FREE ROSTRUM

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Russia on the Way to Green Subsurface Resource Management

M. I. KUZMIN[1], V. S. RUKAVISHNIKOV[2], N. M. SYSOEVA[3], V. I. GREBENSHCHIKOVA[1], A. N. KUZNETSOVA[3]

[1]*A. P. Vinogradov Institute of Geochemistry, Siberian Branch of the Russian Academy of Sciences, Irkutsk, Russia*

E-mail: mikuzmin@igc.irk.ru

[2]*East-Siberian Institute of Medical and Environmental Research, Angarsk, Russia*

[3]*Irkutsk Scientific Centre, the Siberian Branch of the Russian Academy of Sciences, Irkutsk, Russia*

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Abstract

The necessity to introduce the principles of green economics into subsoil management as one of the most important branches of the Russian economy affecting the quality of the environment to the highest extent is considered. The main kinds of the effect of mining and primary processing of mineral resources on the state of geological environment, surface relief and soil cover are presented, as well as the forms of the influence on human health for different stages of the industrial process. The long-term negative effect of the consequences of mineral resource mining is stressed, together with the high cost of recultivation and rehabilitation works. The major goals in the introduction of green approaches in subsoil resource management include improvement of the normative-legal basis of subsoil usage with respect to the ecological aspects of raw material mining and processing, the formation of the state authorities for geological management and innovative development of the economics of the country, broadening of the range of application of financial mechanisms for the technological renewal, public disclosure of the entire ecologically significant information on the companies involved in subsoil resource management.

Keywords: green economics, subsoil resource management, geological environment, geochemical state of territories, health effect, green obligations, technological renewal

INTRODUCTION

The mining industry (according to the All-Russia classifier of the kinds of economic activities) has always been one of the leading branches of industry in Russian economy. Mining of extractable resources (ER) requires a great amount of work to build mines, open pits, excavation sites, wells. V. I. Vernadsky, an outstanding scientist, appropriately said in the beginning of the XX century “Humanity as a whole is becoming a powerful geological force”. He thought that a rational human community relying on the scientific basis forms a new state of the biosphere – noosphere. In 1843, he wrote in his article: “This is a new state of the biosphere, which we approach paying no notice to it” [1]. According to the idea of V. I. Vernadsky, the noosphere is a new geological sphere of the Earth, created by the rational human society. He was sure that it was necessary to conserve our splendid planet as long as possible for future inhabitants of the Earth passing the accumulated knowledge to them.

At the end of the XX century and in the XXI century, in connection with the intense development of industry and progress in the possibilities to determine toxic elements in the sedimentary layers during their formation, environmental studies showed that modern sediments contain a large amount of wastes from various branches of industry. The Earth's surface becomes covered with a new man-made layer, which is represented by the residues of industrial production: plastics, concrete, ceramics, glass, as well as accumulation of aluminium, tungsten, lead, zinc, the products of fossil fuel combustion and other organic and inorganic substances. An idea has been put forward at a number of biological, chemical and geological conferences that modern sediments formed during the recent interglacial period, at the age of 11.7 thousand years, should be called not holocene but anthropocene. "Among global changes occurring at present, which determine the future of the planet, the technosphere is an unpredictable factor. It may form a new anthropocenous state of the planet; maybe people would not be able to be a boss of everything" [2].

A threatening situation with environmental changes in the XX century gave the United Nations Organization a reason to propose the concept of sustainable development of mankind in 1992. The goal of this concept was to solve the social and economic problems of separate states and territories without distorting the environment.

Academician V. A. Koptyug entered into the advisory council at the United Nations Secretary-General on sustainable development. He was actively supporting research over Lake Baikal and believed that Russia had to work on the sustainable development of the Baikal region as a model territory. The main goal of the studies is to conserve the environment of Lake Baikal, the largest reservoir of pure drinking water. Valentin Afanasyevich initiated a number of international conferences at which the research into various problems of the geology of Lake Baikal and the Baikal region was considered, and the importance of those works for solving the ecological problems of the region was evaluated. V. A. Koptyug supported the adoption of the law concerning Lake Baikal.

