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# SOME CONSIDERATIONS REGARDING THE ANTHROPIC GEOMORPHOSTRUCTURES RESULTING FROM MINING ACTIVITIES IN CENTRAL-WESTERN SECTOR OF METALIFERI MOUNTAINS (APUSENI MOUNTAINS, HUNEDOARA COUNTY, ROMANIA)

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**Abstract.** Knowing the territorial realities in the Apuseni Mountains, the changes generated by the anthropic activities and their analysis, imposes the identification of hazards and natural and anthropic risks, in order to find some solutions and optimal models of management, fitting and protection based on strategies of functional and aesthetic reintegration of the degraded areas; the foundation for organizing and restructuring of the geographic areas is ensured by a range of thematic maps. The main sources for data collection and processing were: field investigations, analogical products as well as other sources of non-cartographic data: official reports, syntheses and annuaries of the approved institutions. There were inventoried 22 waste dumps, quarries and sumps resulting from the mining of non-ferrous ore, the industry of non-ferrous metallurgy, thermoenergy and the coal industry. For their typification we tried to use a set of unitary criteria.

**Key words:** Apuseni Mountains-Metaliferi Mountains sector, mining activities, sumps, waste dumps, ATU (administrative-territorial unit).

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## INTRODUCTION

For the researches at the mezo and microscale level, we chose study area which covers 1,108.88 sqkm of the Metaliferi Mountains (figure 1), an extremely complex sector in the Southern Apuseni, where elements of magmatic-volcanic relief, in various stages of evolution, alternate with karstic geomorphostructures, large valleys and small tectonic-erosive internal depressions. Knowing the territorial realities in the Apuseni Mountains, the changes generated by the anthropic

activities and their analysis, imposes the identification of hazards and natural and anthropic risks, in order to find some solutions and optimal models of management, fitting and protection based on strategies of functional and aesthetic reintegration of the degraded areas.

The foundation for organizing and restructuring of the geographic areas is ensured by thematic maps. According to contemporary bookish concepts, mining activities are incompatible with the long-lasting development because of the long term "wounds" on the regional geomorphologic system. The harmfulness of the mining activities manifests itself in all the stages of the technological processes (exploitation, preparation and capitalization), and the anthropic changes are most of the time irreversible. Thus, the scientific act of anticipation and identification of the environmental issues becomes more than necessary, followed by the taking of some measures of prevention, protection, reconstruction and capitalization of the natural elements.

In this stage, we mainly took special interest, beside the achievement of set goals for each step, in the generation of an emergent in the conceptual field of approaching the issue under study.

