ANTHROPIC IMPACT ASSESSMENT ON THE TRUCTURE AND MORPHOLOGY OF THE EASTERN REGION OF PETROȘANI MINING BASIN

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Abstract. Mining, the main economic activity in Petroşani mountain valley, was a vital necessity for the development of the community of this micro-region, but whose "products" could be observed both in the natural and social, political environment. In the natural environment is obvious by the man made morphology which vary by sizes, shapes and morphological processes. The main aim of assessment of anthropic impact on landscape and the identification of areas with affected geomorphological environment, was to be able to find later the necessary solutions for landscape and functional reintegration of the anthropic landscape.
Key words: anthropic impact, geomorphological environment, morphology, structure, assessment, region, sector.

Introduction

As a result of dislocation-relocation and storage of mining mass, the original territory is changed in terms of shape and functionality, the result was the emergence of an anthropic landscape with a high probability of risk appearance.

The areas with coal mining activities are characterized by the presence of anthropogenic morphology with different sizes, various geometrical features, diversity of morphological processes, evolution time, lithological structure, etc.

These anthropic modelling processes are a vital necessity in the technology evolution.

To be more easily to analyze the affected geomorphological environment from Petroşani Depression, I divided the depression, based on geological, geomorphological and economical criteria, in two distinct regions, and each region was divided into sectors [3], as follows:

- Eastern Region: Petroşani-Petrila sector (fig 1);
- Western Region: Aninoasa-Vulcan-Lupeni sector and Uricani-Câmpu lui Neag sector.

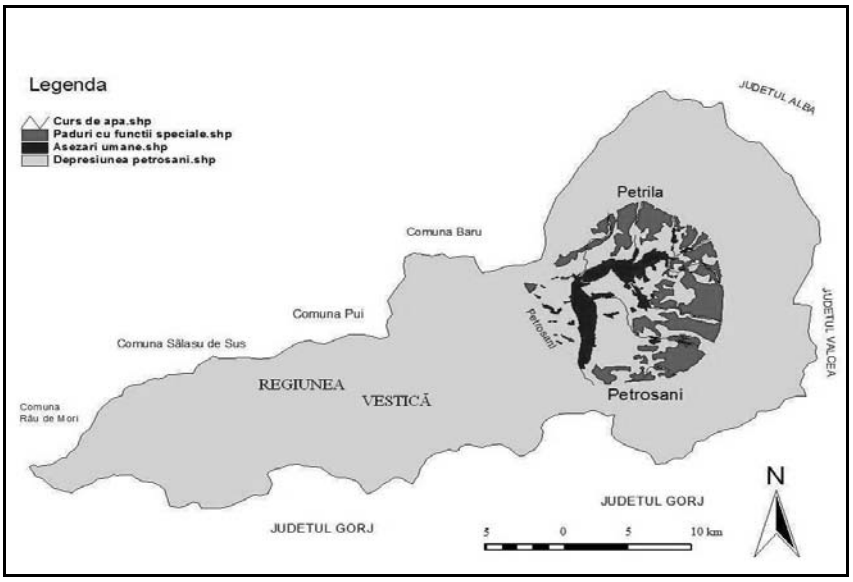

Figure 1. Location of the Eastern Region of Petroşani Depression (Petroşani-Petrila sector)

Limits

In the northern limit of the analyzed region, was taken into account the tectonic line. Along this, it can be observed an over-riding of crystalline over the deposits series of conglomerate of sedimentary [2]. At the two formations contact, can be observed the line of the split slope, which on the direction South West-North East goes under the following peaks: Boţonilor Hill (950 m), Red Stone (1192 m), North Cimpa (978 m). Between Petroşani and North of Cimpa, the northern boundary separates the basin from the Sureau Mountains, formed by crystalline and Mesozoic Domain (Jurassic limestones), which takes the form of a steep.

North-Eastern limit, on a small side, is made up by the Rascoala erosion hollow, sunk on the lower course of this river. It seems that, this hollow was a

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bay of the Miocene Lake, which came into contact with this corner of the basin.

South and South-East Limit separates the Eastern Region of the Petrosani Depression from Parang Mountains. To the South-East of Jiu gullet, the limit passes to the North of Măgura Hill (970 m), crosses the upper course of Salatruc Valley and the middle course of Maleia, continues to the West of Plaiul Godeanu and Cimpa Hill, reaching to Eastern Jiu Valley upstream of the Cimpa village. The same morphological limit, well expressed in the mountains and valley, is observed between Jieţ - Cimpa; here piedmont is clearly detached from the mountain, coming right out break of slope between the two morphological units (figure 2).