In 2012, at the conference in Rio de Janeiro, the concept of sustainable development found its continuation in the model of economic management called green economics [3]. Green economics is defined most frequently as the economics leading to the reduction of ecological risk and ecological deficit and aiming at the sustainable social and economic development without any damage to the environment.

Unlike for general conceptual principles of sustainable development, the model of green economics is more specific in its goals and tasks, so it is more easily embedded into the legislative and institutional forms of economic activities in different countries and territories. The formation of green economics is connected with the application of nature-conserving technologies, which mainly involve innovations on the basis of new knowledge. Different approaches, concepts, models and instruments exist for different countries, corresponding to their national situations and priorities. The choice of urgent directions is also dependent on the state, economic level and goals accepted for the development of specific economics. The green economics is an offspring and necessary attribute of the post-industrial society in which the efficient innovative industry saturates the needs of all segments of the population.

The necessity to restrict expenses in the areas depleting the natural capital is declared in the documents of international organizations dealing with the conditions for the transition to green economies. The policy of the rejection of large projects aimed at the development of new natural resources is promoted. The United Nations Environment Programme (UNEP) distinguished 10 sectors in which the investments are to be made first of all (agriculture, house heating and lighting, energy supply, fishery, forestry, industry, tourism, transport, wastes, water). Russian scientists included the eleventh direction of green economics: modernization of power engineering, which is a junction point for the country [4].

A number of documents dealing with the main ecological principles in the development of the country within the nearest years and in the future were adopted in the Russian Federation. In 2012, President of RF approved the Foundations of the State Policy in the area of the ecological development of the Russian Federation till 2030 [5]. This is practically the first strategic document in Russia in the area of ecology which takes into account a balance between the interests of economic development and conservation of the environment. On 19 April 2017, President of RF adopted the Strategy for the ecological safety of the Russian Federation for the period till 2025 [6]. This is a distinctive set of ecological threats, risks that are to be minimized through involving intellectual, financial and administrative resources of the country. Ecological policy in our country till 2024 will be implemented within the framework of the national project Ecology, and the platform for the measures to be taken should be the ideology of the green growth.

Mineral resources are extracted from the upper layer of the lithosphere – Earth's crust, so it is evident that mining destroys the surface of the planet. Production, concentrating, ore processing, isolation of useful components leave wastes and contaminate the upper layers of the lithosphere, soil, surface waters and atmosphere [7].

The results of environmental pollution, their negative effect on human health are presented below. The necessary organization-economic mechanisms for ecologically reasonable mineral development are described.

MAJOR KINDS OF THE NEGATIVE INFLUENCE OF RESOURCE MANAGEMENT ON THE ENVIRONMENT

Russia is one of the world's leaders in resources, production and export of natural gas, oil, coal, iron ore, nonferrous metals, gold, platinum and diamonds. The economic potential, safety and competitiveness of Russia on the world market are substantially dependent on the development of the mineral raw material complex. Production and processing of mineral resources provide about one half of the income of the federal budget due to the tax for the production of extractable resources (TPER) and export tax, act as the major consumers of the services of power engineering enterprises, transport and processing works, and also supply fuel, energy resources and mineral raw material to other branches of industry [8]. Subsurface resource management accounts for about 40 % of all fixed assets of industrial enterprises and 13 % of the book value of all assets of Russian economics [9].

According to the new Strategy for the development of the mineral and raw material basis of the Russian Federation till 2035 [10], the Far East Federal District and the Baikal Region are priority territories for the development of the highly marketable raw material basis of the country. In the foreseeable future, these regions will conserve their raw material specialization. Thus, the outlooks for the industrial and high-tech development of the Irkutsk Region are connected with the projects aimed at the development of the Kovyktinskoe gas condensate deposit and the Sukhoy Log gold deposit. In 2017, one of the largest industrial projects over the recent 5 years was launched in Siberia – Bystrinskiy ore mining and processing enterprise with the productivity of 10 million t of ore per year, based on the Bystrinskoe gold ore deposit (Transbaikalian Territory).

