PROFESSIONAL PERSONNEL TRAINING

Research paper

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Applied geology – basic training program for mining and geological industry personnel

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Abstract
The development of the human resources potential of the mining and geological industry in Russia is largely a task of the state and its institutions. The shortage of qualified personnel in the field of geological study of the subsurface, as well as the gap in the "education – science – production" system are indicated among other things in the list of challenges and threats to the development of the mineral resource base of the Russian Federation in the new Strategy of Development of the Mineral Resource Base of the Russian Federation until 2035. This strategy was developed and adopted by Order of the Government of the Russian Federation No. 2914 of 22.12.2018 (hereinafter – Strategy). Obviously, the solution of the tasks aimed at developing the geological industry of Russia and reproduction of the mineral resource base, formulated in the Strategy, will be provided mainly by the geological knowledge and skills formed in the scientific and practical activities of the new generation of geologists. The current modernization of geological education in the absence of professional standards is aimed at combining the competences of university graduates and qualifications of representatives of the profession of geologists, geophysicists, geochemists, hydrogeologists and geological prospectors. Interaction of universities with mining and geological companies in terms of improving educational standards and training programs is especially important in the conditions of the development and large-scale implementation of new technologies for mineral resources study at all stages of the geological exploration process. Reproduction of the personnel potential of the exploration industry should certainly be under the close attention of the state and under its direct management, as it will largely determine the mineral resources sovereignty of the country.

Key words
applied geology, personnel training, geological study of the subsurface, system approach, integration, research, production, education, strategy

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ПОДГОТОВКА ПРОФЕССИОНАЛЬНЫХ КАДРОВ. ОРГАНИЗАЦИЯ ИССЛЕДОВАНИЙ

Научная статья

Прикладная геология – базовое направление подготовки кадров горно-геологической отрасли

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Аннотация
Развитие кадрового потенциала горно-геологической отрасли России – во многом задача государства и его институтов. В списке вызовов и угроз развитию минерально-сырьевой базы Российской Федерации в новой Стратегии развития минерально-сырьевой базы Российской Федерации до 2035 года, которая была разработана и принята Распоряжением Правительства Российской Федерации № 2914 от 22.12.2018 г. (далее – Стратегия), среди прочих указан дефицит квалифицированных кадров в области геологического изучения недр, а также разрыв связей в системе «образование – наука – производство». Очевидно, что решение задач, направленных на развитие геологической отрасли России и воспроиз-

водство минерально-сырьевой базы, сформулированных в Стратегии, будет обеспечиваться главным образом геологическими знаниями и навыками, формируемыми в научно-практической деятельности нового поколения геологов. Современная модернизация геологического образования при отсутствии профессиональных стандартов направлена на сопряжение компетенций выпускников вузов и квалификации представителей профессии геологов, геофизиков, геохимиков, гидрогеологов и геологоразведчиков. Взаимодействие вузов с горными и геологическими компаниями в части совершенствования образовательных стандартов и программ обучения особенно важно в условиях развития и масштабного внедрения новых технологий изучения минерального сырья на всех стадиях геологоразведочного процесса. Воспроизводство кадрового потенциала геологоразведочной отрасли безусловно должно быть под пристальным вниманием государства и при его непосредственном управлении, так как во многом будет определять минерально-сырьевой суверенитет страны.

Ключевые слова
прикладная геология, подготовка кадров, геологическое изучение недр, системный подход, интеграция, исследования, производство, образование, стратегия

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Introduction

Development of the personnel training system for the mineral resources complex of the country is one of the priorities of all state institutions [1–3]. It is important to constantly analyze not only the quantitative characteristics of the training system [4–6], and features of scientific and pedagogical schools, but also many other important aspects which affect the quality and efficiency of specialist training [7–9].

As a field of science and education, geology in the Russian Federation is manifested in two interrelated and complementary spheres. The first of them is fundamental geology, which is the science of the history, structure, material composition of the Earth and its cosmic relations, the origin and evolution of life. This sphere forms the core of geology – classical general geology in its broadest sense.

The second sphere is applied geology, based on the foundation of the first one and is represented by a complex of disciplines on metallogeny, forecast, prospecting and exploration of mineral resources. Specialists of this sphere were and are focused on the reproduction of the mineral resource base (MRB) and geological support of the economic activity of the country.

