ASSESSMENT OF ENVIRONMENTAL CHANGES DURING MINING OF FELDSPAR DEPOSITS IN UKRAINE

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ABSTRACT

Possible negative impacts on the environment during mining of feldspar deposits with open-pit and underground mine are defined. The main changes have been identified, which are as follows: air pollution, soil destructions, change of relief, a local decrease in groundwater level, pollution by sewage and waste.

Destructions of the soil cover are fixed under the dumps of the quarry and in the path of the movement of quarry equipment. Through the development of a pit and dumps, the primary relief acquires significant changes and the action of forces caused primarily by gravity is activated, aimed at smoothing out negative and positive relief forms.

An increase in the height difference from the dump ridge to the bottom of the quarry and the formation of a significant, pronounced depression of the relief redirects the surface runoff, increases its speed, and reduces infiltration into the soil. Mining development caused drainage of groundwater due to its release to the surface and evaporation.

Air pollution has a bigger scale than other components of negative impacts. The main impact of mining activities is due to emissions of pollutants into the atmosphere as a result of blowing dust from the surface of dumps and emissions from quarry transport and their deposition on the soil and storage of industrial waste. The main pollutants are inorganic dust with content of SiO_2 - 65-82% and Al_2O_3 - 11-21%.

Separately, the article discusses the impact on the environment during multi-components deposits` exploitation, where feldspar concentrates are produced as by-products. Several deposits in Ukraine belong to the group: Bakhtyn (fluorite ores), Nosachivske (titanium-ilmenite ores), Perzhanske deposits of rare metals, Mazurivske (tantalum and niobium ores). Most of them are planned to be mined underground, which saves more land resources in comparison with open workings. The placement of mine shafts and industrial sites for their maintenance requires an area of about 30 hectares. All of them have a complex ore processing with the separation of several concentrates, which necessitates the use of flotation and other reagents. The development of such deposits involves the organization of tailings and circulating water supply of the processing plant.

Keywords: *feldspar deposits, environmental changes, mining, assessment*

INTRODUCTION

The relevance of assessing the impact of feldspar mining on the environment is associated with an increase in the scale of production. In Ukraine, dozens of deposits are mined for use in the construction and production of ceramics. Globally feldspar consumption has been gradually increasing in ceramics, glass industry for solar panels, housing, and building construction.

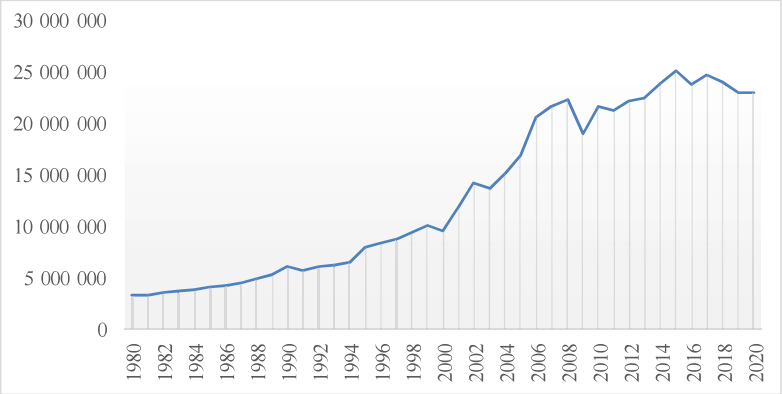

Fig. 1. *Feldspar global production dynamics in metric tons (according to statistical data usgs.gov [6])*

The total production of feldspar raw materials in Ukraine amounted to 634.63 thousand tonnes in 2019.

