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DIGEST



## DIAMONDS

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EMPRESS CATHERINE II  
ST. PETERSBURG MINING UNIVERSITY

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## Abstract

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*Russia has one of the world's largest diamond mineral resource bases (their proven reserves exceed 1 billion carats) and remains the world leader in diamond production by weight. Most of the Russian diamond reserves are concentrated in primary deposits on the territory of the Republic of Sakha (Yakutia), in the Central Siberian and Lena-Anabar diamond-bearing subprovinces. All the most important diamond deposits in Russia are located here, including the largest – the Udachnaya pipe. The pipes with unique diamond potential (Internationalnaya, Mir, Botuobinskaya, Aikhal, Nyurbinskaya), as well as medium-diamond-bearing ones (Yubileinaya, Zarnitsa) have also been explored here. In terms of quality, the stones from the Mir and Internatsionalnaya pipes are the best among diamonds from Russian primary deposits. The ores of the International pipe are characterized by a unique average diamond content and have no analogues in the world in terms of this indicator.*

*On the territory of the Arkhangelsk region there is a diamond-bearing subprovince of the same name, the balance reserves of which are contained in six kimberlite pipes of the group of deposits named after M.V. Lomonosov (Arkhangelskaya, named after Karpinskii 1, named after Karpinskii 2, named after Lomonosov, Pionerskaya, Pomorskaya) and in the V. Grib pipe. A number of areas identified on the territory of Russia are promising for the discovery of diamond accumulations, including in the north-west of the country (Karelo-Kolskaya and Leningrad subprovinces), in the central regions of its European part (Central European), as well as in Eastern Siberia and Far East.*

*Most diamond-bearing objects are located in poorly developed areas with a harsh climate and are characterized by difficult mining and technical conditions. Nevertheless, in the near future, Russia has every chance of remaining the world leader in the production of rough diamonds.*

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## Geology

*Diamond deposits are known on all continents except Antarctica. Until the end of the 19th century, diamonds were mined from alluvial deposits, and then from diamond-bearing kimberlite pipes. The main deposits of this type are located in Russia, Africa, Australia and Canada.*

**Ardalkar R.M., Salunkhe Y.D., Gaonkar M.P., Mane S.N., Ghaisas O.A., Desai S.N., Reddy A.V.R. Depth distribution of radiation defects in irradiated diamonds by confocal Raman spectroscopy. *Journal of Mining Institute*. 2024, p. 1-9 (Online first). EDN: XGGRVF. <https://pmi.spmi.ru/pmi/article/view/16157>**



**Abstract.** Five colored diamonds were investigated. According to the results of the study by FTIR, UV-Vis-NIR and Photoluminescence spectroscopy, they are natural type Ia diamonds. The depth distribution of the color intensity was carried out by measuring the intensity of the PL peak at 741 nm (GR1 center) upon excitation by a laser with a wavelength of 633 nm of Raman Confocal microscope. To minimise the perturbation due to geometrical effects, defect distribution profiles were normalised with respect to diamond Raman peak intensity (691 nm) point by point. For two diamonds, the intensity of the GR1 peak (741 nm) sharply decreased to a depth of 10  $\mu\text{m}$ , and then became equal to the background level, which is typical for irradiation with alpha particles from natural sources like uranium. In other diamonds, the profiles vary slightly with depth, and the color intensity is close to uniform, which is for irradiation with accelerated electrons or neutrons. The source of radiation has not been determined. However, long duration radioactivity measurements of the diamonds suggested that neutrons were not used for colour centers production in the diamonds studied.

**Pystin A.M., Glukhov Yu.V., Bushenev A.A. A new diamond find and primary diamond potential of the Chetlas uplift (Middle Timan). *Journal of Mining Institute*. 2023. Vol. 264, p. 842-855. EDN: GSTWEZ. <https://pmi.spmi.ru/pmi/article/view/15968>**



**Abstract.** In the previously poorly studied southeastern part of the Chetlas uplift in the Middle Timan, a new occurrence of diamond satellite minerals and a diamond grain were found in the modern channel sediments of the Uvuy River basin. In order to assess the prospects of the area under consideration for identification of diamondiferous objects of practical interest, a characteristic of chromium-bearing pyropes and chromspinelides as the main kimberlite of diamond satellite minerals are given and the diamond grain itself is described. The material for the research was 16 schlich samples, each with a volume of 8 to 15 l. The minerals were studied using optical and scanning electron microscopy, Raman spectroscopy, laser luminescence and X-ray diffraction (Debye – Sherrer method). It is shown that among the pyropes, most of which correspond in composition to minerals of the lherzolite paragenesis, there are varieties belonging to the dunite-harzburgite paragenesis, including those belonging to diamond phase stability regions. Among the studied chromspinelides, chrompicotites and aluminochromites similar in composition to those found in rocks such as lherzolites and harzburgites, as well as in kimberlites, were identified. A diamond grain found in one of the samples has the form of a flattened intergrowth with distinct octahedron faces, complicated by co-growth surfaces with other mineral grains that have not been preserved to date. The discovery of the diamond and the established signs the formation of aureoles of the diamond satellites minerals in the channel sediments of the studied area open up the prospects for discovering their primary sources here.