The extraction of mineral resources is one of the most nature-consuming sectors of economics. The main kinds of the negative effect on the environment during extraction, primary processing, storage and transportation of the mineral raw material resources include:

– deformation and destruction of underground beds because of the extraction of solid, liquid and gaseous substances from the earth's interior using wells, mines, open pits, etc.;

– the formation of great amounts of wastes during the extraction and processing of mineral resources in the form of various storehouses, dumps, store grounds, tailings, etc.;

– pollution of soil, water and air with chemical elements unusual for them in the natural state, because of the absence of necessary integrated technologies of extraction and processing of the major and accompanying extractable substances;

– pollution of soil, water and air as a result of emergency and accident situations during extraction, storage and transportation of ER.

The destruction of land occurs to the highest extent during the development of ER deposits. By January 01, 2018, more than 1.24 million ha of disturbed lands have been registered in the Russian Federation. Among these lands, about 0.95 million ha (7 %) were destroyed during the extraction of mineral resources (including widespread ER) [11]. In fact, more than 90 % of the total mass of wastes from the production and consumption in the country relate to the mining industry (overburden and host rocks). About 10 thousand ha of lands suitable for agriculture are assigned every year to store wastes. In 2017, the territorial organs of Rosprirodnadzor recorded 3429 facts of the spillage of oil and its derivatives. The largest polluted site was detected at the territory of the Siberian Federal District (6135 ha, or 99.2 % of the total area of pollution over the country).

It should be noted that the elimination of the negative consequences of resource management takes not years but decades. For instance, the major part of depressions are above mine excavations liquidated 25–40 years ago. Technogenic pollution of industrial territories and entire cities requires great expenses for their liquidation and, as a rule, affect the environment and the health of the population for decades.

GEOCHEMICAL STATE OF TERRITORIES AS A RESPONSE TO THE USE OF MINERAL RESOURCES

The extraction of mineral resources without any ecological restrictions leads not only to the manifestation of geological anomalies but also to the deformations of the properties of soil cover and other environmental components in the sites of ER production. Changes of the geochemical properties of the environment under the action of atmospheric air pollution and direct technogenic action during the industrial process are the subject of many studies and publications, while a substantially smaller amount of effort is paid to the effect of extraction and primary processing of ER on soil cover and its degradation.

Specialists from A. P. Vinogradov Institute of Geochemistry SB RAS (IGC SB RAS) studied the chemical composition of environmental components (rocks, soil, plants, bottom sediments, water) at the territory of Beloziminskoe tantalum-niobium (Ta-Nb) deposit in the Eastern Sayan. The deposit was discovered in the 1960-es, then an experimental plant for the production of ferroniobium was built, and the Belaya Zima settlement appeared. The production was stopped at the end of the 1990-es, and the settlement was evacuated because of unfavourable radioecological situation and its influence on the health of the population.

Modern environmental studies in the region of the former settlement show that some sites are still polluted with technogenic dust, which is connected with the development of the deposit in the past. The composition of the technogenic dust is substantially different from the composition of the surrounding natural components and may be dangerous in the case if the dust enters the environment. The major components of the dust are CaO, P_2O_5 and Fe_2O_3. The concentration of Nb may exceed 10 % [12]. For the overwhelming number of elements, the concentrations are within the range of 0.1–1 %. This group includes also light-weight rare earth elements. Increased radiation at the territory of the concentrating plant (up to 4.08 μSv/h) is due to the increased content of natural radionuclides (Th and U) and the products of their decay in the concentrated products. So, mining and processing of the raw material from the Beloziminskoe deposit require detailed investigation, the use of modern technologies and the application of the means to protect humans from the effect of hazardous components and radiation.

