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DIGEST

SPACE AND GEOSYSTEMS: INTERDISCIPLINARY RESEARCH

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EMPRESS CATHERINE II
ST. PETERSBURG MINING UNIVERSITY

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Abstract

The digest is a collection of abstracts of articles published in the Journal of Mining Institute between 1912 and 2025, united by the common topic of space exploration and its interaction with geosystems.
The articles present the evolution of approaches – from the first descriptions of meteorites from the Mining Museum collection to modern methods of remote sensing of the Earth, satellite navigation, and geodynamic monitoring. The included articles cover a wide range of topics: petrology and geochemistry of cosmic matter, the influence of galactic cycles on geological processes, the cosmogenic factor in the formation of impact structures, as well as the application of satellite and aerospace technologies in geodesy, mining, and ecology monitoring.
The digest is of interest to researchers working at the intersection of planetology, geology, and geoinformatics, and clearly illustrates the development of scientific views on the role of cosmic phenomena in the formation and development of the Earth.

Content

Kupffer A.E. To the description of meteorites from Augustinovka, Petropavlovsk and Tubila // Journal of Mining Institute. 1912. Vol. 3. P. 315-318 (in Russian). https://pmi.spmi.ru/pmi/article/view/15511

Abstract. The descriptions of the named meteorites available in the scientific literature are based on insufficient material from large collections of meteorites and require more detailed characterization. The distribution of the main masses of these meteorites, currently located in the museum of the Mining Institute, made before, was highly imperfect and did not allow for a detailed and complete description of them; pieces of them, partly including the huge main piece of the Augustinovka meteorite, left without a special care, became covered with thick layer of rust.

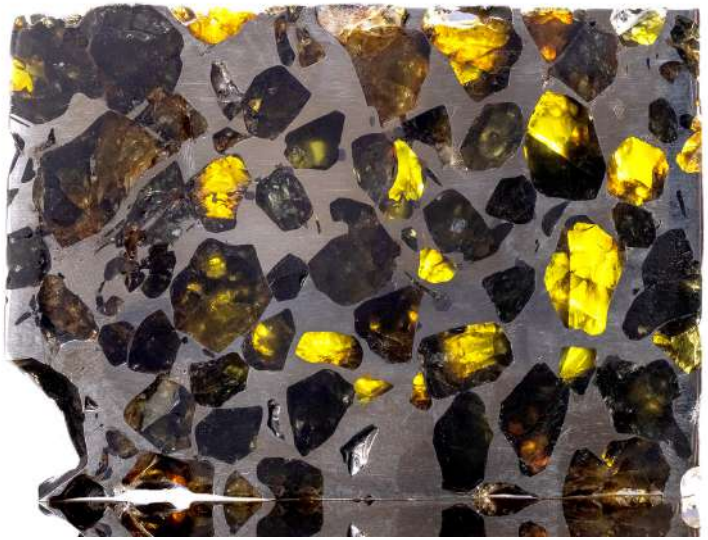
Petropavlovsk (Petropavlovsky Priisk). Main mass of the iron meteorite. Weight: 6000 g. From the collection of the Mining Museum

Toubil River. Main mass of the iron meteorite. Weight: 10,480 g. From the collection of the Mining Museum

Augustinovka. Main mass of the iron meteorite. Weight: 327,500 g. From the collection of the Mining Museum

Dolivo-Dobrovolskaya G.I., Kolomensky V.D. Types of dislocations in olivine from meteorites // Journal of Mining Institute. 1988. Vol. 115. P. 100-103 (in Russian). https://pmi.spmi.ru/pmi/article/view/10382

Abstract. Olivine crystals of cosmic origin are widely used as natural detectors of nuclear radiation in the search for superheavy elements in meteorites.



Esquel. Slice of the stony-iron meteorite.
From the collection of the Mining Museum

Sukhanova K.G., Kuznetsov A.B., Galankina O.L. Features of olivine crystallization in ordinary chondrites (Saratov meteorite): geochemistry of trace and rare earth elements // Journal of Mining Institute. 2022. Vol. 254. P. 149-157. DOI: 10.31897/PMI.2022.39. https://pmi.spmi.ru/pmi/article/view/15827

Abstract. The paper discusses the geochemistry of major (EPMA) and trace (SIMS) elements in olivine of porphyritic, nonporphyritic chondrules, and the matrix of equilibrated ordinary chondrite Saratov (L4). Olivine corresponds to forsterite and is rather heterogeneous (Fo 73-77). No differences in the content of the major elements in the olivine of the chondrule and the matrix of the meteorite were found. However, the content of major and trace elements in olivine within chondrules varies considerably; high values found in olivine from barred chondrules. Olivine from porphyritic chondrules and the matrix of the Saratov meteorite have similar concentrations of trace elements. High concentrations of refractory (Zr, Y, Al) and moderately volatile (Sr and Ba) trace elements in barred olivine chondrule indicate the chondrule melt formation due to the melting of precursor minerals and its rapid cooling in the protoplanetary disk, which is consistent with the experimental data. The olivine of the chondrules center of the Saratov meteorite differs from the olivine of the chondrules rims and meteorite matrix by the increased values of the Yb/La ratio. No relict grains and magnesian cores of olivine were found in meteorite chondrules. Individual grains in the chondrules are distinguished by their enrichment in trace elements relative to the rest of the olivine grains in the chondrule.

Saratov. Fragment of the stone meteorite.
From the collection of the Mining Museum

Sukhanova K.G. Trace elements in the silicate minerals of the Borodino Meteorite (H5) // Journal of Mining Institute. 2024. Vol. 265. P. 16-33. https://pmi.spmi.ru/pmi/article/view/16218

Abstract. Major (EPMA) and trace (SIMS) element geochemistry in olivine, low-Ca pyroxene and mesostasis from porphyritic and barred chondrules, as well as the pyroxene-olivine aggregate and matrix of equilibrated ordinary Borodino chondrite (H5) is discussed. No differences in major element concentrations in the silicate minerals of the chondrules and matrix of the meteorite were found. The minerals of porphyritic olivine-pyroxene and barred chondrules display elevated trace element concentrations, indicating the rapid cooling of chondrule melt in a nebula, and are consistent with experimental data. The trace element composition of low-Ca pyroxene is dependent on the position of a pyroxene grain inside a chondrule (centre, rim, matrix) and the composition of mesostasis

Borodino. Main mass of the stone meteorite. Weight: 137,777 g. From the collection of the Mining Museum

is controlled by the type of the object (porphyritic and barred chondrules, pyroxene-olivine aggregate). The depletion in trace elements of low-Ca pyroxene from the rims of chondrules in comparison with those from the centre and matrix of the meteorite was revealed. The chondrule rim is affected by interaction with surrounding gas in a nebula, possibly resulting in the exchange of moderately volatile trace elements in low-Ca pyroxene and depletion in these elements relative to pyroxene from the centre of the chondrule or matrix of the meteorite. The mesostasis of barred and porphyritic olivine-pyroxene chondrules contains more trace elements than that of porphyritic olivine chondrule and pyroxene-olivine aggregate, suggesting the rapid cooling of these objects or their high liability to thermal metamorphism, which results in the recrystallization of chondrule glass into plagioclase. However, no traces of the elevated effect of thermal metamorphism on the above objects have been revealed. The results obtained indicate no traces of the equilibration of the trace element composition of silicate minerals in equilibrated chondrites.