*Korsakov A.V., Mikhailenko D.S., Zhang L., Xu Y.-G. Inclusions of diamond crystals in the tourmaline of the schorl-uvite series: problems of genesis. Journal of Mining Institute. 2023. Vol. 264, p. 833-841. EDN: UMQOXX. <https://pmi.spmi.ru/pmi/article/view/16082>*



**Abstract.** The mineralogical and geochemical features of diamond-bearing tourmaline crystals (schorl-uvite series) from garnet-clinopyroxene rocks of the Kumdy-Kol deposit (Northern Kazakhstan) have been studied in detail. The formation of the main rock-forming minerals (garnet + K-bearing clinopyroxene) occurred in the diamond stability field at 4–6 GPa and 950–1000 °C. Crystallization of K-bearing clinopyroxene at these parameters is possible in the presence of an ultra-potassic fluid or melt formed because of crustal material melting in subduction zones. Tourmaline crystals (up to 1 cm) containing diamond inclusions perform veins crosscutting high-pressure associations. The composition of individual zones varies from schorl to uvite within both a single grain and the sample as a whole. The potassium content in this tourmaline does not exceed 0.1 wt.% K<sub>2</sub>O, and the isotopic composition of boron  $\delta^{11}\text{B}$  varies from –10 to –15.5 ‰, which significantly differs from the previously established isotopic composition of boron in maruyamaite crystals ( $\delta^{11}\text{B}$  7.7 ‰ in the core and –1.2 ‰ in the rim) of the same deposit. Analysis of the obtained data on  $\delta^{11}\text{B}$  in the tourmalines from the diamond-grade metamorphic rocks within the Kumdy-Kol deposit suggests the existence of two boron sources that resulted in crystallization of K-bearing tourmaline crystals (maruyamaite-dravite series) and potassium-free tourmalines of the schorl-uvite series.

*Gubanov N.V., Zedgenizov D.A., Vasilev E.A., Naumov V.A. New data on the composition of growth medium of fibrous diamonds from the placers of the Western Urals. Journal of Mining Institute. 2023. Vol. 263, p. 645-656. EDN: RYMYTJ. <https://pmi.spmi.ru/pmi/article/view/16079>*



**Abstract.** This article presents the results of studying microinclusions of fluids/melts in diamonds from the placers of the Krasnovishersky District (western slope of the Middle/Northern Urals), which make it possible to establish the evolution of diamond-forming media in the subcontinental lithospheric mantle of the eastern margin of the East European craton. Impurity composition of the studied crystals reveals three different types of diamonds, the formation of which was associated with separated metasomatic events. Microinclusions in B-type diamonds containing A and B nitrogen defects reflect an older metasomatic stage characterized by the leading role of silicic and low-Mg carbonatitic fluids/melts. The second stage is associated with the growth of A-type diamonds containing nitrogen exclusively in the form of A-centers. At this stage, the formation of diamonds was related with low-Mg carbonatitic media, more enriched in MgO, CaO, CO<sub>2</sub>, and Na<sub>2</sub>O compared to B-type diamonds. The third stage probably preceded the eruption of the transporting mantle melt and led to the formation of C-type diamond containing A and C nitrogen defect centers and microinclusions of silicic to low-Mg carbonatitic composition. The recorded trend in the evolution of diamond-forming fluids/melts is directed towards more carbonatitic compositions. Fluids/melts are probably sourced from eclogitic and pyroxenitic mantle substrates.

*Kriulina G.Yu., Vyatkin S.V., Vasilev E.A. Pink-violet diamonds from the Lomonosov mine: morphology, spectroscopy, nature of colour. Journal of Mining Institute. 2023. Vol. 263, p. 715-723. EDN: NYGZOX. <https://pmi.spmi.ru/pmi/article/view/16176>*



**Abstract.** The article presents the results of the first comprehensive study of mineralogical and spectroscopic (IR, PL, EPR) characteristics of diamonds from the Lomonosov mine (Arkhangelskaya pipe) with a unique pink, pink-violet colour. It is shown that all crystals belong to the IaA type, with a total nitrogen content in the range of 500-1500 ppm, with a low degree of aggregation. The colour is heterogeneous, concentrated in narrow twin layers. It is presumably caused by the previously described *M2* centres. The colour shade is affected by the content of *P1* paramagnetic centres (*C*-defect). A positive correlation is observed between the colour saturation and the intensity of *W7* paramagnetic centres. A convergent model of the formation of pink diamonds is assumed, according to which the determining factors are the ratio and concentration of structural impurities in the diamond, its thermal history, and conditions of plastic deformation, and not the origin of the diamond and the petrochemical properties of its host rocks.

*Simakov S.K., Stegnitskiy Yu.B. On the presence of the postmagmatic stage of diamond formation in kimberlites. Journal of Mining Institute. 2022. Vol. 255, p. 319-326. DOI: 10.31897/PMI.2022.22*



**Abstract.** On nowadays multiphase and the facies heterogeneity of the formations are distinguished at the study of kimberlite pipes. Most researchers associate the formation of diamonds only with the mantle source. To date, satellite minerals with specific com-



*MGS 1 160. Diamond in kimberlite. Pipe Mir, Yakutia. Item belongs to the Mining Museum.*

positions associated with kimberlite diamonds have been identified as deep mantle diamond association. They are extracted from the concentrate of the kimberlites heavy fraction and may reflect the diamond grade of the pipe. For some minerals in the diamond association, however, they can not be reliable. Some researchers also revealed shallow diamond associations, related to the formation of serpentine, calcite, apatite, and phlogopite. There is recent data on the formation of diamonds in rocks of the oceanic crust. In the last years microdiamonds were identified in chromites of the oceanic crust in association with antigorite formed at 350-650 °C and 0.1-1.6 GPa. As a result, the authors established a postmagmatic kimberlitic stage of diamond formation associated with secondary mineral associations based on the experimental and mineralogical data for the conditions of the shallow upper mantle and crust. Mineralogical and petrographic studies of Angolan kimberlite pipe show that antigorite is the indicator mineral of this stage.



