STUDIA UBB GEOGRAPHIA, LX, 2, 2015, pp. 27-34
(RECOMMENDED CITATION)

THE IMPACT OF MINING ACTIVITIES ON THE WEST OF PETROŞANI DEPRESSION AND IDENTIFICATION OF AFFECTED GEOMORPHOLOGICAL RESOURCES. CASE STUDY: ANINOASA-VULCAN-LUPENI SECTOR

N. NIMARĂ[1], G. B. TOFAN[2]

ABSTRACT. – The Impact of Mining Activities on the West of Petroşani Depression and Identification of Affected Geomorphological Resources. Case Study: Aninoasa-Vulcan-Lupeni Sector. The west region of Petroşani Depression, like the whole depression, suffered some changes in the geomorphologic environment as a result of coal mining activities. Following displacement processes of mass materials and relocation of it, changes in shape are brought to the original territory that contrast with the natural landscape. The human impact on the West of Petroşani Depression and hence to the analyzed sector is especially highlighted as it materializes into waste dumps and coal pits.

Keywords: *mining activity, coal, anthropogenic impact, geomorphology, Petroșani Depression*

1. INTRODUCTION

The western region of Petroșani Depression was formed on a synclinal oriented West-East, on a length of about 36 km, to the confluence of Eastern Jiu and Aninoasa valleys. It is limited to the North and South by Retezat and Vâlcan Mountains. It appears as a depression corridor inside the surrounding mountains and is the largest region of the depression. The corridor character of this western unit lies in the existence of two major fault systems oriented East-West (Northern Fault of Jiu River). The main type of this unit remains the tectonic element. It imposed the morphologic development direction of the region. Against this background overlapped major elements of diversification and intensification of erosion generated by the rate of petrography, the evolution of the river etc (M. Ardeiu, 2004; Silvia Lupu 1967, I. E. Pop 1963).

The presence of coal deposit in this region has been reported since 1780 but due to the low level of industrialization of Transylvania at the time, the geographical position, the relative isolation of the basin and the lack of appropriate modes, the first industrial operation appeared only in mid-nineteenth century (V. Tufescu, C. Mocanu, 1964; I. E. Pop, 1963).

[1] *University of Petroșani, Faculty of Mining, Department of Management, Environmental Engineering and Geology, Petroșani, Romania, e-mail: cikgeogra@yahoo.com.*

[2] *„Vasile Goldiş" Western University of Arad, Faculty of Natural Sciences, Engineering and Informatics, Department of Biology, Ecology and Geography, Baia Mare Branch, 5 Culturii Street, Romania, e-mail: tofanbogdan_geografie@yahoo.com.*

Underground coal mining has great repercussions on the land surface by causing subsidence, rupture or collapse. These phenomena do not allow normal use of the land by the initial goals, but seriously affect the buildings in the area. The severity of surface deformation depends on assistance from the ground, the level of stress and deformations arising and always have the effect of destroying the stability of the surrounding rock. The impact of coal mining led to the emergence of anthropogenic landforms, both positive (dumps and slag deposits) and negative (coal pits), whose evolution over time is unpredictable (C. Nimară, 2011).

1.1. Location and limits

The ***northern limit*** of the western region of Petroşani Depression is morphologically expressed; one can also see the difference of the physical and geographical features along the morphological limit. This can be seen on the SW-NE direction, between Câmpu lui Neag and East of Aninoasa town.

At the contact of the two units, the slope break line can be seen, which on SW-NE direction goes to the South of the following peaks: Pleşei Hill (1930 m), Păroasa Hill (1436 m), Dealul Mare (1509 m), Zănoaga Peak (1526 m), Ursu Hill (1020 m).

The ***South and South-East limit*** can be seen between Câmpu lui Neag and Western Jiu valley (at the entry of Jiu gorges), the southern limit is represented by Vâlcan Mountains. The limit is between 1601 m (Cioaca Negrul Hill) and 1548 m (Cândoiul Hill) to the gorge.