Sukhanova K.G., Galankina O.L. Trace element composition of silicate minerals from Kunashak Meteorite (L6) // Journal of Mining Institute. 2024. Vol. 270. P. 877-892. https://pmi.spmi.ru/pmi/article/view/16341

Abstract. ПMajor (EPMA) and trace (SIMS) element geochemistry in the silicate minerals (olivine, pyroxene and plagioclase) of Kunashak equilibrated ordinary chondrite (L6) is described. No variations in the major element concentrations of the silicate minerals have been found, which is characteristic of equilibrated chondrites of petrological type VI. Low-Ca pyroxene and plagioclase from the radiated olivine-pyroxene chondrule of Kunashak Meteorite contain an abundance of trace elements (Yb, Cr, Nb and Ti – pyroxene; Sr, Y, Ti and Zr – plagioclase), which is not characteristic of minerals from the porphyritic olivine and olivine-pyroxene chondrules of the meteorite. The porphyritic olivine-pyroxene chondrule of the Kunashak Meteorite has high trace element concentrations in olivine, in particular, the highest Yb concentration (0.12 ppm on the average) relative to porphyritic and radiated olivine-pyroxene chondrules (0.02 ppm). High trace element

concentrations indicate rapid crystallization of a radiated chondrule in a nebula and show no traces of trace element homogenization upon thermal metamorphism. The trace element composition of silicate minerals from Kunashak Meteorite has retained the individual melting pattern of the chondrules and remained unaffected by thermal metamorphism on the parent bodies of the chondrules. Similar results, obtained in the study of Bushkhov Meteorite (L6), indicate that trace elements in olivine and low-Ca pyroxene are resistant to thermal metamorphism. The persistence of the individual pattern of the chondrules enables us to use equilibrated ordinary chondrites for the study of processes at early stages in the formation of the Solar System and to better understand chondrule and planet formation mechanisms.

Kunashak. Individual specimen of the stone meteorite. From the collection of the Mining Museum

Relationship and Influence of Geological and Cosmic Phenomena

Krzhizhanovskaya A.A. Plumb line deviations in mountainous area // Journal of Mining Institute. 1958. Vol. 37 (1). P. 64-82 (in Russian). https://pmi.spmi.ru/pmi/article/view/13014

Abstract. Until recently, the solution of the main task of higher geodesy – determination of the Earth's shape – was connected with the study of the external gravitational field and the shape of Listing's geoid. The only method of gravimetric derivation of the geoid's shape was the Stokes method, the application of which requires the removal of masses external to the geoid, the so-called regularization of the Earth.

Krzhizhanovskaya A.A. About numerical characterization of the local figure of the Earth // Journal of Mining Institute. 1964. Vol. 43 (3). P. 106-113 (in Russian). https://pmi.spmi.ru/pmi/article/view/12717

Abstract. Over the last 20 years, new methods have been introduced in geodesic science, allowing to solve all the main problems of geodesy by the values characterizing the external gravitational field and the figure of the Earth's physical surface. In the non-pratial and complex physical surface of the Earth, a smooth surface close to Listing's geoid, called quasigeoid, is distinguished.

Pavlov A.N. The property of indivisibility of geologic space-time // Journal of Mining Institute. 1988. Vol. 115. P. 6-11 (in Russian). https://pmi.spmi.ru/pmi/article/view/10366

Abstract. In modern geology we can state a paradoxical situation: on geological maps and sections of essentially any purpose time and space are geometrically combined, moreover, they are represented by a mass of rocks that can be characterized by a certain stock of internal energy, and the relationship between these fundamental physical parameters remains virtually unexplored.

Pavlov A.N. Search for invariance of the interval between geologic events // Journal of Mining Institute. 1992. Vol. 134. P. 42-46 (in Russian). https://pmi.spmi.ru/pmi/article/view/10037

Abstract. The energy content of rock, the calculation of which was proposed by the author in earlier works, is considered as the energy of rock existence. By analogy with the energy of existence of a particle (rest energy), a certain limiting velocity is derived from this value, beyond which the rock as an element of the Earth and the Solar System ceases to exist. The invariance of the interval between geological events is based on it.

Barenbaum A.A. Origin of asteroids and meteorites (new cosmogonic concept) // Journal of Mining Institute. 1992. Vol. 134. P. 9-27 (in Russian). https://pmi.spmi.ru/pmi/article/view/10034

Abstract. ΠA concept of the origin of asteroids and meteorites that is different from the generally accepted one is proposed. The solar system is considered as a physically “open” system of bodies, which is periodically exposed to a strong galactic impact, which became 4.7 billion years ago the cause of the destruction of Phaeton. On the basis of meteorite data, a deep connection between the shell structure of Phaethon and the modern Earth has been established, which allows us to better understand the nature of planetary evolution after accretion. The existence of chemical classes and groups of meteorites is explained as a result of mixing of material of separate inner shells of Phaeton and gas-dust substance of galactic comets. Having considered the range of processes currently taking place in the asteroid belt, which are important for understanding the nature and origin of other small bodies of the solar system.

Amphibolite. Kola Superdeep Borehole. Depth: 11,260 m.
From the collection of the Mining Museum

Novo-Urei. Main mass of the stone meteorite. Weight: 1065 g.
From the collection of the Mining Museum

Chebankol. Slice of the iron meteorite.
From the collection of the Mining Museum

Kulinkovich A.E. Physical models of galactic geology // Journal of Mining Institute. 1992. Vol. 134. P. 87-94 (in Russian). https://pmi.spmi.ru/pmi/article/view/10042

Abstract. The physical causes responsible for low-frequency geological cycles (megacycles) with the duration of periods of 2 billion, 1 billion, 500 million, 350 million years and 176 million years are considered.

Zakoldaev Yu.A. The galactic year and global geologic cycles // Journal of Mining Institute. 1992. Vol. 134. P. 70-76 (in Russian). https://pmi.spmi.ru/pmi/article/view/10040

Abstract. Based on the methods of statistical and combinatorial analysis of more than 70 empirical geochronometric scales of the Phanerozoic, cyclic regularities were revealed with high reliability, which allowed us to calculate the parameters of the galactic orbit of the Solar System, to consider the connection of general planetary geological processes with the position of the Solar System in the galactic orbit, and to construct a global theoretical scale of the Phanerozoic, subdivided into ages and combinations of ages.

Kulinkovich A.E. The relationship between the history of the Earth and the Universe // Journal of Mining Institute. 1992. Vol. 134. P. 77-86 (in Russian). https://pmi.spmi.ru/pmi/article/view/10041

Abstract. The interrelation of micro-, macro- and megarhythmics of the Universe is considered, conditioned by their correspondence to the genetic code of the Universe – a set of primordial rhythms unambiguously defined by the world constants. The Universe, thus, has a resonance-interconnected rhythmic structure, a fragment of which is geological cyclicities. This allowed us to construct a single equation describing the occurrence of fundamental events in the history of the Universe, Galaxy and Earth. Comparison of the calculated dates with the dating of real events in the history of the Universe, Galaxy and Earth shows their good correspondence.

Barenbaum A.A. The solar system at the time of Phaethon's explosion. The origin of the moon // Journal of Mining Institute. 1992. Vol. 134. P. 95-106 (in Russian). https://pmi.spmi.ru/pmi/article/view/10043

Abstract. In the evolutionary history of the Solar System, two rather long evolutionary stages are distinguished, separated by the relatively short epoch of the Phaethon explosion 4.7 billion years ago. Before this event, the masses of all planets, excluding Pluto, obeyed a single pattern, which was inherited by them from the protoplanetary stage. During the epoch of Phaethon's destruction, most of the planets of the Solar System underwent significant changes that affected their mass, structure, and composition. The hypothesis of the Moon formation is proposed within the framework of the general scheme.

Dar al Gani 400 (Дар аль Гани 400). Пластина каменного метеорита (лунная анартозитовая брекчия). From the collection of the Mining Museum

Masyutin V.N. Complex-system-structural approach to the problems of cognition of man, the Earth and the Universe // Journal of Mining Institute. 1992. Vol. 134. P. 107-115 (in Russian). https://pmi.spmi.ru/pmi/article/view/10044

Abstract. On the basis of the analysis of the results of the systematic study of the issues of the history of the birth of science, the process of cognition of official science, the set of methods of cognition and the issues of interaction between living and non-living systems, the complex-system-structural approach to the problems of cognition of man, the Earth and the Universe is substantiated. A scientific map of the world in a structural form, a strategy of truth-seeking and a complex-system model of any scientific research are proposed.

