THE CURRENT STATE OF THE GEOLOGICAL ENVIRONMENT OF THE BELGOROD REGION IN THE CONDITIONS OF INTENSIVE MINERAL DEVELOPMENT

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Abstract

The article gives assessment of the current state of the geological environment of the Belgorod region in the conditions of intensive development of mineral resources. Special attention is paid to environmental problems of the geological environment Starooskol-Gubkinsky mining district of the KMA and development of dangerous technogenic processes.

Keywords

Geological environment, minerals, geoecological estimation, transformation of topography, technogenic violations, environmental problems, Kursk Magnetic Anomaly (KMA)

1 Introduction

Kursk Magnetic Anomaly (KMA) – is the largest iron-ore field in Russia, situated on the territory of Kursk, Belgorod and Oryol regions. Unfavorable ecological situation is formed in the region of Kursk Magnetic Anomaly (KMA), where iron-ore raw materials have been intensively extracted for 38 years, and more than 31 thousand hectares of lands have been disturbed. This region takes the first place in Central Black Earth zone in total degradation of the environment.

Apart from the factors of anthropogenic disturbances and pollution of the air, water environment and natural landscapes, the territory of Stary Oskol and Gubkin region shows the progressive development of anomalous changes of geochemical, hydrodynamic, aerodynamic, acoustic, magnetic, electric, gravitational, radiation, vibration and other factors.

These factors refer to anthropogenic ones and fall under the category of conditions that are hazardous for the existence of flora and fauna, and human [4].

The basic cause of environmental problems is man-made impact on the geological environment. On this basis, Starooskol-Gubkinsky mining district of KMA has been selected the object of study.

The subject of research: the ecological state of geological environment of Starooskol-Gubkinsky mining area of KMA. The aim of the research is to study environmental problems of geological environment of Starooskol-Gubkinsky mining area of KMA and the development of dangerous anthropogenic processes.

2 Geological environment of Kursk Magnetic Anomaly (KMA)

By the geological environment in our research, we mean the upper part of the lithosphere being under the influence of the human engineering-economic activities, which, in turn, to a certain extent defines this activity [2].

Geological environment of Stary Oskol iron-ore district of the KMA is a complex natural structure, possessing the certain ecological functions: resource, geodynamic, and geophysical-geochemical ones.

The district of KMA is characterized by complex hydrogeological and engineering-geological conditions. Above-ore strata (clay, sand and carbonate rocks) consist of several aquifers. Deposits of the central part are in more favorable conditions, deposits of the North and the South-Western slopes of the Voronezh crystalline massif are in the less favorable ones [4].

The field development of ferruginous quartzites has been in progress since 1952 in the mine named after I. M. Gubkin (KMAruda iron ore mine). The mine adopted a storey-chamber system of development in the quarries — with external dumping. Open-pit mining is used in the deposits of rich iron ore: Lebedinsky since 1959-60., Stoilensky — since 1969.

3 Mining effect on KMA

Significant damage to the natural environment is caused by the open-pit mining of mineral resources with the use of explosive method of ore breaking in the area of KMA mining and metallurgical complex. Technological processes in mining and processing of iron ore are accompanied by atmospheric emissions of dust, heavy metals, products of blasting, etc. The pollution of the atmosphere, natural waters and the upper part of the soil cover with environmentally harmful substances violates the natural geo-ecological process of self-regulation of the natural environment and can lead to rapid and irreversible soil degradation and negative impact on the health of the population of the region.

Starooskol-Gubkinskiy district demonstrates the formation of the zone of anomalous dust level of soils of elliptical shape with a size of up to 40 km on the long axis. In the Central part of the zone more than 4000 kg/ha of dust fall annually. The content of heavy metals (cobalt, nickel, chromium, vanadium, etc.) is 100 times the natural background in some places. Under the influence of hydroprotection system of pits the groundwater regime is damaged within a radius of 40 km for the upper aquifer and up to 80 km in the crystalline one [3].

There are also many facts indicative of a very negative geo-ecological impact of mining-metallurgical complex of the KMA on the environment. Radiogeochemical study of overburden and ore-bearing rocks, iron ores and products of their processing showed that they contain high concentrations of natural radionuclides and are the sources of abnormally high ionizing radiation, i.e. iron ore deposits of KMA are radiation-dangerous.

Additionally, the radio-ecological situation is complicated by the fact that the area of KMA is within the zone of influence of the "Chernobyl radioactive trace" and includes an extensive areal anomalies of Cs-137. In this regard, some attempts that are being made in the region for the improvement of environmental situation are clearly insufficient. A special danger for the environment of the area is radioactive contamination of the atmosphere by radon and its short-living affiliated decay products, and long-living natural radionuclides (ERN) contained in floating mineral dust (radioactive aerosols).

Radioactive aerosols enter the air during drilling and blasting operations, the crushing of ore at the processing plants, and also in the rising of dust in dumps, tailings, and finished product storages.

4 Comprehensive approach to environmental problem of KMA

We need a comprehensive approach to this problem, including the organization of monitoring of hazardous substances content in the various elements of the natural environment, the development of new technological processes of extraction and processing of ore, which would exclude the ingress of harmful substances into the atmosphere, groundwater and soil, there is a need to adopt a system of legislative and financial measures aimed at ensuring geoecological safety of the environment and the population.

The existing hydraulic connection between groundwater aquifers creates conditions for the penetration of contaminated surface water. Pumping water led to the formation of cone of depression around the quarry Lebedinsky GOK in the area of 350 km^2.

In the gully Chufichovaya, filled with tailings, the dome of the spreading of dirty technical water was formed with losses for infiltration to 7-8 thousand m3/hour. The rivers Oskolets and Chufichka turned into anthropogenic ones and exist due to the dumping of waste and industrial waters. The average annual Oskolets river's flow has become 2 times as low as the natural one, and the average annual discharge of R. Chufichka due to technical and dirty water infiltration from the tailings has become 2 times as much. The process of continuous groundwater contamination with anthropogenic waste and TM has begun on the extensive areas with disturbed regime [6].

The basic cause of environmental problems is anthropogenic impact on the geological environment, which is expressed in the form of changing the properties of the geological environment, changing the surface shapes (landscapes) and radical change of the hydrodynamic and hydrogeochemical environment [1].

The unfavorable ecological situation may be said to be forming at the territory of KMA. The problem of creating the system of rational interaction of community and nature to preserve the favorable conditions of vital activity has become acute.

Anthropogenic impacts are classified into reversible and irreversible. Irreversible anthropogenic impacts include: changing the properties of the geological environment and changing the Earth's surface shapes. Irreversible anthropogenic impacts, in turn can be direct and indirect. Anthropogenic impacts, which last more than the life span of one generation are also irreversible.

Thus, the area of the geological environment, subjected to anthropogenic impact, which resulted in the change of properties of geological environment, can carry danger for the surrounding living environment, and requires great attention.

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