

Monitoring of Damaged Areas Affected by Mining Activity and Possibilities for Reclamation

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ABSTRACT: Environmental transformations, their classification, methods of their monitoring and the prognosis of environmental transformations resulting from mining activity are described. These problems are related with exploited mineral types, prepared and exploited methods, and the characteristics of the area affected by mining activity. Technical suggestions for damaged area reclamation by mining activity are given.

1 INTRODUCTION

Mining activity consists of the exploitation of beneficial ore through three stages: the development of the mine, mineral exploitation and the termination of mining activity. In each stage of mining activity, undesired transformations of the natural and artificial environment are encountered. The range and extent of these transformations are dependent on the deposit type, prepared and exploited methods, the monitoring of damage and the efforts to minimize it. Problems encountered that are related to mining activity may be presented as follows:

- Mining
- Environmental transformations
- Monitoring of mining subsidence
- Preventive methods during mining operations
- Damage reclamation

The effectiveness of environmental protection against the undesired impact of mining operations depends on proper identification and the ability to forecast negative transformations in the environment, and on the preventive methods applied and measures used to reduce the resulting damage.

In Albania, such a practice is not applied and this has caused a lot of damage, in some cases without possibilities for reclamation. The geographical distribution of mines in Albania is shown in Figure 1.

In about 60 % of these cases, there is significant environmental damage and reclamation is necessary.

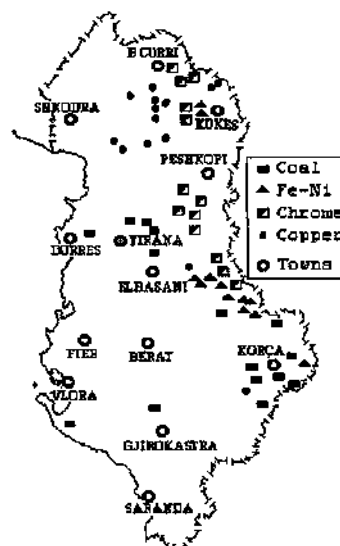


Figure 1 The localization of the main mining regions in Albania.

2 ENVIRONMENTAL TRANSFORMATIONS CAUSED BY MINING ACTIVITY

The damage caused by mining activity may be divided into different categories, according to the source that causes the environmental changes, or the transformed component of the undermining massive. The environmental transformations occurring in Albanian mining areas may be characterized as given below.

2.1 Geomechanical transformations

These transformations are caused by mining- operations performed during the miners construction stage as well as during mineral preparation.

The geomechanical transformations encountered in the mines are:

- open pit excavation (in all mines);
- mine waste dumps during mining and after flotation (Bulqiza, Kalimash, Rehova);
- continuous deformations In the form of a subsiding trough (Vahas, Memaliaj, Mezes, Alarup);
- slides of mining areas (Rehova, Gjegjan, Pishkash),
- non-continuous deformation in the form of gaps and sink-holes (Rehova, Bulqiza, Spaç, Tue).

Geomechanical transformations constitute a direct threat to the surface and any objects situated on it.

2.2 Hydrological and hydrogeologica! transformations

These transformations consist of the alteration of water in quantity, quality and location both at the surface and underground. Consequently, changes are observed in the hydrographie net, location and dynamics of the underground water, the direction and rate of the surface flows, and contamination of waters by components coming from mining waters.

These transformations occur in the form of:

- alterations of both chemical and physical properties of the water (Valias, Memaliaj, Rehova, Alarup),
- formation of drained areas (Lozhan, Rehova, Klos, etc.),
- formation of depression sink,
- formation of waterlogging areas (Valias, Mezes),

The water alterations mentioned above consequently have a negative effect on other components of the environment.

2.3 Flora transformations

These are alterations in the flora as a result of transformations occurring in particular components of the environment. In the mines a destructive influence is produced mainly by water component changes, flowing from mining openings, as well as by underground and surface water regimen changes. Flora damage caused by polluted water is mainly evident in copper mines.

Natural regimen changes of water flows have caused damage to flora in Valias, Mezez, Memaliaj, Lozhan, and Rehova mines and many others.

Flora in mining areas is also damaged by smoke from industrial operations of mineral processing and metallurgical plants. This phenomenon can be observed especially in the Dumrea and Elbasan areas.

Transformation of woodland areas for mining operations and the deposition of mining dusts in these regions have caused flora degradation and have transformed them in unproductive ones.

2.4 Air transformations

These occur through contamination of the air by dusts and gases. These transformations are caused by mining activity as follows:

- mining operations In open pit mines (open pit mines in Gjegjan. Leten, etc.);
- mechanical and chemical processes during mineral processing (Gjegjan, Rehova, Rubik etc.);
- ventilation of underground mines (Valias, Mezez, Mborje Drenova, Prrerjas etc.);
- fires caused in piles (Memaliaj, Alarup, Lozhan, Pishkash etc.);
- dusts caused by mineral and rock piles;
- gases resulting from fuel combustion needed for mining operations (all mines).