Khazanovich-Wulf K.K. Cosmogenic factor of diatherm formation // Journal of Mining Institute. 1992. Vol. 134. P. 141-152 (in Russian). https://pmi.spmi.ru/pmi/article/view/10048

Abstract. Taking into account the data of previous researchers (about spatial and temporal connections between ring explosive structures and diatreme fields, about deep structural indifference diatreme fields and zones, about electric discharge genesis of diatreme cavities, about electric interactions between meteoric bodies and the Earth's surface), the concept of explosion tubes formation as a result of interaction of electric fields of large meteoric bodies and the Earth's interior is put forward.

Zyuviite litho-vitriclastic. Popigai Crater. From the collection of the Mining Museum

Impact diamonds in individual grains and an impact diamond grain in tagamite. Popigai Crater. From the collection of the Mining Museum

Impactite. Janisjarvi Crater, Karelia. From V.L. Masaitis. 1989. From the collection of the Mining Museum

Sobolev L.M. Physical principles of forecasting the dynamics of natural and social processes // Journal of Mining Institute. 2001. Vol. 149. P. 274–276 (in Russian). https://pmi.spmi.ru/pmi/article/view/9654

Abstract. The studied heliophysical and geophysical processes in the Solar System and in the interior of the planet Earth testify to their interconnection and dependence on the global external influence in the form of dissipative energy exchange of the Solar System bodies between themselves and the Earth. The variations of the Earth rotation rate, geomagnetic and gravitational fields are a harmonic series of oscillations determined by gravitational dissipation. Dynamics of relative motion of structural elements (blocks) of the Earth's crust and related catastrophic consequences and technogenic risks are a consequence of heliophysical factors (tidal wave, Cariolis acceleration), which affect not only inanimate nature, but also humans (cardiovascular diseases and immune system disorders).

Step fault in effusive rock.
From the collection of the Mining Museum

Slip surface in silicified sandstone.
From the collection of the Mining Museum

Educational model, tectonics section.
From the collection of the Mining Museum

Serov L.V. Cosmological models of the Universe: theories and facts // Journal of Mining Institute. 2002. Vol. 152. P. 262-265 (in Russian). https://pmi.spmi.ru/pmi/article/view/9386

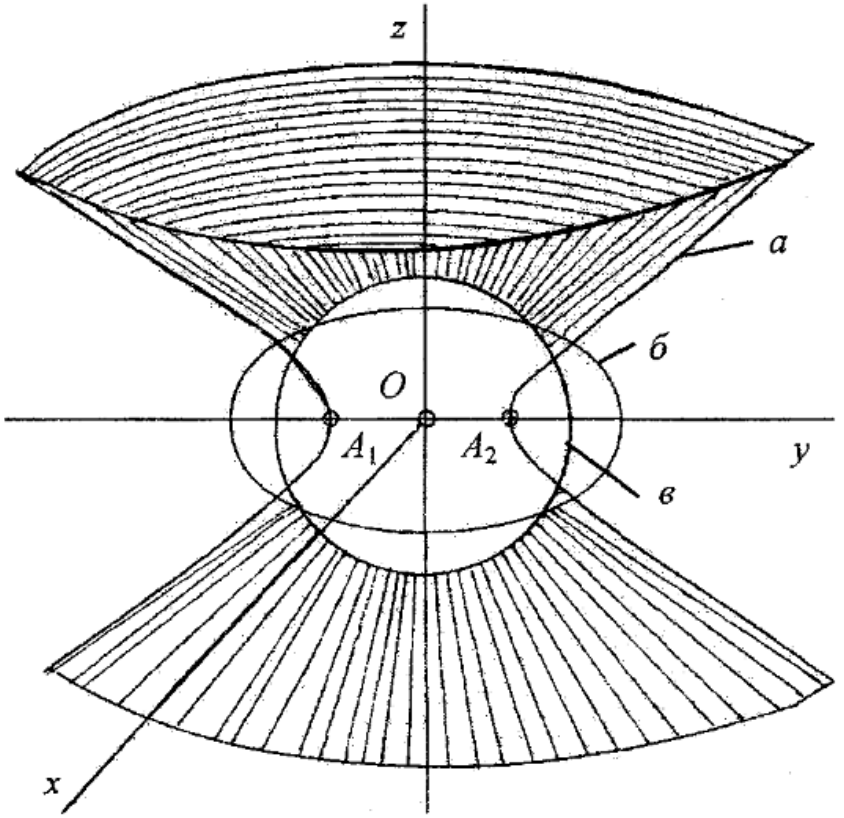
Abstract. Outlines ideas about the universe that have been formed throughout human history. Any cognitive process can be viewed from the perspective of two components: theories and facts. A theory is a product of the human mind, while facts are taken as given and either confirm or refute theoretical assumptions. At the dawn of mankind, ideas about the universe were based only on sensory experience. In ancient times, people had already accumulated enough knowledge and their cosmological models were more realistic, but still idealized. Today's researchers draw on an enormous amount of scientific experience and create powerful theories based on verified facts and advances in the exact sciences. But will today's ideas about the world remain as provable for generations to come? It is difficult to give a definite answer, but one thing is clear: modern theory can answer many questions concerning the evolution of the universe and is flexible and promising enough to be developed and supplemented in the future.

Pandul I.S. Determination of latitude and azimuth without the aid of a chronometer by a star with unknown coordinates // Journal of Mining Institute. 2004. Vol. 156. P. 225-228 (in Russian). https://pmi.spmi.ru/pmi/article/view/8973

Abstract. A new original method of determining the astronomical azimuth of the direction without knowing the coordinates of the location, sidereal time, and equatorial coordinates of the star is proposed. The azimuth is determined by double measurements of the zenith distances of the same star, horizontal directions to it, and measurements with a stopwatch of the difference of hour angles. A theoretical justification of the method is given and the most favorable observational conditions are investigated. The technique of measurements, sequence of field stages of work is given. The schemes of the observation log and calculation sheets are given. The proposed method will allow wider implementation of astronomical azimuth determinations in the practice of topographic and applied geodetic works.

Korobkov S.A. Deriving the equations of surfaces of rotation by transforming the equation of the Earth ellipsoid // Journal of Mining Institute. 2004. Vol. 156. P. 190-192 (in Russian). https://pmi.spmi.ru/pmi/article/view/8962

Abstract. The derivation of the equations of rotation surfaces in the form of tensor transformations of the canonical equation of the Earth ellipsoid is given.



Mutual position of three surfaces:
а – hyperboloid; б – ellipsoid; в – sphere;
A_1A_2 – equator of the hyperboloid

Tarasov B.G., Olovianny A.G., Bugaenko L.V. Preconditions for prediction of technogenic seismic activity by cycles of objects of the solar system // Journal of Mining Institute. 2010. Vol. 188. P. 183-188 (in Russian). https://pmi.spmi.ru/pmi/article/view/6607

Abstract. The paper contains the statistical rows of rockbursts, sudden outbursts of methane at coal mines and ore mines in Russia for the period from 1954 to 2007, as well as the reflection in them of the eleven-year cycles of the Sun activity. Some results are presented of computer modeling of activation periods of outburst-hazardous state of rock mass at coal mines of the Kuzbass basin. Recommendations are given.

Geological Globe. Scale 1:15,000,000. VSEGEI. 1973.
From the collection of the Mining Museum

Chalcopyrite-magnetite-pentlandite ore. Talnakh Deposit, Norilsk.
From the collection of the Mining Museum

Shabarov A.N., Tarasov B.G. Cycles of the Earth and Sun – the important factor of activity of geodynamic processes at coal- and ore mines // Journal of Mining Institute. 2010. Vol. 185. P. 37-40 (in Russian). https://pmi.spmi.ru/pmi/article/view/6766

Abstract. The paper contains the substantiation of the determinable role of the cosmos in rhythms of natural and technogenic phenomena at coal- and ore mines. The latent and explicit periods of up-to-date phase of attenuation of the solar constant in the cycle since 1982 to 2070 are shown, as well as the geodynamic consequences of this depression. This paper seeks to give rise to discussion of this problem for working out of coordinated actions in the decrease of geodynamic risks.

