

Published by Empress Catherine II
Saint Petersburg Mining University

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JOURNAL OF MINING INSTITUTE

DIGEST



MINER'S DAY

№ 12 • 2024

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**EMPRESS CATHERINE II
ST. PETERSBURG MINING UNIVERSITY**

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*On the cover: Coal. Zhdanovskaya mine No. 5, Donbass.
From the collection of the Mining Museum*

Abstract

The work of mining workers has always been associated with dangerous and harmful working conditions, but it is difficult to imagine the modern world without this industry and the people who contribute to its development.

At the proposal of the ministers of the coal industry of the western and eastern regions of the USSR, an annual holiday was established in 1947, Miner's Day, which is still celebrated to this day on the last Sunday of August. Not only miners are involved in it, but also tunnellers, engineers and maintenance personnel.

Interest in mining in Russia arose in the second half of the 15th century, when in 1491 the first expedition set off to the Pechora region to search for minerals. However, the industry received the status of the basic sector of the future industry under Peter I after the establishment in 1700 of the "Order of Mining Affairs". At the end of the 19th century mining occupied first place among other branches of Russian industry. The construction of coal mines began in the Donbass, the Urals, the Moscow and Kuznetsk basins, and the Far East.

By the middle of the 20th century for the base of domestic mining engineering, which had already begun to form, a "golden age" started, which lasted more than three decades. At this time there was an increase in coal mining volumes, an increase in the production capacity of enterprises, an increase in the technical level of mining processes, an improvement in methods of mining deposits and a change in the approach to labor and production management systems.

In modern Russia, the largest producer and supplier of coal is the Kuznetsk basin – in the first quarter of 2023, more than half (51 %) of all coal mined in the country was produced here. The import of Russian coal is also gaining momentum – China and India are Russia's main partners in this area.

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Hydrocarbons, coal

The coal mining industry is one of the key ones in the economy of our country. Thanks to the hard work of miners, we obtain coal, ore and other materials for heating, manufacturing and construction. The distribution of coal throughout the country is extremely uneven. Approximately 95 % of reserves are in the eastern regions, of which more than 60 % are in Siberia. The largest coal deposits in Russia are the Kuznetskoe, Kansk-Achinskii, Tunguskii, Pechorskii and Irkutsk-Cheremkhovskii basins.

Prishchepa O.M., Sinitsa N.V., Ibatullin A.K. Assessment of the influence of lithofacies conditions on the distribution of organic carbon in the Upper Devonian "Domanik" deposits of the Timan-Pechora Province. Journal of Mining Institute. 2024, p. 17. EDN JPUKCM. <https://pmi.spmi.ru/pmi/article/view/16249>



Abstract. The study of high-carbon formations was instigated both by the decreasing raw material base of oil as a result of its extraction, and by the progress in development of low-permeability shale strata, primarily in the USA, Australia, and China. The most valuable formations occur in traditional hydrocarbon production areas – the West Siberian, Volga-Ural and Timan-Pechora, North Pre-Caucasian and Lena-Tunguska oil and gas provinces. Specific features of the Late Devonian-Early Carboniferous high-carbon formation occurring in the eastern marginal part of the East European Platform are: heterogeneous section due to intense progradation of the carbonate platform from west to east; succession of lithofacies environments that determined the unevenness of the primary accumulation and secondary distribution of organic matter (OM); possible migration or preservation in the source strata during the subsidence stages of the moving parts of bitumides, which determined the prospects for oil and gas potential. The distribution pattern of the present OM content was investigated depending on lithofacies conditions and lithological composition of rocks in the "Domanik type" Upper Devonian-Tournaisian deposits in the Timan-

Pechora Province (TPP), its transformation degree to bring it to the initial content of organic carbon and further estimation of the share of stored "mobile oil" in oil and gas source formation. The study was based on the analysis of the data set on organic carbon content in core samples and natural exposures in the Ukhta Region in the Domanik-Tournaisian part of the section including more than 5,000 determinations presented in reports and publications of VNIGRI and VNIGNI and supplemented by pyrolytic and bituminological analyses associated with the results of microtomographic, macro- and lithological studies and descriptions of thin sections made at the Saint Petersburg Mining University. For each tectonic zone of the TPP within the investigated high-carbon intervals, the content of total volumes of organic carbon was determined. The data obtained allow estimating the residual mass of mobile bitumoids in a low-permeability matrix of the high-carbon formation.

Zakharov V.N., Malinnikova O.N. The study of structural features of outburst coal seams. Journal of Mining Institute. 2014. Vol. 210, p. 43-52 (in Russian). <https://pmi.spmi.ru/pmi/article/view/5264>



Abstract. A study of the structural features of outburst-dangerous and non-outburst dangerous coal layers was conducted. It was shown that coal taken from a sudden outburst zone has a significantly greater sorption surface than coal from the same layer which was not part of the sudden outburst. The size of the sorption surface of coal is affected by its history up to that point; thus the heating of the coal sample during its preparation enlarges its sorption surface. An electron microscope study of coal surfaces has shown that for coal from outburst-dangerous layers, a disturbed structure with a large quantity of fissures and partings the size of 1 micrometer is typical. Under the same enlargement, a coal structure from safe coal layers is much more uniform. The study of digital images of coal surfaces, taken with the help of an electron microscope, shows that the structural institution of surface elements may be presented by multifractal analysis, with its spectrum of fractal dimensions, which allows us to state quantitative distinctions in coal microstructures for outburst-dangerous layers. Coal from outburst-dangerous layers has a greater set of structural elements, and therefore a spectrum of fractal dimensions that is 1.5-2 times wider than for no outburst-prone layers.

Kiryukov V.V., Ochkurov N.N. Geological models of the formation of Donetsk coals (experience of systemic research). Journal of Mining Institute. 1993. Vol. 137, p. 112-121 (in Russian). <https://pmi.spmi.ru/pmi/article/view/9993>



Abstract. The geological characteristics of coal formation processes are given. Coal formation systems are considered, including natural factors that determine the properties and composition of fossil ashes. The principle of classification of Donetsk coals based on a systematic approach is substantiated. Issues of discontinuous-continuous series of coal metamorphism are discussed and alternative models for the formation of coals of different reduction levels are proposed, as well as principles for choosing coal classification scales.



The layout of a coal mine of the Novorossiysk company Yuzovka (Donetsk), Donetsk basin. Late 19th century. Scale 1:132. From the collection of the Mining Museum

Afendikov N.N., Buyalov S.I. Underground gasification of coal according to the scheme proposed by B.I. Bokii. Journal of Mining Institute. 1960. Vol. 43 (1), p. 116-121 (in Russian). <https://pmi.spmi.ru/pmi/article/view/12821>



Abstract. The idea of underground gasification of coal was first put forward by D. I. Mendeleev in 1882-1888. In 1913, V.I. Lenin, in his article “One of the Great Victories of Technology,” highly appreciated the idea of underground gasification of coal, foreseeing that under socialism it could be put to the service of society. Vladimir Ilyich believed that with underground gasification it is possible to obtain cheap combustible gas underground and, by burning it in boiler furnaces, to produce cheap electricity at power plants. With the help of underground gasification of coal, in his opinion, it would be possible to use even the poorest and most undeveloped deposits of coal. He pointed out: “The enormous mass of human labor used to mine and transport coal would be saved.”

Kiryukov V.V. Petrographic characteristics of tertiary brown coals from the Babaevskii and other deposits of the southwestern Cis-Urals. Journal of Mining Institute. 1958. Vol. 33 (2), p. 77-101 (in Russian). <https://pmi.spmi.ru/pmi/article/view/13892>



Abstract. Low-metamorphosed brown coals of Tertiary age, widespread within the right bank of Ukraine, the southwestern Cis-Urals and northern Kazakhstan, have not been sufficiently studied from the petrographic point of view. There is still no well-developed methodology for studying low-metamorphosed loose brown coals, which differ sharply from denser brown and hard coals, as well as from peats. This article presents the results of a comprehensive (botanical, petrographic, and chemical) study of the material composition of low-metamorphosed brown coals that make up the thick deposit of the Babaevskoe deposit and compares them with coals from other tertiary deposits of the southwestern Cis-Urals. The issues of the origin of low-metamorphosed brown coals are considered by the author in a special article; a detailed description of the types of coals and the structure of coal deposits of individual deposits of the South Urals brown coal basin is presented in the atlas currently being prepared.