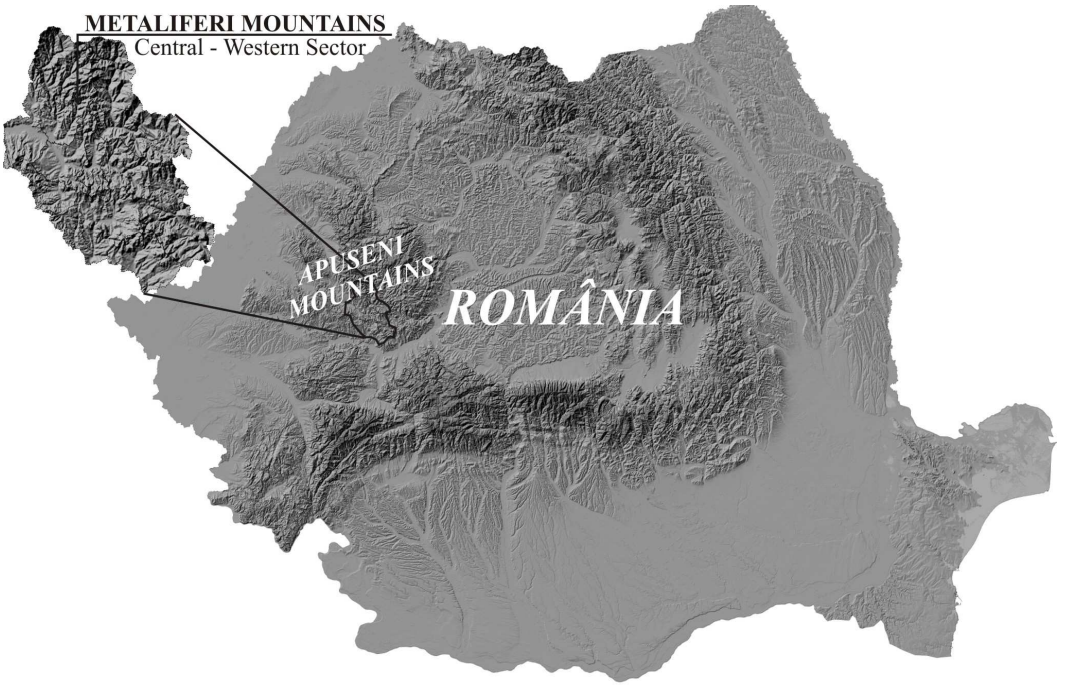


**Figure 1**. Delimitation of the area under study

The anthropic relief within the Apuseni Mountains shows a special structural and evolutional variety, being directly connected with the underground resources extracted for a long time within this area: ex. brown coal (Ţebea, Brad), pyrite (Deva, Boita-Haţeg); non-ferrous complex ore (Metaliferi Mountains, Băiţa, Sacarâmb, Hondol, Măgura-Topliţa), Muntii Zarand (Ciungani, Căzănesti, Almaş Săliste), gold-silver ore (Gurabarza, Săcarâmb, Brad, Certej), travertin (Geoagiu, Cărpinis, Bampotoc), bauxite (Munţii Pădurea Craiului), talc (Lelese, Cerisor), bentonite (Gurasada), andezite and dacite (Baiţa, Criscior etc).

**STUDY METHODOLOGY**

The main resources of data collection and processing were (figure 2): field investigations; analogical products; topographic maps in Gauss-Kruger projection (1963-1984), scale 1: 25000, 1: 50 000, 1: 100 000 published by the Military Topographic Department (MTD); topographic maps, in UTM projection, scale 1:50 000, 1:100 000 (1992, 1994), published by MTD; topographic and

cadastral maps, in Stereo 70 projection (1975-1990), scale 1: 5 000, published by the National Land Office and Real Estate Advertising; geological maps, scale 1: 50 000, 1:200 000, published by the Geologic Institute; pedological maps, scale 1: 200 000, published by the Pedologic Institute; digital sources of information: LANDSAT 7+ (normal resolution -30 m/pixel, forced resolution on panchromatic tape 15 m/pixel); all these are the foundation of supervised classification which generates the CORINE 2000 database; used as a digital support for the definition of the way of land usage; orthophotoplans ANCPI, rezolution 0,5 m; scenes SRTM (x,y,z)-in order to validate DEM; the digital FAO-SOIL Data Base; other sources of non-cartographic data : official reports, syntheses and annuaries of the approved institutions.