*Ustinov V.N., Mikoiev I.I., Piven G.F. Prospecting models of primary diamond deposits of the north of the East European Platform. Journal of Mining Institute. 2022. Vol. 255, p. 299-318. DOI: 10.31897/PMI.2022.49*



**Abstract.** As a result of a comprehensive study of the geological structure and diamond presence of the northern part of the East European Platform, generalization of the data accumulated by various organizations in the USSR, the Russian Federation, and other states, three main prospecting models of primary diamond deposits have been identified and characterized: Karelian, Finnish, and Arkhangelsk. Geological, structural, mineralogical, and petrographic criteria of local prediction, as well as the features of the response of kimberlite and lamproite bodies in dispersion haloes and geophysical fields, are considered using known examples, including data on the developed M.V.Lomonosov and V.P.Grib mines. It is shown that the most complicated prospecting environments occur in the covered areas of the Russian Plate, where, in some cases, the primary diamond-bearing rocks are similar in their petrophysical properties to the host formations. The buried dispersion haloes of kimberlite minerals in the continental Carboniferous and Quaternary deposits are traced at a short distance from the sources. Differences in the prospecting features of magnesian (Lomonosov mine) and ferromagnesian (Grib mine) kimberlites are also shown. Conclusions about the diamond potential of the model objects of various types are given in this paper.

*Vasilev E.A., Kriulina G.Yu., Garanin V.K. Thermal history of diamond from Arkhangelskaya and Karpinsky-I kimberlite pipes. Journal of Mining Institute. 2022. Vol. 255, p. 327-336. DOI: 10.31897/PMI.2022.57*



**Abstract.** This work studies and compares the main morphological, structural, and mineralogical features of 350 diamond crystals from the Karpinsky-I and 300 crystals of the Arkhangelskaya kimberlite pipes. The share of crystals of octahedral habit together with individual crystals of transitional forms with sheaf-like and splintery striation is higher in the Arkhangelskaya pipe and makes 15 %. The share of cuboids and tetrahedra is higher in the Karpinsky-I pipe and stands at 14 %. The share of dodecahedra in the Arkhangelskaya and Karpinsky-I pipes are 60 % and 50 %, respectively. The indicator role of the nitrogen-vacancy N3 center active in absorption and luminescence is shown. Crystals with the N3 absorption system have predominantly octahedral habit or dissolution forms derived from the octahedra. Their thermal history is the most complex. Absorption bands of the lowest-temperature hydrogen-containing defects (3050, 3144, 3154, 3188, 3310  $\text{cm}^{-1}$ , 1388, 1407, 1432, 1456, 1465, 1503, 1551, 1563  $\text{cm}^{-1}$ ), are typical for crystals without N3 system, where in the absorption spectra nitrogen is in the form of low-temperature A and C defects. The above mentioned bands are registered in the spectra of 16 % and 42 % of crystals from the Arkhangelskaya and Karpinsky-I pipes, respectively. The diamond of the studied deposits is unique in the minimum temperature (duration) of natural annealing. Based on a set of features, three populations of crystals were distinguished, differing in growth conditions, post-growth, and thermal histories. The established regularities prove the multi-stage formation of diamond deposits in the north of the East European Platform and significant differences from the diamonds of the Western Cisurals. The results suggest the possibility of the existence of primary deposits dominated by diamonds from one of the identified populations.

Vasilev E.A. Defects of diamond crystal structure as an indicator of crystallogenesi. *Journal of Mining Institute*. 2021. Vol. 250, p. 481-491. DOI: 10.31897/PMI.2021.4.1



**Abstract.** Based on the study of a representative collections of diamonds from diamondiferous formations of the Urals and deposits of the Arkhangelsk and Yakutian diamond provinces, we established patterns of zonal and sectoral distribution of crystal structure defects in crystals of different morphological types, identified the specifics of crystals formed at different stages of crystallogenesi and performed a comprehensive analysis of constitutional and population diversity of diamonds in different formations. We identified three stages in the crystallogenesi cycle, which correspond to normal and tangential mechanisms of growth and the stage of changing crystal



GPI 6 179. Kimberlite deep-earth. Pipe Mir, Yakutia. Item belongs to the Mining Museum.

habit shape. At the stage of changing crystal habit shape, insufficient carbon supersaturation obstructs normal growth mechanism, and the facets develop from existing surfaces. Due to the absent stage of growth layer nucleation, formation of new {111} surfaces occurs much faster compared to tangential growth mechanism. This effect allows to explain the absence of cuboids with highly transformed nitrogen defects at the A-B1 stage: they have all been refaceted by a regenerative mechanism. Based on the revealed patterns, a model of diamond crystallogenesi was developed, which takes into account the regularities of growth evolution, thermal history and morphological diversity of the crystals. The model implies the possibility of a multiply repetitive crystallization cycle and the existence of an intermediate chamber; it allows to explain the sequence of changes in morphology and defect-impurity composition of crystals, as well as a combination of constitutional and population diversity of diamonds from different geological formations.

Vasilev E.A., Klepikov I.V., Kozlov A.V., Antonov A.V. The Nature of the Elongated Form of Diamond Crystals From Urals Placers. *Journal of Mining Institute*. 2019. Vol. 239, p. 492-496. DOI: 10.31897/PMI.2019.5.492



**Abstract.** The article presents the results of a study of the internal structure of highly elongated diamond crystals from placers in the Krasnovishersky district of the Urals. Very elongated crystals are found within diamond-bearing placer with unrevealed primary sources. Determining the conditions of such crystals formation can help one to determine the primary deposits type. There are three hypotheses for the formation of the elongated shape of such crystals: 1) crystals initially elongated along the <100> (strongly distorted octahedra); 2) individual crystals of columnar aggregates; 3) elongated crystals fragments. To study the internal structure, we selected



three most elongated individuals of the 155 crystals samples. The study of the internal structure of selected crystals with the usage of photoluminescent (PL) tomography, cathodoluminescence (CL), and optical microscopy has shown that these samples are fragments of larger single crystals. CL imaging allowed to determine slip lines within the crystal's volume. The recorded PL spectra show the 912, 946, and 986 nm peaks, which are characteristic of crystals with plastic deformation. The revealed features are indicators of plastic deformation accompanying the destruction of the crystals. The significant dissolution following the destruction of the crystals led to the rounding of the vertices and edges of their fragments. Apparently, most of the very elongated crystals from placers with unknown sources are also highly dissolved isometric crystal fragments. The obtained results have shown that the deformation and dissolution of diamond crystals are related events characteristic of diamonds from hitherto undetected, but highly productive primary deposits.

