PROFESSIONAL PERSONNEL TRAINING

Review paper

https://doi.org/10.17073/2500-0632-2022-3-240-259
UDC 622:378

Analytical review of the training system for mining engineers in Russia

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Abstract
Personnel training for the mineral resources sector in Russia has always been one of the most relevant topics for discussion in academic and professional mining community, including the international context. Experts from many countries regularly present their research on the state and achievements of higher education in mining in the national training systems for mining engineers. The purpose of this paper is to analyze and quantify the system of training for mining engineers in Russia. To assess the quantitative characteristics of the training of mining engineers in Russia, the research used methods of analysis based on the objective data of state statistics on the graduation of mining engineers in all universities, as well as admission to the corresponding professions and training programs. Thus, 5,031 mining engineers were trained in Russia in the specialties "Applied Geology"; "Geological Exploration"; "Mining"; "Physical Processes of Mining and Oil and Gas Production" in 2021. 10,789 bachelors and masters were trained under oil and gas directions of training. The results of the analysis are presented in the paper in the context of particular universities, specializations and directions of training of Federal Districts and the country as a whole. The quantitative parameters of personnel training for the mineral resource sector at Russian universities indicate the opportunity for the formation of human resources potential within the higher education system of the industry exclusively at the expense of their own academic schools.

Keywords
mining engineer, mineral resource sector, oil and gas, mining, applied geology, higher education in mining, mining universities, regions of Russia, training, mining professions, prestige, university admission, admission statistics, quality, analysis

For citation
Petrov V.L. Analytical review of the training system for mining engineers in Russia. *Mining Science and Technology* (*Russia*). 2022;7(3):240–259. https://doi.org/10.17073/2500-0632-2022-3-240-259

ПОДГОТОВКА ПРОФЕССИОНАЛЬНЫХ КАДРОВ. ОРГАНИЗАЦИЯ ИССЛЕДОВАНИЙ

Обзорная статья

Аналитический обзор системы подготовки горных инженеров в России

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Аннотация
Подготовка специалистов для минерально-сырьевого комплекса в России является всегда одной из самых актуальных тем для дискуссий в академическом и профессиональном горном сообществе, в том числе и в международном контексте. Эксперты из многих стран регулярно представляют свои исследования о состоянии и достижениях высшего горного образования в национальных системах подготовки горных инженеров. Целью публикации являются анализ и количественная оценка системы подготовки горных инженеров в России. Для оценки количественных характеристик подготовки горных инженеров в России в исследовании использовались методы анализа, основанные на объективных данных государственной статистики выпуска горных инженеров во всех университетах, а также приема на соответствующие специальности и направления подготовки. Так, по специальностям «Прикладная геология»; «Технология геологической разведки»; «Горное дело»; «Физические процессы горного или нефтегазового производства» в 2021 г. в России был подготовлен 5031 горный инженер. По специальностям нефтегазового профиля – 10 789 бакалавров и магистров. Результаты анализа представлены в статье в разрезе конкретных университетов, специальностей и направлений подготовки, федеральных округов и страны в целом. Количественные параметры подготовки кадров для минерально-сырьевого комплекса в университетах России свидетельствуют о возможности формирования кадрового потенциала в системе высшего образования отрасли только за счет собственных научно-педагогических школ.

Ключевые слова
горный инженер, минерально-сырьевой комплекс, нефтегазовое дело, горное дело, прикладная геология, высшее горное образование, горные университеты, регионы России, обучение, горные специальности, престиж, прием в университет, статистика приема, качество, анализ

Для цитирования
Petrov V.L. Analytical review of the training system for mining engineers in Russia. *Mining Science and Technology* (*Russia*). 2022;7(3):240–259. https://doi.org/10.17073/2500-0632-2022-3-240-259

Introduction

Personnel training for the mineral resources sector in Russia is always one of the most relevant topics for discussion in the academic and professional communities [1–3], including in the international context [1, 4, 5]. International experts regularly present their research on the state and achievements of higher mining education in Australia [4, 6], Ukraine [7], South Africa [8], Romania [9], Turkey [10], Slovakia [11], as well as in some other countries. Active public discussions are held on such authoritative platforms as, for example, the Society of Mining Professors (SOMP), at international conferences of mining and mining-geological profile, as well as within the framework of the International Mining Congress. Collections of the works of the mentioned scientific events give an insight into progressive solutions in various areas of the development of training systems for the mining engineers implemented in universities and countries, an opportunity to learn about the objective crises faced by certain countries, by developing their national training systems for the mineral resource sector [9]. Indeed, higher mining education has to address extremely serious challenges, which are determined by the following factors:

- mining industry is often in decline in some regions and countries, the industry of solid commercial minerals is being wound down and is becoming unpopular. This objectively reduces the demand for specialists and causes the stagnation of mining academic schools;
- it is difficult for mining programs at universities to compete with many other training programs, for example, IT specialties, in attracting talented young people to their mining and geological profile programs;
- the new technological order changes the profession and role of a mining engineer significantly. The high speed of these changes does not always allow universities to respond to them in their training programs flexibly, resulting in a gap between the requirements for training specialists from the mining business and the capacity of universities to meet these requirements.

The author makes no pretense to a detailed analysis of all the factors that reduce the prestige of higher mining education and its attractiveness, the article presents only the main self-explanatory reasons of this situation. Perhaps the analysis of these factors will grab the attention of other experts who will express their opinion on this issue.

Advanced universities that implement educational programs based on their academic schools are trying to meet the increasing needs of the mining industry in terms of quantitative and qualitative indicators, by taking the leading positions in terms of timely response to new challenges. We see that advanced technologies based on new digital solutions, including VR [12–15] and AR technologies [16], are being actively introduced into the educational process. Traditionally and almost everywhere, special attention is paid to the formation of competencies of a mining engineer related to technological safety [17–19], as well as practical training [20, 21]. It should be noted that methodological aspects of on-line training in higher mining education were discussed by experts long before the start of Covid-19 pandemic [22].

By assessing the aspects of the development in the part of the mineral resource sector, which is associated with the extraction and primary processing of solid minerals (mining), it is impossible not to touch on the oil and gas industry.

The problems of higher mining and oil and gas education are mostly very similar. However, it should be noted that the oil and gas in Russia is more attractive as a field of professional activity, which creates conditions for the intensive development of oil and gas education system [23–25].

Public, academic, and professional institutes play an important role in the development and harmonization of the global system of personnel training for mineral resource sector [26, 27]. Among the international ones, it is necessary to note Society of Mining Professors in the field of mining, the subject of whose work is closely related not only to the concepts of mining education development, but also to its content, with the development of common approaches the implementation of educational programs.

In the Russian Federation, the state has established a special public-state institute in the higher education system – Federal Academic Methodological Association in educational fields, among which there is also a Federal Academic Methodological Association in the higher education system “Applied Geology, Mining, Oil and Gas, and Geodesics”. This public association

is responsible for the development of scientific and methodological support for the relevant field of education, including the development of federal educational standards, as well as participation in the formation and implementation of state policy in the field of higher education.

Quantitative indicators for assessing graduation of mining engineers in Russia

Issues related to the assessment of quantitative indicators of personnel training for the industry have always attracted the interest of the expert community. Industry representatives often claim a shortage of mining engineers in the industry. Universities did their best to increase their graduation, trying not to reduce training quality. Nevertheless, there are not so many expert analytical materials related to quantitative assessments of the need for training of mining engineers. The last such information in Russia was presented in the author's research in 2017 [3, 28]. The same materials formed the basis of the author's report on higher mining education in Russia within the framework of the 28th conference of the International Society of Mining Professors (SOMP), which was held in Turin (Italy) in 2017.

Quite interesting data on quantitative estimates of the need for mining engineers are given in the study [29]. This is one of the few studies that gives an assessment of the need for mining engineers not in Russia. The study provides an example of formation of a personnel engineering corps of the mining industry in Australia, where the shortage in mining engineers is covered by specialists from other countries, such as Poland, Russia, Ukraine, Peru, etc.

In Russia, quantitative assessments of the training of mining engineers have been presented in the public field since 2005 and are the subject of discussion on the pages of many publications [3, 28]. The same issues are regularly discussed at public events, councils of the Federal Academic Methodological Association in the higher education system "Applied Geology, Mining, Oil and Gas, and Geodesics", the Supreme Mining Council of Russia.