This limit in the West-East direction goes across a series of Jiu valley tributaries, going to the North of Cioaca Negrul Peak (1601 m), Şigleul Mare Peak (1681 m), where the piedmont level dissapear and the limit is made by the northern slope of Şigleul Mare Mountain; this makes a direct contact with the right bank of Jiu River. To the East, the limit goes to the North of Coarnele Mountain (1650 m) and Cândroiul (1548 m) going upstream of Jiu Gorges (Gr. P. Pop, 2006).

The ***eastern limit*** has been considered the conventional line which goes across between Jiu Valley and Aninoasa Valley.

2. IDENTIFICATION OF AFFECTED GEOMORPHOLOGIC RESOURCES

2.1. Căprişoara Valley

The deposit of slag and ash of Căprişoara Valley is located at 1.5 km from the power plant and covers an area of 45 hectares, consisting of two compartments. Deposition of slags and ashes is done in steps, consisting of cant executed successively in the various compartments of the deposit. The impact on the landscape is perceptible from a visual standpoint, being in disagreement with the natural environment, changing the original purpose of the land by the emergence of new landforms (fig. 1).

Fig. 1. Affected geomorphologic environment, in Vulcan perimeter (Căprişoara Valley). (Source: https://earth.google.com/).

Slag and ash dumps from power plants using solid fuel (coal) being in operation or after the termination of exploitation and abandonment represent an anthropogenic hazard increasing the susceptibility to risk through (I. Mac, D. Petrea, 2003):

- the impact of particulate ash against the adjacent areas: reducing visibility, dusting the buildings and the equipment located outdoors, partial necrosis of crop residues as a result of mechanical impact with coarse particles of ash blown by strong winds, increasing the frequency of fall flowers of young trees and fruit trees, tinted powder coating the ash and photosynthetic capacity reduction;
- changing the initial land destination, the emergence of new forms of relief;
- changes in the composition and quality of soil in the vicinity of the dump due to ash deposits;
- noticeable aesthetic impact: landscape changed in contrast to the natural environment.

2.2. Meadow of Arsului River

The anthropogenic landform which affects the Arsului Valley meadow is a small heap, with an area of 1,938 hectares surrounded by Ţarina Chiciorii hills in West and Arsului Hill in East. It was established for tailings storage resulting from underground coal exploitation in block VIII. In terms of geomorphology, the area is relatively flat, represented by Arsului Valley meadow stream with a general inclination from NNE to SSE and a relative altitude of 661 m (fig. 2 b). Following the dump process, because of dumping, besides the geomorphologic processes and phenomena, the terrain morphology was changed by + 3 m to 8.7 m.

In hydrographic terms, the dump area and the adjacent areas are affected by Arsului Valley brook and gullies that formed on the slopes during heavy rainfall. After dumping in the valley, the stream has diverted its riverbed and downstream a lake has been formed due to land sinking by the underground mining activity, with natural drainage possibilities (fig. 2a).

Fig. 2. The anthropogenic lake from Arsului Valley (a); The meadow of Arsului brook (b).
(Source: C. Nimară, 2011).

The presence of the lake, formed locally, is an unfavorable factor in terms of stability, as water saturates the rocks at the bottom of the heap and modifies the physical and mechanical properties of the land base.

By the current configuration of the dump, it results that the dumping was made in several alignments, putting into evidence the existence of two bodies of dumping, the oldest one in the North-West, and the second body located in the southern part.

In the middle of the dump there is now a central clough running through its central body in the NE - SW direction (fig. 3) (C. Nimară, 2011).

Fig. 3. Clough formed in the central part of the sterile dump.
(Source: C. Nimară, 2011).

2.3. The perimeter between Ferejele Valley and Boncii brook

This landform is affected by the sterile dump of Lupeni coal preparation factory (fig. 4), being surrounded by the hills: Dâlma, Boncii and Renghii (the slopes are between 6° and 35°).

Fig. 4. The anthropogenic impact on the relief in the Ferejele valley-Boncii brook perimeter. (Source: https://earth.google.com/).

The slope of the dump is about 9°. Because of these angles and due to the presence of water runoff during periods of heavy rainfall, erosion and some slip phenomena are present. The form of the dump on all three sides is not uniform and the material deposited on the dump consists of sandstone rocks, clay, marl, shale and carbonaceous sandstone. In the area of the waste material, cones can be seen, which are then leveled by a loader so that ultimately leveling platforms are formed.