The contamination of the air over a long period may lead to temporary or permanent alterations of the region's microclimate.

Other transformations caused by mining activity may be technical ones: noises and vibrations produced mainly by mining machinery, fans and lifts, transport operations and pre-seismic shocks caused by blasting.

3 MONITORING OF ENVIRONMENTAL TRANSFORMATIONS CAUSED BY MINING ACTIVITY

Environmental protection against the undesired effects of the transformations mentioned above depends first of all on the qualitative and quantitative estimation and prognoses of particular transformations resulting from designed mining activity.

In relation to environmental components and transformation types, the following observations are often made:

- subsidence and displacements of the surface;
- damage and deformations of the objects existing within mining influence zones;
- monitoring of the surface and underground waters;
- monitoring of flora and forests;
- monitoring of ground and soils;
- monitoring of noise and vibrations;

monitoring of places where mining wastes are located as well as the types and contents of the harmful components of mem.

On the basis of observations carried out, it is possible to predict the final effects of mining activity and determine the types and magnitude of anticipated environmental transformations. Prognosis methods for particular transformations are based on theoretical models of the phenomenon causing these

transformations. The parameters of these models are checked by analysis of monitoring studied results.

A well-prepared prognosis, especially for the influence of planned mineral exploitation, is a precondition for safe mining activity and the minimization of environmental damage during exploitation.

3.1 Prognosis of the continuous deformation

Prognosis of the continuous deformation which will occur on the surface as a result of underground mining of a deposit is prepared using the Knothe-Budryk formula. By making calculations with this formula, we can estimate the values of the deforma-

tion indicators in the area affected by planned mining exploitation. The deformations are presented either in the form of indicator plots along a selected cross-section, or in the form of a surface distribution by means of isolines.

On the basis of graphics compiled for each mine, it is possible to:

- determine deformations of the ground surface and estimate the zone which will undergo maximal subsidence and displacements;
- estimate the resistance of the buildings and other infrastructure constructions located in the area affected by mining operations.

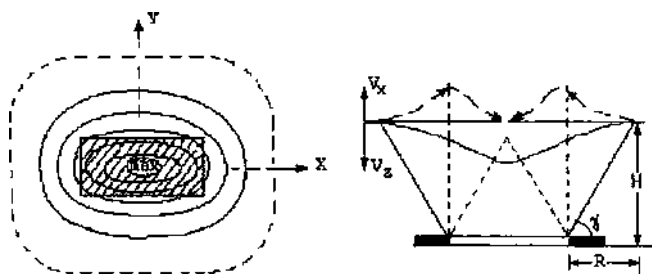


Figure 2 Prognosis of continuous deformations.

3.2 Prognosis of the non-continuous deformations

Prognosis of non-continuous deformations is carried out for the case of shallow deposits mined with fall of roof. As a result of the prognosis, we can estimate the possibilities of non-continuous deformations occurring and the types of these transformations throughout the planned exploitation. The accuracy of the obtained prognosis results depends on the information obtained about the geological structure and deformation mechanism of the rock mass in the mining regions under consideration.

4 PREVENTIVE METHODS AND REPAIR OF DAMAGE IN MINING AREAS

The methods for counteraction and regeneration of the undesired transformations of the environment, as well as minimization of these transformations, depend on the type and range of the forecasted effects of the mining activity. If we have information about the type and range of expected transformations, we may prepare measures and a preventive plan before and during mining activity. These measures can be classified as static or dynamic.

Static measures include the determining the working position in relation to the structures that need protection, limiting the panel in the protective zones and choosing the methods of mining works. The dynamic measures affect interim ground movements and concern the direction and rate of the advancing face, as well as the chronological sequence of the workings.

Reclamation, on the other hand, is carried out in two main phases: technical and biological rehabilitation. The target of the first phase is to re-establish on the despoiled land the conditions required for plant life and restoring the fertility of the soil, or for using it as building ground. The surface of the spoil-bank is leveled and, if necessary, covered with a layer of arable land.

In the biological phase of reclamation, the soil is prepared for agriculture or forestry. Re-cultivation for agriculture presupposes that sufficient quantities of arable land are available to be spread as cover on the sterile sub-soil of the spoil heaps, and that the new farmland will yield a profit.

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At present, especially in Albania, the tendency is to try and solve these problems by imposing the duty of environmental protection and control on industries which disturb the environment.

The first step is the creation of realistic laws and directives that impose the same standards. Once environmental protection has been assigned its proper place in the structure of the economy, it will become

one of the decisive factors in further economic development.

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