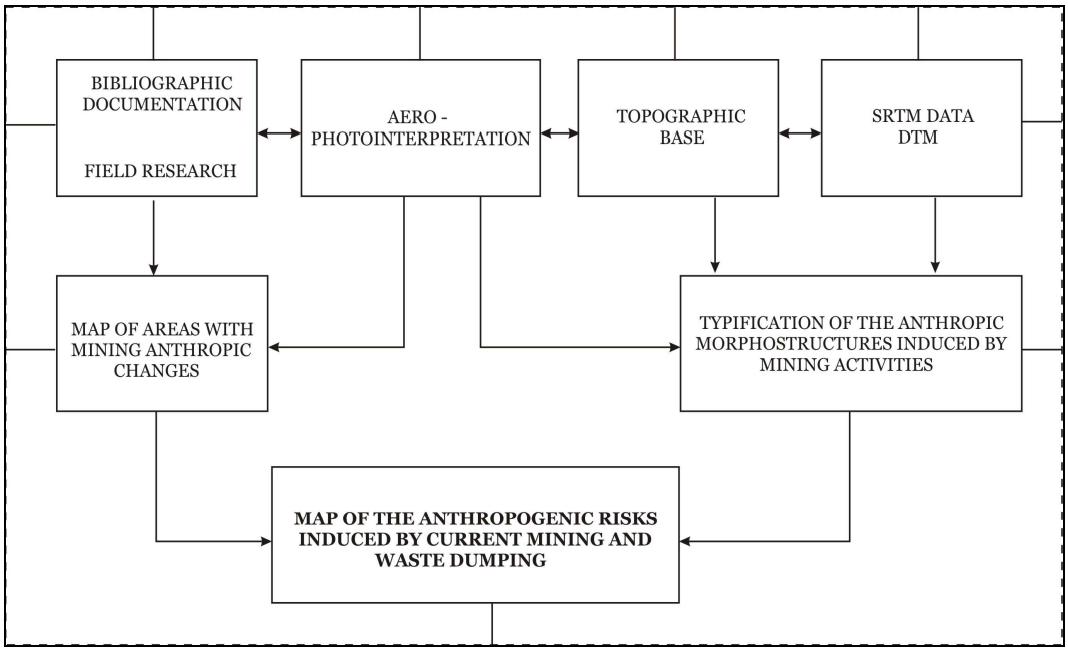


**Figure 2**. The conceptual scheme of elaborating specialistic maps

**ANALYSES OF THE MOST IMPORTANT CHANGES ON THE LANDSCAPE DUE TO MINING ACTIVITIES**

By general integrative analyses, there were highlighted areas with the most important changes on the landscape due to mining activities: Brad – Crişcior – Roşia Montană – Zlatna sector; Vaşcău – Ştei – Băiţa sector; Roşia – Vârciorog – Dobreşti sector; Zarand – Zam sector and Muntele Mare – Valea Ierii sector.

A number of twenty two waste dumps, quarries and sumps were inventorized, resulting from the from the mining of non-ferrous ore, the industry of non-ferrous metallurgy, thermoenergy and the coal industry. For their typification we tried to use a set of unitary criteria: type of activity from which they resulted, surface, degree of stability and fitting, distance to the neighboring localities, distance to adjacent hydrographic network, features of the land on which the settlement was placed, condition of the geodynamic (geomorphological) processes in the areas with waste dumps and quarries.

Considering these (figure 3), three types of waste dumps and sumps have been identified, depending on the aforementioned criteria:

- stabilized waste dumps and sumps (colonization with vegetation);
- unstabilized waste dumps and sumps without active geodynamic processes;
- waste dumps and sumps with active geodynamic processes;

In order to obtain a classification of the territorial units with difficulties in the re-integration of the degraded areas by mining activities (figure 4), we initiated a study of foundation of the anthropogenic risks induced by these activities and resulting structures, which will be extended to the following steps of the project.