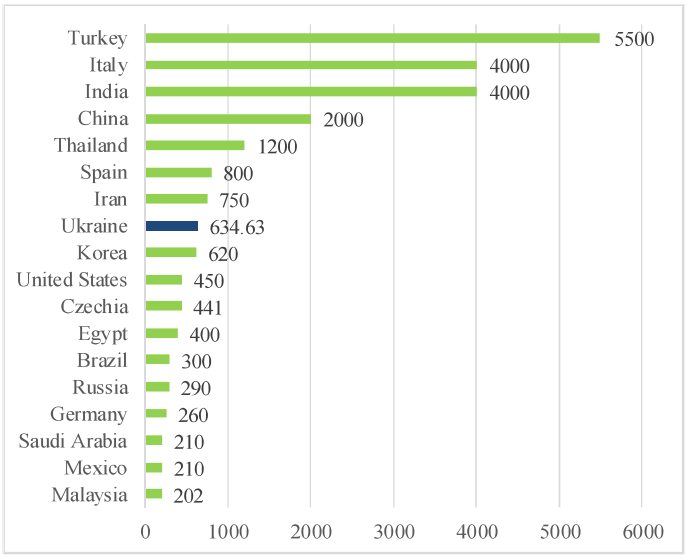

Fig. 2. *Feldspar production in 2019 by country (according to statistical data usgs.gov [6], and statistical data for Ukraine - State Information Geological Fund of Ukraine [1])*

Environmental impact assessment is mandatory in Ukraine for mining enterprises [7] and for feldspar, deposits have their peculiarities. The main source of feldspar raw materials in Ukraine is multi-component deposits. These objects belong to different genetic and mining types, which determine the impact on the environment that occurs during development. The following diagram illustrates the features of mining methods and the processing of feldspar raw materials by the type of deposits (figure 3).

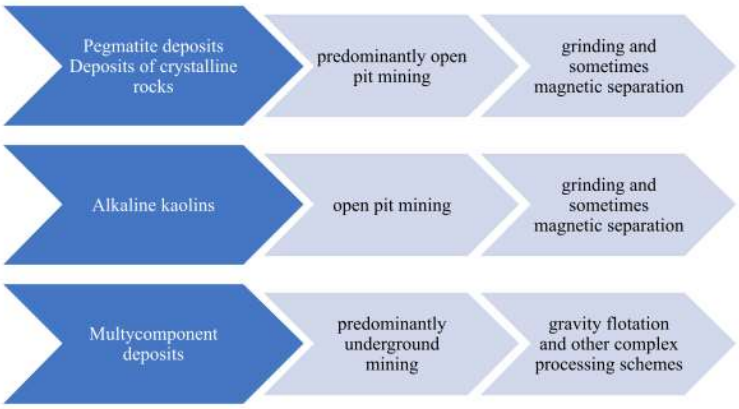

Fig. 3. *Features of mining methods and processing of feldspar raw materials by the type of deposits*

Possible negative impacts on the environment during *open-pit mining* of feldspar deposits are as follows: air pollution, soil destructions, change of relief, a local decrease in groundwater level, pollution by sewage, and waste. The area of disturbed land and the volume of waste with the open method depends on the size of the reserves and the stripping ratio. As a rule, this ratio is less than 1, which has a positive effect on the profitability of mining. The soil is less than 10% of the total overburden volume and the enterprises store it separately for further reclamation. As a rule, the production capacity of mining enterprises ranges from 50 to 200 thousand tons per year, which provides at least 20 years of operation.

Destructions of the soil cover are fixed under the dumps of the quarry and in the path of the movement of quarry equipment. Through the development of a pit and dumps, the primary relief acquires significant changes and the action of forces caused primarily by gravity is activated, aimed at smoothing out negative and positive relief forms.

The main impact of mining activities is due to emissions of pollutants into the atmosphere as a result of blowing dust from the surface of dumps and emissions from quarry transport and their deposition on the soil and storage of industrial waste. The main pollutants are inorganic dust with a content of SiO_2 - 65-82% and Al_2O_3 - 11-21% [5].

An increase in the height difference from the dump ridge to the bottom of the quarry and the formation of a significant, pronounced depression of the relief

redirects the surface runoff, increases its speed, and reduces infiltration into the soil. Mining development caused drainage of groundwater due to its release to the surface and evaporation.

Air pollution has a bigger scale than other components of negative impacts. During the mining operation, a significant amount of gaseous substances of spent fuel and other technological substances, as well as suspended particles of the quarry rock, are emitted into the air.

The influence of mining activity on the disturbance of landscapes and biocenosis should be studied separately. These factors depend on the availability of those items on the territory and the scale of land alienation.

Deposits of crystalline rocks often require preliminary disintegration using drilling and blasting operations. In such cases, the stability of the geological environment and its assimilation potential must be assessed. The boundaries of the development of the deposits in the plan ensure compliance with the 500-meter sanitary protection zones.