When presenting analytical materials, the authors of this paper took into account the interests of international experts who, in order to form a complete picture of the Russian system of personnel training for the mineral resource sector, need to get a general idea of some of the features of the higher education system in Russia (admission to universities, lists of directions and specializations of training, etc.). Overall, the system of state regulation in terms of the implementation of educational programs in different countries has much in common, but each of them, including Russia, has its own nuances.

This research reveals updated data and takes into account the latest trends in the development of higher engineering education in Russia.

Features of admission to higher educational institutions of Russia

Higher educational institutions of Russia plan the number of citizens admitted to study 8–9 months before the start of the basic procedures. In many respects this planning is undertaken at the level of universities, which independently determine the competitive groups of training programs, the list of entrance tests, etc. The key parameter in this planning process is the number of state-funded places that are allocated to the university for training citizens at the expense of the federal budget. The allocation of budget places is based on the competitive procedures between universities, taking into account the need for specialists at the federal and regional levels, as well as objective performance indicators of the universities themselves. According to the results of these competitive procedures, universities are granted "admission quotas" to study at the expense of the federal budget directions of training, specializations of training or group of directions and specializations of training (analogous to personal state grants, which are often used in international systems of higher education) for admission to the first year.

Admission to higher education programs in the Russian Federation is based on the results of a specialized national exam, which is called the "Unified State Exam" (USE). About six months before the end of secondary school, its graduate must plan which subjects in the framework of the Unified State Exam he/she will take after graduation (June of the year of graduation), in order to enter the university (July, August of the year of admission to the university). The results of the Unified State Exam are valid for four years and can be improved in the following years (can be combined with the best results by year).

The state determines the mandatory disciplines that an applicant must pass when entering certain directions or specializations of training. Thus, for programs related to mining and geology, it is Russian language and mathematics. Universities can also establish additional subjects or combinations of subjects at their discretion. In some universities, incoming applicants are invited to submit the results of the Unified State Exam in physics, chemistry or computer science (optional).

The procedures and technologies of the Unified State Exam in Russian society are the source of the most heated discussions, which are not inferior in intensity to such aspects of public life, for example, as pension reform or employment. But this mechanism has been working for more than 20 years, and it allows for admission to universities on the basis of uniform national criteria for assessing the knowledge of graduates of secondary schools in subject areas.

Certain exceptions refer to graduates of specialized secondary schools who have completed secondary vocational education programs (the level of vocational education in Russia, which is before higher education).

Graduates of these secondary schools can choose the trajectory of admission to the university: according to the results of the Unified State Exam or according to the results of the university entrance tests. Most of them, if they wish, can enter the university, having passed the university entrance tests (not the Unified State Exam). According to the results of university entrance tests, persons who have received secondary general education abroad, including foreign citizens, can enter as well.

All applicants to the university are ranked according to a list, in which almost all applicants are on an equal basis before being enrolled in the first year. Only those persons who have positive results of entrance tests or corresponding results of the Unified State Exam take part in the competition.

A small category of citizens (orphans, disabled people, etc.) have non-competitive benefits or preferential rights, and the winners of All-Russian and international subject school specialized Olympiads can enter in universities without exams. The number of persons who use such exceptions in the implementation of competitive procedures for directions and specializations of training in personnel training for the mineral resource sector is insignificant, and in general they do not play a big role in increasing competitive indicators.

If a particular person did not pass the competition, he has the opportunity to study at his own expense or at the expense of legal entities (paid tuition) by signing a contract with the university. The university also plans this quantitative indicator, by announcing passing score and the number of places, conducting separate competitive procedures for these places.

Specializations and directions of training for personnel of the mineral resource sector of Russia

The Russian Federation has its own system of classification of specializations and directions of training in higher education. At the federal level, a list specializations and directions of training is approved, which is fixed in the administrative act of the department that forms and implements state policy in the country's higher education system (the Ministry of Science and Higher Education of the Russian Federation). It should be noted that Russia has a tiered system of higher education, but it has certain specifics.

The following levels of higher education are fixed by federal law:

- higher education – bachelor's degree (4 years of study);
- higher education – specialist's degree (5–5.5 years of study);
- higher education – master's degree (2 years of study), which is possible to obtain only after any previously obtained level of higher education, usually bachelor's degree);
- higher education – training of highly qualified personnel (postgraduate studies).

Bachelor's and master's degree programs are implemented on program tracks, while specialist's degree programs, on specialties. The pattern of classification of program tracks (training programs) and specialties in higher education in Russia is presented in Fig. 1.

Specialist's programs (training is conducted in specializations of training) and master's degree programs belong to the programs of the second level of higher education. Specialist's programs are implemented not after the bachelor's degree, like the master's degree, but simultaneously with it.

An applicant entering higher education programs can choose where to enroll: for a bachelor's degree or for a specialist's. After a bachelor's degree, he can continue his studies in a master's degree, and then in a postgraduate course. After the specialist's degree, you can immediately enroll in postgraduate school. Bachelor's and master's degree programs are implemented in the directions of trai-ning, specialist's degree – in specializations of training (see Fig. 1).

Universities develop and implement the main professional educational programs of higher education in the directions and specializations of training, by for-ming their own profile (name of the program) (see Fig. 1). For example, within the framework of the specialization "Mining", universities often adhere to the classical names of the programs "Open-pit mining", "Underground mining of mineral deposits", "Surveying", "Mineral enrichment", "Mining machines", "Technological safety and mine rescue", "Mine and underground construction", "Blasting work", "Electrification of mining industry", etc. In the last 10 years, under the influence of various factors, new names of programs have begun to appear, such as: "Mining and geological information systems", "Mining ecology", etc. Thus, universities, using their freedom in terms of forming new training programs for specialists, can look to the future and try to foresee new professions of a mining engineer.

Personnel training for the mineral resource sector in Russian universities is currently carried out in the following main specializations of training:

- "Applied Geology" with the qualification of mining engineer (5 years of training);
- "Geological Exploration" with the qualification of mining engineer (5 years of training);
- "Mining" with the qualification of mining engineer (5.5 years of training);
- "Physical Processes in Mining or Oil and Gas Production" with the qualification of mining engineer (5.5 years of training);
- "Oil and Gas Engineering and Technologies" with the qualification of mining engineer (5.5 years of training).

Within the bachelor's and master's degree programs, the main program is "Oil and Gas" (4 years of bachelor's degree and 2 years of master's degree).

The names of the main directions and specializations of training are similar to the names of professional activities – geological exploration, mining, and processing of mineral raw materials, etc.

However, this does not mean that graduates of only the main directions and specializations of training can engage in engineering activities in the mineral resource sector. Certainly, companies in this sector of the economy need engineers from related industries – power engineers, economists, specialists in the field of information systems and technologies, technological machines, transport, and many others who want to realize themselves in the field of geology, mining or oil and gas.

In some sectors of the mineral resource complex, for example, the extraction of solid minerals, in order to perform official duties related to the management and conduct of mining operations, the management and conduct of blasting, personnel must meet the requirements of the The Federal Service for the Supervision of Environment, Technology and Nuclear Management (Rostekhnadzor). This department imposes special requirements on the basic higher education of such specialists. In particular, for the above-described case, people, who manage mining operations, must have a basic higher mining education – a diploma of a mining engineer in the specialization "Mining". It is precisely such features that limit the activities of specialists at mining enterprises, even from very close areas. For example, a bachelor or master who has completed training program "Geology" within the framework of classical education (without the qualification of a mining engineer or a mining engineer-geologist) will not be able to manage mining operations, but will certainly be in demand as a specialist, an expert whose activities may be related to analysis, testing, prospecting, design engineering, etc. Similar situations can be observed in the oil and gas field.

Universities, by using their freedoms in terms of forming profiles of educational programs, create and implement programs focused on the mineral resource sector on the basis of non-core directions and specializations of training. This process is especially typical for regions with a dominant mining sector of the economy. For example, within the framework of the master's degree program "Informatics and Computer Science", a program called "Mining and geological information systems" is being created and implemented in universities (an analogue of the profession or profile in the specialist's degree, which was written above). This approach makes it possible to attract additional personnel to the industry, by using graduates of various training programs, and also enables universities to quickly respond to the needs of companies when implementing projects related to the development and exploration of the mineral resource base in the regions.