Shabarov A.N., Tarasov B.G., Mulev S.N., Bugaenko L.V. New technologies for analysis and revision of risks in the planetary-cosmic genesis in designing of mining operations // Journal of Mining Institute. 2012. Vol. 198. P. 114-121 (in Russian). https://pmi.spmi.ru/pmi/article/view/5926

Abstract. For the first time in practice of providing the safety in mining work consideration is given to the method of due account of the dynamics factors of rock masses of the cosmic genesis. The values of coefficient of rock mass dynamics in the 24-hours, monthly, annual, 11-year and 70-year cycles of geodynamic activity are given.

Lunar Globe.
From the collection of the Mining Museum

Chalcopyrite-magnetite-pentlandite ore. Talnakh Deposit, Norilsk.
From the collection of the Mining Museum

Tarasov B.G., Melnikov E.K., Bugaenko L.V. On cosmic rotation-pulsatory cycles of the Earth and the natural-technogeneous status of objects in underground space under conditions of geodynamic instability and solar depression in 1982-2065 // Journal of Mining Institute. 2012. Vol. 199. P. 35-42 (in Russian). https://pmi.spmi.ru/pmi/article/view/5816

Abstract. The Article contains the suggestions to assign the status of natural-technical systems functionating in the global rotation-pulsatory regime, to the objects of underground space, i.e. underground structures of water-supply system, electric power system, gas and heat-supply systems, to the metro structures, underground spaces of coal mines and ore mines and other technological complexes, and to assign the natural-technogeneous status to geodynamic phenomena occurring at these objects, i.e. breakage of pipelines with explosions and burning oydrocarbons, gushing of boiling water and rocks, deformation of tunnel walls and the metro stations causing leakage, etc., which takes account of a temporary natural component in dynamics of geospheres being attributed to vibratory rotation-pulsatory regimes of the Earth by contrast to the acting status of these events as technogeneous phenomena, with no taking account of dynamics of the planet in variations of cosmic weather.

Kell L.N., Trunin A.P. Prospects of helicopter application for aerial surveying // Journal of Mining Institute. 1958. Vol. 37 (1). P. 27-41 (in Russian). https://pmi.spmi.ru/pmi/article/view/13012

Abstract. At present, the use of aerial photography has acquired a wide scope not only for small-scale mapping of the Earth's surface, but also for the creation of topographic plans on a large scale. We know, for example, the successes of Soyuzmarkstrest, whose enterprises, using aerial photography, annually produce on a large area of topographic plans on a scale of 1:5000 and 1:2000. Large-scale surveying is also used with great success in road surveys, in urban surveying, in land management.

Pyatnitskaya M.P. Use of triple overlapping of aerial images in creation of large-scale topographic plans // Journal of Mining Institute. 1958. Vol. 37 (1). P. 42-63 (in Russian). https://pmi.spmi.ru/pmi/article/view/13013

Abstract. Analyzing the possibility of topographic plan creation using triple overlaps of aerial images.

Skoblov G.Z. Peculiarities of stereophotogrammetry use for determining the deformation of building structures // Journal of Mining Institute. 1969. Vol. 59 (1). P. 183-191 (in Russian). https://pmi.spmi.ru/pmi/article/view/11984

Abstract. Photogrammetric methods are widely used for non-topographic purposes and, in particular, in construction to determine deformations of engineering structures. A number of works devoted to this topic have appeared in recent years and some experience has been accumulated in this field. However, researchers often either copy the methodology and principles of aerial photography, which complicates and complicates the necessary calculations, or simplify the method to such an extent that it becomes suitable only for architectural measurements or for determining large absolute values of deformations (2–3 mm).

Golovko V.A., Kondranin T.V. Theoretical model for quantitative assessment of ecosystem dynamics using time series of remotely sensed satellite data // Journal of Mining Institute. 2001. Vol. 149. P. 61-63 (in Russian). https://pmi.spmi.ru/pmi/article/view/9577

Abstract. Theoretical model of quantitative assessment of the progressive development of the ecosystems with the application of time series of remote sensing satellite recordings. As a result of the ecosystems' remote sensing of synological and regional scale, received by satellites, there has been formed the computer database, has been made the scientifically acknowledged model validation, has been carried out the formalization and has been created the new theoretical model of quantitative assessment of the progressive development of ecological systems, which use the time series observations of natural objects made by the special space equipment as the basic data, there have been worked out the pattern generation algorithm and the software support of the model; the model was approved on a test polygons, supplied with a sufficient number of satellite and ground-based observation recordings. On the basis of this research the model was adapted for the solution of the prognostic tasks of the development of the regional ecosystems in conformity with the highly informative satellite recordings.

Tereshin A.G., Klimenko V.V. Use of data from satellite monitoring of planetary atmospheric composition to quantify nitrogen oxide emissions // Journal of Mining Institute. 2001. Vol. 149. P. 120-122 (in Russian). https://pmi.spmi.ru/pmi/article/view/9598

Abstract. Based on GOME satellite data on NO_2 distribution in the troposphere, the anthropogenic emission of nitrogen oxides in Russia in 2000 was estimated. The obtained value of 4 million tons agrees well with the value calculated from energy consumption data, which allows using space monitoring to substantiate emission inventories.

Safaraliev G.K., Bulaeva N.M., Tupik N.V. Geodynamics and thermal fields of the eastern Precaucasian region // Journal of Mining Institute. 2001. Vol. 149. P. 170-173 (in Russian). https://pmi.spmi.ru/pmi/article/view/9616

Abstract. It is noted that the territory of Dagestan and the adjacent part of the Caspian Sea as an object of monitoring of geodynamic movements and thermal fields is a unique geophysical laboratory, where on a relatively small territory there are different landscapes: from glaciers and alpine meadows to deserts and semi-deserts. The territory has a complex tectonic structure, geodynamic and seismic activity is high, and anthropogenic load on the environment is significant. The collected long-term factual material is used in the ongoing research along with the establishment of a geodynamic GPS-observation network and modern thermal survey of the region. As part of the work, field studies were conducted at the polygon to measure the temperature field at shallow depths; thermal space images were studied, and the obtained information was compared and analyzed.

Valeev V.G. Remote control of dangerous goods transportation // Journal of Mining Institute. 2001. Vol. 149. P. 257-259 (in Russian). https://pmi.spmi.ru/pmi/article/view/9647

Abstract. Transportation of dangerous goods by road in populated areas requires continuous control of the route, mode and conditions of transportation. Continuous remote control of transportation is a new technological task, the solution of which is based on scientific and technical achievements in satellite radio navigation, data transmission from mobile objects and geoinformation technologies. The principles of construction of the remote control system in relation to Russian conditions are considered, technical substantiation of the principles of construction of all components of the system is given: vehicle equipment (VE), radio-technical network of data transmission from VE to dispatching center (DC), equipment and software of DC. The possibilities of using hardware and software products of domestic manufacturers in the system are shown.

Gusev V.N., Takranov R.A., Volokhov E.M., Zarukin A.S., Zverevich V.V., Pavlov S.P., Sheremet A.N. Forecast and assessment of the technogenic impact of mining on the geological environment // Journal of Mining Institute. 2001. Vol. 146. P. 3-8 (in Russian). https://pmi.spmi.ru/pmi/article/view/9785

Abstract. In the article the methods of an estimation of technogenic effect of mining minings on geologic medium, statistical and probabilistic models of distribution of quality for the geographical demarcation of fields are adduced. Are set up to fundamentals of the theory of operation GPS of instrumentation and electronic tacheometers at overseeing ground movement of rocks, ergonomics of realisation of these supervision (observations).

Yakovlev N.N. On the choice of the optimal interval between measurements when calculating the orbits of spacecrafts equipped with satellite receivers // Journal of Mining Institute. 2001. Vol. 146. P. 178-180 (in Russian). https://pmi.spmi.ru/pmi/article/view/9820

Abstract. The problems of selection measurement interval for satellite orbit determination with using GPS/GLONASS are regarded. Research results may be used in designing different satellite apparatus.