Aluminium production is permanently increasing all over the world because this element is indispensable in many branches of industry. At first, aluminium oxide (Al_2O_3) is obtained from the ore with complicated composition (bauxites), then electrolysis is carried out in the melt of fluoride salts at a temperature of about 950 °C to obtain the major component of the melt, cryolite (Na_3AlF_6 salt). Aluminium is used in the pure form much more rarely than in the form of alloys. Alloys additionally contain various elements that enhance the hardness, density, thermal conductivity and other characteristics. For this purpose, Be, B, Li, Fe, Si, Mg, Mn, Zr, Ag, Pb, Cu, Ni and other components serving as the sources of environmental pollution are added into the alloys.

As an example, the Irkutsk aluminium plant is functioning since 1962 in Shelekhov, a town situated at a distance of 15 km to the south-west from Irkutsk. Both primary aluminium and the products made of it are manufactured at this plant from the raw material transported from elsewhere. Increased concentrations of Al, Be, Li, F, Na and some other elements (2–20 times higher than the regional background, approximate permissible concentrations (APC) and maximum permissible concentrations (MPC_{soil}) in soil) are detected at the driveway to the plant territory, around the plant and in the band corresponding to the wind rose at this territory. The range of the influence of the aluminium plant on the state and pollution of the soil cover in the town and its surrounding territories may reach 15–25 km, depending on the wind direction and speed. As a result, the aureole of pollution with Al, Be, F affects the Olkha settlement in the south, the territory of the plant and around it, the territories of Shelekhov, Smolenshchina settlement, and reaches the bank of the Irkut river. These data show the necessity to improve the systems of gas purification at the aluminium plant [13].

The source of the global pollution of the territory of the Irkutsk Region is the Irkutsk coal basin providing fuel to the regional heat and power system. It was established that a specific group of elements is characterized by the increased content in the towns of the Irkutsk Region: U, Th, S, Hg, Cr, Co, Ni, V. The concentrations of these elements are always higher than the regional background level. These results provide evidence of a substantial effect of heat and power plants on the environment due to the combustion of local coal, which contains the listed elements in relatively elevated amounts [14]. Coal burning under non-industrial conditions causes especially active soil pollution at the territories of the private sectors of the towns, which is dangerous from the viewpoint of the use of these territories for gardening and for vegetable gardens. Increased soil concentrations of heavy metals including radioactive ones bring about the possibility of their enhanced arrival in human organisms, which requires additional special studies.

An example of the long-term influence of emergency situations during the transportation of ER is the spillage of oil products in March, 1993, at the Krasnoyarsk – Irkutsk oil pipeline near the Elovka settlement in the Irkutsk Region. The area of the primary pollution as a result of oil spill was 2.5 ha. Oil was partially pumped out, the upper layer of the ground was removed, transported to an open pit and burnt. However, even in 2017 analysis showed that the average mass fractions of oil products in the soil in the region of the oil spot and outside it exceed the background level [15].

It is necessary to carry out permanent control of the chemical state of various environmental components and the health of the local population in the monitoring mode in the regions of operating plants dealing with ER mining and primary processing, concentrating. An integral component of the best available technologies for the plants must be innovative digital technologies, for example, the Internet of Things, IoT – networking of any devices and sensors using special software for information exchange [16]. The sensors of environmental control help to measure temperature, humidity, air composition, radiation level, and the content of hazardous microelements in water and in soil. Investigations carried out at the IGC SB RAS may help in creating an optimal network and in choosing the necessary parameters of monitoring.

EFFECT OF MINERAL EXTRACTION ON HUMAN ORGANISMS

It has been already mentioned that mining and processing of mineral raw materials have a substantial effect not only on the migration of chemical elements in the outer layers of the Earth's crust but also cause pollution of atmospheric air, soil and water reservoirs, which causes serious disorders in the health of the population, especially the workers of those plants.

Speaking of the negative effect of mining on human health, it must be stressed that this effect is mainly involved in the following facilities:

– extraction of minerals;

– mineral raw processing;

– long-term storage of solid and liquid industrial wastes, the absence of recultivation of open-pit mines, grounds and worked out mines.