Zhemchuzhnikov Y.A. *On the issue of types of coal basins. Journal of Mining Institute. 1953. Vol. 29 (2), p. 33-45 (in Russian).* <https://pmi.spmi.ru/pmi/article/view/15589>



Abstract. Issues of genetic classification and typification of coal basins are of fundamental and great practical importance. The value of such a classification will depend on the importance of the principles underlying it, on its applicability in practice and on the ability to make a more or less complete forecast based on it. Since the advent of the classification of coal basins by G.A. Ivanov, it can be considered established that the geotectonic principle is the first and most important for genetic divisions into large groups. 15 years after the appearance of this classification, the study of geotectonic structures now makes it possible to make a more detailed division according to the same geotectonic principle. However, for other various purposes, this does not exclude the possibility and need to have other classifications of coal basins, based on completely different criteria, For example, based on the relationship of coal-bearing sediments to the proximity of the sea, basins have long been divided into parallel and limnic. This is, so to speak, a paleogeographic division. From the point of view of exploration and study, it is important to subdivide coal basins into open, semi-closed and completely closed, based on the development and preservation of the rocks covering the coal-bearing strata. For the needs of geophysical work, they can be classified according to the nature of the tectonic forms, i.e., according to the type of dislocations, as P.I. Stepanov does. Basins can be divided into lignite and hard coal basins based on the quality of the coals, and based on age into Carboniferous, Permian, Jurassic, Tertiary, etc.

Kuprov I.G. *Materials for the petrographic characteristics of coal seams of the Aralichevskoye deposit of the Kuznetsk Basin. Journal of Mining Institute. 1950. Vol. 24, p. 17-55 (in Russian).* <https://pmi.spmi.ru/pmi/article/view/14075>



Abstract. Over the past years, since the beginning of the industrial development of the Kuznetsk basin, petrographic research has covered coal from almost all deposits known within the boundaries of the basin. The results of coal petrographic studies, which contributed to exploration and identification of the quality of coals in the basin, were

published in a number of works. However, most of this work concerns those deposits whose coals are interesting as metallurgical fuel and as chemical raw materials. Coal petrographic studies of thermal coal deposits, which include Aralichevskoe, have received much less attention. In particular, in works on the study of coals from the Aralichevskoe deposit, their petrographic properties are usually casually mentioned. In essence, there are no completed coal petrographic studies of this industrially important and unique coal deposit. The information presented in this article cannot be considered exhaustive, but still, to a certain extent, it fills the existing gap in the coverage of the petrographic properties of coals and the structure of coal seams of the Aralichevskoe deposit. The article is written based on materials from petrographic sampling of coal seams and camera processing of samples carried out by the author in the pre-war years in connection with his dissertation work on the comparison of coal seams of the Prokopyevskoe and Aralichevskoe deposits based on coal petrographic characteristics.



The coal is banded. Peat bog facies. Item belongs to the Mining Museum



Sample Mine

Shale oil, shale gas, oil shale

Shale oil belongs to unconventional hydrocarbons, as it is extracted from oil shale. Shale gas is also produced from shale deposits. Involvement in the development of resources of unconventional hydrocarbon deposits is of particular relevance in connection with the emerging depletion of more accessible oil deposits. In addition, fundamentally new solutions are needed to develop such strata. In Russia, high-carbon shale-like strata have been identified within the Volga-Ural and Timan-Pechora oil and gas provinces (Domanik formation), in the Ciscaucasia trough, in the oil and gas provinces of Eastern Siberia and Western Siberia.



*Actinolite shale. R. Ishalova, Orskii district.
Item belongs to the Mining Museum*

Makeyev A.B., Bryanchaninova N.I., Krasotkina A.O. Unique titanium Deposits of Timan: genesis and age issues. Journal of Mining Institute. 2022. Vol. 255, p. 275-289. DOI: 10.31897/PMI.2022.32



Abstract. The article critically analyses the hypotheses about the formation, age, and sources of material of large Timan titanium deposits, which were previously considered ancient buried placers formed along the weathering crusts of the Riphean shales. We discuss an alternative hydrothermal-metamorphic hypothesis about the formation of these deposits and the source of ore material. It is established that the incoming zircon of different ages (570-3200 Ma), as well as two other geochronometers, rutile and monazite, underwent a thermal effect common for all varieties as a result of a hydrothermal process about 600 Ma ago. According to modern concepts, the closing temperature of the U-Pb system in rutile exceeds 500 °C, which suggests high-temperature conditions for the hydrothermal processing of rutile during the formation of the considered deposits in the Riphean.

Dolgi I.E. Methods to enhance oil recovery in the process of complex field development of the Yarega oil and titanium deposit. Journal of Mining Institute. 2018. Vol. 231, p. 263-267. DOI: 10.25515/PMI.2018.3.263



Abstract. Yarega oil and titanium deposit is a unique facility due to a combination of two mineral resources – oil and titanium ore – in one geologic structure. The paper describes mining and geologic conditions of the field, as well as engineering solutions to enhance oil recovery and the efficiency of heat transfer. The author focuses on the issues of deposit opening and preparation for development, and provides recommendations regarding the exploitation procedure of the oil and titanium parts of the field, which take into account field data on the extraction rates of high viscosity oil and titanium ore from the start of deposit development. The paper contains analysis of existing technological schemes of high viscosity oil extraction and steam heating of the oil bed, as well as

assessment of their feasibility. Issues of field preparation for development are reviewed from the position of accumulated practical experience, and recommendations on the feasibility of combined underground and open-pit mining are supported with evidence. The main advantages of the proposed system are explained; key technical and economic indicators are calculated.



*Sandstone-gravelite, impregnated with oil.
Yaregskoye field.
Item belongs to the Mining Museum*

Kondrasheva N.K., Khorkhe A. *Effect of chemical composition and quality of heavy yarega oil on selection of appropriate processing technology. Journal of Mining Institute. 2016. Vol. 222, p. 833-838. DOI: 10.18454/PMI.2016.6.833*



Abstract. The paper explores physical and chemical properties and composition of heavy oil from Yarega field and its vacuum residue, i.e. the tar. The capillary chromatography and gas chromatography-mass spectrometry were used to identify specific group hydrocarbon composition of heavy Yarega oil and components extracted therefrom, which has proven its belonging to highly resinous sulfurous naphthenic and aromatic oils. Based on the comparative analysis of composition and quality of feedstock a possibility has been assessed to produce a high-quality needle coke with low content of sulphur and metals from the heavy oil of Yarega field and its vacuum residue. An integrated process flow diagram for heavy Yarega oil refinement has been proposed, including preliminary deasphalting and demetallization, hydrotreatment, delayed coking and thermdestructive processes or gasification.

Bezkaravainyi V.G. *Features of the manifestation of rock pressure during the chamber-lava mining system at the mines of the Slantsy plant. Journal of Mining Institute. 1963. Vol. 48 (1), p. 43-50 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/12589>*



Abstract. The combined chamber-lava development system combines elements of the pillar and chamber systems. In controlling rock pressure, the system has the following characteristic features: the main roof is supported for a long time by specially placed support pillars; to increase the load-bearing capacity of the immediate roof and control the condition of the roof, a lightweight wooden support is installed in the mined-out space, designed to support only the lower layer of the immediate roof with a thickness of no more than 4 m; the face of the longwall chamber with a total length of up to 215 m is moved in the same way as the excavation longwalls - parallel stops in one direction; the bottomhole space 3.4–3.8 m wide is not secured at all.

Nikitin M.N., Gladkov P.D., Kolonskikh A.V., Petukhov A.V., Mikheev A.I. *Analysis of rheological properties of Yaregskoe field heavy high-viscosity oil. Journal of Mining Institute. 2012. Vol. 195, p. 73-77 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/6105>*



Abstract. Results of experimental determination of Yaregskoe field degassed oil rheological features are given in the article. Modern methods of visco-elastic and thixotropic properties research are described and results of these methods application while abnormal oil research are shown. As a result an improved data of Yaregskoe field oil is obtained and there is a recommendation to extend a number of enhanced oil recovery methods, including physicochemical and wave methods application.

