

## GIS USED IN RECENT ANTHROPIC RELIEF ALTERATIONS ASSESSMENT WITHIN CĂLIMANI NATIONAL PARK

### GIS UTILIZAT ÎN EVALUAREA MODIFICĂRILOR ANTROPICE RECENTE ASUPRA RELIEFULUI ÎN PERIMETRUL PARCULUI NAȚIONAL CĂLIMANI

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**Abstract.** *Interesting mineral resources economic areas were always intensely humanized and are displaying, sometimes, dramatic changes of the landscape, especially on topography. The communist period, with centralized economy, the state desire to be independent energetically and resource pools at any costs often generated, huge transforming works on landscape, but with doubtful economic results. The impact on the original topography is devastating, with pollution phenomena in the environment, which bluntly modifies the rhythm, direction and the intensity of the relief normal evolution. A characteristic example is the large sulphur open quarry in the Călimani Mountains, now engulfed in the National Park with the same name. Are presented selected morphometrical and morphographical indices which are relevant to describe the actual status in two distinct moments before opening the mining works and after closing the exploitation. This kind of analysis is relevant and useful to scientific founding for all the actions that may be taken for ecological rehabilitation of this former mining area..*

**Rezumat.** *Arealele interesante din punctul de vedere al resurselor minerale au fost întotdeauna intens antropizate, prezentând, uneori, modificări radicale ale peisajului, în special ale reliefului. Perioada comunistă, cu economie centralizată, dorința statului de a deveni cu orice preț independent din punct de vedere energetic și al rezervelor de resurse minerale a generat, deseori, lucrări transformante de mare amploare asupra reliefului, dar cu rezultate economice îndoielnice. Impactul asupra reliefului original este devastator, cu declanșarea unor procese geomorfologice intense, de fenomene de poluare asupra mediului, care modifică radical ritmul, sensul și intensitatea sensului de evoluție a reliefului. Un exemplu relevant îl constituie imensa carieră de exploatare a sulfului din Masivul Călimani, acum inclusă în perimetrul Parcului Național Călimani. Sunt prezentate câteva aspecte morfometrice și morfografice relevante în două situații distincte, înainte de deschiderea carierei și după închiderea exploatării. Analiza este interesantă și utilă pentru fundamentarea demersurilor care se fac pentru reabilitarea ecologică a acestui areal minier.*

GIS and RS can successfully be used for assessing anthropic impact on topography. Precision and the wealth of quantitative data can be used for many purposes and in this example may be useful for site ecological rehabilitation.

## MATERIAL AND METHODS

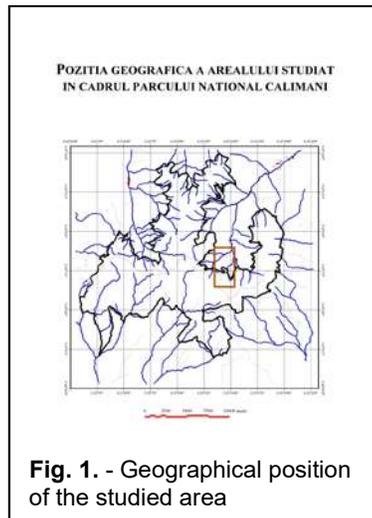
Topographical, cadastral and GPS information were used in order to generate digital thematic maps for two distinct moments of the area: original topography, before the works had started and the second, when the quarry was closed and was put to technical conservation for future ecological rehabilitation. Base maps were at scale 1:5,000 (for 1964) and the mining topographical plan at the same scale (2002). Some additional information was obtained from CLC (Corine Land Cover Project) 2000 vector files and LANDSAT TM 5 imagery.

GPS readings for location of certain altitudes in the quarry and dump sites were made with a GARMIN GPSmap 76CSx device.

GIS classic techniques were used to create specific initial layers and spatial interpolation and classification were used to generate the final layers. The GIS software used was Microimages TNTMips v. 6.3.

Selected thematic maps regarding morphometry and morphography indices in the two moments are presented below.