The ***Western limit*** of the analyzed area was considered to be the section between Eastern Jiu Valley and Aninoasa River [3].

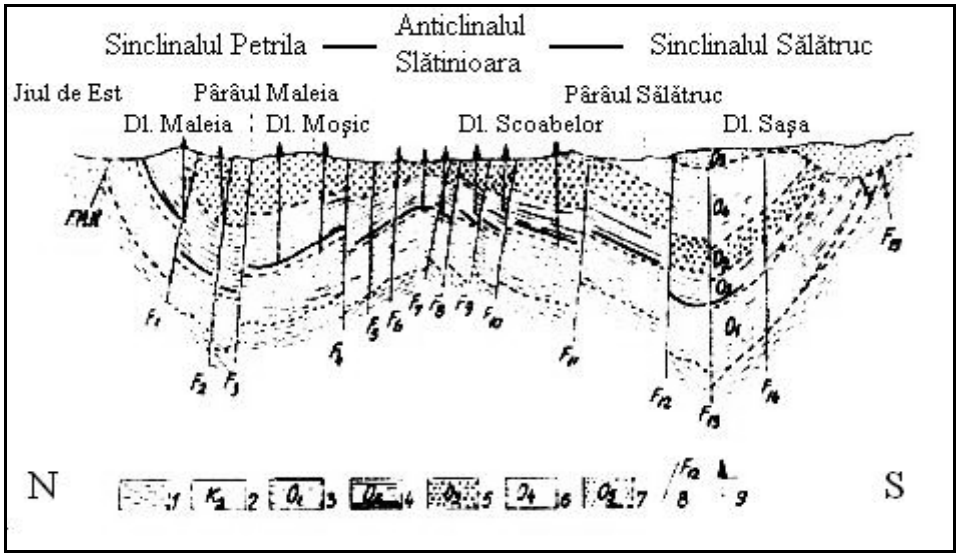

Figure 2. Transversal section through Eastern Region of Petroşani mountain valley

Anthropic landforms: dumps

The main anthropogenic structure created as a result of coal mining activity in the Eastern Region of the Petroşani Depression are represented by dumps and coal pits. The vast majority of dumps are located on hillsides or along valleys with or without the hydrological regime.

Land storage quotas generally varies from 650 m in the axis of valleys and 750 m on hillsides with slope angle ranges between 6 ° and 35 °.

In some cases, waste dumps were built on areas where they crossed out valleys without permanent water courses; in periods of rainfall, lakes are being made, which presence could be a risk for the stability of dumps. The infiltrated water into dumps, changes the physical and mechanical properties of materials and of the land base and may give rise to erosion phenomena. It can also produce a hydrostatic pressures and ultimately can cause landslides or plastic and muddy leakage.

The dumps are composed mostly of clays, shales, sandstones, argillaceous sandstone, depending on the lithology of the exploited area (figures 3, 4 and 5).