Shallow formations represented by topsoil and hillside covering the area are sometimes eroded and basic rocks in outcrops occur. There are landslides on the southern slope in the area of P4 and P5 pillars, accompanied by repressions of the land base. This landslide that extends over 170 m in the present is stabilized by placing the rocks of the group of sliding at an angle of slope of 24°-25°. After waste materials were dumped in the perimeter of the two valleys, the stream riverbeds have been diverted and upstream several lakes were formed without natural drainage possibilities.

Three such lakes are between the two dump bodies of the branches R-1 and R-2 with a surface area of 550-1 320 m^2 and the other three lakes were formed in the upstream of R-2 branch, the lakes 1 and 2 have small areas of approx. 800-1 100 m^2 and lake no. 3 has the largest surface of about 7 600 m^2 (C. Nimară, 2011).

2.4. Câmpişoara Hill

Câmpişoara Hill affected area is delimited to the East by Vulcan mining field, and to the West is delimited by Bărbăteni, Bolosineştilor and Plisabeia brooks. To the North it is delineated by Retezat Mountains, and to the South by Vâlcan Mountains.

The total surface area that corresponds to Victoria coal pit is 200,682.6 m^2, which is totally degraded. On the other hand, the northern slope of the coal pit is affected by landslides due to rainfall.

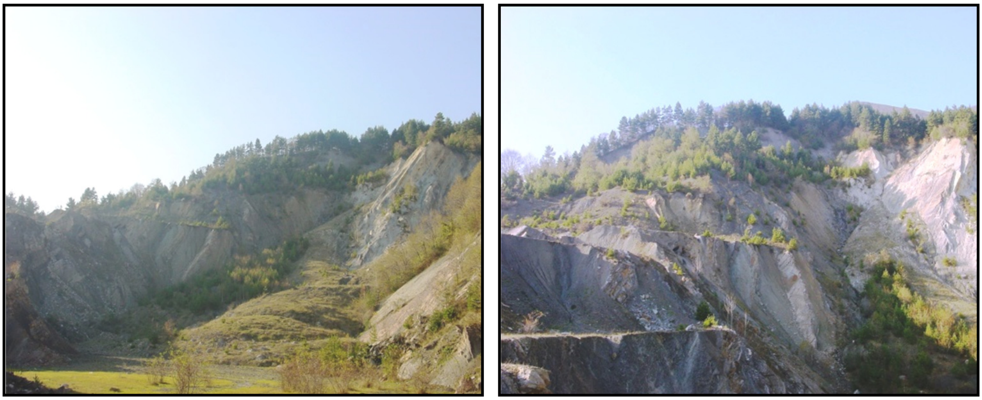

Fig. 5. Victoria coal pit and the landslides on its slopes.
(Source: Nimară, 2011).

Generally in areas with rugged terrain, as in the area where Victoria coal pit is located, breaking the static equilibrium where there is a rock deposit is caused by shear forces that alter the internal cohesion of the particles constituting the rocks in a field gravitationally active as a side can initiate land mass displacements (fig. 5) (R. U. Cooke, J. C. Doomkamp, 1990; I. Rotunjanu, 2005).

The sterile dump of Victoria coal pit is in conservation. Structurally, the dump is made of clay covering an area of 3.18 hectares and has a volume of 2,875,272 m^3 (fig. 6).

Fig. 6. Sterile dump, Victoria coal pit.
(Source: Nimară, 2011)

2.5. Mierlaşului Valley

The sterile dump from Bărbăteni mine is located on the southern slope of Mierlaşu Valley (Mierlesei Valley on some maps, fig. 7 a). This form of anthropogenic accumulation is located about 2 km away from Lupeni and arose from mining excavation processes of EM Bărbăteni.

The largest amount has been dumped since 1980, but in recent years the site has not been used for dumping, but for the storage of ashes from the thermal power plant of the mine.

Fig. 7. The sterile dump from the left slope (a); The lake formed at Mierlaşului Valley (b). (Source: Nimară, 2011)

In terms of grain size, the sterile dump consists of rock fragments with similar particle size fractions of gravel and boulders, covered in a mass of yellow-gray clay.