Yakovlev A.I., Yakovlev N.N., Stepanov I.V. On the calculation of orbits of spacecrafts equipped with receiving devices GLONASS/GPS // Journal of Mining Institute. 2001. Vol. 146. P. 181-184 (in Russian). https://pmi.spmi.ru/pmi/article/view/9821

Abstract. The main question of using GPS/GLONASS receivers for satellite orbit determinations are given. The “a priori” calculations of satellite orbit accuracy are done. The investigation results may be applied in designing perspective cosmic geodetic apparatus.

Alekseev V.F., Markovkin N.D., Yakovlev A.I. Methods for the determination of geodetic azimuths with the use of the equipment of space navigation system users // Journal of Mining Institute. 2001. Vol. 146. P. 185-187 (in Russian). https://pmi.spmi.ru/pmi/article/view/9822

Abstract. The technique of definition of geodetic azimuth for mean and large distances with application of satellite navigational systems is offered and the analysis of efficiency of this technique in comparison with conventional ways is carried out.

Abbud M., Yunes Z. Development of methods of geodetic support of hydraulic structures construction on the basis of satellite technologies // Journal of Mining Institute. 2003. Vol. 155 (1). P. 118-121 (in Russian). https://pmi.spmi.ru/pmi/article/view/9083

Abstract. The technological scheme of geodetic support for the construction of hydraulic structures intended for the safety of the runway of the airfield in Beirut (Lebanon) was developed. The basic method of geodetic measurements is accepted a satellite method in a relative mode. This method is multidimensional for the considered object of works (the method is used for the survey of the bottom relief, embankment of the dam body and laying of building blocks).

Kuleshov A.A. Ways to improve the quality of operation of quarry road transport systems in modern conditions // Journal of Mining Institute. 2004. Vol. 157. P. 181-185 (in Russian). https://pmi.spmi.ru/pmi/article/view/8906

Abstract. The structure of the system of quarry motor transport, differentiated criteria of its quality are considered. The analysis of the current quality level of each of the subsystems is given. The methods and means of solving problems of qualitative performance by the system of its functions are shown. The scheme of dispatching of technological motor transport on the basis of satellite communication-GPS-system of global positioning of the observed object (dump truck) is given.

Astapovich A.V., Bryn M.Ya., Koltsov I.V., Sugako V.V. On the problem of strict alignment of geodetic networks developed by a set of satellite navigation system stations // Journal of Mining Institute. 2004. Vol. 156. P. 205-206 (in Russian). https://pmi.spmi.ru/pmi/article/view/8966

Abstract. The problem of strict equation of geodetic networks developed by a set of stations of satellite navigation systems is raised, which is caused by the fact that as a result of post-processing by existing programs receive covariance matrices of errors of increments of spatial coordinates for each measured side of the geodetic network separately. The matrix does not take into account the correlation that is caused by the fact that the results of observations of many satellites are used simultaneously to determine the coordinate increments on all measured sides of the network. It is shown that for a rigorous equation, the covariance matrix of satellite measurement errors should be determined as a result of correlation analysis, and the equation should be performed by the regularized least squares method.

Sergeev O.P. Surveying work on the construction of the cable-stayed bridge over the Neva River in St. Petersburg // Journal of Mining Institute. 2004. Vol. 156. P. 217-218 (in Russian). https://pmi.spmi.ru/pmi/article/view/8970

Abstract. The Department of Engineering Geodesy of the University of Railway Transport carries out geodesic works on the construction of the cable-stayed bridge across the Neva river in St. Petersburg. Two steel pylons of 124 m height each will hold on the steel cables – cable stays –the span of 670 m length (322 m – the river span and two shore spans of 174 m). The geodetic demarcation network for the bridge construction, including 51 points, was created with the use of electronic total stations and the GPS satellite system. Electronic total stations from “Leica”, “Sokkia”, “Topcon” with an accuracy of angles measurements of 2-3” and distances ($2 + 2 \cdot 10^{-6} S$) mm allow with high accuracy to mount the blocks of the pylon and the superstructure. Deformations of pylons and span arising due to the influence of wind and uneven heating by the sun, high requirements to the accuracy of installation of cable fastening devices in the span and pylons required the development of original methods of geodetic works with the use of laser and high-precision devices.

Tselovalnikov V.G. Possibility of application of satellite radio-navigation systems in modern construction // Journal of Mining Institute. 2006. Vol. 167 (1). P. 153-155 (in Russian). https://pmi.spmi.ru/pmi/article/view/8092

Abstract. Modern construction technologies are developing very quickly. Geodetic support of construction has a significant impact on the quality and timing of building erection and, as a final result, on the economic efficiency of capital investments. The article presents a combined method of using modern satellite technologies and traditional ground methods of axes transfer to the installation horizon. Application of GPS systems allows to solve construction tasks with considerable accuracy and with minimal time expenditures. Attention is also paid to the existing regulatory framework.

Fox L. New developments in the field of equipment for MTZ and AMTZ methods // Journal of Mining Institute. 2008. Vol. 176. P. 114-120 (in Russian). https://pmi.spmi.ru/pmi/article/view/7297

Abstract. There are two parallel approaches clearly appeared in elaboration of the fifth generation of multifunctional electroprospecting equipment. Both approaches have multiple channels. The first one (which is more closely related to the previous generations models) has, as the main features, a central (recording, controlling and processing) unit connected by cables to 20-24 one- or two-channel boxes, each with preamplifier, ADC and small memory. Only two channels are used for horizontal magnetic components, all other channels measure horizontal electric components. The second approach (dominating now at the world equipment market) features an unlimited number of independent (without cables) 5-, 3- and 2-channels boxes, all synchronized by GPS. Most recently (in 2005) «Phoenix Geophysics Ltd» released a telemetric multifunctional system under the trade name SSMT.net, which incorporates advantages from both mentioned approaches. Since 2003, a natural field electroprospecting technique, measuring only three magnetic components, has grown rapidly for various types of useful minerals.

Serpentine in kimberlite. Udachnaya pipe, Yakutia. From the collection of the Mining Museum

Diamond in kimberlite. Mir pipe, Yakutia. From the collection of the Mining Museum

Kuznetsova E.N. Surveying methods for providing geodynamical safety of mining operations // Journal of Mining Institute. 2010. Vol. 185. P. 240-242 (in Russian). https://pmi.spmi.ru/pmi/article/view/6812

Abstract. It is impossible to solve the main task of geodynamics without using technologies including traditional measurements of bench marks excursion, as well as new technologies of the end of XX – beginning of XXI century, such as photogrammetry, global positioning system, laser measurements and technologies of geophysical well logging. The paper concerns with the analysis of the mine surveying methods facilitating the solution of tasks related to the geodynamical safety assurance.

Kantemirov Yu.I., Baranov Yu.B., Kiselevskii E.V., Bilyansky V.V., Nikiforov S.E., Gryaznov V.G., Bolsunovsky M.A., Lanzl R. Control of deformations of buildings and constructions at the built-up territories within mining diversions of oil and gas fields under conditions of Far North // Journal of Mining Institute. 2010. Vol. 185. P. 247-249 (in Russian). https://pmi.spmi.ru/pmi/article/view/6814

Abstract. Results of monitoring of buildings' deformations in Noviy Urengoi town (situated inside the lease of giant oil and gas Urengoi field) are presented. Monitoring consists of multi-pass satellite radar imaging, GPS-measurements and repeated geometric leveling.