Grosberg G.G. *Ways to improve the operating mode of cutter machines in mines extracting oil shale. Journal of Mining Institute. 1954. Vol. 32 (1), p. 124-130 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/14372>*



Abstract. In recent years, oil shale production in the Soviet Union has increased significantly. The pace of development of the shale mining industry significantly exceeds the pace of development of the coal industry. The directives of the 19th Congress of the CPSU on the fifth five-year plan for the development of the national economy of the USSR for 1951-1955 stated: "...to increase oil shale production by 2.3 times, especially in the Estonian SSR." Such rapid development of the shale mining industry is possible only on the basis of advanced technology. Slate mines are equipped with modern powerful machines and mechanisms. However, this technique is not yet used effectively enough, which is mainly explained by insufficient knowledge of the processes of operation of mining machines in the specific conditions of shale mines. There is a large number of studies on cutting coal, but there is absolutely no research on cutting oil shale. The materials presented in this article are based on experimental studies of cutting in oil shale. Research was carried out for several years at the Leningradslanets mines and in the laboratories of the Leningrad Mining Institute. The experiments were carried out without recording instruments; only a set of small-sized electrical measuring instruments was used, which somewhat reduced the accuracy of the readings (within 5-7%).

Charnotskii S.I. Essay on iron ore deposits in the western part of central Russia and the Kingdom of Poland. Journal of Mining Institute. 1908. Vol. 1 (5), p. 343-372 (in Russian). <https://pmi.spmi.ru/pmi/article/view/15336>



Abstract. Brown and spar iron ores of central Russia and the Kingdom of Poland are of, in addition to scientific, enormous practical interest, since they are almost the only iron ores in these two regions, which, due to their geographical location and other conditions, have all the prospects for a large iron industry developed here. The author describes ores in the following provinces: Tver province, Kaluga province, Oryol province (list of literature 1837-1902), Kursk province, Kingdom of Poland (literature from 1816 to 1903). Next comes a description of the age and origin of ores in the western part of Central Russia (provinces: Tula, Kaluga, Oryol, and Kursk).

Mines. Underground coal mining

Currently, despite the predominance of open-pit mining in the world, the underground mining method remains dominant in providing raw materials. The section presents solutions to the problems of underground mining of coal seams using resource-saving technologies aimed at optimizing losses and increasing productivity, improving technological schemes, organizing installation, and dismantling work in mines.

Vinogradov Y.I., Khokhlov S.V., Zigangirov R.R., Miftakhov A.A., Suvorov Y.I. Optimization of specific energy consumption for rock crushing by explosion at deposits with complex geological structure. Journal of Mining Institute. 2024. Vol. 266, p. 231-245. EDN RUUFNM. <https://pmi.spmi.ru/pmi/article/view/16223>



Abstract. The selection of efficient drilling and blasting technology to achieve the required particle size distribution of blasted rock mass and reduce ore dilution is directly related to the accurate definition of rock mass properties. The zoning of the rock massif by its hardness, drillability and blastability does not consider the variability of the geological structure of the block for blasting, resulting in an overestimated specific consumption of explosives. The decision of this task is particularly urgent for enterprises developing deposits with a high degree of variability of geological structure, for example, at alluvial deposits. Explosives overconsumption causes non-optimal granulometric composition of the blasted rock mass for the given conditions and mining technology. It is required to define physical and mechanical properties of rocks at deposits with complex geological structure at each block prepared for blasting. The correlation between

the physical and mechanical properties of these rocks and drilling parameters should be used for calculation. The relation determined by the developed method was verified in industrial conditions, and the granulometric composition of the blasted rock mass was measured by an indirect method based on excavator productivity. The results demonstrated an increase in excavation productivity, thus indicating the accuracy of given approach to the task of identifying the rocks of the blasted block.



*Gas coal. Donetsk coal basin.
Item belongs to the Mining Museum*

Sidorenko A.A., Dmitriev P.N., Alekseev V.Y., Sidorenko S.A. Improvement of technological schemes of mining of coal seams prone to spontaneous combustion and rock bumps. Journal of Mining Institute. 2023. Vol. 264, p. 949-961. EDNSCAFOE. <https://pmi.spmi.ru/index.php/pmi/article/view/15644>



Abstract. On the example of the Alardinskaya mine, the problem of underground mining of seams prone to spontaneous combustion and rock bumps in the conditions of the Kondomsky geological and economic region of the Kuznetsk coal basin is considered.

The contradictions in the requirements of regulatory documents for the width of the inter-panel coal pillars in the mining of seams with longwalls in conditions of endogenous fire hazard and in the mining of seams that are dangerous due to geodynamical phenomena are discussed. These contradictions impede the safe mining of seams using traditionally used layouts with the danger of spontaneous combustion of coal and rock bumps. A mining-geomechanical model is presented, which is used for numerical three-dimensional simulation of the stress-strain state of a rock mass with various layouts for longwall panels using the finite element method. The results of the numerical analysis of the stress state of the rock mass immediately before the rock bump are presented, and the main factors that contributed to its occurrence during the mining of the seam are established. A dangerous degree of stress concentration in the coal seam near the leading diagonal entries is shown, especially in conditions of application of abutment pressure from the edge of panels' gob. The analysis of the features of stress distribution in the inter-panel pillar at different widths is carried out. Recommendations for improving the layout for the development and mining of coal seams that are prone to spontaneous combustion and dangerous in terms of rock bumps in the conditions of Alardinskaya mine have been developed. The need for further studies of the influence of pillars for various purposes, formed during the mining of adjacent seams, on the stress-strain state of previously overmined and undermined seams is shown.

Zubov V.P., Phuc L.Q. *Development of resource-saving technology for excavation of flat-lying coal seams with tight roof rocks (on the example of the Quang Ninh coal basin mines). Journal of Mining Institute. 2022. Vol. 257, p. 795-806. DOI: 10.31897/PMI.2022.72*



Abstract. It is shown that the creation of the variants of resource-saving systems for the development of long-column mining is one of the main directions for improving the technological schemes for mining operations in the mines of the Kuang Nin coal basin. They provide a reduction in coal losses in the inter-column pillars and the cost of maintaining preliminary workings fixed with anchorage. The implementation of these directions is difficult (and in some cases practically impossible) when tight rocks are lying over the coal seam, prone to significant hovering in the developed space. In the Quang Ninh basin, 9-10 % of the workings are anchored, the operational losses of coal reach 30 % or more; up to 50 % of the workings are re-anchored annually. It is concluded that the real conditions for reducing coal losses and the effective use of anchor support as the main support of reusable preliminary workings are created when implementing the idea put forward at the St. Petersburg Mining University: leaving the coal pillar of increased width between the reused mine working and the developed space and its subsequent development on the same line with the stoping face simultaneously with the reclamation of the reused mine working.

Kazanin O.I., Ilinets A.A. *Ensuring the excavation workings stability when developing excavation sites of flat-lying coal seams by three workings. Journal of Mining Institute. 2022. Vol. 253, p. 41-48. DOI: 10.31897/PMI.2022.1*



Abstract. On the basis of analysis of mining plans and field studies at mines of JSC SUEK-Kuzbass, it is shown that in conditions of increasing the size of excavation columns during the development of flat-lying coal seams the stress-strain state of the rock mass along the workings length changes significantly. The necessity of predicting the stress-strain state at the design stage of the workings timbering standards, as well as subsequent monitoring of the workings roof state and its changes in the mining operations using video endoscopes, is noted. The results of numerical studies of the stress-strain state of the rock mass during the development of excavation sites by three workings for various combinations of width of the pillars between the workings for mining-geological and mining-

technical conditions of the “Taldinskaya-Zapadnaya-2” mine are provided. The stresses in the vicinity of the three workings are compared with the values obtained during the development of the excavation sites by double drift. A set of recommendations on the choice of the location of the workings, the width of pillars, timbering standards that ensure the stable condition of the workings throughout the entire service life at the minimal losses of coal in the pillars is presented.