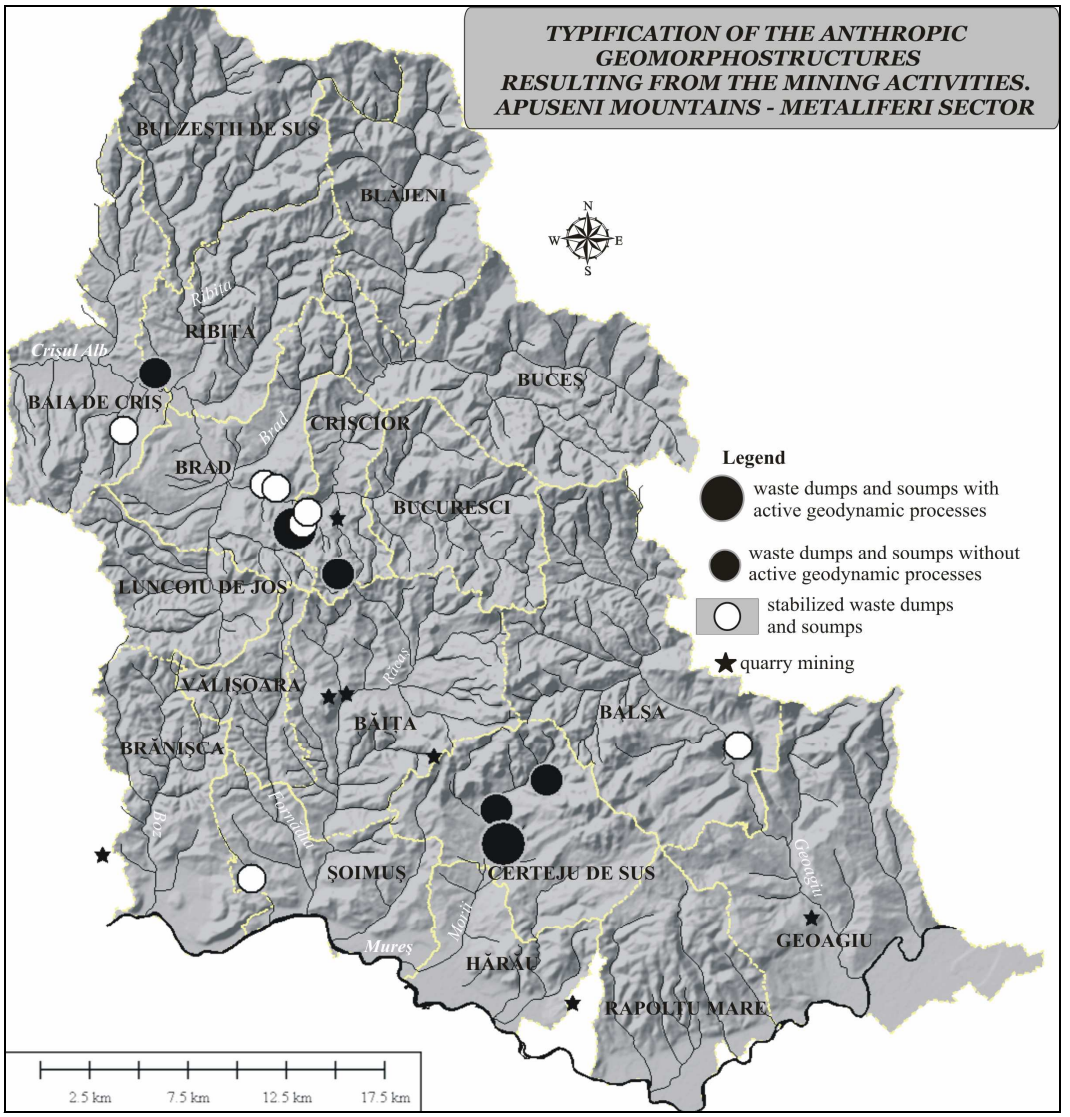


**Figure 3**. Typification of the anthropic geomorphostructures resulting from the mining activities in central-western Metaliferi sector, Apuseni Mountains

Essentially, we used as criteria for establishing the risk factor for each ATU (administrative-territorial unit): number of anthropic geomorphostructures for ATU, degree of their stability depending on the geotechnical fittings, possibility to start some connective geomorphological processes with distructive potential, their presence in projects of re-fitting. Four types of ATUs have thus resulted, and implicitly classes of anthropogenic risks (figure 4): ATUs with extremely reduced mining anthropogenic risk, ATUs with reduced mining anthropogenic risk, ATUs with average mining anthropogenic risk, ATUs with increased mining anthropogenic risk.

Minute analyses were carried out in the mining region Brad, which distinguishes by extraction and processing of the gold-silver ore resulting from the underground exploitation of the Barza deposit, and of the copper-vein in Valea Morii. By processing, gold and copper concentrates are obtained and capitalized.