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*Vasilev E.A., Kozlov A.V., Petrovskii V.A. Volume and surface distribution of radiation defect in natural diamonds. Journal of Mining Institute. 2018. Vol. 230, p. 107-115. DOI: 10.25515/PMI.2018.2.107*



**Abstract.** In the following article, we have studied the variations of natural irradiation of diamond crystals. The natural diamonds in some cases show homogeneous green colour, caused by irradiation of the entire crystals volume. Radiation damage effects, produced by the low-radiation doses, are detected by the luminescence of the GR1 system. The high-radiation doses cause bluish hue, turning into a greenish colour, while the maximum level of volume

irradiation produces the black crystals. The crystals with homogeneous volumetric black colour distribution were also studied. The major source of radiation in such cases may represent a local stream containing water rich in  $^{222}\text{Rn}$  and its decay products. There is a review of the geological environment in which diamonds could be irradiated due to the decay of the  $^{222}\text{Rn}$  containing in water.

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*Mustafaev A.S., Pschelko N.S., Pavlikov I.I., Zevelev E. Yu. Electric methods for identification of diamonds and jewelry stones. Journal of Mining Institute. 2006. Vol. 167 (1), p. 283-285 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/8132>*



**Abstract.** A comprehensive analysis of modern methods used for diamond identification has been carried out. It is shown that high thermal conductivity cannot unambiguously testify to the authenticity of a diamond, since synthetic imitations of silicon carbide have recently appeared. It is shown that electrical methods of gemstone diagnostics are promising but not yet sufficiently developed. A set of innovative electrocalcium methods for diamond identification is proposed. Techniques for measuring high resistivity, dielectric permittivity and surface potentials, which can be used in the procedure of diamond identification, are developed. An operational model has been tested in the study of new and traditional dielectric materials. The possibility of detecting differences in electrical and physical properties of externally identical materials using this method is shown.

Zaitsevskii F.K., Utyupin Yu.V., Manakov A.V. *Computer simulation of the geological environment based on the calculation of potential fields in forecasting and searching for diamond deposits. Journal of Mining Institute. 2005. Vol. 162, p. 132-135 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/8439>*



**Abstract.** A program for three-dimensional modeling of the geological environment with the calculation of magnetic and gravitational geophysical fields is proposed. The program works with GS Binary (single and double precision) and Geosoft Grid File formats. The model is formed as multi-layered, without size restrictions, simultaneous work with 10 layers is possible. To compensate for distortions in the edge parts of the area, the “radius of influence” parameter is introduced, which is calculated automatically for a given permissible error value. As an example, a model of the lithosphere of the Yakutskaya kimberlite province over an area of 1000 x 1500 km is given. By comparing model and experimental fields, the territory was zoned and anomalous areas were identified. Productive kimberlites are localized in blocks of crystalline crust with increased density.



*Kimberlite. Pipe Udachnaya, Yakutia.  
Item belongs to the Mining Museum.*

Shafranovskii I.I. *Crystallography, mineralogy and petrography in “Proceedings of the Leningrad Mining Institute”. Journal of Mining Institute. 1959. Vol. 40, p. 47-50 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/12861>*



**Abstract.** During the 50 years of its existence, the Proceedings of the Leningrad Mining Institute occupy a prominent role in the history of the development of domestic mineralogy and crystallography. From the beginning of the founding of the journal until the end of his life, one of the most active contributors to the Notes was the famous professor and director of the Mining Institute, the greatest Russian crystallographer, geometer, petrographer and mineralogist E.S. Fedorov (1853-1919). From 1907 to 1917, 144 of his works appeared on the pages of the Notes. Of these, 65 relate to crystallography proper, 4 to mineralogy and 5 to petrography. The remaining articles treat mainly issues of new geometry, which was intensively developed by scientists in those years. However, in these seemingly purely geometric works, E.S. Fedorov paid special attention to the practical use of the theoretical conclusions he received in the field of crystallography, mineralogy and mining. For example, in the article “Accurate representation of points in space on a plane” (1907, vol. I, issue 1), various methods are proposed for depicting points in three-dimensional space on a plane using circles (vectoral and ordinary) and parallel vectors. In the article “Representation of the structure of a crystal by vector circles” (1908, vol. I, issue 4), the mentioned methods were successfully used to depict the elementary particles that make up spatial crystal structures on a plane. A.N. Zavaritsky recalled this remarkable method and showed its effectiveness using examples of images of real crystal structures.