Other features of the impact on the environment are multi-components deposits, where feldspar concentrates are produced as by-products. Several deposits in Ukraine belong to the group: Bakhtyn (fluorite ores), Nosachivske (titanium-ilmenite ores), Perzhanske deposits of rare metals, Mazurivske (tantalum and niobium ores).

Most of them are planned to be mined underground, which saves more land resources in comparison with open workings. The placement of mine shafts and industrial sites for their maintenance requires an area of about 30 hectares. All of them have a complex ore processing with the separation of several concentrates, which necessitates the use of flotation and other reagents. The development of such deposits involves the organization of tailings and circulating water supply of the processing plant.

The impact on the atmosphere is different from open-pits since dust pollution from mining is less due to production volumes and is concentrated in underground buildings. Processing can be a source of air pollution and pollutants depend on the composition of enrichment reagents.

For the Nosachivske, Bakhtyn, and Perzhanske deposits listed above, it is planned the mining system with backfilling. Considering the underground mining, overburden rocks in a large volume will not be, and those crystalline rocks that will be raised to the surface will be used in the construction of a mining and processing complex. For these deposits, it`s proposed to organize the recycling water supply system of the processing plant. A decrease in the level of groundwater in the adjacent territories is possible [3], [4].

In terms of land resources, it is planned to withdraw land and change their intended purpose for the placement and operation of main, auxiliary, and auxiliary buildings and structures associated with the use of subsoil for mining. Contamination of the soil with oil products from faulty equipment is assumed;

violation of the soil cover during the surface construction of the mining and processing complex.

The planned activities are considered to have a minor and tolerable impact on flora and fauna. Sources of increased noise from mining operations may cause minor impacts on habitats, breeding conditions, and animal migration routes. As a result of the implementation of the planned activities, an insignificant permissible impact on the spatial, species, population diversity of flora objects is possible.

Individual design solutions are directed to the processing and use of production waste. On the example of the Mazurivske deposit, the production of feldspar concentrate is associated with processing stored waste. It allows us to free up large areas of tailings and eliminate the source of potential environmental hazards given the existing connection of tailings with the river Kalchyk basin. However, a base of feldspar raw materials can be created for the ceramic industry quite quickly and without significant investment. Such production will become a testing ground for the preparation of the complex development of the Mazurivske deposit [2].

Generalized objects of influence on the environment for the named types of deposits are shown in Table 1.

Table 1. *Main objects of influence on the environment for feldspar deposit un Ukraine*

Type of deposit	List of feldspar deposit un Ukraine	The main objects of influence on the environment
Pegmatite deposits	Bilchakivske, Ustia village, Hruzlivetske, Lozuvatske, Volodymyrivske, Balka Velykoho Taboru	Open-pit, drilling and blasting operations, crushing plant, overburden dumps
Deposits of crystalline rocks	trachytes of the Verbova site, microgranodiorites of the Dubrynetske deposit	
Alkaline kaolins	Prosianivske, Pershozvanivske, Biliayivske, Katerynivske	Open-pit, crushing, and grinding plant, overburden dumps, processing plant for dry, wet, and electromagnetic separation, tailings
Multicomponent deposits	Bakhtyn (fluorite ores), Nosachivske (titanium-ilmenite ores), Perzhanske deposits of rare metals, Mazurivske (tantalum and niobium ores)	underground mine, processing plant (gravitation, flotation, and electromagnetic separation), tailings

CONCLUSION

Objects of negative impact for different types of deposits are highlighted:

1. for pegmatite deposits and deposits of crystalline rocks it is open-pit, drilling and blasting operations, crushing plant, overburden dumps;

2. for kaoline deposits it is (except for the above) processing plant for dry, wet, and electromagnetic separation, tailings;
3. for multicomponent deposits - underground mine, processing plant, tailings.

Possible negative impacts on the environment during open-pit mining of feldspar deposits are air pollution, soil destructions, change of relief, a local decrease in groundwater level, pollution by sewage, and waste. For underground mines, important changes are disturbances in the rockmass and its stability, changes in the regime and composition of surface and ground waters. For all facilities where there are processing plants, the development and condition of tailing dumps and the possibility of processing waste are critical.

Important and effective measures for improving facilities are the reduction of disturbed mining areas and their early reclamation, backfilling during underground mining, the maximum extraction, and processing of all useful components of minerals, which reduces the amount of production waste.

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