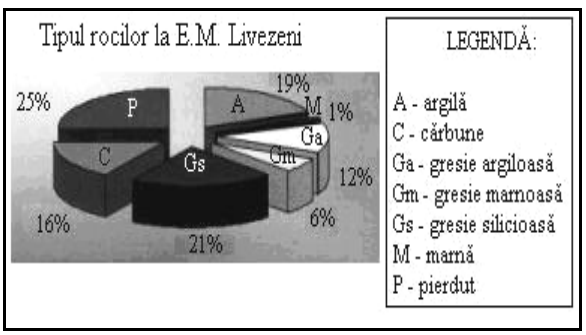

Figure 3. Type of rocks at E.M. Livezeni

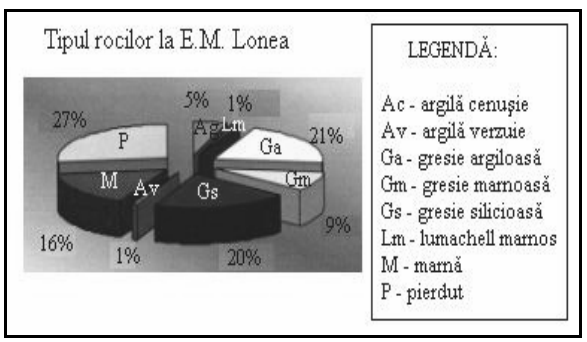

Figure 4. Type of rocks at E.M. Lonea

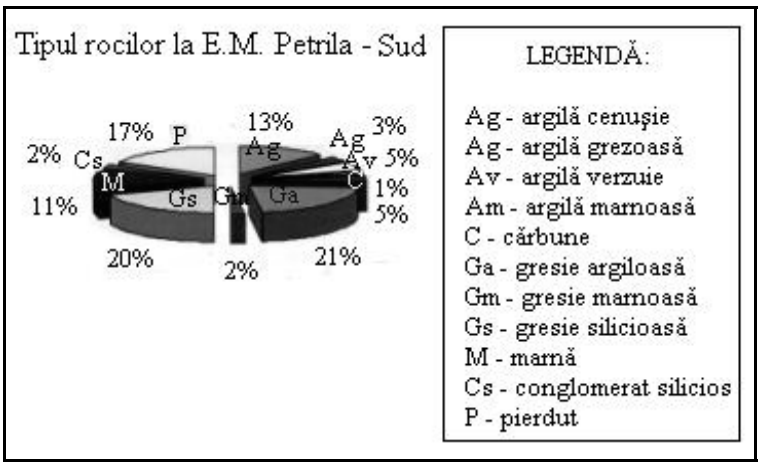

Figure 5. Type of rocks at E.M. Petrila-Sud

Land observations led to the finding of the some essential aspects related to the presence of sterile dumps (the current state of the dumps of Petroşani Depression is shown in table 1). Usually, the areas of occupied land, and the dumps have the following fatures:

- the dumps have a non-uniform geometry and are formed in areas with rough terrain;
- it hasn't been executed any work before locating the dumps; this works should ensure the soil scraping, appropriate benches, water drainage etc.;
- it hasn't been executed any work for leveling the dumps, which often goes to water accumulation.

Under ground coal mining has special repercussions for surface land as well, by causing crashes, declines or crashing in. These phenomena, don't allow the normal usage of land, for the original purposes, and severely affect the constructions in the area.

Processes from the land surface develop depending on the thickness of the layers. Exploiting the thin layers of small hip causes only the surface subsidence without being affected the crops from the area. For thicker layers, the subsidence is manifested in the form of steps with intense areas of fractures in the line with layers. Other associated phenomena are: formation of springs, drying up wells and formation of permanent lakes on the bottom of subsidence bed [1]. Fractured and unstable land has affected almost 70 individual peasant households, and in some cases have necessitated the evacuation and demolition of residential blocks in the town of Petrila.

The phenomenon of subsidence has a greater magnitude above the undermined beds and near the fissures limit.

As already noted above the undermined beds, the land affected by subsidence was large and the topographic surface is changed, involving in this way, the restrictions regarding the use of the land.

Table 1. Present situation regarding the affected lnad in the Eastern Region

No.	Economic unit	Name of dump	Area (ha)	Volume (m^3)	Technical status	Owner, administrator
1	Mina Petrila Sud	Haldă de steril Jieț Vest	7,53	1.772.000	Rehabilitated	CNH Petroşani
2	Mina Petrila Sud	Haldă de steril Jieț Puț 4	1,14	57.000	Rehabilitated	CNH Petroşani
3	Mina Lonea III	Haldă de steril Defor	12,75	2.149.970	Idle	Consiliul local Petrila
4	Mina Taia	Haldă aferentă incintei	3	8.400	Idle	CNH Petroşani
5	Mina Petrila 2	Haldă de steril 2 Est	1,63	388.540	Idle	Consiliul local Petrila
6	Mina Dâlja	Haldă de steril Puț auxiliar nr.1	1,74	63.000	Idle	CNH Petroşani
7	Mina Dâlja	Haldă de steril Plan înclinat	1,74	280.000	Idle	CNH Petroşani
8	Mina Dâlja	Haldă de steril Puț aux. 1+2	8,00	1.270.000	Idle	CNH Petroşani
9	Mina Dâlja	Haldă de steril Tericon PA 3	1,20	77.500	Idle	CNH Petroşani
10	Mina Lonea 1	Haldă de steril Valea lui Ciort	7,19	982.472	Idle	Consiliul local Petrila