## Development of underground space and mining

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*Diamond drilling is widely used in geological exploration and construction work, mining, and the unique physical properties of diamond have made it possible to increase the productivity of drilling rigs. Diamond drilling became widespread after the synthesis of artificial diamonds.*

*Neskromnykh V.V., Popova M.S., Golovchenko A.E., Petenev P.G., Baochang L. Method of drilling process control and experimental studies of resistance forces during bits drilling with PDC cutters. Journal of Mining Institute. 2020. Vol. 245, p. 539-546. DOI: 10.31897/PMI.2020.5.5*



**Abstract.** A rational, theoretically proved and empirically verified control system is a condition for optimal management of the drilling process in compliance with the criteria for minimizing the cost of time and material resources. A new generation of rock-cutting tools using PDC cutters (polycrystalline diamante cutters), which are extremely effective when drilling wells for various purposes in medium-hard rocks, dictates the need to develop methods and criteria for optimal control of the drilling process using this tool. The paper presents an analysis of the force interaction between rock-cutting elements, face rock, and drilling mud saturated with slam, highlights the influencing factors and provides dependencies for determining the parameters of rock failure. Empirical verification of the theoretical propositions was carried out based on the data analy-

sis from experimental bit drilling of marble with PDC cutters with a diameter of 76.2 mm, processed using the method of full factor experiment to obtain mathematical models of factors and their graphical interpretation. The method of controlling the drilling process based on the optimal ratio of the tool rotation frequency, axial weight and deepening per one turnover is considered, which allows determining the rock failure mode at the well bottom by indirect signs and choose the optimal values of the drilling mode parameters that correspond to the most optimal conditions in terms of achieving the maximum mechanical drilling speed in conjunction with the rational mode of rock-cutting tool operation. A scheme is presented that contains possible variants of the bit run mode and ways to recognize them by the ratio of the deepening per turnover and the rotation frequency of the rock-cutting tool.

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*Gorshkov L.K., Osetskii A.I. Development of principles of construction and operation of new diamond bits. Journal of Mining Institute. 2012. Vol. 197, p. 40-45 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/5959>*

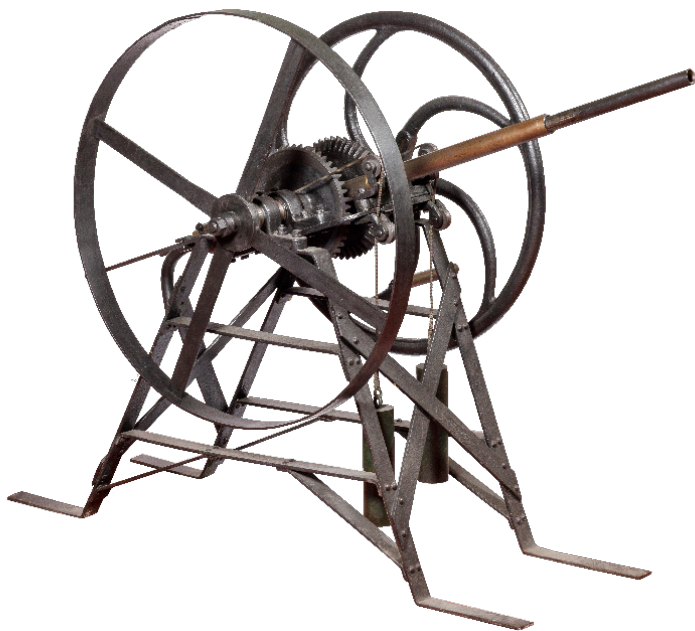


**Abstract.** In the article questions of development of mathematical-mechanical model of rock destruction process, abnormal wearout of diamond bits, mechanical and temperature tensions in drill diamonds, technology of drilling with new diamond bits were observed.

*Vorona M.A. Choice of rational technology of development of V. Grib diamondiferous pipe. Journal of Mining Institute. 2006. Vol. 167 (1), p. 57-59 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/8063>*



**Abstract.** Various methods of development of the V. Grib diamondiferous pipe located in the territory of the Arkhangelsk region are considered; the most rational technology of development of this deposit is proposed. These methods of development include: the use of excavators, dredgers and cutter combines, the technology of drilling large-diameter wells. All the above mentioned methods have already been applied at diamondiferous pipes of the Russian Federation and proved the expediency of their use: dredging equipment and technology for drilling large-diameter wells at the Arkhangelskaya and Karpinsky pipes in the Arkhangelsk Region, and milling machines at the Yubileynaya pipe in the Sakha Republic.



*TI 6. Diamond drill for drilling holes with a diameter of 2 inches of the Mather&Platt system. Item belongs to the Mining Museum.*

*Vedin A.T., Konovalenko V.Ya. Influence of explosion energy on the quality of rough diamonds. Journal of Mining Institute. 2001. Vol. 148 (2), p. 18-21 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/9666>*



**Abstract.** Technogenic damage (TD) of diamond crystals is currently estimated by mass indicators: relative change in mass separately and in the sieve aggregate (degree of disturbance and mass loss in the class), the number of fragments in the class, etc. This system of indicators (10 grades of sieve size and two major indicators per grade) does not permit unequivocal estimation of quality changes in rough diamonds as a whole and description of many physical and mineralogical changes (cracks, microdefects). More expedient may be the estimation of technogenic changes in the value of crystals. Its price parameters can serve as a scale of importance, and crystal value can be considered as an integrated quality indicator. Interrelation between TD, cost of crystals and extraction parameters and dressing technology in general is caused by natural uncertainty of change of sieve and quality composition of diamond crystals, high statistical variation with low frequency of appearance of some indicators (for example the price of very large crystals) that requires analysis of large statistical samples and hasn't been evaluated so far. In addition, the influence on the damageability of crystals in the processes of mechanical crushing and grinding the degree of dissolution of pieces of ore during the explosion has not been determined. Indirect confirmation of possible ambiguous influence of explosion energy on damageability of crystals are results of experiments [5], in which growth of energy costs at BWR on 25 % led to their reduction on ore preparation as a whole, taking into account crushing and grinding processes at the plant, on 10 %.