Higher geological education in Russia from the first days of its foundation has been based on the methodological triad of the conjugation of geological science, geological training and geological practice[1] [6, 8]. Implementation of this principle in the Soviet Union allowed strong geological schools to be formed in Russia and the Union republics which formed part of the USSR.

[1] The concept of geological education in Russia: Proceedings of the joint meeting of the boards of the Ministry of Education of Russia and the Ministry of Natural Resources of Russia. Moscow: NIA-Priroda; 2000. 24 pp.

Historical background

Before large-scale reforms in the system of the Russian higher education, the special feature of professional education of specialists-geologists was the relevance (closeness to production) of educational programs and the high uniformity of university curricula. The dynamic development of geological education and the geological industry as a whole (in the so-called “golden age of geology”) was also facilitated by a well-functioning system of developing scientific and pedagogical staff, coordinated policy in conducting field training and production practices, and state allocation of mining and geological graduates to the industry enterprises after graduation [10].

The USSR Ministry of Geology played an important coordinating role in this process, participating in the planning of enrollment in geological disciplines and determining their nomenclature. The Ministry assisted universities in organizing educational and industrial geological practices, building a system of advanced training and retraining of geological personnel. The support of scientific researches in higher educational institutions and financing of scientific researches in industry-related research institutes and production departments were of great importance. The result of this policy was the high level of qualification of engineering geological staff. For example, during this period up to 20–30 % of lead specialists-geologists in thematic and geological survey expeditions of the Krasnoyarsk Geological Administration had scientific degrees. The implementation of a well-coordinated personnel policy allowed the Soviet Union to establish one of the world’s best systems of professional higher geological education, ensuring the dynamic development of the native mineral resource complex and a stock of reserves of most mineral resources for many years ahead.

It is no secret that the mineral resource base of solid minerals in Russia was largely formed in Soviet times. From the USSR, Russia inherited the position of a country most prosperous in mineral resources. The country's share in the world oil reserves is 13 %, gas 32 %, coal 11 %, lead, zinc, cobalt, nickel, and iron – from 10 to 36 %, etc. The gross value of explored reserves and preliminary estimated resources in the subsurface is about $ 30 T [10, 11].

After the collapse of the Soviet Union, Russia also faced the problem of self-sufficiency in certain types of minerals. There was a deficit of more than 15 types of solid minerals (manganese, chromium, strontium, mercury, etc.). Almost all commercial reserves of chromium remained beyond the borders of the Russian Federation, in Kazakhstan. 80 % of uranium reserves are located in Kazakhstan, Uzbekistan and Ukraine. Manganese deposits remained in Ukraine and Georgia, about 40 % of gold resources are in Uzbekistan and Kazakhstan, etc. The iron ore reserves were reduced by 30 % of what they were in the Soviet Union.

This circumstance, as well as the trends formed in the recent decades in the mining and geological industry of the country, namely a decrease in the rate of growth and depletion of reserves of many major types of solid minerals, a decrease in their production volumes, slowing development of new deposits, identified the need to update the development strategy of the mineral resource base of Russia as a whole.

Actualness

The new Strategy for the Development of the Mineral Resource Base of the Russian Federation until 2035 was developed and adopted by Order of the Government of the Russian Federation No. 2914 of 22.12.2018 (hereinafter – the Strategy)[2]. The Strategy reflects the current negative situation with scarce mineral resources, including uranium, manganese, chromium, titanium, bauxite, zirconium, beryllium, lithium, rhenium, rare earths of the yttrium group, and fluorspar. It is demonstrated that the reproduction of resources of these types of minerals should be provided by the discovery of deposits with high-quality ores. These in turn should be based on the introduction of improved forecast and prospecting complexes, as well as the development of new cost-effective technologies for the enrichment and processing of low-quality minerals and their involvement in the development.

The list of challenges and threats to the development of the mineral resource base in the Russian Federation in the new Strategy includes, inter alia, the lack of qualified personnel in the field of geological exploration of mineral resources, as well as the gap in the "education – science – production" system. Obviously, the resolution of tasks aimed at developing the geological industry of Russia and reproduction of the mineral resource base, formulated in the Strategy, will be provided mainly by geological knowledge and skills formed in the scientific and practical activities of the new generation of geologists.