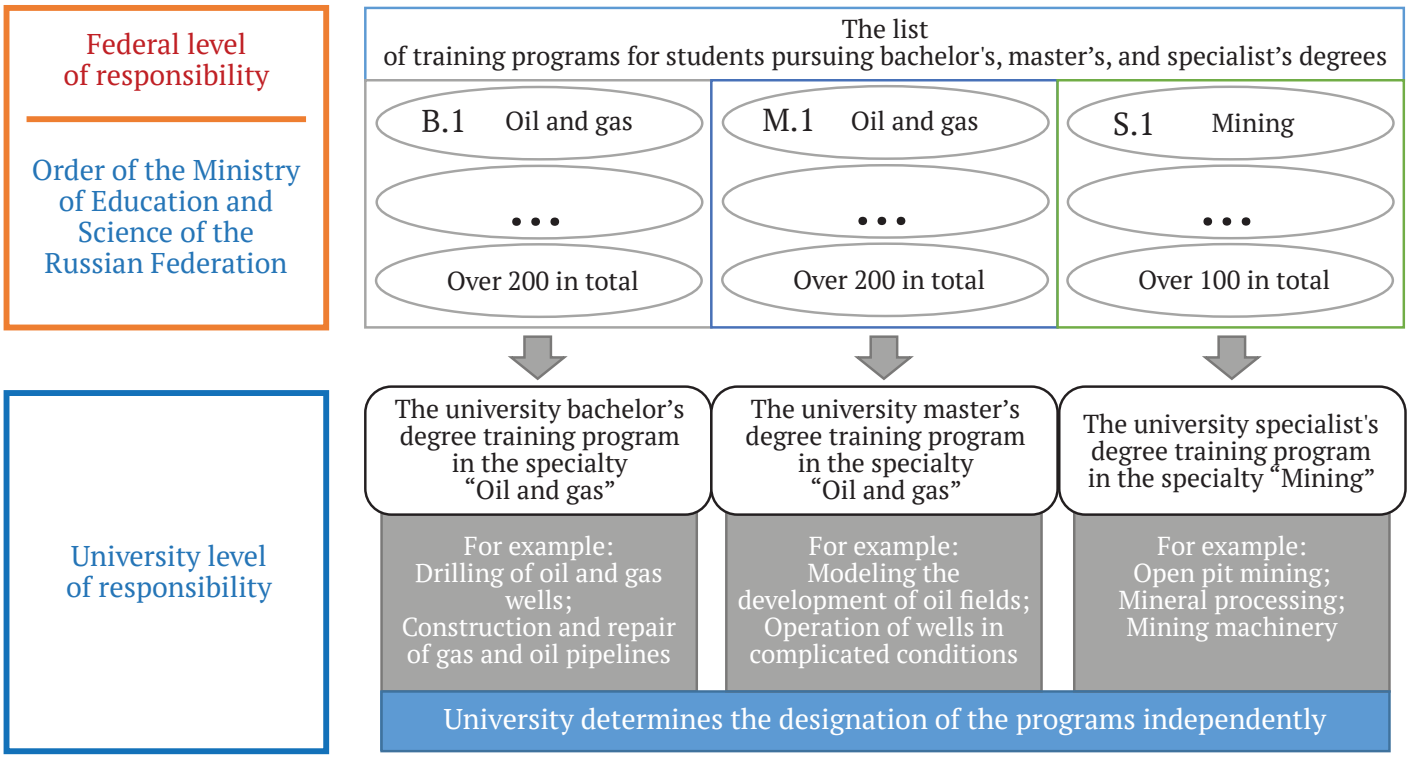

Fig. 1. The pattern of classification of program tracks (training programs) and specialties in higher education in Russia

Universities that train personnel for the mineral resource sector. Analysis of quantitative characteristics of personnel training

Over the past 15 years, the development of universities in Russia has been carried out on the basis of special government programs, the purpose of which was to increase the competitiveness of both universities and the country's higher education system in general. As a result, a national network of universities was formed, based on federal universities, national research universities [16].

Federal universities are organized in federal districts, usually one university per federal district. However, in the Far Eastern Federal District, taking into account its scale and the special attention of the state to the development of this region, two federal universities were established: in Yakutsk (North-Eastern Federal University) and in Vladivostok (Far Eastern Federal University). There are a total of 10 federal universities in the Russian Federation. They are established to provide training for the integrated socio-economic development of the subjects of the Russian Federation.

The activities of national research universities are aimed at staffing priority areas of development of science, technology, engineering, economic sectors, social sphere, for development and introduction of "high" technologies into production. There are a total of 29 such universities in the Russian Federation.

All federal and national research universities are developing on the basis of development programs that are approved for federal universities by the government of the country, and for national research – by relevant ministries. The development of these universities is carried out under conditions of additional funding. Unfortunately, there are no universities in the Russian Far East that have the status of national research ones.

Under the Russian federal legislation, national research universities have more academic freedoms.or example, they are able to develop and implement their educational programmes based on their own educational standards, while other universities must strictly follow the Federal State Educational Standards of Higher Education (FSES HE). This allows them to respond to the demands of the labor market in a more flexible and creative way, to create programs that can constitute an integral part of large industrial projects, and to "look beyond" some of the constraints that hold back the development of innovative education due to the bureaucratic formal requirements of certain documents. It is fair to note that over the past ten years, federal regulatory documents, including the Federal State Educational Standard of Higher Education itself, have evolved greatly in the direction of transferring significant powers to universities, developing their freedoms, including academic ones, which allows universities to respond more flexibly to new challenges.

This study presents the results of the data analysis of state statistics of the Russian Federation in the higher education system. Universities provide data on the main statistical indicators in the relevant directions and specializations of training annually. The author of the article obtained these data from the Ministry of Science and Higher Education of the Russian Federation. In this publication, they are presented for public discussion (data are given for 2021). Tables 1 and 2 provide information about universities and the number of graduates in training programs and professions for the mineral resource sector in 2021. Statistical data are presented with an accuracy of one accounting unit (one graduate) and are given in tables without rounding, as they reflect the absolute values of indicators from the system of state statistics of the Russian Federation. Table does not provide data on the graduation of mining engineers in the training program "Oil and Gas Engineering and Technology", which is due to the fact that this specialization is new. Training on it was started only five years ago, and the first graduation in specialized Russian universities will take place in 2022 only. An analytical review of the training of mining engineers in this profession will be presented by the Federal Academic Methodological Association in the coming publications. The data is grouped by federal districts of Russia.

Table 1

Number of graduates by specializations of training: "Applied Geology"; "Geological Exploration"; "Mining"; "Physical Processes in Mining or Oil and Gas Production" in 2021

	University	Specialization of training							
		Mining		Applied Geology		Geological Exploration		Physical Processes in Mining or Oil and Gas Production	
		admission	graduation	admission	graduation	admission	graduation	admission	graduation
Central Federal District									
1	National Research University "Belgorod State University", Belgorod	52	17	22	7	–	–	–	–
2	Belgorod State Technological University named after V. G. Shukhov, Belgorod; Gubkin branch, Belgorod region	22	43	–	–	–	–	–	–

Table 1 continued

	University	Specialization of training							
		Mining		Applied Geology		Geological Exploration		Physical Processes in Mining or Oil and Gas Production	
		admission	graduation	admission	graduation	admission	graduation	admission	graduation
3	Voronezh State University, Voronezh	–	–	9	–	–	–	–	–
4	Moscow Polytechnic University, Moscow	49	92	–	47	–	17	–	–
5	Sergo Ordzhonikidze Russian State University for Geological Prospecting, Moscow; branch in Stary Oskol, Belgorod Region	117	52	203	95	77	74	20	9
6	Peoples' Friendship University of Russia, Moscow	24	15	23	22	–	–	–	–
7	Gubkin Russian State University of Oil and Gas (National Research University), Moscow	–	–	79	54 (84*)	49 (75*)	49	25	21
8	Tver State Technical University, Tver	16	10	–	–	–	–	–	–
9	Tula State University, Tula	44	27	–	–	–	–	–	–
10	Dubna University, Dubna, Moscow region	–	–	–	–	19	17	–	–
11	University of Science and Technology MISIS, Moscow; branch – Technological Institute named after A.A. Ugarov in Stary Oskol; branch in Gubkin, Belgorod region	303 (408**)	260	–	–	–	–	26	22
12	Southwest State University, Kursk	29	24	–	–	–	–	–	–
	Итого	**656**	**540**	**336**	**225**	**150**	**157**	**71**	**52**
	Total: 12 universities are training in the Central Federal District								
	Southern Federal District								
1	Astrakhan State Technical University, Astrakhan	–	–	29	16	–	–	–	–
2	Astrakhan State University, Astrakhan	–	–	–	–	–	–	–	–
3	Kuban State University, Krasnodar	–	–	–	–	23	–	–	–
4	Platov South-Russian State Polytechnic University (NPI), Novocherkassk branch – Shakhty Highway Institute in Shakhty, Rostov region	79	106	58	62	–	–	–	–
5	Southern Federal University, Rostov-on-Don	–	–	23	15	–	–	–	–
	Total	**79**	**106**	**110**	**93**	**23**	**–**	**–**	**–**
	Total: 5 universities are training in the Southern Federal District								
	North-Western Federal District								
1	Murmansk Arctic State University, Murmansk, branch in Apatity, Murmansk region	53	36	–	–	–	–	10	–