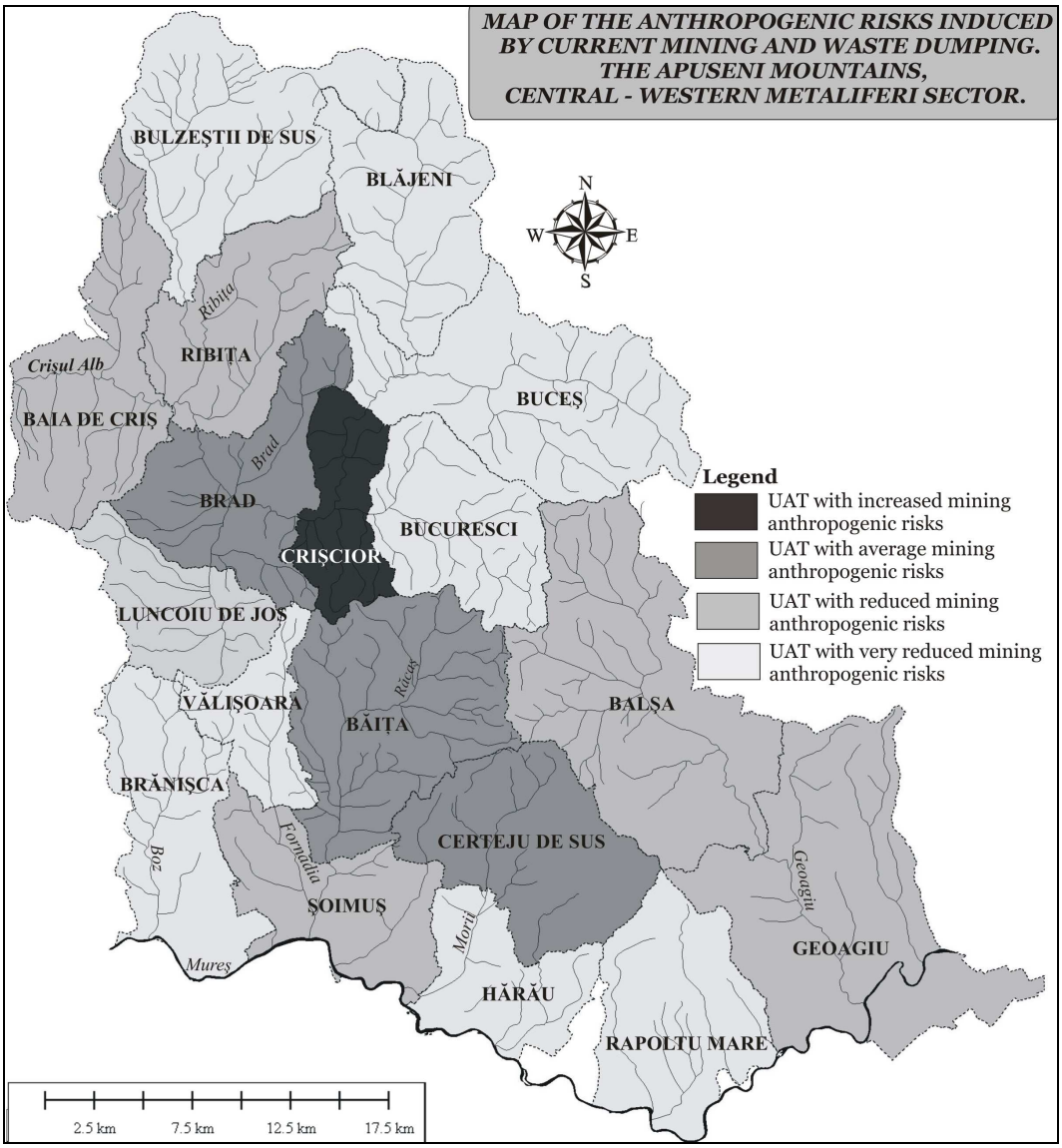


**Figure 4**. Map of the anthropogenic risks induced by current mining and waste dumping. The Apuseni Mountains – central-western Metaliferi sector.

The Barza deposit is part of the deposits of native gold and gold polymetallic sulphides associated with neogen volcanism in Metaliferi Mountains, Brad – Săcărâmb region. Genetically, the Barza deposit is a hydrothermal vein. Around it and inside the volcanic bodies there are several vein groups (Musariu, Brădișor, Carpen, Cireșata, Plumb și Ruda).

Following the analysis carried out on the field we noticed that the main elements of anthropic relief within the mining area of Brad are related to: Barza Mining; Valea Morii quarry;

Gurabarza Processing Plant; waste dumps at Valea Blojului (underground mining); Cireşata (current mining) and the sump at Ribița-Curteni. In association with the geomorphologic analysis of such structures, we took into consideration the quality of the environment within this area, respectively the way in which these anthropic landforms and the activities they generated influence the quality of life.

The Valea Morii quarry. Resulting from ground mining, there are dusts which mainly contain $SiO_2$, whose concentration varries depending on the working places. Also, during the mining of the mineral deposit, important quantities of quarry water result, which overflow directly into the emisary, thus contaminating it and creating certain unbalances in the water ecosystem.

The Gurabarza Processing Plant. Following the processing of the copper and gold mineral, the following toxins are evacuated on average: dusts mainly containing $SiO_2$, whose concentration varries depending on the working places; processed waste (pulp), annual quantity being 990 000 t/year, with 5:1 ratio of liquid-solid dilution.

**WASTE DUMPS**

Valea Blojului waste dump pollutes the area with dust in dry season and when transported to the processing plant; Cireşata waste dump pollutes the area with dust in dry season, part of the metals pertaining to it are carried by the water from the rainfalls and flow into the brooks in the area. Ribița-Curteni sump- the waste obtained in the Gurabarza Processing Plant is cranked through the pumping station, through pipes with Ø = 400 mm, to the Ribița-Curteni sump (fig. 5), the surface of the sump is approx. 60 ha, over a distance of approximately 14 km. Disposal of pure water is done through inverted drills, the disposed water discharge being 270 l/s. A percentage of 40-50 % of the pure water disposed in the sump is re-circulated to the Gurabarza Processing Plant, and the rest is overflown into Crişul Alb. Waste water overflown into Crişul Alb mainly contain iron and sulphates.

**Figure 5**. Ribița-Curteni sump

**CONCLUSIONS**

The anthropic geomorphostructures in the Apuseni Mountains-central-western Metaliferi sector, resulting from mining activities must be linked to local morphologic and hydrographic units, to land use etc. By identifying the effects of the anthropic structures on the landscape dynamics as well as the effects of the relief on the anthropogenic structures, together with the inventory, investigation, analysis, mapping of the areas affected by natural and technogenic

hazards in Apuseni Mountains, one can successfully contribute to the elaboration and application of efficient patterns and strategies regarding the ecological and landscape fitting of the degraded areas and the reduction of the negative impact of the mining activities.

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