In order to ensure sustainable development of the scientific and personnel potential of the geological industry, capable of providing works on expanded reproduction of the MRB of the Russian Federation, the Strategy proposes a number of measures, the key ones being:

1) development and implementation of monitoring and forecasting (medium- and long-term) with respect to the need for personnel;

2) development and improvement of the system of industry-related professional standards;

3) creation of a continuous professional development system aimed at formation of new competences of specialists, necessary for the innovative development of the industry;

4) creation and development of a network of industry-related regional centers of competence for the coordination of interaction between educational organizations of different levels and enterprises of the industry in the regions in order to ensure a high quality of professional training.

Activities and tasks defined by the Strategy in the field of personnel policy of the geological industry, including training of geological engineers in the field of applied geology, are still far from being implemented.

Monitoring of the state and forecast of the need for geological personnel

In the recent years, there has been a large shortage of applied geologists both in specialized geological organizations and in mining companies working in support of mining operations. At the same time, there has been no increase in target figures for enrollment in the field of applied geology training. In some leading universities (Irkutsk, Krasnoyarsk, Moscow, and Tomsk) in the recent 5–8 years there has been a decrease in the number of applicants to this type of training. There is a lack of coordination between the departments of the Ministry of Education and Science of Russia and the Ministry of Natural Resources of Russia in determining target figures for enrollment, and the needs of the geological industry for specialists.

Unfortunately, there are serious problems with enrollment for geological disciplines. For a number of reasons, they are especially acute in the case

[2] Strategy of Development of the Mineral Resource Base of the Russian Federation until 2035. Decree of the Government of the Russian Federation of 22.12.2018, No. 2914-r.

of regional universities. As a rule, this is due to a low number of school graduates, the outflow of applicants with high USE scores to universities in Moscow, difficulties in attracting foreign students, the low prestige of mining, geological and metallurgical professions among young people. There is no state policy in terms of monitoring and forecasting the need for geologists. The work on occupational guidance of young people and popularization of geological professions leaves much to be desired.

Development and improvement of the system of industry-related professional standards

Industry-related professional standards should define the content of educational standards for educational institutions which provide training in the relevant field. As of today, professional standards containing generalized labor functions and qualification requirements for mining engineers have not been developed.

In this case, universities and faculties are given the right to independently establish professional competencies implemented in the basic educational program for specializations of their educational program.

It is due to these circumstances that during the recent five years mining and geological universities and faculties have carried out work on modernizing federal state educational standards of higher education (hereinafter, FSES HE) – specialist program.

The federal state educational standard of higher education – specialist program "Applied geology" was approved by Order of the Ministry of Education and Science No. 953 dated August 12, 2020 and introduced into the system of the Russian higher education since September 2021[3].

Coordination of the activities of the mining and geological universities in the development of educational standards was carried out by the Federal Educational and Methodological Union in the Higher Education System. This system was created in 2016 for enlarged groups of specialties and fields of training "Applied geology, mining, oil and gas engineering and geodesy".

The federal state educational standard for "Applied geology" provides for the formation of universal, general professional and professional competencies for graduates in the field of "Applied geology". The FSES HE takes into account the provisions of the Resolution of the Russian Ministry of Labor No. 37 of 21.08.98, which stipulate that professionals in the "Applied geology" field should be trained to meet qualification requirements for the positions of mining engineers – geologist, mineralogist, geochemist, etc. depending on the area of specialization obtained.

Independent public and professional expertise has established the correspondence of the content of FSES HE in terms of implementation of universal and general professional competences of graduates with the priority areas of scientific and technological development of the Russian Federation, namely:

– transition to advanced digital, intellectual, production technologies, robotized systems, new materials and methods of designing, creation of systems for processing large volumes of data, machine learning and artificial intelligence;

– transition to environmentally friendly and resource-saving energy, increasing the efficiency of hydrocarbon production and deep processing, formation of new sources, methods of transportation and storage of energy;

– potential for effective response on the part of Russian society to meet great challenges, taking into account the interaction between man and nature, man and technology, social institutions at the current stage of global development.

Due to the absence of industry-related professional standards, and taking into account the experience of harmonizing the requirements for qualification levels of specialists and researchers in different sectors of the economy available in the world geological science and practice, a "Basic Qualifications Register" (BQR) in the sphere of mining and geological research and development of the subsurface needs to be developed. This should also apply to the training of scientific and technical personnel. For this purpose, the most demanded spheres of professional activities need to be included in the BQR, such as scientific-research; design-survey; industrial-technological; pedagogical; and organizational-managerial, which are established in the FSES HE.