* Gubkin Russian State University of Oil and Gas (National Research University) trains specialists in the field of Geological Exploration at the branch in Tashkent, Republic of Uzbekistan. In 2021, the admission to this specialization course amounted to 30 persons, while the number of graduates was 26. These figures are not included in the overall statistics for the Russian Federation.

** University of Science and Technology MISIS trains specialists in the field of Mining at the branch in Almalyk, Republic of Uzbekistan. In 2021, the admission to this specialization course amounted to 105 persons. The first graduation in the branch is planned for 2023. These figures are not included in the overall statistics for the Russian Federation.

Table 1 continued

	University	Specialization of training							
		Mining		Applied Geology		Geological Exploration		Physical Processes in Mining or Oil and Gas Production	
		admission	graduation	admission	graduation	admission	graduation	admission	graduation
2	Murmansk State Technical University, Murmansk	–	–	–	–	–	–	22	3
3	Petrozavodsk State University, Petrozavodsk, Republic of Karelia	37	38	–	–	–	–	–	–
4	Saint Petersburg Mining University (National Research University), Saint Petersburg	392	296	129	88	52	47	–	–
5	Northern (Arctic) Federal University named after M. V. Lomonosov, Arkhangelsk,	19	11	15	10	–	–	–	–
6	Ukhta State Technical University, Ukhta, Komi Republic; branch in Vorkuta	38	15	18	20	–	11	–	–
	Total	**539**	**396**	**162**	**118**	**52**	**58**	**32**	**3**
	Total: 6 universities are training in the North-Western Federal District								
	Far Eastern Federal District								
1	Amur State University, Blagoveshchensk, Amur region	–	7	35	31	–	–	–	–
2	East Siberia State University of Technology and Management, Ulan-Ude, Republic of Buryatia	8	–	–	–	–	–	–	–
3	Far Eastern Federal University, Vladivostok	–	68	–	–	–	–	–	–
4	North-Eastern State University, Magadan	78	43	24	7	–	–	–	–
5	Ammosov North-Eastern Federal University, Yakutsk, Republic of Sakha-Yakutia; branch in Mirny, branch in Neryungri	212	179	46	24	46	23	–	–
6	Pacific National University, Khabarovsk	27	14	–	–	–	–	–	–
	Total	**325**	**311**	**105**	**62**	**46**	**23**	**–**	**–**
	Total: 6 universities are training in the Far Eastern Federal District								
	Siberian Federal District								
1	T. F. Gorbachev State Technical University, Kemerovo, Kuzbass; branch in Prokopyevsk; branch in Mezhdurechensk; branch in Novokuznetsk; branch in Belov, Kemerovo region	591	402	–	8	–	–	19	17
2	Siberian Federal University, Krasnoyarsk	158	136	70	44	75	32	–	–
3	Siberian State Industrial University, Novokuznetsk, Kemerovo region	261	140	20	14	–	–	–	–
4	Irkutsk National Research Technical University, Irkutsk	366	147	25	18	27	21	–	–
5	Irkutsk National Research State University, Irkutsk	–	–	24	26	–	–	–	–
6	N. M. Fedorovsky Polar State University, Norilsk, Krasnoyarsk krai	66	37	–	–	–	–	–	–

End of Table 1

	University	Specialization of training							
		Mining		Applied Geology		Geological Exploration		Physical Processes in Mining or Oil and Gas Production	
		admission	graduation	admission	graduation	admission	graduation	admission	graduation
7	Siberian State University of Geosystems and Technologies, Novosibirsk	117	29	–	–	–	–	–	–
8	National Research Tomsk Polytechnic University, Tomsk; branch – Yurginsky Technology Institute, Yurga, Kemerovo region	–	8	83	57	51	30	–	–
9	National Research Tomsk State University, Tomsk	–	–	–	9	–	–	–	–
10	Tuvan State University, Kyzyl, Republic of Tuva	38	–	–	–	–	–	–	–
11	Novosibirsk State University of Architecture and Civil Engineering (SIBSTRIN), Novosibirsk[1]	–	–	–	–	–	–	–	–
12	Transbaikal State University, Chita	169	158	40	7	–	8	–	–
	Total	**1766**	**1057**	**262**	**183**	**153**	**91**	**19**	**17**
Total: 12 universities are training in the Siberian Federal District									
Ural Federal District									
1	Nosov Magnitogorsk State Technical University, Chelyabinsk region	247	140	–	–	–	–	–	–
2	Technical University of UMMC, Verkhnyaya Pyshma, Sverdlovsk region	30	20	–	–	–	–	–	–
3	Tyumen Industrial University, Tyumen	44	–	88	107	54	35	–	–
4	Ural State Mining University, Yekaterinburg, Sverdlovsk region	626	350	91	89	109	86	–	–
5	Yugra State University, Khanty-Mansiysk, Khanty-Mansi autonomous district	–	–	25	22	–	–	–	–
6	South Ural State University (National Research University), branch in Miass, Chelyabinsk region	–	–	9	–	–	–	–	–
	Total	**947**	**510**	**213**	**218**	**163**	**121**	**–**	**–**
Total: 6 universities are training in the Ural Federal District									
Volga Federal District									
1	Bashkir State University, Republic of Bashkortostan, Ufa, Sterlitamak branch	–	–	–	–	34	49	18	–
2	Kazan National Research Technological University, Kazan, Republic of Tatarstan	25	14	–	–	–	–	–	–
3	Orenburg State University, Orenburg	–	–	103	96	–	–	–	–
4	Perm State National Research University, Perm	–	–	–	–	16	–	–	–

[1] The university had no admission and graduation in 2021, but has license and accreditation for the Mining specialty. According to the information from the University, the RF Ministry of Education and Science has allocated 10 state-financed openings for the enrollment of students in 2023.

	University	Specialization of training							
		Mining		Applied Geology		Geological Exploration		Physical Processes in Mining or Oil and Gas Production	
		admission	graduation	admission	graduation	admission	graduation	admission	graduation
5	Perm National Research Polytechnic University, Perm, branch in Berezniki, Perm Krai	106	72	94	35	–	–	19	12
6	Samara State Technical University, Samara	–	–	23	40	–	–	22	19
7	Saratov (Chernyshevsky) State University, Saratov	–	–	76	41	–	–	–	–
8	Udmurt State University, Izhevsk, Republic of Udmurtia	–	–	22	15	–	–	–	–
9	Ufa State Petroleum Technical University, Ufa, Republic of Bashkortostan	–	–	34	62	17	34	–	–
	Total	**131**	**86**	**352**	**289**	**67**	**83**	**59**	**31**
	Total: 9 universities are training in Volga Federal District								
	North Caucasus Federal District								
1	Grozny State Oil Technical University, Grozny, Chechen Republic	–	–	23	26	31	23	–	–
2	North Caucasus Mining and Metallurgical Institute (State Technological University), Vladikavkaz, Republic of North Ossetia	106	69	27	17	–	–	–	–
3	North Caucasus Federal University, Stavropol	–	–	49	31	12	35	–	–
	Total	**106**	**69**	**99**	**74**	**43**	**58**	**–**	**–**
	Total: 3 universities are training in the North Caucasus Federal District								
	Total: 59 universities are training in the Russian Federation								
	Summary total	**4549**	**3075**	**1639**	**1262**	**697**	**591**	**181**	**103**