*Aleksandrov A.T., Azam M. Evaluation of the efficiency of diamond drilling using fog blowing. Journal of Mining Institute. 1993. Vol. 136, p. 79-85 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/10006>*



**Abstract.** Currently, gas-liquid cleaning agents are widely used when drilling geological exploratory wells. The effectiveness of their use is most clearly demonstrated when drilling in conditions of absorption of drilling fluid, to combat complications that arise when drilling permafrost, as well as during exploration of deposits in high mountain and desert areas where water supply is difficult.

*Pariiskii Yu.M., Bandi M. Assessing the complexity of diamond drilling conditions. Journal of Mining Institute. 1993. Vol. 136, p. 86-91 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/10007>*



**Abstract.** The complexity of the conditions for diamond drilling of geological exploration wells is one of the significant factors affecting its effectiveness. In connection with the optimization of drilling processes, there is a need to develop objective quantitative assessments of the degree of complexity of drilling conditions.



TI 215. Diamond bit SSK 59 1 for removable core receiver. Item belongs to the Mining Museum.

*Blinov G.A., Vasilyev V.I. Some issues of high-speed diamond drilling. Journal of Mining Institute. 1985. Vol. 105, p. 3-9 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/10565>*



**Abstract.** The development and widespread introduction of high-speed diamond drilling into the practice of geological exploration for solid minerals requires studying the nature of the direct interaction of the diamond bit with the rock, since it is here that one should look for the main factors influencing the efficiency of rock destruction and the performance of the rock-cutting tool.

*Tarakanov S.N. Study the process of drilling in hard rock as applied to partial exposure of the face of drill bit Journal of Mining Institute. 1976. Vol. 71 (2), p. 92-108 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/11255>*



**Abstract.** General points on the drilling process in bottom hole under study. Modern impregnated bits can run in the bottom hole in two modes: with total and partial exposure of diamond in the face of the drill bit. The position is considered as impregnated and multilayer bits as single-layer bits operated with force feed. The article explains the theory of operation during partial or incomplete exposure of the bits. Let us examine specific features of the process.



TI 216. Diamond bit ZA-59-42. Item belongs to the Mining Museum.



*Pariiskii Yu.M., Gorshokov L.K., Fisenko V.F. Experience of diamond drilling with air flush. Journal of Mining Institute. 1969. Vol. 57 (2), p. 95-102 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/12195>*



**Abstract.** The area of Deputatskoe field where drilling was conducted is formed with regular sediments, dislocated in large low angle folds of east-west and north-east trending. In the context of geotech data that is responsible for the choice of diamond tool, the sediments that form the field can be divided into three main groups: 1) crushed sandstones (medium- and fine-grained) and sandy shale, bounded with lime material and ice (VIII-IX drillability grades); 2) sandy shales of VII drillability grade; 3) non-porous quartz (partially hornfelsed) fine-grained lightly abrasive sandstones of X–XI drillability grades.

## Economics and management

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*Production of mineral resources is one of the leading economic activity in the country's industry as well as in its economy. Diamond deposits being a national wealth are of the country's strategic importance that is why the need of development and renovation of the sector cannot be denied.*

*Pavlova K.I., Fedchenko A.A., Iseeva L.I. The comparative analysis of the technical and economic results of activity Russian and foreign mining diamond enterprises. Journal of Mining Institute. 2012. Vol. 196, p. 189-104 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/6049>*



**Abstract.** It is analyzed output, costs and other results of mining activity two large diamond mining enterprises: Russian “Severalmaz” and foreign “De Beers – Venetia Mine”. It is considered that “Severalmaz” has a huge potential for development. The possible technical, technological and organizational solutions are necessary as they permit to increase the effectiveness of the mineral mining “Severalmaz”. The experience of the company “De Beers – Venetia Mine” can be used.

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*Novozhilova E.V., Lyubek Yu.V. Condition and tendencies of the world diamond-mining industry development. Journal of Mining Institute. 2011. Vol. 191, p. 145-151 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/6383>*



**Abstract.** The diamond's extraction and diamond's production realization by the diamond-mining companies of the countries in the world is decreasing in the modern conditions. The forecast of world diamond's business development for short-term prospect is connected with working out of development's scenarios and variants. Modern tendencies in the diamond business are directed towards the optimistic scenario.

*Belov A.K., Vasil'tsov V.S. Cluster approach to development of the diamond complex of Russia. Journal of Mining Institute. 2011. Vol. 191, p. 93-97 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/6373>*



**Abstract.** State to initiate the formation of clusters in the diamond complex Russia assumes priority financing of innovation the industry and the simultaneous strengthening of the economic system, mediating diamond complex infrastructure and geographically. But productivity growth due to innovative activity of one branch can lead to a slowdown in other sectors. Indirect support for clusters include the activities of public-private partnership to stimulate competition, demand creation and support of allied industries, export promotion, development of training programs and links to science, infrastructure support of the cluster, antitrust, insurance risks, etc.

*Belov A.K., Vasil'tsov V.S. Development of innovative potential of subjects of economic system on the basis of principles klasterization (on the example of the almazno-diamond complex). Journal of Mining Institute. 2011. Vol. 189, p. 332-335. <https://pmi.spmi.ru/index.php/pmi/article/view/6556>*



**Abstract.** Now the economy of Russia possesses a heredity in the form of the Soviet model of the organization of the industry – territorial industrial complexes which needs updating for conformity to market economy and globalization calls. Today “growth points” – industrial complexes as set concerning homogeneous the companies with high innovative potential which simultaneously would act as the base, “nutritious” environment for formation and development of new subjects of economic system are necessary not large, badly operated and разнонаправленные conglomerates, and. Industrial clusters represent one of the most effective forms of the organization of the industry and all subjects of economic system.