Potyukhlyaev V.G. The calculation of accuracy of breaking the network using satellite navigation systems // Journal of Mining Institute. 2012. Vol. 199. P. 325-328 (in Russian). https://pmi.spmi.ru/pmi/article/view/5867

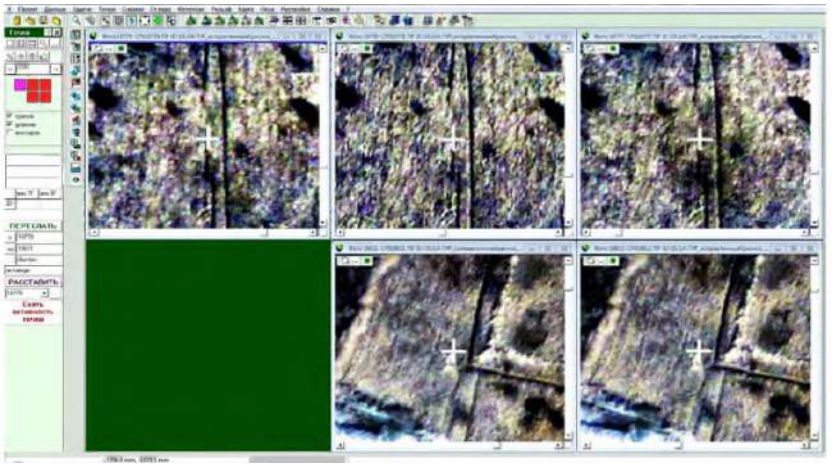
Abstract. Data is expounded about the modern production technology of marking works at building various objects, including those in mining industry with the use of satellite navigating systems and electron-optical devices. There are examples of accuracy calculation on constructing network of a building site proceeding from building admissions with the subsequent moving of starting points on wall signs.

Khudiakov G.I., Makarov G.V. Use of affinne coordinate conversion at the local geodetic surveys with applying of GPS-receivers // Journal of Mining Institute. 2013. Vol. 204. P. 15-18 (in Russian). https://pmi.spmi.ru/pmi/article/view/5542

Abstract. For the local geodetic surveys carried out with the help of the receivers of satellite radionavigation systems, it is offered to use the affinne conversion of flat coordinates, is well known in analytical geometry in the plane. The algorithm of the solution of a problem of such coordinate conversion is given. The testing of the implementation of this algorithm used for electronic-cartographical support of intelligent transportation systems, in real service conditions of intelligent transportation systems is described.

Kornilov Yu.N., Zvereva O.V., Artemyev P.A. The improvement of a technique of an automatic set of binding points in software «Geomatika-Fotoskhem 0.0.1» // Journal of Mining Institute. 2013. Vol. 206. P. 56-59 (in Russian). https://pmi.spmi.ru/pmi/article/view/5436

Abstract. This article is dedicated to consideration and the analysis of an automatic binding points kit option in software «Geomatika-Fotoskhem», and also development of a new technique of arrangement of points in the offered software product.



Incorrect tie point position in overlap zones

Litvinenko V.S. Unique engineering and technology for drilling boreholes in Antarctic ice // Journal of Mining Institute. 2014. Vol. 210. P. 5-10 (in Russian). https://pmi.spmi.ru/pmi/article/view/5259

Abstract. As the result of many years of research into the processes of the transfer of ice as a rock mass on a global scale, concerning the Antarctic ice sheet at the ultra-deep 5G borehole, a discovery has been made that is of international significance in the areas of glaciology and geodynamics. Those who created the theory of thermal and mechanical penetration into ice and loose sediments have developed unique technology and engineering processes in order to drill boreholes using thermal and mechanical methods.

According to representatives of the National Aeronautics and Space Administration (NASA), a comprehensive study of Lake Vostok is the first and necessary step in a long-term program to search for signs of life in subglacial seas on Mars and Europa (a moon of Jupiter).

Petrova T.A. Approach to the conduct of monitoring studies in the area of the mineral and raw complex objects using remote sensing // Journal of Mining Institute. 2014. Vol. 207. P. 210-212 (in Russian). https://pmi.spmi.ru/pmi/article/view/5420

Abstract. The article gives a brief description of the spacecraft used to monitor the environment in the vicinity of industrial facilities mineral complex. Describes the basic uses of satellite data for assessing the impact of objects mineral complex on the components of the environment.

Pervukhin D.A., Ilyushin Yu.V. A parallel analysis of hydrolithospheric beds geodata of Narzan mineral water Kislovodsk deposit // Journal of Mining Institute. 2016. Vol. 221. P. 706-711. DOI: 10.18454/PMI.2016.5.706. https://pmi.spmi.ru/pmi/article/view/5894

Abstract. The area of the Caucasus Mineral Waters – an environmental spa – occupies a special place among the other spa regions of Russia due to richness, diversity, abundance and value of its mineral waters, landscape and climate conditions, and therapeutic muds. Lately the rate increased of developing its mineral water resources for both the local spa use and bottling for retail consumers. The growing number of mineral water bottling enterprises and sanatorium organizations affects significantly the amount of mineral water uptake. Irrational water uptake results in deterioration of underground water quality, change of its chemical composition and temperature. Expansion of the depression crater may eventually result in a collapse of seams roofing and vanishing of many water springs. It refers to all the waters underlying the area of Kavkazskie Mineralnye Vody. Due to that situation there is a potential threat of degradation of these deposits of mineral waters. Therefore, an important task consists in building forecast models of hydro-lithospheric processes in the region while the scope of water uptake changes in various parts of the deposit. It will be based on analyzing aerial photographs taken from board unmanned aerial vehicles. Currently such analysis is conducted using simple linear algorithms. The paper suggests to use the Nvidia CUDA technology for the purpose, adapting the mathematics used to analyze aerial photographs to that technology. The initial data for processing were obtained by aerial photography in the course of remote sensing of the area by unmanned aerial vehicles belonging to OJSC «Narzan», Kislovodsk, an enterprise for mining mineral water. Presented in this paper have their Author's Certificates issued by the Federal Institute of Industrial Property, the Russian Federation.

Mustafin M.G., Balandin V.N., Bryn M.Ya., Matveev A.Ya., Menshikov I.V., Firsov Yu.G. Topographic-geodetic and cartographic support of the Arctic zone of the Russian Federation // Journal of Mining Institute. 2018. Vol. 232. P. 375-382. DOI: 10.31897/PMI.2018.4.375. https://pmi.spmi.ru/pmi/article/view/12305

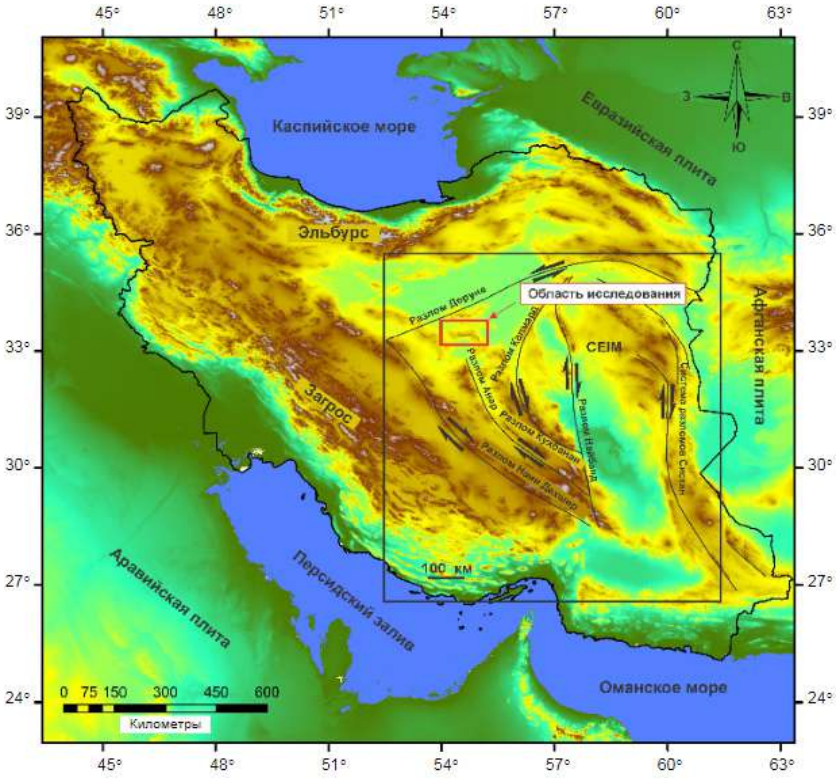
Abstract. A version of the project of the concept of topographic, geodetic and cartographic support of the Arctic zone of the Russian Federation based on the use of modern means and tools is presented, including its content. The results of the development in the Arctic, carried out with the participation of the authors in 1961-1967 and 1975-1992, are presented in detail. The strategic importance and great attention of the state structures to the development of the Arctic zone is underlined. The key moments of the development of topographic, geodetic and cartographic support for this region are given. The role of leading research institutes in this process is shown. The proposed concept includes six stages. When creating a planimetric geodetic base, the authors recommend an alternative innovative algorithm for determining the height H without first calculating the latitude B and use only satellite measurements. The extremely important question of converting geodetic coordinates B, L into rectangular plane coordinates x, y is considered. For the territory of the Russian Federation new developments are proposed, they use data from satellite determinations, a new approach to the determination of normal heights and the conversion of rectangular space coordinates into rectangular plane coordinates necessary for mapping. The required regulations of reference documentation for the topographic survey of the shelf are shown. The importance of implementing the concept in connection with the definition of the outer boundary of the continental shelf of the Arctic Ocean is shown.