For ER mining, the major unfavourable factors affecting human organisms are: blasting operations, drilling and extraction of ER, carried out using the equipment generating general and local vibration, noise, at the levels exceeding the maximum permissible ones. All these kinds of works are accompanied by the high dust formation; in the case of chronic action, dust generated in these processes (as a rule, with high silicon content) promotes such diseases as dust bronchitis, silicosis, pneumoconiosis. High levels of vibration and noise cause such professional diseases as the vibrational disease and neurosensory bradyacusia.

The most powerful unfavourable factors are formed during ore processing: grinding, sorting, concentrating, hydrometallurgical and pyrometallurgical processes, which are accompanied by the arrival of very hazardous chemical compounds, along with the factors of the technological process.

For example, gold concentrating and extraction from ores involves the use of cyanide solutions, xanthates as floating reagents, dithiophosphates, polyacrylamide and, until recently, mercury [17]. Investigations show that hazardous substances detected in the air of industrial premises may be represented by four groups according to the formation conditions:

the 1st group – direct evaporation from technological solutions: mercury vapour, aerosol of sulphuric acid and alkalis, dust from disintegration;

the 2nd group – the result of hydrolysis and oxidation-reduction reactions of the solutions of major technological reagents: cyanide melt

(NaCN); copper and iron sulphates; polyacrylamide; thiourea xanthates etc. As a result, a complex of hazardous substances is detected in the air: hydrogen sulphide, ammonia, carbon disulphide, hydrogen cyanide, sulphuric anhydride;

the 3rd group – the formation of volatile gases from the metal compounds of arsenic and antimony in the processed ores, which as a rule involves the evolution of arsenious and antimonous hydrogen;

the 4th group – the formation as a result of the specificity of technological processes: electrolysis of gold and ore roasting. In these cases, ozone and a set of sulphurous compounds are formed, along with aerosols of various metals.

These factors have a strong effect on the health of the workers. Underground and open-pit mining of ores, concentrating, and manufacture of final products are always accompanied by the formation of the high levels of professional and general diseases. In the structure of general diseases of the workers of mining plants, substantial fractions are due to such diseases as vegetovascular dystonia, bronchopulmonary diseases, lumbosacral radiculitis. The major forms of professional pathology still are the manifestations of vibrational pathology, dust-caused bronchitis, neurosensory bradyacusia, chronic poisoning.

For the workers of concentrating and extracting plants, among whom women are prevailing, attention is attracted to the high levels of the diseases of upper air passages (acute respiratory diseases, pharyngitis, tracheitis, laryngitis), the diseases of female genital organs, nervous system and organs of sense. Among the professional diseases, prevailing are chronic diseases caused by poisoning with mercury, cyanide compounds, and skin diseases [18].

The most large-scale consequences for the environment, ecology and health of all groups of the population are those related to the storage of solid and liquid wastes (tailings) and non-recultivated open pits. Tailings include not only the liquid pulp of ores with all inclusions of metals, compounds formed during ore concentrating and processing, but also a set of toxic compounds used in the technological operations of ore processing. An example of the unfavourable effect of non-recultivated residues from the works may be the emergency situation that occurred in 2018 in Bashkortostan at the Kamagan open pit near Sibay town (with the population about 70 thousand people), where copper ore with the high sulphur content was mined at a copper pyrite deposit. The open pit is not used in operation for more than 10 years, but recultivation was not carried out. As a result of the local climatic conditions (high temperature and humidity), oxidation proceeded; as a consequence, the self-ignition of sulphide ores happened. The aerosols of sulphurous compounds started to enter the atmospheric air; with respect to sulphur dioxide, the excess over the MPC was 8–24 times, which caused mass diseases and references to doctors with complaints about the symptoms of asphyxia, allergy, broncholaryngitis, asthmatic attacks, etc.

It should be stressed that the diseases of the workers of mining and concentrating plants diagnosed as professional diseases are characterized by long-term chronicity, many of these diseases are resistant to treatment and rehabilitation, they cause disability with the loss of work capacity for many years. Our studies show that more than 10 years are sometimes necessary after the cessation of the contact with a hazardous environmental factor for health parameters to return to the initial level.