Rainfall that have a high frequency in April-May and September-October, given the physical and mechanical properties of the rocks present in the constitution of this form of accumulation (clay, marl, sandstone, shale coal), led to the launch of mass displacement processes, after which there was a partial crossing of the brook and the formation of a reservoir upstream of the dump body at the western end. The bottom of the lake is situated at an altitude of 867 m and has an almost oval shape (fig. 7 b).

3. CONCLUSIONS

The impact of mining activities on landforms is influenced by various factors, which usually act synergistically: the extraction procedure and the development stage of the operation, local hydrological conditions, the type of rock, work scope, topographic surface characteristics. It manifests itself in all the stages of mining works. It is about the exploration stage, production and decommissioning as well as the intensity and duration of the specific interaction between the anthropogenic component and geomorphological elements (G. Darmer, N. Dietrich, 2001; Maria Hosu, 2003, Y. Wang et al., 2001).

For the western region of Petroşani Depression, the impact sources have a local and regional significance, the effects being felt at the geomorphological component level by the cascade system character. The main geomorphological units affected are: Căprişoara Valley, meadow of Arsului Valley, Ferejele Valley and Boncii Valley, Câmpişoara Hill and Mierlaşului Valley.

Modifying actions related to mining activities consist of the deployment of large amounts of materials (especially for open pit mining), relocation and storage in various forms and at various stages of the production process. In addition to these, there are morphological and functional changes caused by geomorphological processes (for example: subsidence/collapse).

The geomorphological significance of anthropogenic activities in general and of mining in particular, derives from both the morphological and functional changes induced by these landforms and the relationship of these changes with the anthropogenic component.

REFERENCES

1. Ardeiu, M. (2004), *Spaţiul geografic al Depresiunii Petroşani*, Teză de doctorat, Universitatea „Babeş-Bolyai", Facultatea de Geografie, Cluj Napoca.
2. Darmer, G., Dietrich, N. (2001), *Landscape and surface mining: Ecological guidelines for reclamation*, New York.
3. Cooke, R.U., Doomkamp, J.C. (1990), *Geomorphology and Environmental Management*, Calderon Press, Oxford.
4. Hosu, Maria (2003), *Impactul activităţilor miniere asupra reliefului şi riscul geomorfologic indus*, Revista Riscuri şi catastrofe, Edit. Casa Cărţii de Ştiinţă, Cluj Napoca.
5. Lupu, Silvia (1967), *Procesele şi formele actuale de versant în Depresiunea Petroşani*, Studia UBB, Geologie-Geografie, nr. 2, Cluj-Napoca.
6. Mac, I., Petrea, D. (2003), *Sisteme geografice la risc*, Riscuri şi catastrofe, Edit. Casa Cărţii de Ştiinţă, Cluj Napoca.
7. Nimară, C. (2011), *Cercetări privind reintegrarea peisagistică a arealelor afectate antropic din cadrul bazinului minier Petroşani*, Teză de doctorat, Universitatea din Petroşani, Facultatea de Mine, Petroşani.
8. Pop, I. E. (1963), *Monografia geologică a Bazinului Petroşani*, Edit. Academiei Române, Bucureşti.
9. Pop, P. Gr. (2006), *Carpaţii şi Subcarpaţii României*, Edit. Presa Universitară Clujeană, Cluj-Napoca.
10. Rotunjanu, I. (2005), *Stabilitatea versanţilor şi taluzurilor*, Edit. Infomin, Deva.
11. Tufescu, V., Mocanu, C. (1964), *Depresiunea Petroşanilor-Valea Jiului*, Edit. Ştiinţifică, Bucureşti.
12. Tufescu, I. (1966), *Modelarea naturală a reliefului şi eroziunea accelerată*, Edit. Academică, Bucureşti.
13. Wang, Y., et al. (2001), *Landscape ecological planning and design of degraded mining land, Land degradation and development*.
14. *** (1987), *Geografia României III, Carpaţii Româneşti şi Depresiunea Transilvaniei*, Edit. Academiei RSR, Bucureşti.
15. *** (2010), *Planul de amenajare a teritoriului zonal Valea Jiului*.
16. *** *www.google.com/earth*