The BQR will serve as the basis for the development of improved educational HE programs in the relevant types of professional activities and at the same time as a criterion for the development of the features (job description) of specific positions of scientific and technical workers. This will provide an opportunity to create a higher education trajectory, taking into account new fields of geological science, the regional features and labor market in the organizations of the geological service of Russia and companies of the mineral resources complex. It will also support the training of elite specialists in the field of applied geology, inter alia.

In addition to the choice of areas of professional activity, the higher educational organization in accor-

[3] Federal state educational standard of higher education – specialist program 21.05.02 Applied geology. Moscow: Ministry of Education and Science of the Russian Federation; 2020. 18 pp.

dance with the standard will be able to choose a specialization of the educational program on "Applied geology" of solid mineral deposits from the following[4]:

– geological survey, prospecting and exploration of mineral deposits;

– geology of oil and gas fields;

– prospecting and exploration of groundwater and engineering-geological surveys;

– applied geochemistry, mineralogy and gemology;

– field geology;

– exploration and evaluation of strategic minerals.

When choosing a specialization, an educational organization should base is choice on the changing demand for personnel and the regional specifics of enterprises of the mineral resource sector. The list of specializations should not be static. For example, the specialization "Exploration and evaluation of strategic minerals" was initially focused on training specialists in the field of research of rare and radioactive metals deposits. Today the list of strategic types of mineral resources has been significantly expanded. By Order of the Government of the Russian Federation No. 2473-r dated August 30, 2022, this list was increased from 29 to 61 items. It includes all major types of mineral resources – oil, natural gas, non-ferrous, ferrous, noble, rare and disseminated metals, and other types of raw materials important for ensuring the country's economic and defense sovereignty. This document was adopted against the backdrop of political turbulence and unprecedented, worsening sanctions. It emphasizes the importance of ensuring the country's raw material independence in terms of the uninterrupted functioning of the production of "critical types" of mineral resources important for the economy and defense.

At present, certain leading universities (National Research Tomsk Polytechnic University and Russian State University for Geological Prospecting) are already implementing the "Geology of deposits of strategic types of mineral resources" field of training since 2019, even before Government Order No. 2473-r was issued, according to the master's degree program.

Experts from Rosgeologiya JSC came to the conclusion that a high-tech economy requires full confidence in sufficient reserves of rare-earth metals, tin, titanium, manganese, chromium, tungsten, gold and a number of other minerals (including non-metallic minerals). At the same time, forecasts show a moderate increase in the consumption of fossil fuels in the midterm, despite the development of "green energy". This means that resources and the human capital asset need to be reallocated toward the accelerated reproduction of solid mineral resources and appropriate human resource transformations.

The principle of inter-industry balance in the mineral resource sector of solid minerals should be reoriented towards a significant increase in the volume of thematic, experimental and methodological, and research exploration work. Primary attention should be paid to the development of new methods and technologies of prospecting and appraisal works focused on the identification of weak mineralization and potential deposits of scarce types of mineral resources. This will require the transformation of the educational programs of universities which train specialists in the "Applied geology" of deposits of solid minerals. They need to take into account the current features:

– a fundamental knowledge of the geology of rare and radioactive metals, physical and chemical geotechnology and related disciplines at the world level;

– an understanding of the rules of creating design documents for the exploration and development of deposits, taking into account modern international standards and regulations;

– an ability to analyze the scientific-technical and industrial-technological work and make non-standard creative decisions;

– the use of modern computer technologies and software systems in mining and geological practice;

– mobility and the ability to work in a team.

The formation of these qualities among young specialists in the period of training, assumes the formation of general professional and professional competences as a combination of knowledge and skills of theoretical training and practical activity:

– an ability to apply the basic provisions of fundamental natural sciences and scientific theories in carrying out research work on the study and reproduction of the mineral resource base;

– an ability to apply the legal basics of geological study of the subsurface and subsurface use, ensuring environmental and industrial safety, and ability to take them into account when prospecting, exploring and exploiting deposits;

– an ability to study and analyze the material composition of rocks and ores and geological-industrial and genetic types of mineral deposits when resolving problems on the sound and integrated development of the mineral resource base;

– an ability to work with software of general, special purpose, including modeling of mining and geological objects;

– an ability to perform engineering design for projects, technical-economic and functional-cost analysis of project efficiency;

[4] Federal state educational standard of higher education – specialist program 21.05.02 Applied geology. Moscow: Ministry of Education and Science of the Russian Federation; 2020. 18 p.