IMPROVEMENT OF THE INSTITUTIONAL SYSTEM ON THE WAY TO GREEN RESOURCE MANAGEMENT

In the presence of the general consensus about the necessity to develop the green directions in nature management, researchers have different opinions on the possibilities of the society and the state with respect to the implementation of this paradigm. It is stated in some articles that the green economics is incompatible with the market principles of economy arrangement and may be possible only with the transition to the new stage of civilization development, that is, the strategy of sustainable development is opposed to the economic model based on competitiveness and search for profits. However, in the majority of cases, researchers look for the possibilities and mechanisms for the restriction of the negative environmental effects within the framework of the existing institutions protecting social comforts, along with the creation and development of new relations [19, 20]. This direction, based on the evolutionary approach to development, has a greater chance to be implemented at present, during the lifetime of the present generation.

Within the transformation of industrial processes and models of consumption, the green economics may bring new comforts to the society, including new workplaces in the corresponding branches of economy, a decrease in the amount of wastes and in the level of habitat pollution, which now have a direct influence on life quality even in the country with so great area of unused lands as Russia. The states have developed the mechanisms for the protection of the main media in which human life proceeds: atmosphere, water, soil cover. Through the international organizations, exchange of experience and narrowing of differences in the positions occur. This process may be promoted by the current agreements on climate and other aspects. However, subsurface resource management is strongly lagging behind the formation of the normative-legal and experimental-design basis for the adequate liquidation of the damage, either due to the scale of consequences and therefore the necessary investment and effort aimed at the liquidation of the damage or due to the recognized abundance of underground natural resources and the idea of their inexhaustible status for several generations ahead. The examples described in the paper illustrate the necessity to take precautions even at present because the situation in geology and resource management requires immediate and cardinal changes in the branch. This is no more a point of discussions, this is an objective necessity for the provision of the physical and economic safety of citizens and the competitiveness of our country. Because of this, the state is interested in the creation of an efficient nature-conserving system stimulating the development of ecologically safe technologies and enhancement of the reasonableness of the use of mineral resources.

What are the most essential steps that are to be made on the way to green subsurface resource management?

Improvement of the normative-legal provision of subsurface resource management. The Law of the RF "About the Earth's Interior" [21] is regulating all activities in the country for many years, both in geological studies of the interior and directly in the extraction of ER. During the recent years, corrections to the legislation were aimed mainly at simplification of the order of licensing for exploration and mining works: a declarative principle was introduced in considering the claims for the right to use the Earth's interior; provision of land plots belonging to the state and to municipalities for the needs of underground resource management has been simplified; the possibility to change the boundaries of such a plot has been fixed; a mechanism for the involvement of accompanying ER and other components into processing through the possibility to make corrections in the licenses has been developed; *etc*.

At present, it is necessary to broaden the institutional conditions for the transition to the green development. The key importance is known to belong to the systemic implementation of the measures aimed at the transition to the best available technologies (BAT). For the development of green economics, not less important than the development of nature-conserving norms and rules is the improvement of the normative-legal basis in the area of development and acceptance of innovative solutions in the management of underground resources. The principle of prohibitory measures (MPC, limits, quotas) must be replaced by the stimulating mechanisms for nature conservation (decrease in tax and payments in the case of technology improvement, preferential crediting, special subsidies, access to resources, etc.). For new and hard-to-develop deposits, it is reasonable to introduce a zero tax rate for TPER, the major tax in the management of underground resources.

Specialists speak in favour of the creation of a united state organ to manage the branches of subsurface resource exploration and use, similarly to the former Ministry of Geology of the USSR, and then RF. This is especially urgent today when the branch faces the problems of cardinal renewal. It is important that this organ should have the state status and functions (elaboration of the strategies of development, programming, monitoring, regulation) and stand for the long-term interests of the state.

It is also reasonable to make a nation-wide system for the management of the innovative process, with the united state centre of the implementation of innovative policy in branches, including underground resource management. Within this system, the strategies of the scientific and technological development of the country should be generated, as well as new technologies, investment programmes, control and monitoring of the innovative development of the country.