Meshkov A.A., Kazanin O.I., Sidorenko A.A. *Improving the efficiency of the technology and organization of the longwall face move during the intensive flat-lying coal seams mining at the Kuzbass mines. Journal of Mining Institute. 2021. Vol. 249, p. 342-350. DOI: 10.31897/PMI.2021.3.3*



Abstract. The reasons for the lag of the indicators of the leading Russian coal mines engaged in the longwall mining of the flat-lying coal seams from similar foreign mines are considered. The analysis of the efficiency of the longwall face move operations at the JSC SUEK-Kuzbass mines was carried out. A significant excess of the planned deadlines for the longwall face move during the thick flat-lying seams mining, the reasons for the low efficiency of disassembling operations and the main directions for improving the technology of disassembling operations are revealed. The directions of ensuring the operational condition of the recovery room formed by the longwall face are considered. The recommended scheme of converged coal seams mining and a three-dimensional model of a rock mass to justify its parameters are presented. Numerical studies using the finite element method are performed. The results of modeling the stress-strain state of a rock mass in the vicinity of a recovery room formed under conditions of increased stresses from the boundary part of a previously mined overlying seam are shown. The main factors determining the possibility of ensuring the operational condition of the recovery rooms are established. It is shown that it is necessary to take into account the influence of the increased stresses zone when choosing timbering standards and organizing disassembling operations at a interbed thickness of 60 m or less. A sufficient distance from the gob of above- or undermined seams was determined to ensure the operational condition of the recovery room of 50 m, for the set-up room – 30 m. Recommendations are given for improving technology and organization of the longwall face move operations at the mines applied longwall mining of flat-lying coal seams with the formation of a recovery room by the longwall face.

Shishkov R.I., Fedorin V.A. Justification of stripping and development of a modular mine site for a combined coal mining method in Kuzbass on the example Baikaimskaya mine site. Journal of Mining Institute. 2020. Vol. 243, p. 293-298. DOI: 10.31897/PMI.2020.3.293



Abstract. The article considers one actual method for development coal deposits in the Kuzbass by open-underground mining. The scientific and practical advantages of the proposed method due to the use of common infrastructure of coal mine and a modular mine site (subsequently transformed into a mining and technological structure operating according to the mine – longwall scheme) are presented. Currently, a development strategy for Kuzbass until 2035 has been developed. As part of the strategy, a draft program for subsoil use is being formed in the coal industry department. The program should take into account all the positive and negative aspects associated with coal mining in cities and municipal areas and also their prospects. In the Kuznetsk coal basin, 42 mines and 52 opencast mines are mining, of which 12 enterprises use partially unified infrastructure. According to the results of open-underground mining work conducted by the laboratory of the Institute of Coal and Coal Chemistry of the Siberian Branch of the Russian Academy of Sciences (Institute of Coal SB RAS), the list of sites includes favorable mining and geological conditions with incidence angles of up to 18 degrees. As open-pit coal production increases, many sites encounter such a parameter as maximum allowable (boundary) strip ratio. At the stage of preparing the feasibility study for the development of a coal deposit, this coefficient is calculated first of all, since duration of enterprise's work and its economic component depend on it. In order to increase parameters, it is necessary to carry out transition from open works to underground. As a result, coal mine will not work at a loss, providing production with an economically disadvantageous strip ratio.

Zubov V.P. Status and directions of improvement of development systems of coal seams on perspective Kuzbass coal mines. Journal of Mining Institute. 2017. Vol. 225, p. 292-297. DOI: 10.18454/PMI.2017.3.292



Abstract. The article presents the results of the analysis of the Russian coal mines experience in using the variant of the long-pillar development system with the abandonment of coal pillars in the mined out areas of

longwall faces. In the Kuzbass mines, this option accounts for 90-95 % of the total volume of coal mined by the underground method. It is pointed out that it is necessary to take into account the negative influence of the pillars left in the worked out space on the geomechanical conditions of conducting mining operations in the overworked (underworked) seams. A significant negative effect of the pillars is shown in combination with selective extraction of the adjacent layers on reduction of the balance reserves. The measures allowing to increase the efficiency of the use of long pillar mining systems for the development of adjacent series of seams are considered.

Shabarov A.N., Tsirel S.V., Goncharov E.V., Zubkov V.V. The technology of extracting gaseous fuel based on comprehensive in situ gasification and coalbed degassing. Journal of Mining Institute. 2016. Vol. 220, p. 545-550. DOI: 10.18454/PMI.2016.4.545



Abstract. The study considers a comprehensive technology (designed and patented by the authors) of developing coal and methane deposits which combines in situ gasification of lower coalbeds in the suite of rock bump hazardous gassy beds, extraction of coal methane and mechanized mining of coal. The first stage of the technology consists in mining gaseous fuel that enables one to extract up to 15-20 % of total energy from the suite of coalbeds. Geodynamic zoning is used to select positions for boring wells. Using the suggested technology makes it possible to solve a number of tasks simultaneously. First of all that is extracting gaseous fuel from the suite of coalbeds without running any mining works while retaining principal coalbeds in the suite and preparing them for future processing (unloading and degassing). During the first phase the methane-coal deposit works as a gas deposit only, the gas having two sources – extracted methane (which includes its locked forms, absorbed and adsorbed) and the products of partial incineration of thin coalbeds, riders and seams from thee suite. The second stage consists in deep degassing and unloading of coal beds which sharply reduces the hazards of methane explosion and rock bumps, thus increasing the productivity of mechanized coal mining. During the second stage coal is mined in long poles with the account of degassing and unloading of coal beds, plus the data on gas dynamic structure of coal rock massif.

Belikov V.V., Belikova N.V. Innovative technologies and problems of scientific and methodological provision of design decisions in mining coal layers in difficult mining and geological conditions. Journal of Mining Institute. 2013. Vol. 205, p. 93-99 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/5499>



Abstract. The paper discusses the reasons for unsatisfactory design solutions for the existing and designed coal mines in Russia, as well as new innovative and scientific and methodological developments to improve performance of coal mines working in difficult geological conditions.



The mine pithead building of the Berestovskaya mine from the side of the access roads. Donbass. Late 19th century. Item belongs to the Mining Museum

Kozhukhov L.F., Struk K.V. Mechanization of steep thick coal seams working. Journal of Mining Institute. 2012. Vol. 198, p. 61-64 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/5915>



Abstract. This article presents the data concerning application of techniques and technologies in mining steep thick coal seams both in domestic mines and abroad. The preference is given to application of mechanized complexes with partings output. The article gives the description of research tasks.

The description of flat stand for modeling from equivalent materials and mining technologies with the use of moving drifts complex is also presented.

Kovalev O.V., Mozer S.P., Tkhorikov I.Y. Designing of complex mining operations in coal mines. Journal of Mining Institute. 2012. Vol. 198, p. 86-90 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/5920>



Abstract. The basic laws of gas filtration at different stages of coal deposit mining are considered. The technique used for studying complex development of power resources of coal deposits, allowing with reference to concrete conditions to receive engineering dependences for

a quantitative estimation of all key parameters of investigated processes is given. On the basis of the developed approach to complex development the algorithm of the practical solution of the problem is offered.

Sidorenko S.A., Sidorenko A.A., Nikishin D.Y. Justification of rational parameters of prospective technological schemes of layer mining of thick polohugol beds. Journal of Mining Institute. 2007. Vol. 173, p. 51-53 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/7552>



Abstract. Analysis of perspective flow diagrams of layered mining of high flat coal-seam in the Kuzbass Region is carried out. A conclusion is made on the necessity to consider the influence of the underworked massif of the 2nd layer in determination of the ultimate thickness of

the interlayer coal pack. Analytical studies of the stress-and-strain state of the underworked massif have been made. Sizes of weakened coal zones are determined and recommendations are given how to determine the ultimate thickness of the protective pack.

Sedin V.A., Pozhariskaya S.I. Assessing the efficiency of construction and reconstruction of coal mines. *Journal of Mining Institute*. 1987. Vol. 114, p. 55-60 (in Russian). <https://pmi.spmi.ru/pmi/article/view/10395>



Abstract. The efficiency assessment was made based on the mines of the Pechora coal basin, which is characteristic of the coal industry as a whole in terms of the state of new construction and reconstruction of existing mines for 1959-1980 in the Pechora basin, four mines were reconstructed.