*Belov A.K. Efficiency klasterization of the almazno-diamond complex of Russia. Journal of Mining Institute. 2011. Vol. 189, p. 331-335 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/6555>*



**Abstract.** Innovation processes in the diamond-brilliant complex provides qualitative changes that lead to greater efficiency of the complex and thus contribute to the growth of competitiveness and efficiency of the enterprises included in the complex. For export-oriented diamond-brilliant complex implementation of an innovative cluster structure is one of the determining factors, since it is under modern conditions determines the success of this business. Thus, evaluation of the effectiveness of the implementation mechanism for the clustering of the diamond-brilliant industry of Russia is a challenge whose solution will improve the efficiency of the complex and to identify areas for further development.

*Smirnova N.V. Problems and prospects for development of the Russian diamond mining industry. Journal of Mining Institute. 2009. Vol. 180, p. 54-57. <https://pmi.spmi.ru/index.php/pmi/article/view/7092>*



**Abstract.** The basic problems of the Russian diamond-mining industry development in modern economic conditions are instability of diamond production demand; necessity of significant investments (180 billion dollars) for construction new mines and modernization of enterprises; unstable position of lapidary and jeweler branches; inefficient state regulation; necessity to increase the financing of geological prospecting works. Demonopolization of the diamond market has led to competition strengthening between independent manufacturers. In this connection, prospects of the Russian diamond-mining industry development directly connected with its competitiveness. The analysis of the Russian diamond-mining industry competitiveness has shown presence of its stable and steady position in the world market and favorable development prospects. Steady development of the diamond-mining company in the long term depends on its ability to predict and flexibly react to changing conditions of an external environment, to keep and get new competitive advantages.

*Vasil'tsova V.M., Belov A.K. Problems of development of the diamond complex on company "Alros". Journal of Mining Institute. 2009. Vol. 184, p. 13-17 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/6823>*



**Abstract.** Diamond complex – one of the economy sectors, the kept potential of the expanded reproduction in the conditions of crisis. Russia, along with the republic of South Africa, Australia, Zaire, Botswana, Angola and Namibia is included into number of seven largest diamond-mining countries of the world and takes the second place in the world on volume of extraction of diamonds, being the world leader on stocks of diamond raw materials. Reserves of increase of efficiency at the separate enterprises and branch as a whole are revealed. Problems of strengthening of position of object of research on internal and a foreign market are defined.

*Smirnova N.V. Economic evaluation of the effectiveness of investment projects of diamond mining industry. Journal of Mining Institute. 2007. Vol. 170 (2), p. 216-219 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/7755>*



**Abstract.** The diamond mining industry occupies an important place in the Russian economy. In this regard, it is of great importance to increase the investment activity of promising foreign projects consisting in the construction and reconstruction of existing diamond mining enterprises. The article analyzes the diamond market, indicates the main prospects and trends of its development, considers the basic methodology for assessing the effectiveness of investment projects, and evaluates the effectiveness of investment projects to increase ore production using economically significant criteria.

*Zhigulevich P.A. Economic efficiency of Open Society Severalmaz. Journal of Mining Institute. 2007. Vol. 173, p. 168-170 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/7587>*



**Abstract.** This paper estimates economic efficiency of Open Society "Severalmaz". This topic is especially critical because of the necessity to attract significant investment in this project. The main indices of economic efficiency have been determined as the result of the research into current production activity of the company which allows assessing feasibility of investment in production expansion and realization of the main project of the mining and concentration plant.

*Smetankin A.V. Prospects for the development of the Russian diamond mining industry and its competitiveness in the world market. Journal of Mining Institute. 2005. Vol. 161, p. 49-52 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/8456>*



**Abstract.** Prospects for the development of the Russian shale industry based on the innovative project. The article reviews the current problems of development of the diamond mining industry in Russia against the background of changes in the diamond market related to the level of availability of mineral resources, legislative innovations, corporate strategies, competitive struggle and redistribution of sales markets, on the part of non-economic forces on the development of the industry. Possible measures to influence the new trends are assessed. Recommendations are given on the framework formation of a long-term development strategy for diamond mining companies in modern conditions.

*Smetankin A.V. Assessment of environmental and conflict competitive risk in the diamond mining industry. Journal of Mining Institute. 2003. Vol. 155 (1), p. 252-255 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/9122>*



**Abstract.** The article offers a methodology for assessing the unique competitive risks of the diamond mining industry: the environmental competitive risk and the competitive conflict risk. These risks become especially relevant for diamond mining companies operating in the conditions of intensified competition on the global diamond market, more complicated global military and political situation associated with armed conflicts and terrorist acts, deterioration of environmental parameters and increased consumer attention to the environmental quality of products. The proposed methodology is based on an indirect statistical-probabilistic method of calculating the estimated risk, the nature and complexity of which do not allow applying a direct calculation. The risk indicators obtained are different for individual national jewelry markets and for different diamond mining companies.

## Environmental safety of mining operations and engineering protection

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*Ecological agenda is one of the country's policy priorities. Speaking of diamond industry, we should mention environmental safety. Ecological impact is the issue that influences the local life and biological diversity of domestic ecological system.*

*Legostaeva Ya.B., Gololobova A.G., Popov V.F., Makarov V.S. Geochemical properties and transformation of the microelement composition of soils during the development of primary diamond deposits in Yakutia. Journal of Mining Institute. 2023. Vol. 260, p. 212-225. DOI: 10.31897/PMI.2023.35*



**Abstract.** Extraction of diamonds from primary deposits in Siberia is associated with the development of kimberlite pipes in challenging environmental conditions, accompanied by a complex impact on the environment. The article presents the results of monitoring the soil cover of the Nakyn kimberlite field in the Yakutia diamond province, which is affected by the facilities of the Nyurba Mining and Processing Division. Development of primary diamond deposits has a large-scale impact on the subsoil, topography, and soil cover: creation of the world's largest quarries, formation of dumps more than 100 m high, arrangement of extensive tailings, formation of solid and liquid industrial wastes of various chemical composition. The research is aimed at studying the spatial and temporal patterns of the technogenic impact on the soil cover, identifying the nature and level of transformation of the microelement composition of soils based on the analysis of the intra-profile and lateral distribution of mobile forms of trace elements.