11	Mina Livezeni Sud	Haldă de steril Halda aferentă incintei	11,00	54.000	Idle	CNH Petroşani
12	Preparația Petrila	Haldă de steril Ramura I, II, III, IV şi VI	30	5.105.000	Idle	Consiliul local Petrila
13	Preparația Petrila	Haldă de steril Ramura V	19,59	2.802.299	Active	CNH Petroşani
14	E.M. Lonea	Haldă de steril Lonea I	2,10	350.000	Active	CNH Petroşani
15	E.M. Lonea	Haldă de steril Jieț	0,78	51.000	Active	CNH Petroşani
16	E.M. Livezeni	Haldă de steril P.A nr. 2 - 3 incinta Maleia	2,30	301.792	Active	CNH Petroşani
17	E.M. Livezeni	Haldă de steril U.P.Livezeni	2,38	427.057	Active	CNH Petroşani

Anthropic landforms: coal pits

Another specific situation for mining activity in the Eastern Region and in the Petroşani mining basin as well, generally, is represented by the existence of derelict coal pits due to uneconomic exploitation (table 2).

Table 2. Features of derelict coal pits from Eastern Region

Name of coal pit	Area (ha)	Area of influence (ha)	Relative stability
Cimpa	9,30	0,75	
Jieț Defor	12,56	1,05	
Jieț Vest	6,41	0,50	

Anthropic impact assessment on the landforms from the Eastern region

In designing the assessment methods have been taken into account the type of anthropogenic activity, the resulting products, the ability to rehabilitate the degraded land, the exhibition of the original land and the man made one, solar radiation and the level of interest for the original surface.

Three assessment methods have been proposed to assess the anthropic impact on the natural landforms [4, 5], which have been applied later for the entire basin.

➢ **Assessment method of geomorphological quality depreciation**

According to the value of the quality depreciation, calculated with the ratio:

$$DC = Rg + D \quad (1)$$

value which can be found in table 1 (completed by table 2) and comparing this value with the scale of values shown bellow, it is obvious that, for the Eastern Region of Petroşani mountain valley, the most affected by the anthropic activity is the Eastern Jiu meadow from Petrila town (DC=11) and Maleia accumulation piedmont (DC=10) [5].

The scale of values for quality depreciation is:

- 0 unaffected geomorphological environment;
- 1 - 3 less affected geomorphological environment;
- 4 - 6 moderately affected geomorphological environment;
- 7 - 10 strongly affected geomorphological environment;
- ≥ 10 intense modified geomorphological environment.

Table 3. Assessment matrix for geomorphologic quality depreciation in Eastern Region

No	Name of geomorphological resource	Geomorphological type, R_g	Diversity of geomorphological features of interest, D	Quality depreciation, DC
1	Meadow of Eastern Jiu (Petrila town)	1	10	11
2	Meadow of Eastern Jiu (right bank, Petroşani)	2	1	3
3	Piemontul Dâlja	1	4	5
4	Maleia Piedmont	3	7	10
5	Valea Arsului	1	2	3
6	Ciort's Valley	1	1	2
7	Defor Valley	1	5	6

Table 4. Diversity of geomorphological features of interest in the Eastern Region

No.	Name of geomorphological resource	Types of geomorphological elements			Diversity of geomorphological features, D
		Accumulation forms	Negative landforms (hollows)	Water accumulation (lakes)	
1	Meadow of Eastern Jiu (Petrila)	5	1	4	10
2	Meadow of Eastern Jiu (right bank)	1	0	0	1
3	Dâlja Piedmont	4	0	2	6
4	Maleia Piedmont	4	1	2	7
5	Valea Arsului	1	1	0	2
6	Ciort's Valley	1	0	0	1
7	Defor Valley	1	3	1	5

➢ **Assessment method based on the relationship surface exhibition - solar radiation**

As regards the exhibition of the originally land (before being subject to anthropogenic interference) in the Eastern Region, it is observed that the terrain with Northern exhibition occupies the most significant area (37,76 ha), while the southern areas are the smallest (3 ha) (figure 6).