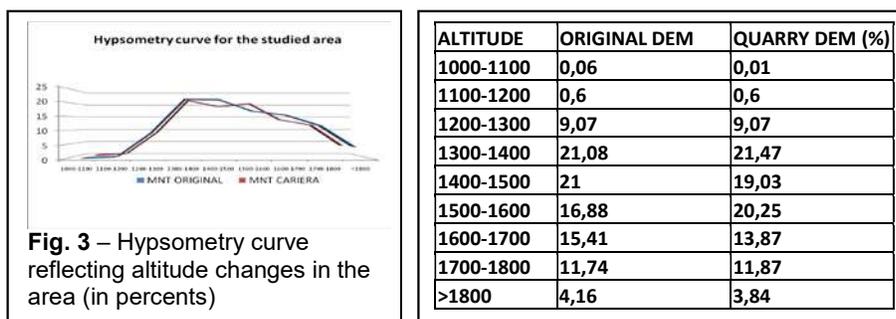
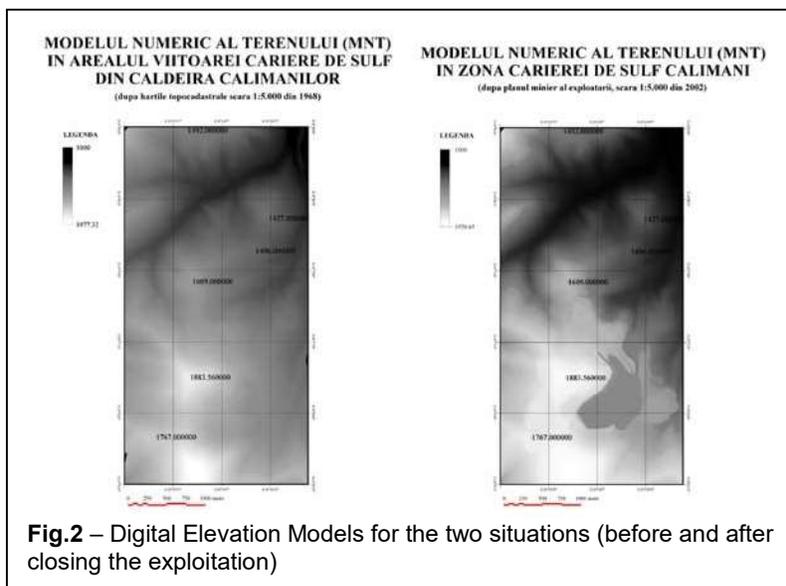
## RESULTS AND DISCUSSIONS



The exploitation of the sulphur ore was conducted near Negoiu Românesc Peak (fig.1). Some technical parameters of the exploitation are: bottom of the quarry is at 1,420 m altitude; the borders of the quarry have various altitudes and are encompassed between Negoiu Românesc Peak at 1,860 m and goes down to 1,560 m, and on the opposite side of the quarry, from 1,740m to 1,560 m. There were opened exploitation terraces with heights of 10 or 20 m, as follows: 20 m height terraces are between 1,560 and 1,820 m, regarded as optimal for the extraction of the sterile rocks that covered the ore; 10 m height terraces are between 1,560 m and 1,420 m, regarded as optimal for sulphur ore mining.

These works are reflected in alterations of the original topography as illustrated below:

## Digital Elevation Model (DEM)

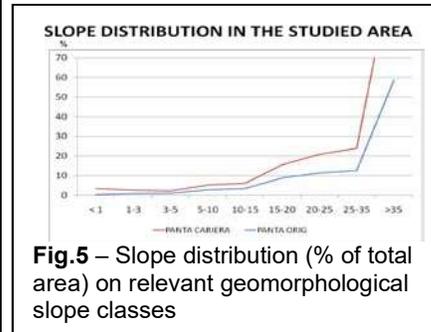
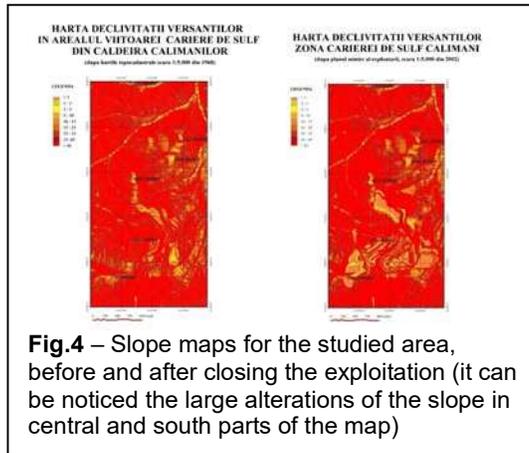


As it can be noticed in the figures 2 and 3 the changes are between 1,400 and 1,800 m reflecting both the excavation and deposition of the sterile in the dump areas with dramatic fluctuations for 1,500-1,700 m. Original altitude values went down in the upper part of the mountain (due to the exploitation) and altitudes increased at lower altitudes (due to sterile dump sites).

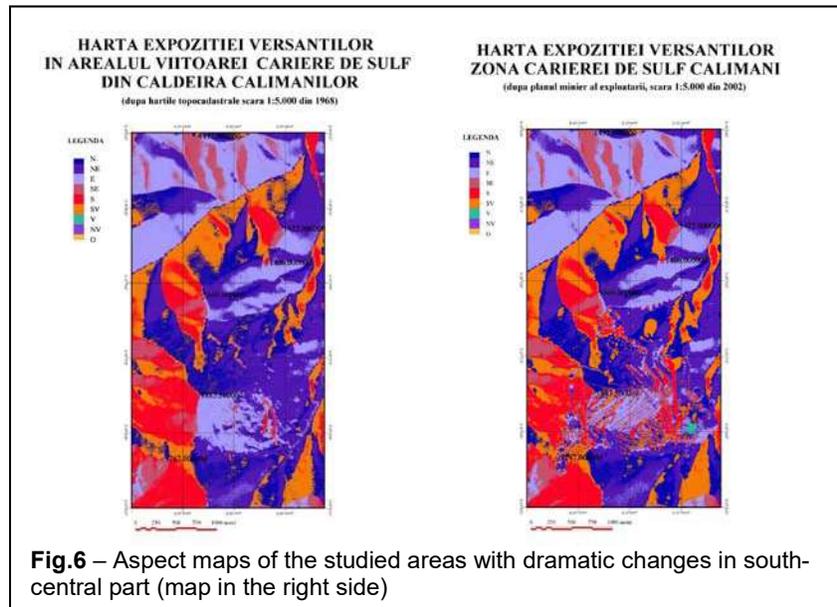
### Morphometry and morphography aspects