Gastropod. Barents Sea. From the collection of the Mining Museum

Iron-manganese nodule of the nodular type. Depth: 33 m. White Sea. From the collection of the Mining Museum

Sohrabi A., Nadimi A., Talovina I.V., Safaei H. Structural model and tectonic evolution of the fault system in the Southern part of the Khur area, Central Iran // Journal of Mining Institute. 2019. Vol. 236. P. 142-152. DOI: 10.31897/PMI.2019.2.142. https://pmi.spmi.ru/pmi/article/view/13191

Abstract. In the southern part of the Khur area, there is faults system with predominantly North-West strike. This network of tectonic disturbances is one of the most important fault systems in Central Iran which crosses Paleozoic metamorphic rocks, Cretaceous limestones, and Eocene volcanic rocks. Interpretation of satellite imagery ETM+ (Enhanced Thematic Mapper plus, Landsat) and field observations showed the presence of left-lateral shifts along with fault system. This formed the structure of the branch faults at the northeast end of the main fault. Another feature associated with shear dislocations is the rotation of blocks in the northeastern and southwestern segments of the area under study. There are several basins and positive structures within the area such as a series of uplifts and thrusts, indicating the presence of compressional and extensional tectonics. Another part of the work is devoted to the study of the correlation between active faults and earthquakes. Processing of satellite images, field observations, records of micro-earthquakes within a radius of 17 km made it possible to analyze the earthquakes parameters and the position of tectonic disturbances, and, as a result, confirm the presence of active faults in the region. In addition, we have identified three successive stages of the Khur area tectonics: rifting, contraction, change of convergence and uplift direction.



The main fault systems and the position of the Khur region in Iran's digital elevation model CEIM – Central Eastern Iran microcontinent

Trushko V.L., Protosenya A.G. Prospects of geomechanics development in the context of new technological paradigm // Journal of Mining Institute. 2019. Vol. 236. P. 162-166. DOI: 10.31897/PMI.2019.2.162. https://pmi.spmi.ru/pmi/article/view/13192

Abstract. The article describes the role of geomechanics for forecasting the development of geosystems and ensuring the safety of mining operations during the transition to a new technological paradigm. The state and prospects of development of the mineral resource base, including the Arctic zone of the Russian Federation, are considered. The directions of technological breakthroughs and the possibility of transforming industrial production based on «cross-cutting» technology and the digital economy are presented. The analysis of geomechanical problems was carried out considering advanced technological changes and the rapid growth of requirements for the preservation of the Earth's interior and natural landscapes. The concept of the development of geomechanics and geodynamics to ensure rational subsoil use in terms of the use of «breakthrough» technology is proposed, and the need to integrate scientific and industry collaboration into the system of engineering and professional education is shown.

Ustavich G.A., Nevolin A.G., Padve V.A., Salnikov V.G., Nikonov A.V. Analysis of technological schemes for creating a geodetic control at the industrial site // Journal of Mining Institute. 2021. Vol. 249. P. 366-376. DOI: 10.31897/PMI.2021.3.5. https://pmi.spmi.ru/pmi/article/view/13409

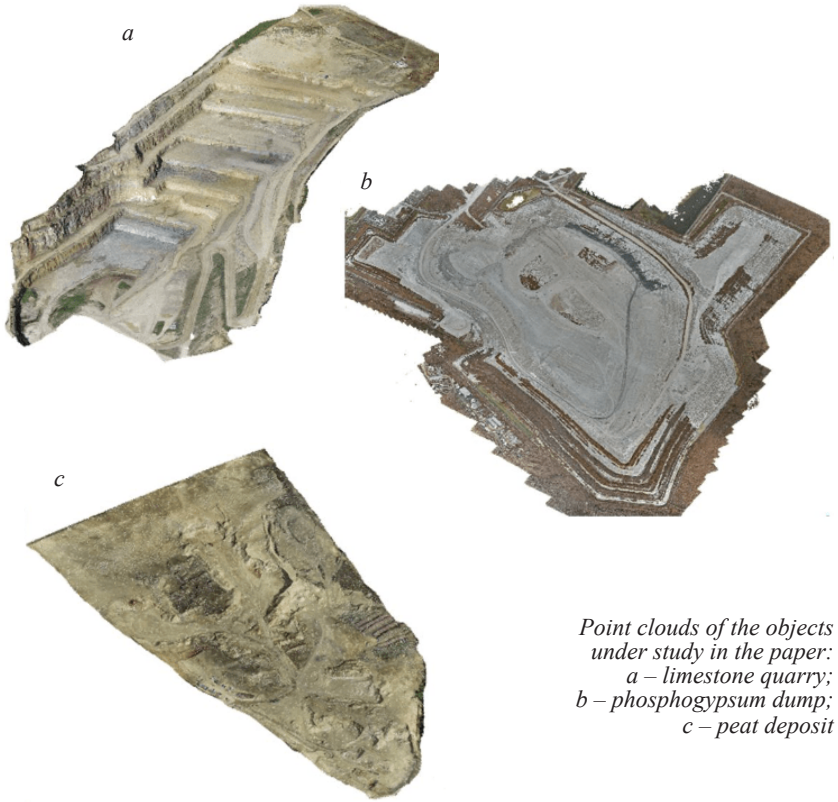
Abstract. The article highlights the issues of creating with the necessary accuracy a planned control on the industrial site of the engineering structures under construction using satellite technologies and total stations. Depending on the design features of the engineering structures under construction, as well as the technological scheme for the installation of building constructions and industrial equipment, various schemes for creating such control are considered, based on the application of the inverse linear-angular notch. Errors in the source data are one of the main errors that affect the accuracy of geodetic constructions, including the solution of the inverse linear-angular notch. When creating a geodetic network in several stages, the errors of the initial data of the first stage affect the values of the root-mean-square errors (RMS) of determining the position of the second stage points, the errors of which affect the value of the RMS of the position of the third stage points, etc. The reason for their occurrence is the errors of geodetic measurements that occur at each stage of control creating, as well as the stability violation of the points during the production of excavation, construction and installation works. When determining the coordinates of a separate project point at the stage of its removal in-situ by a total station, the entire network is not equalized in the vast majority of cases, and the coordinates of the starting points to which the total station is oriented are considered error-free. As a result, the RMS determination of the points coordinates of the control network or the removal of the design points of the elements of building structures and equipment will also be considered satisfying the requirements, i.e. the measurement accuracy will be artificially overestimated and will not correspond to the actual one obtained. This is due to the fact that the accumulation of errors in the initial data is not taken into account when the number of steps (stages) of control creating increases. The purpose of this work is to analyze the influence of measurement errors and initial data when creating a geodetic control on an industrial site by several stages of its construction based on inverse linear-angular notches and a priori estimation of the accuracy of the determined points position.