Borisov D.F. On determining the production capacity of coal mines // *Journal of Mining Institute*. 1960. Vol. 43 (1), p. 18-26 (in Russian). <https://pmi.spmi.ru/pmi/article/view/12814>



Abstract. At present, when the Soviet coal industry has entered a new phase of development, based on the construction of new large mines and increasing the capacity of existing mines, it is of particular interest to consider, from the point of view of the history of the development of our coal industry, the existing theoretical views on the methodology for determining production capacity mines.

Zhemchuzhnikov Y.A. Coal-bearing provinces, regions and belts. *Journal of Mining Institute*. 1950. Vol. 24, p. 3-10 (in Russian). <https://pmi.spmi.ru/pmi/article/view/14073>



Abstract. The question of coal-bearing provinces is of great practical importance. It is closely related to forecasts in the search for new or closed coal deposits and the prediction of the possible qualities of coal in unexplored areas. Therefore, not only coal geology is interested in establishing coal provinces, but also prospecting and exploration and the coal industry. This issue can be correctly resolved only as a result of an in-depth comparative study of coal basins and the generalization of individual coal occurrences into a single whole. However, it cannot be divorced from the discussion of the volume of both larger and smaller divisions than provinces. The next smaller unit of the division is the coal

basin. The province consists of several basins and isolated deposits. The basin itself is divided into a number of areas and deposits. The boundaries of these concepts are quite clear. The question of larger units of the coal hierarchy is much less developed. Academician P.I. Stepanov introduced into science the concept of coal accumulation belts. By coal accumulation belt, he means that "...the area of the ground surface within which, during a certain geological period, the most abundant accumulation of carbonaceous deposits and coal masses occurred."

Kazakovskii D.A. On the issue of organizing surveying measurements during the development of coal deposits. *Journal of Mining Institute*. 1946. Vol. 19, p. 63-79 (in Russian). <https://pmi.spmi.ru/pmi/article/view/14860>



Abstract. In its concept, the task of surveying measurements is simple, however, its practical solution, provided that the necessary accuracy is ensured, in a number of cases becomes complex and requires the use of special techniques. This task becomes especially difficult in the conditions of deposits of non-metamorphosed platform-type coals, which are characterized by complex structure of seams, variability of thickness, ash content, and volumetric weight and intensive weathering of coal during storage in piles. In 1944, we carried out the work to study the issue of surveyor measurements at the Cheremkhovskoe field (Irkutsk basin), which is a field of this type. The results obtained, which we want to share in this article, can be successfully used in a number of other fields. Since during surveying measurements in the conditions under consideration the most difficult thing is to accurately determine the volumetric weight of coal, we will focus on the results of our work on this issue.

Serd A.I. On the question of the possibility of developing open-pit operations at the Cheremkhovskoe deposit. *Journal of Mining Institute*. 1946. Vol. 19, p. 104-110 (in Russian). <https://pmi.spmi.ru/pmi/article/view/14862>



Abstract. The Cheremkhovskoe coal deposit in the Irkutsk basin is one of the deposits where open-pit coal mining is possible on a large scale. The geological structure of the deposit favors the quarrying of many sections of its large reserve explored area.

Trushkov N.I. *Classification of ore deposit development systems. Journal of Mining Institute. 1946. Vol. 19, p. 24-38 (in Russian).* <https://pmi.spmi.ru/pmi/article/view/14857>



Abstract. Due to the differences not only in the methods themselves and their details, but also in the principles of development of ore and coal deposits, drawing up a unified classification of development systems for both is impractical. An attempt to compile such a general classification turned out to be unsuccessful due to complexity and contradictions, and the proposed classifications, to the detriment of one of the specialties, ore or seam, were practically unacceptable. For ore mining systems, which have long been an independent and most important branch of mining in the national economy of the Union, a simple independent classification of ore mining methods is necessary.



*A gift to B.V. Bokii for his 70th birthday from the miners of Donbass.
Item belongs to the Mining Museum*

Zhuravskii A.M., Andreev S.P. *On calculating the reserves of an ore deposit explored at the horizon and cut by a borehole at depth. Journal of Mining Institute. 1937. Vol. 10 (3), p. 47-60 (in Russian).* <https://pmi.spmi.ru/pmi/article/view/15580>



Abstract. When calculating mineral reserves in deposits, instead of the volume of the actual ore body, the volume of a body that is sufficiently close to it and has the correct geometric shape is usually calculated. An unsuccessful choice of such a geometric body can lead to a significant decrease in the calculation accuracy or greatly complicate the calculations. In the practice of calculating reserves with such exploration data, the volume of the explored body was sometimes calculated as the volume of a cone with a base equal to the contoured area on the horizon, and with the apex at the point where the drill well exits the deposit, without taking into account the thickness of this latter. The calculation made in this way gave reserves below the minimum determined by exploration data, and the discrepancy reached a significant value of several tens of percent. Below are methods for calculating the volume of a conoidal body, which can be used to calculate the reserves of a part of an ore deposit, limited by a contoured area at a certain horizon and cut by a drill hole at depth.

Kumpan A.S. *On the geology of the Bukachachinsky coal deposit. Journal of Mining Institute. 1937. Vol. 11 (1), p. 109-131 (in Russian).* <https://pmi.spmi.ru/pmi/article/view/15099>



Abstract. The Bukachachinskoe field, located in Eastern Transbaikalia (coordinates 53°N and 116°50'E), attracts attention for three reasons. Firstly, among other Mesozoic spots in Transbaikalia, it has undergone the most detailed geological research, and therefore the results of work on it make it possible to outline a methodology for studying such deposits, which has not yet been sufficiently developed, secondly, because its study sheds light on the genesis of Upper Jurassic deposits and tectonics and, thirdly, because the deposit has hard caking coals, which sharply distinguishes it from other Transbaikal lignite deposits. The coal-bearing deposits of the deposit occupy an area of about 40 km², their boundaries are the Sarananda and Kudikhta rivers. Coal-bearing deposits are surrounded

by hills of crystalline rocks, and the boundary of their distribution coincides with the boundaries of the valley. These contours, in addition to their natural outlines, due to the different hardness of crystalline rocks and coal-bearing deposits, were established by exploration work, the lines of which intersect the deposit at a close distance from each other, and these lines in places extend onto granites. There are no natural outcrops of coal-bearing strata in the area, and all data on its occurrence and composition were obtained based on workings.

Rutenberg L.M. *Determination of the most advantageous dimensions of a mine field // Journal of Mining Institute. 1912. Vol. 4 (1), p. 11-22 (in Russian).* <https://pmi.spmi.ru/pmi/article/view/15415>



Abstract. Within the land plot occupied by the mine, there may be one or more lifting shafts, each of them serving a certain well-defined part of the seam or suite of mineral strata. The area of such part of the seam or suite is called the mine field. Like any area, a mine field is measured in square units, that is, it is determined by the product of two linear quantities. Unfortunately, our practicing engineers share their experience very sparingly, and there is no data on this issue in the specialized literature. This article discusses various formula methods for determining the size of a mine field.

Salt mines and rocks

In nature, table salt is widely distributed both in solid form (layers of rock salt lying in the ground) and in the form of solutions (seawater, salt lake water, underground springs). The mine method of salt extraction is the main one. The raw materials for the salt industry are table salt, potassium salt and Glauber's salt. In Russia, the largest salt deposits are located in the Orenburg region, Perm region, Nizhny Novgorod region, as well as in the Irkutsk region and Altai region.

Rybak J., Khayrutdinov M.M., Kuziev D.A., Kongar-Syuryun C.B., Babyr N.V. *Prediction of the geomechanical state of the rock mass when mining salt deposits with stowing. Journal of Mining Institute. 2022. Vol. 253, p. 61-70. DOI: 10.31897/PMI.2022.2*



Abstract. The technogenic impact of mining on the environment is analyzed and the transition to geotechnology with stowing to reduce the impact of mining operations is proposed. The results of the research work devoted to the justification of parameters of the development of salt deposits with stowing and the definition of the influence of stowing on the dynamics of deformation of the underworked rock massif are presented. The relevance of research aimed at creating a safe and efficient technology for the transition from systems with natural maintenance of stoping space to systems with stowing has been substantiated. The results of studies on qualitative and quantitative assessment of the state of the rock massif (by the finite element method using FLAC3D software), worked out by combines, are given and the dynamics of the impact of mining operations on the rock mass and the change in the maximum stresses during the hardening of the stowing in the chambers are revealed. The numerical modeling method is used to analyze the conditions of change in the state of the underworked rock mass, to establish the mechanisms of its deformation at various stages of development. It is recommended to use this approach for geotechnical assessment of the rock mass state in conditions of using development systems of different classes.