Table 2

The number of graduates in the directions of training "Oil and Gas" (bachelor's degree, master's degree) and specialization "Oil and Gas Engineering and Technology" (specialist's degree) in 2021

	University	Directions and specialization of training					
		"Oil and Gas", bachelor's degree		"Oil and Gas Engineering and Technologies", specialist's degree		"Oil and Gas", master's degree	
		admission	graduation	admission	graduation	admission	graduation
	Central Federal District						
1	Voronezh State Technical University, Voronezh	110	128	–	–	60	49
2	Moscow Polytechnic University, Moscow	10	63	–	–	–	–
3	Sergo Ordzhonikidze Russian State University for Geological Prospecting, Moscow; branch in Stary Oskol, Belgorod Region	36	54	–	–	42	69
4	Gubkin Russian State University of Oil and Gas (National Research University), Moscow	388 (604*)	329 (508*)	53	–	323	384
5	Peoples' Friendship University of Russia, Moscow	83	56	–	–	17	7

* Gubkin Russian State University of Oil and Gas (National Research University) trains bachelors in the field of Oil and Gas at the branch in Tashkent, Republic of Uzbekistan. In 2021, the admission to this specialization course amounted to 216 persons, while the number of graduates was 179. These figures are not included in the overall statistics for the Russian Federation.

Table 2 continued

	University	Directions and specialization of training					
		"Oil and Gas", bachelor's degree		"Oil and Gas Engineering and Technologies", specialist's degree		"Oil and Gas", master's degree	
		admission	graduation	admission	graduation	admission	graduation
6	Skolkovo Institute of Science and Technology, Moscow	–	–	–	–	12	13
7	Tambov State Technical University, Tambov	3	11	–	–	2	2
	Total	**630**	**641**	**53**	**–**	**456**	**524**
Total: 7 universities are training in the Central Federal District							
Southern Federal District							
1	Astrakhan State Technical University, Astrakhan	109	132	–	–	52	108
2	Don State Agrarian University Novocherkassk Engineering and Reclamation Institute named after A.K. Kortunova – branch of Don State Agrarian University, Novocherkassk, Rostov region	29	–	–	–	–	–
3	Kuban State Technological University, Krasnodar, branch in Armavir, Krasnodar Krai	213	276	–	–	86	137
4	Maykop State Technological University, Maykop, branch in Yablonovsky, Republic of Adygea	115	136	–	–	19	–
5	Platov South-Russian State Polytechnic University (NPI), Novocherkassk, Rostov region	62	47	24	–	–	–
	Total	**528**	**591**	**24**	**–**	**157**	**245**
Total: 5 universities are training in the Southern Federal District							
North-Western Federal District							
1	Murmansk State Technical University, Murmansk	17	10	–	–	–	–
2	Saint Petersburg Mining University (National Research University), Saint Petersburg	317	227	92	–	137	109
3	Saint Petersburg State University, Saint Petersburg	16	8	–	–	9	13
4	Northern (Arctic) Federal University named after M.V. Lomonosov, Arkhangelsk	100	68	–	–	24	9
5	Ukhta State Technical University, Ukhta, Komi Republic; branch in Vorkuta, branch in Usinsk	263	287	69	–	75	44
	Total		**600**	**161**	**–**	**245**	**175**
Total: 5 universities are training in the North-Western Federal District							
Far Eastern Federal District							
1	Far Eastern State Transport, Khabarovsk, branch in Svobodny, Khabarovsk region	34	44	–	–	1	–
2	Far Eastern Federal University, Vladivostok, Far Eastern region	52	92	–	–	30	35
3	Maritime State University named after admiral G.I. Nevelskoy, Vladivostok, Far Eastern Region[2]	–	–	–	–	–	–
4	Sakhalin State University, Yuzhno-Sakhalinsk	39	60	–	–	–	–
5	Ammosov North-Eastern Federal University, Yakutsk, Republic of Sakha-Yakutia, branch in Mirny	42	49	33	–	–	–

[2] In 2021, the University did not have an admission and graduation on these specialties. However, there is a certain number of students enrolled in previous years (59 people at different study years).

Table 2 continued

	University	Directions and specialization of training					
		"Oil and Gas", bachelor's degree		"Oil and Gas Engineering and Technologies", specialist's degree		"Oil and Gas", master's degree	
		admission	graduation	admission	graduation	admission	graduation
6	Pacific National University, Khabarovsk	25	56	–	–	–	–
	Total	**192**	**301**	**33**	**–**	**31**	**35**
Total: 6 universities are training in the Far Eastern Federal District							
Siberian Federal District							
1	Irkutsk National Research Technical University, Irkutsk	112	292	107	–	37	4
2	National Research Tomsk Polytechnic University, Tomsk	182	205	–	–	125	99
3	Omsk State Technical University, Omsk	209	153	–	–	80	85
4	Siberian Federal University, Krasnoyarsk	33	88	–	–	–	–
5	Tomsk State University of Architecture and Building, Tomsk	81	34	–	–	–	–
	Total	**617**	**772**	**107**	**–**	**242**	**188**
Total: 5 universities are training in the Siberian Federal District							
Ural Federal District							
1	Nizhnevartovsk State University, Nizhnevartovsk, Khanty-Mansi autonomous district	62	122	–	–	–	–
2	Tyumen Industrial University, Tyumen, branch in Noyabrsk, branch in Surgut, branch in Nizhnevartovsk, Khanty-Mansi autonomous district	411	1137	493	–	216	669
3	Yugra State University, Yugra, Khanty-Mansi autonomous district	262	363	–	–	–	–
	Total	**735**	**1622**	**493**	**–**	**216**	**669**
Total: 3 universities are training in the Ural Federal District							
Volga Federal District							
1	Almetyevsk State Oil Institute, Almetyevsk, Republic of Tatarstan	135	176	–	–	60	73
2	Kalashnikov Izhevsk State Technical University, Udmurtia	22	–	–	–	8	–
3	Kazan (Volga Region) Federal University, Kazan, Republic of Tatarstan	102	57	–	–	52	38
4	Kazan National Research Technological University, Kazan, Republic of Tatarstan	51	78	–	–	–	–
5	Kamsky Institute of Humanitarian and Engineering Technologies, Izhevsk, Udmurtia	9	23	–	–	–	–
6	Nizhny Novgorod State Technical University named after R.E. Alekseev, Nizhny Novgorod	54	10	–	–	7	5
7	Perm National Research Polytechnic University, Perm	124	234	50	–	75	31
8	Volga State Technological University, Yoshkar-Ola, Republic of Mari El	43	9	–	–	–	–
9	Samara State Technical University, Samara	688	726	–	–	232	210
10	Yuri Gagarin State Technical University of Saratov, Saratov, branch in Engels, Saratov region	100	200	–	–	–	–
11	Saratov (Chernyshevsky) State University, Saratov	61	31	–	–	–	–

End of Table 2

	University	Directions and specialization of training					
		"Oil and Gas", bachelor's degree		"Oil and Gas Engineering and Technologies", specialist's degree		"Oil and Gas", master's degree	
		admission	graduation	admission	graduation	admission	graduation
12	Udmurt State University, Izhevsk, Republic of Udmurtia, branch in Votkins	235	408	186	–	69	63
13	Ulyanovsk State Technical University, Ulyanovsk	18	16	–	–	14	3
14	Ulyanovsk State University, Ulyanovsk	38	68	–	–	14	–
15	Ufa State Petroleum Technical University, Ufa, Republic of Bashkortostan, Sterlitamak branch, Oktyabrsky branch, Salavat branch	475	732	805	–	367	495
16	Branch of Gubkin Russian State University of Oil and Gas (National Research University) in Orenburg	128	185	–	–	–	–
17	Cheboksary Institute (branch) of "Moscow Polytechnic University", Cheboksary, Chuvash Republic	45	–	–	–	–	–
	Total	**2328**	**2953**	**1041**	**–**	**898**	**918**
	Total: 17 universities are training in the Volga Federal District						
	North Caucasus Federal District						
1	Grozny State Oil Technical University, Chechen Republic	75	106	71	–	28	20
2	Dagestan State Technical University, Makhachkala, Republic of Dagestan	95	66	–	–	14	32
3	Ingush State University, Magas, Republic of Ingushetia	54	–	–	–	–	–
4	North Caucasus Mining and Metallurgical Institute (State Technological University), Vladikavkaz, Republic of North Ossetia[3]	–	–	–	–	–	–
5	North Caucasus Federal University, Stavropol	161	233	–	–	55	98
6	Kadyrov Chechen State University, Grozny, Chechen Republic	3	–	–	–	–	–
	Total	**388**	**405**	**71**	**–**	**97**	**150**
	Total: 6 universities are training in the North Caucasus Federal District						
	Total: 54 universities are training in the Russian Federation						
	Summary total	**6131**	**7885**	**1983**	**–**	**2342**	**2904**

[3] In 2021, the University did not have an admission and graduation on these specialties. However, there is a certain number of students enrolled in previous years (41 people at different study years).

