteria allowed extending the boundaries of the Kirovohrad area of the Central diamond prospective region and delineate potential diamond placers there.

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Мета. Оцінити перспективність алмазоносності райгородської товщі Українського щита.

Методика. Авторами використаний комплекс польових і лабораторних методів. Проведені петрографічні та мінераграфічні дослідження, палеогеографічні реконструкції, літолого-фаціальний аналіз.

Результати. Встановлено, що алмазовміщуючі породи райгородської товщі відносяться до прибережно-морського типу утворень осадово-пірокластичної групи порід. Можливими джерелами надходжень алмазоносного уламкового матеріалу можна вважати безпосередньо корінні алмазоносні породи, що переробляються хвилеприбійною діяльністю, а також його алювіальне знесення. Утворення прибережно-морських алмазовміщуючих фацій райгородської товщі обумовлене особливостями палеогеографії периферії палеоценового Сумського морського басейну. Виявлені флюїдизатно-експлозиві утворення, просторово пов'язані з райгородською товщею, що за складом аналогічні алмазоносним слюдяним лампрофірам типу Мінетт зони Паркер Лейк, Канада, а також алмазоносним ровненскітам Українського щита. Встановлено, що прояви алмазів, встановлені раніше в райгородській товщі, аналогічні пірокластичним кімберлітам області Форт а ля Корн (Саскачеван, Канада) і виявляють схожість формаційного типу з пірокластичними кімберлітами, що акумулюються в мілководних морських басейнах.

Наукова новизна. Виявлені особливості літолого-фаціального складу та стратиграфічного положення райгородської товщі; встановлені флюїдизатно-експлозивні утворення, обґрунтована їх потенційна алмазоносність; обґрунтований формаційний тип встановлених раніше проявів алмазів; визначені ймовірні напрямки перенесення та області акумуляції алмазоносного уламкового матеріалу порід райгородської товщі.

Практична значимість. Сформульовані нові прогнозно-пошукові критерії алмазоносності райгородської товщі, що дозволили розширити межі Кіровоградської площі Центрального алмазоперспективного району та виділити перспективні на виявлення розсипів алмазів ділянки.

Ключові слова: *вулканогенно-осадові породи, флюїдизатно-експлозивні утворення, пірокластичні кімберліти, слюдяні лампрофіри, розсипи алмазів*

Цель. Оценить перспективность алмазоносности райгородской толщи Украинского щита.

Методика. Авторами использован комплекс полевых и лабораторных методов. Проведены петрографические и минераграфические исследования, палеогеографические реконструкции, литолого-фациальный анализ.

Результаты. Установлено, что алмазовмещающие породы райгородской толщи относятся к прибрежно-морскому типу образований осадочно-пирокластической группы пород. Возможными источниками поступающего алмазоносного обломочного материала в породы райгородской толщи можно считать непосредственно перерабатываемые волноприбойной деятельностью коренные алмазоносные породы, а также его аллювиальный снос. Образование прибрежно-морских алмазовмещающих фаций райгородской толщи обусловлено особенностями палеогеографии периферии палеоценового Сумского морского бассейна. Выявлены флюидизатно-эксплозивные образования, пространственно связанные с райгородской толщей, которые по составу аналогичны алмазоносным слюдяным лампрофирам типа минетт зоны Паркер Лейк, Канада, а также алмазоносным ровненскитам Украинского щита. Установлено, что проявления алмазов, установленные ранее в райгородской толще, аналогичны пирокластическим кимберлитам области Форт а ля Корн (Саскачеван, Канада) и обнаруживают сходство формационного типа с пирокластическими кимберлитами, аккумулирующимися в мелководных морских бассейнах.

Научная новизна. Выявлены особенности литолого-фациального состава и стратиграфического положения райгородской толщи; установлены флюидизатно-эксплозивные образования, обоснована их потенциальная алмазоносность; обоснован формационный тип установленных ранее проявлений алмазов, определены вероятные направления переноса и области аккумуляции алмазоносного обломочного материала пород райгородской толщи.

Практическая значимость. Сформулированы новые прогнозно-поисковые критерии алмазоносности райгородской толщи, которые позволили расширить границы Кировоградской площади Центрального алмазоперспективного района и выделить перспективные на обнаружение россыпей алмазов участки.

Ключевые слова: *вулканогенно-осадочные породы, флюидизатно-эксплозивные образования, пирокластические кимберлиты, слюдяные лампрофиры, россыпи алмазов*

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