Kozlovskiy E.Y., Zhuravkov M.A. Determination and verification of the calculated model parameters of salt rocks taking into account softening and plastic flow. *Journal of Mining Institute*. 2021. Vol. 247, p. 33-38. DOI: 10.31897/PMI.2021.1.4



Abstract. The article suggests using a combination of the modified Burgers model and the Mohr – Coulomb model with the degradation of the adhesion coefficient and the increase in the friction coefficient to determine the parameters of salt rocks. A comparative analysis of long-term laboratory tests and field observations in underground mine workings with the results obtained using a calculated model with certain parameters is carried out. The parameters of the Mohr – Coulomb model with the degradation of the adhesion coefficient and the increase in the friction coefficient were obtained from the statistically processed data of laboratory tests, and the parameters of the modified Burgers model were determined. Using numerical methods, virtual (computer) axisymmetric triaxial tests, both instantaneous and long-term, were performed on the basis of the proposed model with selected parameters. A model problem is solved for comparing the behavior of the model with the data of observation stations in underground mine workings obtained from borehole rod extensometers and contour deformation marks. The analytically obtained coefficients of the nonlinear viscous element of the modified Burgers model for all the analyzed salt rocks did not need to be corrected based on the monitoring results. At the same time, optimization was required for the viscoelastic element coefficients for all the considered rocks. The analysis of the model studies showed a satisfactory convergence with the data on the observation stations. The comparative analysis carried out on the models based on laboratory tests and observations in the workings indicates the correct determination of the parameters for salt rocks and the verification of the model in general.

Pankov I.L., Morozov I.A. Salt Rock Deformation under Bulk Multiple-Stage Loading. *Journal of Mining Institute*. 2019. Vol. 239, p. 510-519. DOI: 10.31897/PMI.2019.5.510



Abstract. The paper presents experimental justification of the possibility to use bulk multiple-stage loading to study the process of salt rock deformation in the laboratory conditions. Results of comparative tests between bulk

multiple-stage and single-stage loading of salt rock samples are demonstrated. The paper contains results of research on the rate of lateral pressure and its impact on strength limit and residual strength limit of sylvinites, estimated using single-stage and multiple-stage methods. Research results demonstrate how the rate of lateral pressure impacts dilatancy boundary of salt rocks. Analysis of how the loading method influences certificate parameters of Mohr-Coulomb strength of sylvinites has been carried out. The dynamics of elastic modulus in the process of salt rock deformation is analyzed depending on the rate of lateral pressure. It is demonstrated how the method of multiple-stage loading adequately reflects the processes of salt rock deformation and decomposition, and facilitates not only lowering impact of sample's inner structure heterogeneities on the experimental results, but also significant reduction in the required amount of rock material.

Karasev M.A., Buslova M.A., Vilner M.A., Nguyen T.T. Method for predicting the stress-strain state of the vertical shaft lining at the drift landing section in saliferous rocks. *Journal of Mining Institute*. 2019. Vol. 240, p. 628-637. DOI: 10.31897/PMI.2019.6.628



Abstract. The article proposes a method for predicting the stress-strain state of the vertical shaft lining in saliferous rocks at the drift landing section. The paper considers the development of geomechanical processes in the saliferous rock in the landing area, the support is viewed as a two-layer medium: the inner layer is concrete, the outer layer is compensation material. With this in view, the paper solves the problem of continuum mechanics in a spatial setting, taking into account the long-term deformation of salts and the compressibility of the compensation layer. Long-term deformation of saliferous rocks is described using the viscoplastic model of salt deformation into the numerical model, and the crushable foam model to simulate the deformation of the compensation layer. This approach considers all stages of the deformation of the compensation layer material and the development of long-term deformations of saliferous rocks, which makes it possible to increase the reliability of the forecast of the stress-strain state of the vertical shaft lining.

Kovalev O.V., Mozer S.P. Ways of improving waste disposal in the workings of salt mines. Journal of Mining Institute. 2014. Vol. 207, p. 50-54 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/5379>



Abstract. Address the major aspects of waste disposal in underground space. The key problems of waste isolation in the workings of salt deposits are analyzed. Proposed waste disposal technology, based on the use of waste for immobilization of natural mineral salts.

Baryakh A.A., Asanov V.A., Sanfirov I.A. The method of potash salt interchamber pillars stability control. Journal of Mining Institute. 2012. Vol. 198, p. 186-190 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/5940>



Abstract. The research of potash salt rock deforming and damaging features has made it possible to develop the method of load bearing element state examination by chamber-and-pillar system. This method consists in instrumental control of pillars by geophysical and in situ methods with following prognosis of their residual life by mathematical simulation methods.

Mozer S.P., Kovalev O.V., Tkhorikov I.Y. Utilization of exhausted potash mines in Russia as repositories for radioactive waste disposal. Journal of Mining Institute. 2011. Vol. 190, p. 105-107 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/6433>



Abstract. The growth in energy consumption demands increase in power output of the existing nuclear power plants and construction of the new ones. Radioactive waste requires high-reliable repositories to be disposed. One of the perspective types of the repositories is underground excavations in halogenous formations (created by underground mining or dissolution through boreholes from surface). The new method of radioactive waste disposal is offered in the paper.

Bespalov L.A., Gospodarikov A.P. One variant of boundary element method application to calculation of bearing pressure on conditions to coal and salt deposits. Journal of Mining Institute. 2010. Vol. 187, p. 11-15 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/6616>



Abstract. The analysis of stress-strain state near excavations was carried out in this work as applies to coal and salt deposits. The indirect boundary element method was used as a tool of research.

Sirenko Y.G., Brovko A.V., Sankovskii A.A. Research of the probability of sudden salt rock outbursts on the basis of measuring of their volume shrinkage. Journal of Mining Institute. 2010. Vol. 186, p. 75-78 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/6713>



Abstract. The article is devoted to research of probability of sudden salt rocks outbursts on the basis of measuring of their volume shrinkage. The design scheme of the device for measuring quantity of the microincluded gases in rocks is proposed. Criteria to estimate the possibility of sudden salt rocks outbursts is revealed.

Lytkina A.Y. Research of regularities of salt rocks strength change from conditions of occurrence. Journal of Mining Institute. 2009. Vol. 181, p. 43-45 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/7022>



Abstract. Experience of production practice mines shows that geological structure and chemical composition of saliferous rocks exercises significant influence on their mechanical properties. The research attempts to use data on geological structure and chemical composition of productive strata to forecast the rock mechanical properties. The main approach used is to reveal statistical correlations between basic mechanical properties and characteristics of their geological structure and chemical composition with consequent development of correlating equations to forecast mechanical properties of rocks in prospective sites planned for production.

Gospodarikov A.P., Bespalov L.A., Zatsepin M.A. About one algorithm of calculation of stressed state of salt reservoirs roof taking into account optimal choice of technological schemes parameters. Journal of Mining Institute. 2006. Vol. 167 (1), p. 254-259 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/8124>



Abstract. The design and construction of underground mine workings, mining, construction of underground facilities at great depths and in complex mining and geological conditions are closely related to the analysis of the stress-strain state (SSS) of rock masses. To determine the stress-strain state of a massif in mining geomechanics, data from engineering geology and geophysics are used, the results of experimental studies are used, as well as various analytical and numerical methods of continuum (discrete) mechanics.



Collection of samples of potassium salt deposit and products of the 1st potassium plant "Soyuzkali". Given to A.P. German by miners on his anniversary. 1934. Item belongs to the Mining Museum

Sustainable geotechnologies and efficient degassing

In connection with the increasing pace of production in the Russian coal industry, degassing of coal mines is becoming a necessary technological process. When developing gas-bearing coal seams, the gas content of workings is one of the main factors influencing the speed of work and the safety of working conditions. The system for maintaining methane safety includes, in addition to opening and preparing the deposit, its development and ventilation, such mandatory elements as dust suppression and monitoring of the production environment. Additional measures to extract methane lead to increased plant productivity.