Among the universities that train personnel for the mineral resource sector of the economy, different categories of universities can be determined. There are historical industry universities of mining, geological or oil and gas profile, for example, Saint Petersburg Mining University (National Research University); Gubkin Russian University of Oil and Gas (National Research University) (Moscow), University of Science and Technology MISIS (Moscow), Ural State Mining University, and also federal universities, such as North-Eastern Federal University (Yakutsk), Siberian Federal University (Krasnoyarsk), Far Eastern Federal University (Vladivostok), etc. There are universities in each federal district that train personnel for the country's mineral resource sector, which indicates the possibility of supporting the implementation of geological exploration projects and the development of new mineral deposits.

Based on the data provided in the table, the following conclusions can be drawn:

- In total, 85 universities in all federal districts are training specialists for the mineral resource sector in the Russian Federation.

● 36 universities in all federal districts are training specialists for the extraction and processing of solid minerals (Mining).

● 49 universities in all federal districts are training specialists for the extraction, primary processing, and transportation of liquid and gaseous minerals (Oil and gas).

● 37 universities in all federal districts are training specialists for geological exploration (applied geology, geological exploration).

● Among the universities that train specialists for the mineral resource sector, 7 are federal universities, 13 are national research universities of Russia.

● The largest number of universities that train personnel in the programs and professions of the mineral resource sector is concentrated in the Central Federal District – 15, which is determined by the concentration of large-scale enterprises of the industry that form tens of thousands of jobs, including for engineering personnel (Lebedinsky Mining and Processing Plant, Stoilensky Mining and Processing Plant, Mikhailovsky Mining and Processing Plant, and other enterprises).

Among the universities that make a significant contribution to the formation of quantitative characteristics of personnel training for the mineral resource sector, the following universities should be noted.

Mining: T.F. Gorbachev State Technical University (13.7 % of the total training of specialists); Ural State Mining University (11.38 %); Saint Petersburg Mining University (9.63 %); University of Science and Technology MISIS (8.46 %); Ammosov North-Eastern Federal University (5.82 %); Transbaikal State University (5.14 %); Irkutsk National Research Technical University (4.78 %); Siberian State Industrial University (4.55 %); Magnitogorsk State Technical University named after G.I. Nosov (4.55 %); Siberian Federal University (4.42 %); Platov South-Russian State Polytechnic University (NPI) (3.45 %), – providing training for more than 75 % of the total graduation of relevant personnel in the country.

Applied Geology: Tyumen Industrial University (8.48 %); Orenburg State University (7.61 %); Sergo Ordzhonikidze Russian State Geological Exploration University (7.53 %); Ural State Mining University (7.05 %); Saint Petersburg Mining University (6.97 %); Platov South-Russian State Polytechnic University (NPI) (4.91 %); Ufa State Petroleum Technical University (4.91 %); National Research Tomsk Polytechnic University (4.52 %); Gubkin Russian University of Oil and Gas – National Research University (4.28 %); Moscow Polytechnic University (3.72 %); Siberian Federal University (3.49 %); Saratov (Chernyshevsky) National Research State University (3.25 %); Samara State Technical University (3.17 %); Perm National Research Polytechnic University (2.77 %); Amur State University (2.46 %); North Caucasus Federal University (2.46 %), providing training for more than 75 % of the total graduation of relevant personnel in the country.

Geological Exploration: Ural State Mining University (14.55 %); Sergo Ordzhonikidze Russian State Geological Exploration University (12.52 %); Gubkin Russian University of Oil and Gas National Research University (8.29 %); Bashkir State University (8.29 %); Saint Petersburg Mining University (7.95 %); Tyumen Industrial University (5.92 %); North Caucasus Federal University (5.92 %); Ufa State Petroleum Technical University (5.75 %); Siberian Federal University (5.41 %); National Research Tomsk Polytechnic University (5.08 %); Grozny State Oil Technical University (3.89 %); Ammosov North-Eastern Federal University (3.89 %); Irkutsk National Research Technical University (3.55 %), providing training for more than 90 % of the total graduation of relevant personnel in the country.

Oil and Gas (bachelor's degree): Tyumen Industrial University (14.42 %); Ufa State Petroleum Technical University (9.28 %); Gubkin Russian State University of Oil and Gas – National Research University (6.52 %); Samara State Technical University (9.21 %); Udmurt State University (5.17 %); Yugra State University (4.60 %); Irkutsk National Research Technical University (3.70 %); Ukhta State Technical University (3.64 %); Kuban State Technological University (3.50 %); Perm National Research Polytechnic University (2.97 %); North Caucasus Federal University (2.95 %); Saint Petersburg Mining University (2.88 %); Tomsk National Research Polytechnic University (2.60 %); Yuri Gagarin State Technical University of Saratov (2.54 %); Almetyevsk State Petroleum Institute (2.23 %), providing training for more than 75 % of the total graduation of relevant personnel in the country.

Oil and Gas (master's degree): Tyumen Industrial University, Tyumen (23.04 %); Ufa State Petroleum Technical University (17.05 %); Samara State Technical University (13.22 %); Udmurt State University (7.23 %); Uygra State University (4.72 %); Gubkin Russian State University of Oil and Gas (National Research University (3.75 %); Irkutsk National Research Technical University (3.72 %); Ukhta State Technical University (3.41 %); Kuban State Technological University (3.37 %); Perm National Research Polytechnic University (2.93 %), providing training for more than 80 % of the total graduation of relevant personnel in the country.

The regional analytical section is of great importance in the study of the education system for mining engineers in the country. In the Russian Federation, regional analytics is presented at the level of the constituent subjects of the federation. Given that there are 89 such subjects in the country, it would be difficult to provide relevant research results on the training of mining engineers in all these regions. There-

fore, we present these data at the level of federal districts. Grouped information on the graduation of personnel from universities for the mineral resource sector in the context of federal districts is presented in Table 3.

Quantitative characteristics of personnel training for the mineral resource sector in Russian universities in the context of federal districts demonstrate not only the ability of universities in the regions to train professional personnel, but also the demand for them in the respective regions. Thus, the oil and gas sector is concentrated in the large oil and gas regions of the country such as the Ural (20.57 %) and Volga (37.45 %) federal districts. Mining, respectively, in the Siberian Federal district (34.38 %). Professions related to geological exploration of minerals are in demand both in mining companies and oil and gas sector at the same time, which reflects a more uniform distribution of the training of relevant specialists across federal districts.

When assessing quantitative characteristics, analytical data reflecting the dynamics of personnel training over the years are of particular interest.

In the Federal Academic Methodological Association in the system of higher education, statistical accounting of quantitative characteristics of mining engineers graduation in mining specializations has been conducted since 1992 [28, 30]. Updated data on the dynamics of total graduation of mining engineers by year in the professions Mining and Physical Processes in Mining or Oil and Gas Production are presented in Fig. 2.

Similar data for the graduation of specialists in otherdirections and specializations of training of the mineral resource sector are presented in Figs. 3, 4.

The analysis of the presented data allows us to draw the following conclusions:

1. A tendency to decrease the graduation of mining engineers at Russian universities is observed in such specializations as Mining, Applied Geology, Geological Exploration. The reason for this are several factors, among which it should be noted:

- deterioration of reputation of the mining engineer and geologist profession, which affects the attractiveness of these programs at universities;
- relatively low quality indicators of students enrolled in the first year of mining and geological specializations, which is determined by the average indicators of the Unified State Exam. The value of this indicator determines to the greatest extent the student's ability to successfully master the educational program of higher education – its "academic survival".

2. There are fairly stable graduation rates for the oil and gas industry at almost all levels of higher education (bachelor's and master's degrees).