**Slope.** Derived from DEM slope values in the area were also dramatically altered that has a strong impact in the natural evolution of the landscape with large areas where slope was artificially increased (dump sites slopes, road works on the mountain, by-product dump lakes (that modifies local base level for some small creeks around the area, etc.)(Fig.4). The increase of the slope allow a

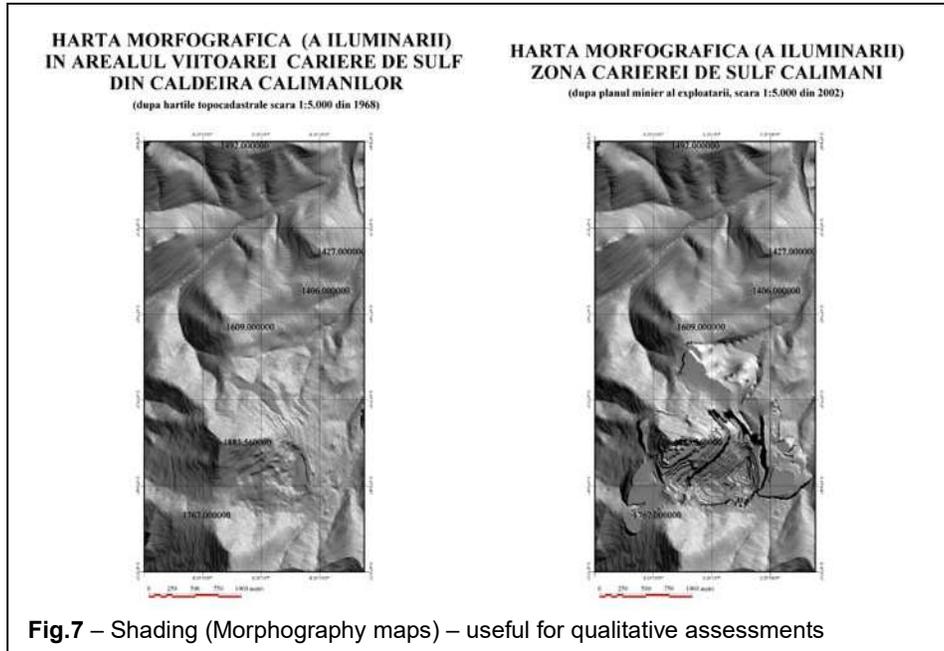
stronger surface erosion, in all areas where the original slope was modified, both inside the quarry and on the dump sites slopes with values exceeding 35-45°. Also, were created large artificial areas of quasi-horizontal surfaces on the dump sites where wind erosion is dominant, from the sterile deposited there ( $< 5^\circ$ ) (Fig.5).



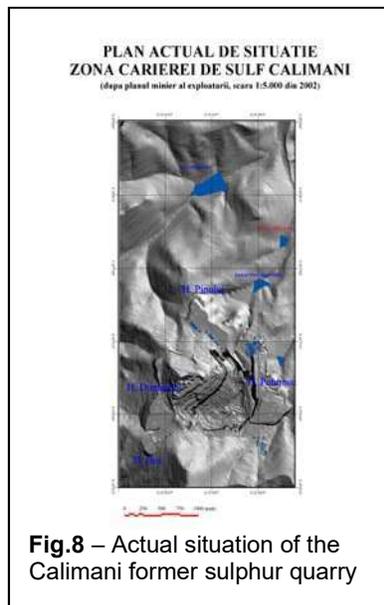
*Aspect.* Was also intensely modified especially due to creation of the quarry (with large exploitation steps as shown above), large dump sites and of the deposition lakes, also from artificial levelling for plant construction, miners' colony and other infrastructure works (Fig.6).



*Shading (Morphography maps).* Are quite relevant for qualitative description of the studied area that may suggest to civil engineers involved in restoration ways to rehabilitate the affected areas (Fig.7-8).



**Fig.7** – Shading (Morphography maps) – useful for qualitative assessments



## CONCLUSIONS

The above morphometrical and morphographical are only selected thematic maps that can be generated for topography modifications assessment and for ecological rehabilitation can be produced many more, in respect of the data provided.

GIS / RS can be successfully used for scientific founding and modelling of the research projects in various scientific fields (biology, forestry, geology, ecology, etc)

When made at large or very large scales can become a useful pool for quantitative and qualitative data, as a basis for mining conservation/rehabilitation implementation actions for former mining areas and not only.

The technology permits modelling, prognosis and monitoring for various processes and phenomena from the sites envisaged to be ecologically rehabilitated and for choosing the best technical solution to do this.

### Acknowledgements

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