Nepsha F.S., Voronin V.A., Liven A.S., Korneev A.S. Feasibility study of using cogeneration plants at Kuzbass coal mines. Journal of Mining Institute. 2023. Vol. 259, p. 141-150. DOI: 10.31897/PMI.2023.2



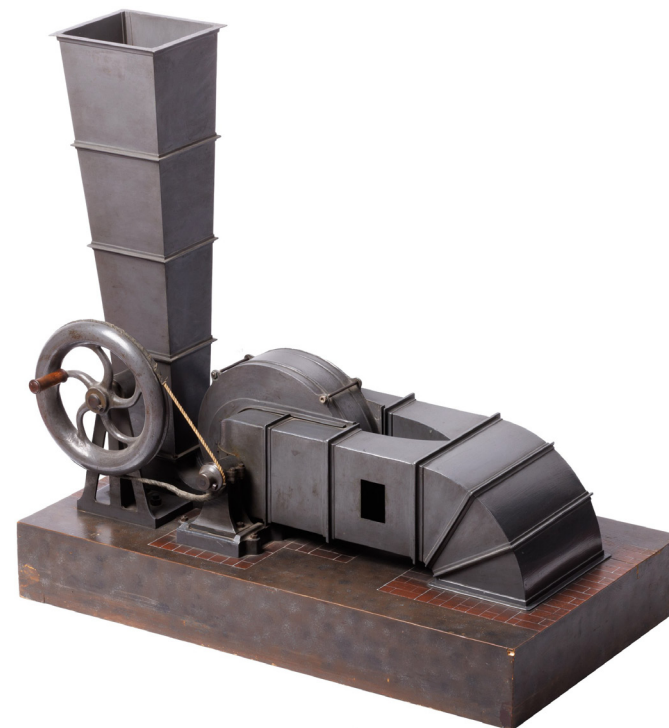
Abstract. The paper considers the problem of reducing greenhouse gas emissions in the process of coal mining during the coal mine methane utilization in power supply systems. An algorithm to form recommendations for the implementation of CMM generation is presented. A simulation model for one of the Kuzbass coal mines was developed in the PowerFactory software application. The simulation model considers the uneven nature of the power consumption of mining equipment. As a result of modeling, daily power consumption profiles and voltage levels in the coal mine power supply system were determined before and after the implementation of the proposed measures. Based on the results, the technical and economic effects was estimated, which consisted in

reducing the direct and indirect carbon footprint, electricity and capacity fees. It has been established that the cost of carbon dioxide emission quotas significantly affects the investment attractiveness of cogeneration projects. Based on the results, recommendations are given to stimulate the development of small generation in coal mines.

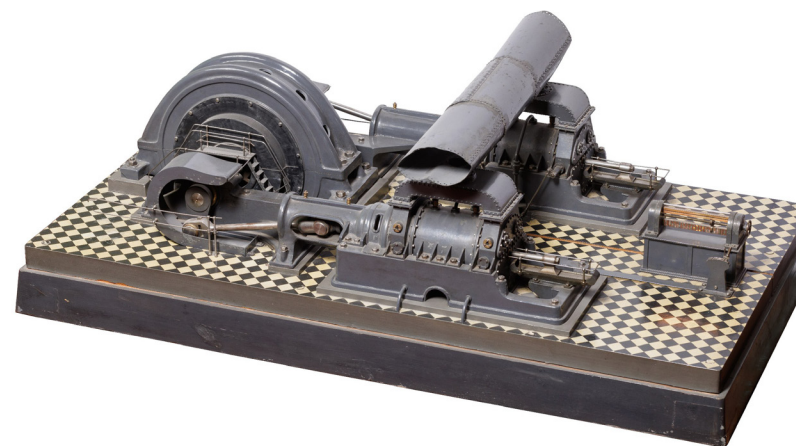
Hosseini A., Najafi M., Morshedy A.H. Determination of suitable distance between methane drainage stations in Tabas mechanized coal mine (Iran) based on theoretical calculations and field investigation. Journal of Mining Institute. 2022. Vol. 258, p. 1050-1060. DOI: 10.31897/PMI.2022.106



Abstract. A large amount of gas is emitted during underground mining processes, so mining productivity decreases and safety risks increase. Efficient methane drainage from the coal seam and surrounding rocks in underground mines not only improves safety but also leads to higher productivity. Methane drainage must be performed when the ventilation air cannot dilute the methane emissions in the mine to a level below the allowed limits. The cross-measure borehole method is one of the methane drainage methods that involves drilling boreholes from the tailgate roadway to an un-stressed zone in the roof or floor stratum of a mined seam. This is the main method used in Tabas coal mine N 1. One of the effective parameters in this method is the distance between methane drainage stations, which has a direct effect on the length of boreholes required for drainage. This study was based on the measurement of ventilation air methane by methane sensors and anemometers placed at the longwall panel as well as measuring the amount of methane drainage. Moreover, in this study, the obtained and analyzed data were used to determine the suitable distance between methane drainage stations based on the cross-measure borehole method. In a field test, three borehole arrangements with different station distances in Panel E4 of Tabas coal mine N 1 were investigated. Then, the amounts of gas drained from these arrangements were compared with each other. The highest methane drainage efficiency was achieved for distances in the range of 9-12 m between methane drainage stations.



*Модель рудничного вентилятора модели СЭР.
Из коллекции Горного музея*



*Модель сдвоенной воздуходувной машины с электродвигателем.
Из коллекции Горного музея*

Kaledina N.O., Malashkina V.A. Indicator assessment of the reliability of mine ventilation and degassing systems functioning. Journal of Mining Institute. 2021. Vol. 250, p. 553-561. DOI: 10.31897/PMI.2021.4.8



Abstract. The gas emission control in the mines is operated by ventilation and degassing systems that ensure the aerological safety of the mines or minimize the aerological risks. The ventilation system of the mine and its individual sites includes a significant number of technical devices and equipment, and the air tubes are mainly mining workings, the condition of which determines the quality of the ventilation network (its capacity) and depends on a number of mining factors. Similarly, one of the most important elements of the degassing system, which includes its own chain of technological equipment, are wells, and in some cases, mining workings. Thus, mine ventilation and degassing systems cannot be attributed to purely technical systems, since they include mining elements characterized by high variability of the determining parameters. To assess their reliability, it is necessary to use various combined methods that include additional characteristics in relation to the mining component. At the same time, the reliability of technical devices that ensure the functioning of mine ventilation and degassing systems largely determines the efficiency (stability and reliability) of these systems and, consequently, affects the level of aerological risks. The described approach to assessing the reliability of ventilation and degassing systems of coal mines when analyzing aerological risks is based on the developed system of risk indicators for the methane factor and will allow determining the risk dynamics in automatic mode based on monitoring the parameters of the ventilation and degassing system state.