Table 3

Data on the graduation of mining engineers in the main specializations and directions of training of the mineral resource sector in the federal districts of Russia

Federal district	Oil and gas, bachelor's degree	Oil and gas, master's degree	Applied Geology, specialist's degree	Geological Exploration, specialist's degree	Mining, specialist's degree	Physical Processes in Mining or Oil and Gas Production, specialist's degree
Central Federal District	641 (8.13 %)	524 (18.04 %)	225 (17.83 %)	157 (26.57 %)	540 (17.56 %)	52 (50.49 %)
Southern Federal District	591 (7.50 %)	245 (8.44 %)	93 (7.37 %)	–	106 (3.45 %)	–
North-Western Federal District	600 (7.61 %)	175 (6.03 %)	118 (9.35 %)	58 (9.81 %)	396 (12.88 %)	3 (2.91 %)
Far Eastern Federal District	301 (3.82 %)	35 (1.21 %)	62 (4.91 %)	23 (3.89 %)	311 (10.12 %)	–
Siberian Federal District	772 (9.79 %)	188 (6.47 %)	183 (14.50 %)	91 (15.40 %)	1057 (34.37 %)	17 (16.50 %)
Ural Federal District	1622 (20.57 %)	669 (23.04 %)	218 (17.27 %)	121 (20.47 %)	510 (16.59 %)	–
Volga Federal District	2953 (37.45 %)	918 (31.61 %)	289 (22.90 %)	83 (14.04 %)	86 (2.80 %)	31 (30.10 %)
North Caucasus Federal District	405 (5.14 %)	150 (5.17 %)	74 (5.86 %)	58 (9.81 %)	69 (2.24 %)	–
Total	**7885 (100 %)**	**2904 (100 %)**	**1262 (100 %)**	**591 (100 %)**	**3075 (100 %)**	**103 (100 %)**

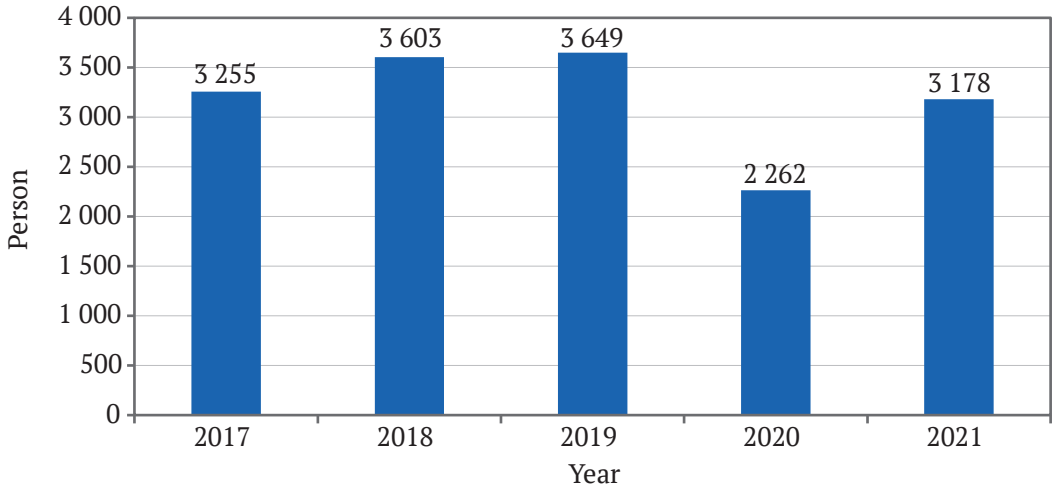

Fig. 2. Graduation of mining engineers in Russia in specializations "Mining" and "Physical Processes in Mining or Oil and Gas Production" from 2017 to 2021

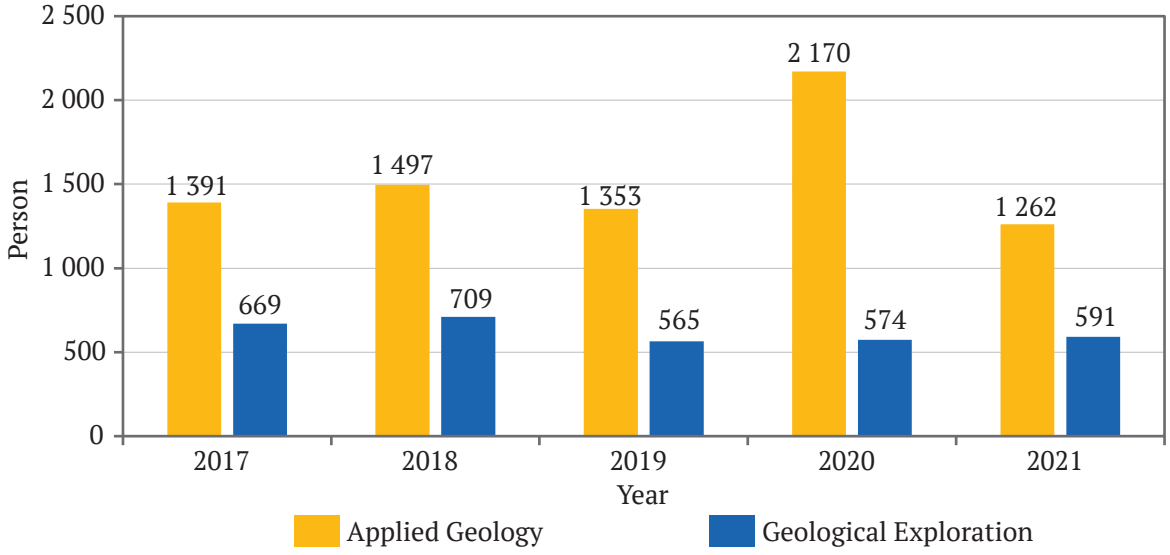

Fig. 3. Graduation of mining engineers in Russia in specializations "Applied Geology" and "Geological Exploration" from 2017 to 2021

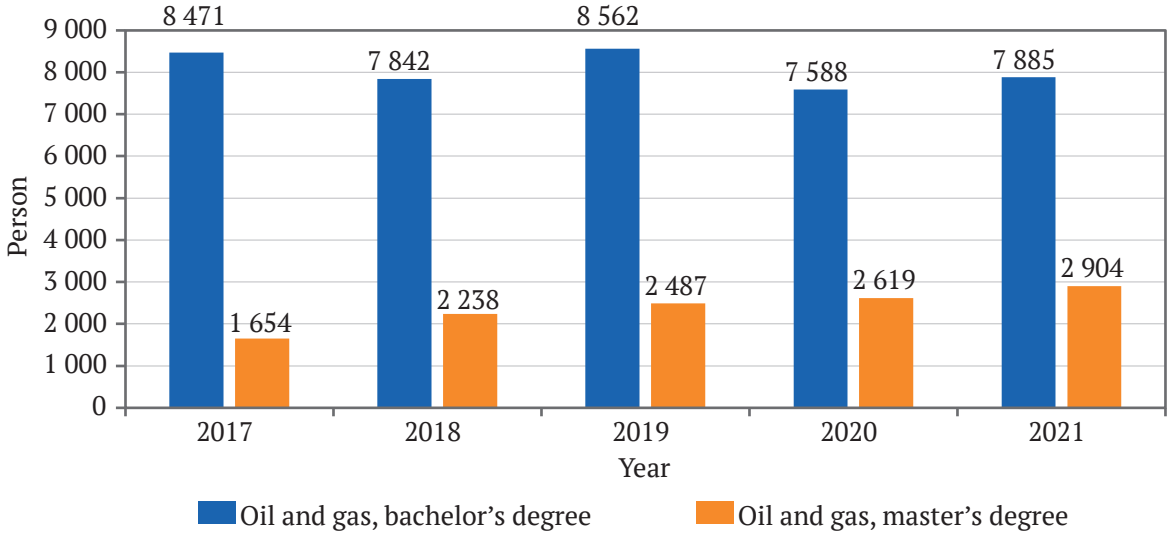

Fig. 4. Graduation of bachelors and masters in Russia in the program "Oil and gas" from 2017 to 2021