Buzmakov S.A., Sannikov P.Yu., Kuchin L.S., Igoscheva E.A., Abdulmanova I.F. The use of unmanned aerial photography for interpreting the technogenic transformation of the natural environment during the oilfield operation // Journal of Mining Institute. 2023. Vol. 260. P. 180-193. DOI: 10.31897/PMI.2023.22. https://pmi.spmi.ru/pmi/article/view/16039

Abstract. The traditional approach to monitoring observations of the technogenic processes development in oilfields, which consists in determining the concentration of marker pollutants in various natural environments, does not provide the necessary completeness of information and the efficiency of its receipt. The paper considers an example of expanding the range of observations due to unmanned aerial photography and a number of other methods. Interpretation signs (for panchromatic survey) were determined that register such consequences of technogenic transformation of the natural environment as mechanogenesis, bitumization, and halogenesis. Technogenic mechanogenesis is understood as a physical violation of the integrity of ecosystems, the movement of soils and grounds. Bitumization is expressed in the migration of petroleum hydrocarbons through soils, ground, surface, subsurface, and underground waters, and their destruction. Salt migration in these media is defined as halogenesis. The most reliable indicators are linearly elongated areas of dead forests, dark red spots in drying microdepressions and reservoirs. It was found out that the oilfield impact on the raised bog leads to anthropogenic eutrophication, the introduction of plant species, uncharacteristic coenotic groups, the replacement of subshrubs with grasses, and morphometric changes in forest pine. In the peat deposits of the disturbed area, an unusual interlayer of whitish, undecomposed moss was recorded. The moment of the beginning of a pronounced technogenic transformation was registered in the course of work with the archive of multispectral space images. Continuous remote sensing with the help of unmanned aerial photography and interpretation by sedimentological, geobotanical methods significantly expand the possibilities of studying the technogenic transformation of the natural environment. To ensure environmental safety, it is advisable to develop remote methods and technologies to include them in the environmental monitoring system.

Vystrchil M.G., Gusev V.N., Sukhov A.K. A method of determining the errors of segmented GRID models of open-pit mines constructed with the results of unmanned aerial photogrammetric survey // Journal of Mining Institute. 2023. Vol. 262. P. 562-570. https://pmi.spmi.ru/pmi/article/view/16227

Abstract. The methodology of building a digital elevation model based on the results of aerial photogrammetric survey from an unmanned aircraft is proposed, which is based on the division of the initial point cloud into equal segments. This allows, having made an assumption of the linear character of change of height of points in a separate segment, to approximate them by separate planes. RMS errors of the models from the survey data were calculated according to the scattering of the points in relation to the approximating surfaces, which made it possible to reveal the dependence of the model construction error relative to the sizes of their constituent segments, as well as to propose a method for filtering the cells containing outliers with respect to the expected model error. The proposed method was tested on the models of three mining objects – limestone quarry, phosphogypsum dump, and peat cut. The experimental results showed a multiple reduction in model error compared to standard DEM models providing the required accuracy for mining documentation.



Point clouds of the objects under study in the paper: a – limestone quarry; b – phosphogypsum dump; c – peat deposit

Tham B.T.H., Thanh P.T. Determination of the accuracy of leveling route based on GNSS/leveling and Earth gravitational model data SGG-UGM-2 at some typical regions in Vietnam // Journal of Mining Institute. 2024. Vol. 265. P. 34-44. https://pmi.spmi.ru/pmi/article/view/15913

Abstract. This paper presents the accuracy of leveling routes determined by using GNSS/leveling at three grades and Earth gravitational model data SGG-UGM-2 in four regions of Vietnam by calculating the difference between the measured height anomalies and the model of pairs of points. The calculation is made based on the total points of three grades for four regions (99 in the Northwest, 34 in the Red River Delta, 130 in the Central Highlands, and 96 in the Mekong River Delta) with the leveling routes, connected between pair of points in each region are 189, 92, 294, and 203. The calculated results of the percentage of accuracy of the leveling routes of the four regions have shown that most of the leveling routes are satisfactory (grades I-IV, and technical leveling). The determination of the accuracy of the leveling route is completely applicable to other areas when the points have simultaneous ellipsoid and leveling heights and it also helps managers and surveyors to predict the accuracy of the height points when the above-mentioned leveling routes are connected and to take reasonable measures when implementing the project.

Bryn M.Ya., Mustafin M.G., Bashirova D.R., Vasilev B.Yu. Investigation of the accuracy of constructing digital elevation models of technogenic massifs based on satellite coordinate determinations // Journal of Mining Institute. 2025. Vol. 271. P. 95-107. https://pmi.spmi.ru/pmi/article/view/16310

Abstract. At all stages of the life cycle of buildings and structures, geodetic support is provided by electronic measuring instruments – a laser scanning system, unmanned aerial vehicles, and satellite equipment. In this context, a set of geospatial data is obtained that can be presented as a digital model. The relevance of this work is practical recommendations for constructing a local quasigeoid model and a digital elevation model (DEM) of a certain accuracy. A local quasigeoid model and a DEM were selected as the study objects. It is noted that a DEM is often produced for vast areas, and, therefore, it is necessary to build a local quasigeoid model for such models. The task of assessing the accuracy of constructing such models is considered; its solution will allow obtaining a better approximation to real data on preassigned sets of field materials. A general algorithm for creating both DEM and local quasigeoid models in the Golden Software Surfer is presented. The constructions were accomplished using spatial interpolation methods. When building a local quasigeoid model for an area project, the following methods were used: triangulation with linear interpolation (the least value of the root mean square error (RMSE) of interpolation was 0.003 m) and kriging (0.003 m). The least RMSE value for determining the heights by control points for an area project was obtained using the natural neighbour (0.004 m) and kriging (0.004 m) methods. To construct a local quasigeoid model for a linear project, the following methods were applied: kriging (0.006 m) and triangulation with linear interpolation (0.006 m). Construction of the digital elevation model resulted in the least aggregate value of the estimated parameters: on a flat plot of the earth's surface – the natural neighbour method, for a mountainous plot with anthropogenic topography – the quadric kriging method, for a mountainous plot – quadric kriging.

Kazantseva V.V., Ozhigin D.S., Kosarev N.S., Satbergenova A.K., Ozhigina S.B. Development of complex system of geotechnical monitoring of technogenic objects based on geospatial data // Journal of Mining Institute. 2025. Vol. 276 (1). P. 142-156. https://pmi.spmi.ru/pmi/article/view/16590

Abstract. Monitoring of the stability of technogenic objects is a critical aspect of ensuring safety and preventing emergencies caused by mining and geological processes. The integrated use of various monitoring methods allows obtaining comprehensive information on the dynamics of deformation processes. The complex system of geotechnical monitoring of technogenic objects on the basis of geospatial data was developed, which was tested in the conditions of the "Edelweiss +" open-pit coal mine (Republic of Kazakhstan). The system was based on the step-by-step integration of Earth remote sensing methods, satellite radar interferometry, aerial photography with the use of unmanned aerial vehicles (UAVs), as well as modern instrumental methods – electronic tacheometry and GNSS measurements. The first stage – analysis of archive satellite images to identify areas of significant surface displacements. The second stage is aerial photography using UAVs to create detailed 3D models of surface areas with deformations. The third stage includes the creation of a geomechanical monitoring system based on instrumental observation methods in areas with critical changes. The final stage is the creation and updating of a geospatial database that provides continuous monitoring of the object's condition. As a result of testing of the geotechnical monitoring system based on Sentinel-1 and TerraSAR-X/TanDEM-X satellite images, surface subsidence of up to 25 mm was detected on the northern side of the "Edelweiss +" open-pit mine. Aerial photography of the open-pit mine allowed us to construct digital 3D models of the terrain, the comparison of which confirmed deformation processes at the +556 m horizon. Instrumental observations using modern geodetic methods clarified the type and dynamics of deformations of the rock mass. Integration of geospatial data in the geotechnical monitoring system ensures prompt detection of deformations, their analysis and forecast, which allows us to minimize the risks of destruction and increase the safety of operation of technogenic objects.

Scientific edition

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