– an ability to plan and perform analytical, simulation and experimental studies, to critically evaluate research results and draw conclusions;

– an ability to estimate forecast resources and calculate reserves of solid mineral deposits.

According to the expert community, the training of such specialists should be based on the formation of not only universal and professional competencies, as established in the FSES HE "Applied geology", but also specialized professional competencies. These competences are developed by a given university, taking into account the opinion of employers and lead specialists of research institutes (Institute of Mineralogy, Geochemistry and Crystal Chemistry of Rare Elements, All-Russian Scientific-Research Institute of Mineral Resources named after N.M. Fedorovsky and Central Geological Research Institute for Nonferrous and Precious Metals), the institutes of the Russian Academy of Sciences (Institute of Geology and Earth Mechanics, Institute of Physics) and structural subdivisions of Rosgeologiya JSC.

The future successful scientific and production activity of graduates lies in the fact that during the process of training in "Applied geology", they will be able to enhance scientific forecasting, prospecting and appraisal of deposits of solid minerals and the basics of mineralogical, analytical, technological methods of study and evaluation of in-demand types of raw materials.

The motivation for training of highly qualified specialists in exploration and appraisal of solid minerals should be to provide students with financial support in the form of scholarships and grants, at the expense of leading mining and geological companies. This should be aimed at the practical mastering of modern methods to study the ores of mineral resources and geotechnology of their integrated processing [12].

The educational and methodological support of the system for training mining engineers and geologists should not be forgotten. The publication of popular science and educational literature on the geology of deposits of strategic mineral resources and creation of electronic textbooks, as well as scientific and reference literature, are of great importance today, taking into account the current state of the mineral resource base and peculiarities of marketing of scarce metals.

The science intensive nature of Russian industry, and the concentration of advanced competitive developments therein, stipulate the necessity for advanced investments in personnel training, scientific and technical improvement of this cluster of the mineral resource complex in order to maintain its high technological potential.

Continuous education and innovative development of the geological industry

The rapid development of technologies in the mineral resource sector of the economy determines the need for continuous training and retraining of personnel. Production often requires specialists who do not fit into the framework of educational programs for particular specializations. Advanced training in the field of geoinformatics is particularly relevant in the field of applied geology, where digital technologies (introduction of computer modeling of deposits, remote sensing technologies, use of neural network analysis and artificial intelligence in working with large data arrays in forecasting, etc.) are actively emerging. In mining (mine) geology in the world and in Russia a new field is being formed – geometallurgy. This field combines the competences of the mine geologist, miner, processor and metallurgist. In the conditions of global warming, for construction, mining and metallurgical companies operating in the permafrost zone, competences in geocryology become relevant for geologists-applicants of the "Prospecting and exploration of groundwater and engineering-geological surveys" specialization.

In the Russian Federation as a whole, the system of continuous professional development and retraining, as well as obtaining additional education is constructed at different levels. These are advanced training courses, master's degree, and post-graduate courses. The implementation of additional education and retraining of geological personnel is carried out both in corporate centers and educational institutions, and in state universities, including the use of remote and network technologies. An example of the successful implementation and active development of remote technologies in Russia is the Geowebinars educational platform. The platform has been created with the participation of specialists from reputable mining companies, scientific and educational institutions. This platform hosts online conferences and lectures on a regular basis, as well as enrollment in refresher courses in industry-related disciplines[5].

In the Russian Federation, certain negative trends can be noted in the field of training geological personnel at the highest level of qualification – candidates and doctors of sciences. According to the RF State Commission for Academic Degrees and Titles, there are 363 thousand candidates and 79 thousand doctors of science in Russia. More than 50 % of the doctors of science are over 60 years old. In the field of natural sciences, including "Earth Sciences", 21 % of the

[5] Geowebinars. Geology and mining knowledge platform. URL: https://geowebinar.com

total number of scientists have been awarded academic degrees, of which only 1 % in geological and mineralogical sciences.