The study targets in 2007-2018 were zonal types of permafrost soils of northern taiga landscapes, cryozems, occupying 84 % of the total study area, which are characterized by biogenic accumulation of mobile forms of Ni, Mn, and Cd in the upper AO, A<sub>cr</sub> horizons, and Cr, Ni, Co, Mn, Cu in the suprapermafrost CR horizon. We found out that the contamination of the soil cover of the industrial site at the Nyurba Mining and Processing Division is of a multielement nature with local highly to very highly contaminated areas. Over a ten-year observation period, areas of stable soil contamination are formed, where the main pollutants are mobile forms of Mn, Zn, Ni. We suggest that against the background of a natural geochemical anomaly associated with trap and kimberlite magmatism, technogenic anomalies are formed in the surface horizons of soils. They are spatially linked to technogenically transformed landscapes. One of the sources of pollutants is the dispersion of the solid phase of dust emissions in the direction of the prevailing winds, which leads to the formation of soils with abnormally high contents of mobile forms of Mn, Zn, Ni.

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*Oblitsov A.Yu., Rogalev V.A. Prospective ways of diamondiferous rock enrichment wastes utilization at M.V.Lomonosov diamond deposit. Journal of Mining Institute. 2012. Vol. 195, p. 163-167. <https://pmi.spmi.ru/index.php/pmi/article/view/6127>*



**Abstract.** In this article a problem questions of diamondiferous rock enrichment wastes accumulation at M.V. Lomonosov diamond deposit, perspective ways of wastes utilization are stated. The current situation with wastes accumulation is passed in review. The technology of utilization is described in detail. The data on chemical composition, acid-base balance, ability to decrease soil acidity are given.

*Arnautov A.I., Iskhakov M.S. Engineering and environmental problems in the development of the V.P. Grib diamond deposit. Journal of Mining Institute. 2003. Vol. 153, p. 117-119. <https://pmi.spmi.ru/index.php/pmi/article/view/9269>*



**Abstract.** The methods of development of the V.P. Grib diamond deposit, characterized by complex engineering-geological and hydrogeological conditions, are considered. Based on the analysis of the conditions and taking into account the specifics of the geological structure, a combined method of development is proposed. The characteristic of the environmental problems arising with this method is given and engineering ways of their solution are outlined.



MGS 783 1 6. Wash pan concentrate of chrome-diopside, olivine and pyrope. Item belongs to the Mining Museum.



## Retrospective journey to the history

The section contains the articles of archive issues, dedicated to diamond crystallography.

**Gur'ev Yu.S. Geologist Sobolev and the discovery of diamond deposits in Yakutia. *Journal of Mining Institute*. 2003. Vol. 155 (1), p. 270-271 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/9128>**



**Abstract.** For the anniversary of the Department of Geology and Exploration of Mineral Deposits a presentation was prepared about the activity of the geologist V.S. Sobolev and his main work – prediction of a diamond deposit in Yakutia, carried out on the basis of comparison of the geological structure of diamond-bearing provinces of South Africa and Western Siberia. This can serve as a vivid example of successful use of mathematical model in geology. Material about the life and work of a scientist is combined with a story about mathematical models and the most common example of the use of a mathematical model (the discovery of the planet Neptune) most expressively reproduced in the program PowerPoint. The material is organized on 13 slides, which run automatically, so it looks like a movie. The presentation is accompanied by audio and video and lasts 8 minutes.

**Editorial board. Ilarion Ilarionovich Shafranovsky (in commemoration of 60th anniversary). *Journal of Mining Institute*. 1968. Vol. 54 (2), p. 3-5 (in Russian). <https://pmi.spmi.ru/pmi/article/view/11987>**



**Abstract.** In his scientific work Professor I.I. Shafranovsky combines successfully ideas and methods of crystallography and mineralogy interests. I.I. Shafranovsky put much work into studies of zircon, quartz and diamond. Important work dedicated to zircons of the Veshnyovye mountains is his PhD thesis [1936]. Most interesting observations of quartz dealt with physical regeneration on mineral crystals (so-called Shafranovsky's rule), twinnings and mineral intergrowth. Cubic quartz, the form of natural dissolution, and other issues of crystal morphology. I.I. Shafranovsky is the author of monograph on quartz crystallography from the country's [1937].

**Fyodorov E.S. Of crystal structure of diamonds sensu Bragg. *Journal of mining institute*. 1914. Vol. 5 (1), p. 68 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/15134>**



**Abstract.** The article is prompted by the desire to present Bragg's final conclusion in a visual form, then, due to the complete singularity of the conclusion and quite dramatic difference with our earlier idea of particle structure, we wanted to decide if it's possible to adapt this conclusion with our ideas. Analyzing the atom arrangement, we will realize its double nature. Some atoms come to the centre of rhombic dodecahedrons, others come to the four trigonal tops of the dodecahedron that belong to the tetrahedron all together. This position contributes to hexakis – tetrahedral symmetry. Though position of some particle centres contributes to dodecahedron structure, the case differs because of position of other atoms.

*Scientific edition*

**DIAMONDS**

Digest

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