Improvement of financial mechanisms for technological renewal. For the purpose of financing the reproduction of the mineral and raw material basis, it is reasonable to introduce compulsory payments from the profits of the operating producers of underground mineral resources (according to the experience of the USA, Canada and other countries) into a specialized foundation. Without reducing the role of direct state and private investments, it is necessary to bring back the practice of the formation of the federal and regional ecological foundations for the accumulation of ecological payments.

It is necessary to be more active in using the experience of different countries in issuing private green bonds and in introducing the green credits [22]. The amount of the world greed bonds has reached a level of about 390 billion US dollars; nearly a half of this amount (160 billion US dollars) have been floated in 2018. The first issue of green bonds in Russia took place in December 2018. At the Russian Investment Forum, in February 2019, Deputy Minister of the Economic Development of Russian Federation I. E. Torosov stressed that the demand for green bonds in the world comes from investors rather than from issuers, however, the Russian market has not been formed yet [23]. As a conclusion, the formation of the market of green bonds in Russia requires the support from the state, in particular, subsidy assistance from the state.

Public disclosure of all ecologically significant information of the companies working as the producers of underground mineral resources, because the participation of the society is the basic principle of sustainable development. The available ecological information is not only the means for control but also the basis for research and technological studies.

The rating of openness of 34 mining and metallurgical companies in Russia in the area of ecological responsibility in 2018 was published [24]. It was compiled by the World Wildlife Foundation WWF-Russia and the National rating agency. The rating included 26 criteria divided into three groups: ecological management, the effect of the environment, transparency of ecological data. Only the information arranged in the public space was taken into account. The first position in the rating is occupied by the gold-mining company Kinross-Gold, the second position is held by Polyus Zoloto, the third position is occupied by the coal-mining company SDS-Ugol. In general, the level of information openness of Russian companies is growing, but more than one third of the companies remain completely closed. Evaluations of the environmental effects, recultivation projects, amounts of industrial emissions and waste waters are the secrets of the companies. The closeness of information and the absence of feedback with companies should become a signal for the society and the organs of State Control that the state of the environment and the population risk.

Reports on the sustainable development of companies are submitted to the public both for image-related and for economic reasons by the largest producers of underground resources in Russia: PAO Gazprom, Alrosa company, PAO NK Rosneft and others. The history of public non-financial reports in Russia starts from the first publication made by Gazprom in 1995. In 2017, the Government adopted the Concept for the development of public non-financial reporting [25] according to which, since 2023, the necessity to publish non-financial reports will be spread over 500 largest enterprises in Russia.

Russia is interested in the international collaboration with the countries that accepted the economics of green technologies as the strategy for their national development (South Korea, Great Britain, Sweden, Kazakhstan and many others). In particular, Russia is a participant of the International Partnership Programme Green Bridge which is to govern the green economic growth in Central Asia through scientific and technological collaboration and assistance in the transfer of technologies, knowledge exchange and financial support.

CONCLUSION

At present, Russia remains a large resource-based economy with an enormous mineral raw material basis and low energy cost. Underground resource management forms the basis of the economic potential of the country and at the same time, it is the most destructive branch for the environment. The negative consequences of mineral raw mining and processing are manifested for decades in the form of environmental pollution and worsening of the health of the population, including the workers. Transition to nature-saving technologies must start from underground resource management as one of the largest sources of ecological disasters and disturbances.

During the implementation of economic-organizing mechanisms of the introduction of green economics, it is important to recognize the actual technological and economic conditions under which our economy is operating. The most efficient way seems gradual and extensive modernization of the whole branch of underground resource management, without the formation of separate isles and zones of ecological well-being. The main task of the state is to develop a system of market and fiscal tools providing the economic efficiency of investments into the development of nature-saving technologies in underground resource management and re-equipment of producing units. Finally, the success will depend on how strong the stimulus for business and for final consumers is for real but not declarative transition to the way of green economics in mineral resource mining and processing.

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