The number of awarded degrees in geological and mineralogical sciences has decreased 5 times compared to 2010. This is due to the closure of a large number of industry-related geological research institutes, the reduction of the number of dissertation councils, a fall in the interest of young people in scientific research and, as a consequence, the loss of scientific schools in a number of training centers.

A comprehensive governmental approach is required, in order to resolve this problem. This would include: incentives by employers for employees who improve their qualifications through university degrees, postgraduate and doctoral studies; as well as increased targeted funding for geological research through the Ministry of Education and Science and the Ministry of Natural Resources, including support for young researchers with grants.

The creation and development of a network of industry-related regional centers of competence for the coordination of interaction between educational organizations of different levels and enterprises of the industry in the regions, aimed at ensuring high quality of professional training is relevant in the conditions of reduction of the number of industry-related geological scientific research institutes and thematic teams at large regional geological offices. Such centers have been established in separate regions as entities with different legal organizational forms. For example, the Siberian School of Geosciences was established on the basis of the Irkutsk Research Institute as part of the Irkutsk Polytechnic University and, at the same time, as a major geological corporation in the ore exploration industry. The research program of this center is aimed at optimizing the methodology and technology of developing the mineral resource base for ore minerals in complex conditions. The Siberian School of Geosciences conducts scientific research and implements original educational programs aimed at creating a set of new exploration technologies with ultra-low cost and high productivity, and, based on these technologies, shifting of the University into the position of an active subject of the mining and geological industry[6].

Another example of the formation of a regional center of competencies as a result of interaction between a university and a large company is the Nor-Nickel R&D Center at the Institute of Mining, Geology and Geotechnologies of the Siberian Federal University[7]. The Center was established in 2017 with the assistance of MMC Norilsk Nickel, as a “Scientific and Technological Center for Developing a System for Mineral Production and Processing Control and Quality Based on Deposit Modeling and Ore Flow Management”. The Center develops competences in the field of computer modeling of deposits and mining scheduling, as well as the improvement of methods of process mapping and quality control of ores and their processing. The long-term objective of the center is to implement scientific projects and educational programs in the fields of “Geometallurgy” and “Mining geology”.

Successful competence centers include basic departments of industry-related research institutes: All-Russian Scientific-Research Institute of Mineral Resources Named after N.M.Fedorovsky, Central Geological Research Institute for Nonferrous and Precious Metals, Institute of Mineralogy, Geochemistry and Crystal Chemistry of Rare Elements. In recent years they have been training highly qualified experts in solid minerals and forming the range of highly qualified personnel of the exploration industry.

An example of the network center of competence which is in the process of formation is the Engineering and Technical Center for Lithium Raw Materials Research. This center is based on the PJSC “Chemical and Metallurgical Plant” in Krasnoyarsk. The tasks of this Center will include geology, exploration, enrichment and processing of lithium raw materials, all of which are in high demand in the world market. It is assumed that the competence center will form the basis of the scientific and production cluster of “Lithium” rare-earth metals. This will bring together companies with licenses for deposits of lithium ores, the production capacities of JSC “Chemical and Metallurgical Plant”, and laboratory and expert capacities of the industry-related geological institute All-Russian Scientific-Research Institute of Mineral Resources Named after N. M. Fedorovsky. They will also attract the educational and experimental capabilities of universities, such as the Moscow Institute of Steel and Alloys and the Siberian Federal University. The cluster approach will ensure not only the development of new technologies, but also training of specialists in the field of prospecting, mining and processing of strategically important minerals relevant for the national economy.

[6] Siberian School of Geosciences. URL: https://www.istu.edu/deyatelnost/obrazovanie/

[7] R&D Center of NN – Institute of Mining, Geology and Geotechnology, Siberian Federal University. URL: https://rdcnnsfu.ru/

Conclusion

It is impossible to resolve personnel issues in the geological industry, both current and in the long-term perspective, without addressing the issue of improving the image of the mineral resource industry and popularizing mining and geological professions. Here it is necessary to combine the efforts of the relevant ministry, universities and businesses in the implementation of long-term integrated measures including the development of joint career guidance programs by universities and mining and metallurgical companies in the region of presence. This involves the creation of positive newsbreaks in terms of science and innovation, and positive environmental solutions. The efforts of universities and companies in the promotion of mining and geological knowledge need to be combined in the creation of popular science (feature) films, articles, television programs, Internet resources (First Geological Channel), in order to promote the essence of geological professions, new mining projects, and their social and economic importance.

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