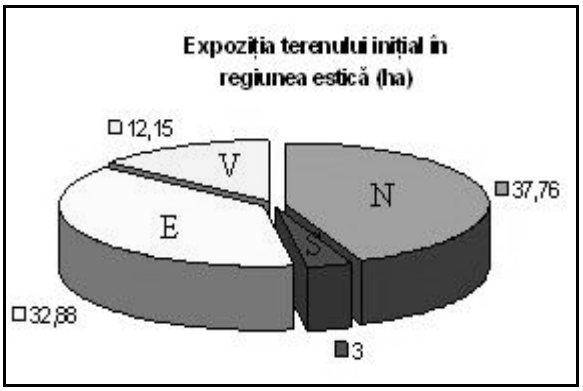

Figure 6. Exhibition of original land

As a result of anthropogenic interference on morphology, it is seen that the new created surfaces have a Western orientation (23,68 ha), and areas which benefit for a lower sunlight radiation are those with southern orientation (17, 66 ha) (figure 7). Creditworthiness for the original land were 2, due to the predominantly Northern exhibition, and 6 for areas created by human activity, due to the predominantly Western exhibition [4].

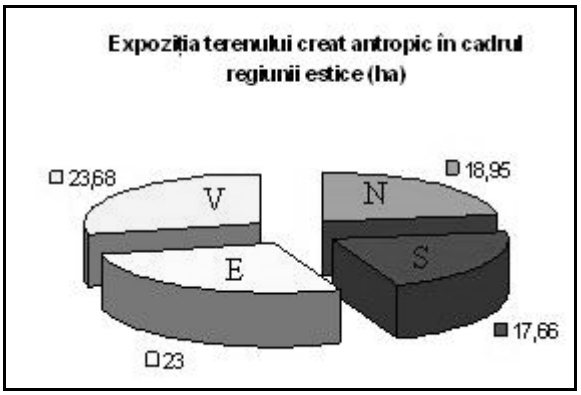

Figure 7. Exhibition of anthropic land

➢ **Assessment method "alteration – reuse"**

After using this assessment method, by calculating the anthropic impact using the ratio:

$$MR = \mathbf{N_s} \cdot \mathbf{T_a} \cdot R \qquad (2)$$

and comparing the obtained value with the following scale of values:

- 0 – unaffected geomorphological environment, no human intervention, natural environment;
- (0 – 25] – less affected geomorphological environment;
- (25 – 50] – moderately affected geomorphological environment;
- (50 – 100] – strongly affected geomorphological environment;
- (100 – 150] – very strongly affected geomorphological environment due to overall change;

it has been obtained values between 11,8 and 67 (table 3) [4].

Comparing the obtained values from table 5 with the scale of values shown above, it can be notice that:

➢ areas with less affected geomorphological environment : meadow of Eastern Jiu (Petroşani – E.M. Livezeni), Valea Arsului and Ciort's Valley, Dâlja Piedmont;

➢ areas with strongly affected geomorphological environment are : meadow of Eastern Jiu (Petrila), Maleia Piedmont and Defor Valley.

Table 5. Matrix for human impact assessment on the relief in the Eastern Region

No.	Name of the geomorphological resource		Products of human activity	Strategic level (N_s)	Type of activity (T_a)	Recovery capacity (%) (R)	Value of the final rate (MR)
	Natural modeling system	Affected landform					
1	Fluvial	Meadow of Eastern Jiu, Petrila	h, a, sb, ci, ps, pt, pec, dtm	2	6,1	5 (0)	61
2		Meadow of Estern Jiu, Petroşani (EM Livezeni)	h, sb, ci, pt,	2	2,95	2 (50 – 75)	11,8
3		Dâlja Piedmont	h, a, pec,	2	4,7	5 (0)	47
4		Maleia Piedmont	h, a, sb, ci, pt, ps, gs	2	5,3	5 (0)	53
5		Valea Arsului	h, ps, gs	2	2,85	3 (25 – 50)	17,1
6		Ciort's Valley	h, pt	2	2,65	3 (25 – 50)	15,9
7		Defor Valley	h, a, ex, pec,	2	6,7	5 (0)	67

Conclusions

In the Eastern Region of Petroşani mountain valley, the affected geomorphological environment by the mining activity, represent an area of 136,09 ha.

After using the propose assessment methods, it was noticed that the most affected geomorphological resources and those with a very low recovery capacity were: Defor Valley, meadow of Eastern Jiu (near Petrila town) and Maleia accumulation piedmont.

According to the creditworthiness obtained by using the assessment method „exhibition-solar radiation", (6), comparing it with the value of original land (2), it resulted that the new anthropic land, created by mining activity in the Petroşani-Petrila sector, present a high posibility of recovery in terms of landscape integration.

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