Dzhioeva A.K., Brigida V.S. Spatial non-linearity of methane release dynamics in underground boreholes for sustainable mining. Journal of Mining Institute. 2020. Vol. 245, p. 522-530. DOI: 10.31897/PMI.2020.5.3



Abstract. The paper is devoted to the problem of increasing energy efficiency of coalmine methane utilization to provide sustainable development of geotechnologies in the context of transition to a clean resource-saving energy production. Its relevance results from the fact that the anthropogenic effect of coalmine methane emissions on

the global climate change processes is 21 times higher than the impact of carbon dioxide. Suites of gassy coal seams and surrounding rocks should be classified as technogenic coal-gas deposits, while gas extracted from them should be treated as an alternative energy source. Existing practices and methods of controlling coalmine methane need to be improved, as the current “mine – longwall” concept does not fully take into account spatial and temporal specifics of production face advancement. Therefore, related issues are relevant for many areas of expertise, and especially so for green coal mining. The goal of this paper is to identify patterns that describe non-linear nature of methane release dynamics in the underground boreholes to provide sustainable development of geotechnologies due to quality improvement of the withdrawn methane-air mixture. For the first time in spatial-temporal studies (in the plane of CH_4 -S) of methane concentration dynamics, according to the designed approach, the parameter of distance from the longwall (L) is introduced, which allows to create function space for the analyzed process (CH_4 of S-L). Results of coalmine measurements are interpreted using the method of local polynomial regression (LOESS). The study is based on using non-linear variations of methane concentration in the underground boreholes and specific features of their implementation to perform vacuum pumping in the most productive areas of the undermined rock mass in order to maintain safe aerogas conditions of the extraction block during intensive mining of deep-lying gassy seams. Identification of patterns in the influence of situational geomechanical conditions of coal mining on the initiation of metastable gas-coal solution transformation and genesis of wave processes in the coal-rock mass allows to improve reliability of predicting methane release dynamics, as well as workflow manageability of mining operations. Presented results demonstrate that development of high-methane Donbass seams is associated with insufficient reliability of gas drainage system operation at distances over 40 m behind the longwall face. Obtained results confirm a working hypothesis about the presence of spatial migration of methane concentration waves in the underground gas drainage boreholes. It is necessary to continue research in the area of estimating deviation angles of “advance fracturing” zone boundaries from the face line direction. Practical significance of research results lies in the possibility to use them in the development of scientific foundation for 3D gas drainage of a man-made coal-methane reservoir, taking into account spatial and temporal advancement of the production face.

Smirnyakov V.V., Fen N.M. Justification of a methodical approach of aerologic evaluation of methane hazard in development workings at mines of Vietnam. Journal of Mining Institute. 2018. Vol. 230, p. 197-203. DOI: 10.25515/PMI.2018.2.197



Abstract. The methods of evaluation of the aerological conditions to be performed for the purpose of normalization of mining conditions are provided in the present review; the location of possible accumulations of explosive gases during the drift of the development workings are taken into account. To increase the safety of the development working regarding the gas factor, a complex evaluation of a working was developed with respect to the dynamics of methane emission and air coursing along the working which is strongly affected by the character of the leakages from the ventilation ducting. Thereby, there occurs a necessity of the enhancement of a methodical approach of calculation of ventilation of a working which consists in taking into consideration a total aerodynamic resistance of the booster fan including the local resistances of the zones of the working. An integer simulation of the gas-air flows realized on the basis of a software package FLOWVision allows to evaluate a change in the methane concentration in the zones of local accumulations.

Peich L.M., Torrent K.G., Anez N.F., Eskobar K.-M.M. Prevention and protection against propagation of explosions in underground coal mines. Journal of Mining Institute. 2017. Vol. 225, p. 307. DOI: 10.18454/PMI.2017.3.307



Abstract. Over the past century, the coal mining industry experienced a large number of explosions leading to a considerable loss of life. The objective of this study is preventing the propagation of methane and/or coal dust explosions through the use of passive water barriers and its implementation to the Spanish coal mining industry. Physical and chemical properties, flammability and explosibility parameters of typical Spanish coals are presented. In this paper, a flexible approach to meet the requirements of the EN-14591-2:2007 standard is presented for the very specific local conditions, characterized by small cross-sections galleries, vertical seem, use of explosives, etc. Authors have proven the viability of standard requirements to the typical roadway from Spanish underground mines, considering realistic roadway lengths as well as available cross-sections taking into account ubiquitous obstacles such as: locomotives, conveyor belt, ventilation ducts, etc.



*Evan Thomas lamp.
Item belongs to the Mining Museum*

Alabev V.R., Korshunov G.I. Safety provision during heating of coal downcast shafts with gas heat generators using degassed methane. Journal of Mining Institute. 2017. Vol. 225, p. 346-353. DOI: 10.18454/PMI.2017.3.346



Abstract. The article describes new technology of heating downcast shafts in coal mines in Ukraine using heat generators (air heaters) of mixed and indirect action type. It compares this method with traditional heating systems for downcast shafts and describes all their disadvantages. It is shown that application of new heating technology enables not building such elements as boilers and pipelines and not buying metal-consuming heaters. These peculiarities will help to significantly reduce capital and operation costs for construction and operation of heating system with significantly shortened commissioning periods for heating systems. The article describes an example of heater unit design layout for heating downcast shaft in mine «Scheglovskaya-Glubokaya» at colliery group «Donbass» using mixed type heat generators. It presents a layout of sensors for controlling parameters of ventilation air flow taking into account incoming hazardous combustion products from methane-air mixture combustion in channels of heating unit. The article mentions features of automated control system providing protection of heat generators in emergency situations. It also notes disadvantages of mixed type heat generators limiting their application in Russian Federation. Together with heat generators of mixed type the article also describes a working principle of heat generator of indirect action type, which to the fullest extent possible meets requirements of Russian Federation legislation and regulation for application of this heat generators in coal mines conditions. The article has a principal working scheme of heat unit layout using this type of generator. It is shown that after development of corresponding normative documents regulating processes of design, construction and operation of heating units using heaters of indirect action, their application in Russian coal mines will be possible without breaking Safety standards and rules.

Korshunov G.I., Isakov R.R. Professional morbidity and traumatism at coal enterprises. Journal of Mining Institute. 2009. Vol. 180, p. 25-26. <https://pmi.spmi.ru/index.php/pmi/article/view/7085>



Abstract. The article gives information on the sickness rate and industrial injuries at coal-mining operations. Professional occupation and ages of workers that the most susceptible to illnesses are shown.

Dzhigrin A.V., Gorlov A.Y. Risk analysis and prevention of emergency situations associated with the explosion of methane and coal dust in mines // Journal of Mining Institute. 2006. Vol. 168, p. 94-96 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/7918>



Abstract. For the Russian coal industry, the issues of developing a risk analysis of emergency situations caused by the explosion of methane and coal dust in mines are extremely relevant. Feasibility studies made it possible to propose for the classification assessment of an emergency a severity coefficient of the consequences of accidents, taking into account the volume of explosion propagation, economic damage from the destruction of fixed assets and loss of production, as well as the severity of injuries to working personnel.

Govor R.A. Technological and technical solutions for prevention and extinguishing of endogenous fires at the mines of OJSC UCC Yuzhkuzbassugol. Journal of Mining Institute. 2006. Vol. 167 (2), p. 89-92 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/7967>



Abstract. The risk of endogenous fires at the mines of Southern Kuzbass, developing mainly coal seams prone to spontaneous combustion, is quite high. The occurrence of underground fires leads to significant material losses, both direct and for emergency rescue work. The data on the volumes of production from thick seams at the mines of OJSC UCC Yuzhkuzbassugol and on the number of endogenous fires in recent years are given. A comprehensive system of measures to prevent and extinguish endogenous fires at the stage of design, development of the mining area passport, mining and isolation of the mined-out space is proposed. Application of the system will significantly reduce the risk of spontaneous combustion of coal, ensure the safety of mining coal seams prone to spontaneous combustion, and significantly reduce material losses associated with extinguishing endogenous fires.

Vinokurov V.A. Issues of Industrial Safety and Integrated Use of Subsoil in OAO Krasnoyarskkrayugol. Journal of Mining Institute. 2005. Vol. 164, p. 58-60 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/8313>



Abstract. The article deals with the activities of Open Joint Stock Company Krasnoyarskkrayugol on multi-purpose utilization of coals for associated rare metals mining, for the formation of semi-coke, for the manufacture of briquettes and other products. The ways of realization of some provisions of the law on industrial safety of hazardous production facilities are shown.

Trofimov A.Y., Yaragin A.A. The influence of rock pressure on the gas factor of the outburst hazard of salt rocks in zones of geological disturbances. Journal of Mining Institute. 1980. Vol. 82, p. 129-132 (in Russian). <https://pmi.spmi.ru/index.php/pmi/article/view/11020>



Abstract. One of the main factors causing salt and gas outbursts is gas. As established in the work, this also applies to emissions originating from zones of local geological disturbances encountered during the development of the third potash horizon of the Starobinskii deposit.

Scientific edition

MINER'S DAY

Digest

JOURNAL OF MINING INSTITUTE

№ 12 • 2024

Editor *S.V. Sinyavina*

Digester *P.V. Kotova*

DTP specialist *S.A. Lysenko*

Photos are submitted by the Mining Museum
(photographer *P.V. Dolganov*)

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of Empress Catherine II
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