3. It is obvious that the indicators of personnel training for the mineral resource sector in the Far Eastern Federal district (see Table 3) do not correspond to its needs necessary to solve those tasks that are now being formalized at the level of the state vector of development of the country's economy. The Far Eastern Federal District occupies a dominant position in reserves and extraction of the main types of minerals among other regions of the Russian Federation. The region has large reserves of hydrocarbons, 49.1 % of coal reserves, 73.85 % of uranium reserves, almost all tin reserves (100 % of Russian production), 65.8 % of wolfram reserves (100 % of Russian production), 34.6 % of copper reserves, 54.3 % of lead reserves, 57.4 % of zinc reserves, 61.06 % of molybdenum reserves, 64.8 % of mercury reserves, 97 % of arsenic reserves (100 % of production in the Russian Federation), 87 % of antimony reserves, 62.7 % of bismuth reserves, 59.8 % of germanium reserves, 76.45 % of diamond reserves, 73.2 % of iron reserves, 99.68 % of boron reserves, 91.5 % of jade reserves, 97 % of perlite reserves, which forms a significant industrial and export potential of the territory [31]. A significant increase in the number of mining enterprises is expected in the segment of common minerals, which is associated with the development of the regional construction industry and the production of local building materials [31]. According to official data presented in the analytical note of the Ministry for Development of Russian Far East "Calculation of the personnel needs of key sectors of the economy of Far Eastern Federal District with distribution by region, taking into account the requirements for the education level 2020–2025 and proposals on the volume and structure of personnel training with higher education and secondary vocational education for 2020–2025", the need for specialists with higher education and work experience for the mining of coal, metal ores, and diamonds for 2020–2025 amounted to 1876 people. The Analytical Note of Russian Far East an Arctic Development Corporation on personnel needs in key sectors of the economy in Far East indicates that as of 01.01.2021, the average number of employees in the coal, metal ores, and diamonds mining industry was 114,112 people. Employment growth in the industry is expected to be the largest and will amount to 20–25 % by 2027. At the same time, the additional need will be from 30,000 employees [31].

It is noteworthy that the increase in demand for specialists in Russian Far East was predicted as early as 2005 [30]. Forecast justification was carried out at Moscow State Mining University (now, University of Science and Technology MISIS) and presented in a number of publications. Unfortunately, the situation has only worsened over the past time, the formed federal universities in Yakutsk and Vladivostok have not been able to increase the graduation of mining engineers, and targeted training for the needs of Far East in other regions does not work actually. The fragmentation of

Table 4

Admission to universities in the directions and specializations of training of the mineral resource sector

Directions and specializations of training	Admission in 2021/22		
	Total	Budget	The share of students accepted for the first year to study at the expense of the state budget of Russia, %
Oil and gas, bachelor's degree	6 131	3 138	51
Oil and gas, master's degree	2 342	1 247	53
Applied Geology, specialist's degree	1 639	1 252	76
Geological Exploration, specialist's degree	697	603	87
Mining, specialist's degree	4 549	2 781	61
Physical Processes in Mining or Oil and Gas Production, specialist's degree	181	160	88
Oil and Gas Engineering and Technologies, specialist's degree	1 983	444	22

Table 5

The average subject score of the Unified State Exam of an enrolled first-year mining and geology student

Form of training	Maximum value of the average subject score of the Unified State Exam in Russian universities when applying for mining and geological specializations	Minimum value of the average subject score of the Unified State Exam in Russian universities when applying for mining and geological specializations
Training at the expense of the Russian Federation (state grant)	84.7 out of 100 possible	47.4 out of 100 possible
Training at the expense of private and legal entities	72.9 out of 100 possible	48.2 out of 100 possible

country's regions, outflow of population to other regions, the weak attractiveness of jobs in the Far East for the younger generation is affected. It is to be hoped that the situation will change.

All these facts indicate the need for additional state measures related to planning the development of this segment of higher education in Russian Far East [30].

Analysis of admission to universities for directions and specializations of training of the mineral resource sector

The characteristics of graduation and admission to universities may differ significantly. It is due not only to the presence of a delay determined by the time of learning process itself (4–6 years), but also changes in management decisions at the federal and university levels. The analysis of the quantitative characteristics of admission makes it possible to predict the upcoming graduation, taking into account the likely "dropout" of students during learning process.

Table 4 shows data on admission to universities in training programs and professions of the mineral resource sector in 2021.

The data given in Table 4 reflect a higher level of extra-budgetary training in training programs related to oil and gas, which again indicates their higher attractiveness. The establishment of the Oil and Gas Engineering and Technology profession for training personnel in the oil and gas industry was justified, which reflects its popularity among university entrants. Most of the students enrolled in the first year of this profession study at the expense of individuals and legal entities (in fact, about 80 %). This does not mean that bachelor's degree programs in this field are not in demand. Most likely, specialized universities and companies have decided on the functionality and areas of responsibility of graduates of bachelor's and specialist's degree in employment, and effectively use both levels of higher education to form the human engineering potential of the industry.

Analysis of the data presented in Tables 2 and 4, indicates that graduation of bachelors in the program Oil and Gas is much higher than admission this year. This phenomenon is largely explained by the fact that at the federal level, within the framework of all directions and specializations of training in the field of oil and gas, a decision to terminate extra-mural education was made. Experts drew attention to the fact that personnel training in these directions and specializations of training using extra-mural programs has taken hypertrophied forms. This contingent of students began to dominate, which began to affect the overall quality of industry training. At the level of the Federal Academic Methodological Association, it was decided to exclude the possibility of extra-mural training in all areas of directions and specializations of training in the field of oil and gas business. The decision was made collectively and reflected in the requirements of federal state educational standards.

Express analysis of admission quality of higher education programs of mining and geological profile

When describing some of admission features to the university of Russia, the author noted the need for the results of the Unified State Exam (USE) for the applicant when entering the university. Universities are competing with each other to attract applicants with high USE scores or winners of Olympiads. Indicators that determine the average USE score of an enrolled student are included in the quality indicators of admission in the federal monitoring systems and the national university ranking systems.

Many processes and procedures for admission to the university are implemented on the basis of information platforms, which allows for the systematic collection of voluminous information and its analysis. Information reflecting the average score of the Unified State Exam in the disciplines of the enrolled applicant is also accumulated in information systems, grouped, and presented publicly (https://ege.hse.ru/rating).

Here are some data that will allow for an express assessment of the quality of admission to mining and geological professions in Russia.

Table 5 presents data on the average subject score of the Unified State Exam of an enrolled first-year mining and geology student in 2021.

Table 5 indicates that the specialized universities achieve different results in the qualitative characteristics of student enrolment in the first year of mining and geology. It is obvious that the universities of Moscow and Saint Petersburg win in this competition. The universities located in the capital city have always attracted gifted young people from the regions, while the specialized training in secondary schools is actually better in these regions.

At the same time, the status of universities does not always guarantee to win in the competition. Sometimes both federal and national research universities face significant difficulties in attracting well-trained applicants.

The situation in this regard is particularly difficult in remote mining and industrial regions and one-company towns – cities whose economy is dominated by the mining and industrial sector. Examples of such regions are Magadan, Murmansk region, Komi Republic, Krasnoyarsk Krai (Norilsk), etc. Universities and their branches have to do a lot of work to attract applicants with high USE scores. It should be taking into account that this problem also has a social connotation.

Conclusion

1. The system of personnel potential formation for the mineral resource sector of Russia is based on a national network of universities represented in virtually all regions with a developed mining complex.

2. In the specializations "Applied Geology", "Geological Exploration", "Mining", "Physical Processes in Mining or Oil and Gas Production" in 2021, 5,031 mining engineers were trained in Russia; in the programs of the oil and gas profile – 10,789 bachelors and masters.

3. Quantitative parameters of personnel training for the mineral resource sector at Russian universities indicate the opportunity of forming human resources of the industry only at the expense of their own academic schools in the higher education system.

4. The system of mining engineer training in Russia is developing in conditions of acute competition with other fields of higher education training in terms of attracting the most trained and talented young people to mining and geological programs who are able to master educational programs effectively and take jobs in the industry after graduation.

5. Universities and mining businesses should undertake significant efforts to improve the reputation of the mining engineer profession in society, including aspects of remuneration and social positioning within the community.

6. Particular attention should be paid to the development of the system to form human resources potential of the mineral resource sector in the Russian Far East, where large-scale projects for the extraction and processing of minerals are to be implemented, requiring new personnel trained at regional universities.

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Received 08.05.2022
Revised 09.07.2022
Accepted 25.08.2022