G.I.S. TECHNIQUES USED IN THE ANALYSIS OF THE MORPHOMETRICAL PARAMETERS OF THE RED LAKE DRAINAGE BASIN

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Abstract: Red Lake in Hăghimaş Mountains was formed by the natural barrage of the Bicaz brook in 1837. It is one of the most interesting lakes of this type in Romania, and that is why scientists from all fields are interested in it. In order to realize the morphometrical analysis, the most modern methods and computerized programs have been used. The cartographic material is represented by the topographical maps drawn in 1972 and reambulated in 1990. For the whole river basin four topographical maps have been used, on the scale 1:25 000. The software we have used is Microimages – TNTmips. By means of this program a series of vectors layers with different destinations have been realized. The cartographic material we have realized for the morphometrical analysis of Red Lake river basin points out the limit of the river basin, the hydrographical network, the landforms fragmentation, the water courses order, the slope value, the slope orientation etc. The vectorial layer for the contour lines represented the support of the land numeric model (MNT). The resulted thematic maps emphasize the landscape value in this area and its hydrological importance.

Keywords: *lake basin, morphometry, natural barrage lake, river basin,.*

1. Introduction

The Red Lake is the lacustrine basin representing the model of an acvatorium formed after a landslide. Because of this reason, the researches have involved very different domains. Despite this, very little information regarding the drainage basin and from where the sediments and rivers originate, can be found. This study is meant to revealing the physical-geographical characteristics of the Red Lake drainage basin, and the main hydrographic arteries that contribute to it's sustainance.

Information regarding the nature of the surrounding area have been taken both from hydrological literature and field data. Therefore, we can mention the following works: Bojoi, 1968, Cărăuşu, Ghenciu, Timofte, 1969, Dobrescu, Ghenciu, 1970, Ghenciu, 1968 a,b, Ghenciu, Apăvăloaie, 1969, Gîştescu, 1971, Grasu, Turculeţ, 1980, Mihăilescu, 1940, Pandi, 2004, Pandi, Buzilă, 2004, Pandi, Magyari, 2003, Pelin, 1967, 1971, Pişota, Iancu, Buga, 1976, Pişota, Năstase, 1957, Popescu, Dimitriu, 1950, Popp, 1941, Preda, 1967, 1971, Preda, Pelin, 1963, Preda, Puşcariu, 1939, Romanescu, 2009 a,b,c, Udrişte, 1963 etc.

2. Geographical location and limits

Romania's best known natural barrage lake is located in the Central Group of the Oriental Carpatian Mountains, inside the Hăşmaşu Mare (Curmăturii) mountain range (Fig. 1). It's tributary rivers are: Vereşchiu, Licoş, Suhard şi Oaia (Oii).

It has formed in the summer of 1837, when, after heavy rainfall, a landslide deluvium broke apart from the Ghilcoş (Ucigaşu) Mountain, blocking the Bicaz river. Behind the landslide mass, a lake has formed, and it still holds the fosilised tree trunks of the forest caught in the landslide.

Latitudinaly speaking, it is situated between the $46^0$47'0'' parallel North in the south sector and the $46^0$47'37'' parallel North in the northern sector, and, as far as longitude is concerned, it is located between $25^0$47'0'' eastern longitude in the north-west sector and $25^0$47'30'' eastern longitude in the eastern one.

Figure 1 The geographical location of the Red Lake in Romania

The Red Lake isn't the only one in Romania which was formed by the forming of a natural barrage of a river course, because of a massive landslide. Therefore, we can mention some other examples of lakes with similar genesys: Vulturilor, Crucii, Bălătău, Dracului etc.

It is called the „Red" Lake, because at sundawn, the Sun's rays fall directly on the red clay of the western slope (Piciorul Licoş), which mirrors in the relatively calm waters of the lake.

The high percentage of forrest surfaces in the basin have determined that the silting rate of the lake is relatively low. The man-made modifications around the lake are are minor. The only significant influences abve thw water quality are represented by a few inns located along the river courses and the trout farm from the southern sector.

3. Methodes and techniques

For the morphological analysis of the drainage basin, several methodes, which are specific for geography, have been used: topographical maps at a scale of 1:25000, geological maps and land use maps. The topographical maps have been redrawn in 1982.

In order to make thematic maps and the required measurements on the aerial images and satellite images, we have used the software called TNTMips. The manipulation of data has been made inside the Laboratory of Geoarcheology of the Faculty of Geography and Geology in „Al.I.Cuza" University, Iaşi.

4. Results and discutions

The morphological data regarding the lacustrine aquifer, indicates the following values: a surface of 12,01 ha (120 134,44 m^2); a perimeter of 2 905,79 m; a maximum lenght of 1 361,72 m; a maximum width of 160,24 m; a maximum altitude, upstream, south (where the Oaia stream flows into the lake) 965,199 m; maximum altitude, upstream, north-west (where the Suhard stream flows into the lake) 966,041 m. The lenght of the main sector (between where the Oaia stream flows into the lake and the exutor) is 958,89 m. The lenght of the secondary sector (between where the Suhard stream flows into the lake and the exutor) is 403,32 m. The exutor is situated at an altitude of 965,05 m. The height difference between where the Oaia stream flows into the lake and the exutor is 14 cm. Between where the Suhard stream flows into the lake and the exutor there is a height difference of 99 cm.

The surface of the drainage basin is 40,59 km^2, remaining relatively small in comparison to the dimensions of the lake. It is this very fact that determined a low silting rate and the resistance in time of this lake.

The maximum lenght, on a NV-SE direction, is of 10,78 km, and the medium lenght is 3,76 km. The total lenght of the drainage network is 166 km, most having arteries with a temporary character (Fig. 2).

The maximum width of 5900 m is situated in the northern half of the basin. It's elongated shape doesn't allow the accumulation of a large amount of water, therefore reducing the probability of catastrophic floods. The watershed rises at altitudes that rise above 1500-1600 m. The water surface of the lake is situated at altitudes between 966-965 m (Fig. 3).

The most important river courses are: Suhard, Licoş, Vereschiu, Oaia (Oii), Calul, Sec, Zgomotos, Hăghimaş şi Hăghimaşul Negru. All of them have a permanent character. The other river courses have a temporary flow, most of them concentrating water only during heavy rainfall.

The most important river course is Oaia (Oii), which feeds the southern sector, after which we can mention Vereschiu şi Suhard rivers. These are also rivers that flow directly into the lake, the other ones being just direct or indirect tributaries of these main ones.

According to the Horton-Strahler river hierarchy system, the rivers that are tributary to the Red Lake reach a value of 5. Most have a value of 1, summing up 108,66 km (66,2%), after which follow the rivers that are ranked 2, with 26,39 km (16,1%), rank 3 rivers sum up 18,88 km (11,5%), rank 4 sum up 8,85 km (5,4%) and the last cathegory, ranking 5, have 1,25 km (0,8%) (Fig. 4).

As a consequence of the high degree of landscape fragmentation, the slopes have different orientations. From this point of view, the flat surfaces ocupy 0,4%, those orientating NE ocupy 16,5%, E 14,1%, N 13,9%, NV 13,5%, SV 11%, V 10,9%, S 9,9% şi SE 9,7% (Fig. 5).

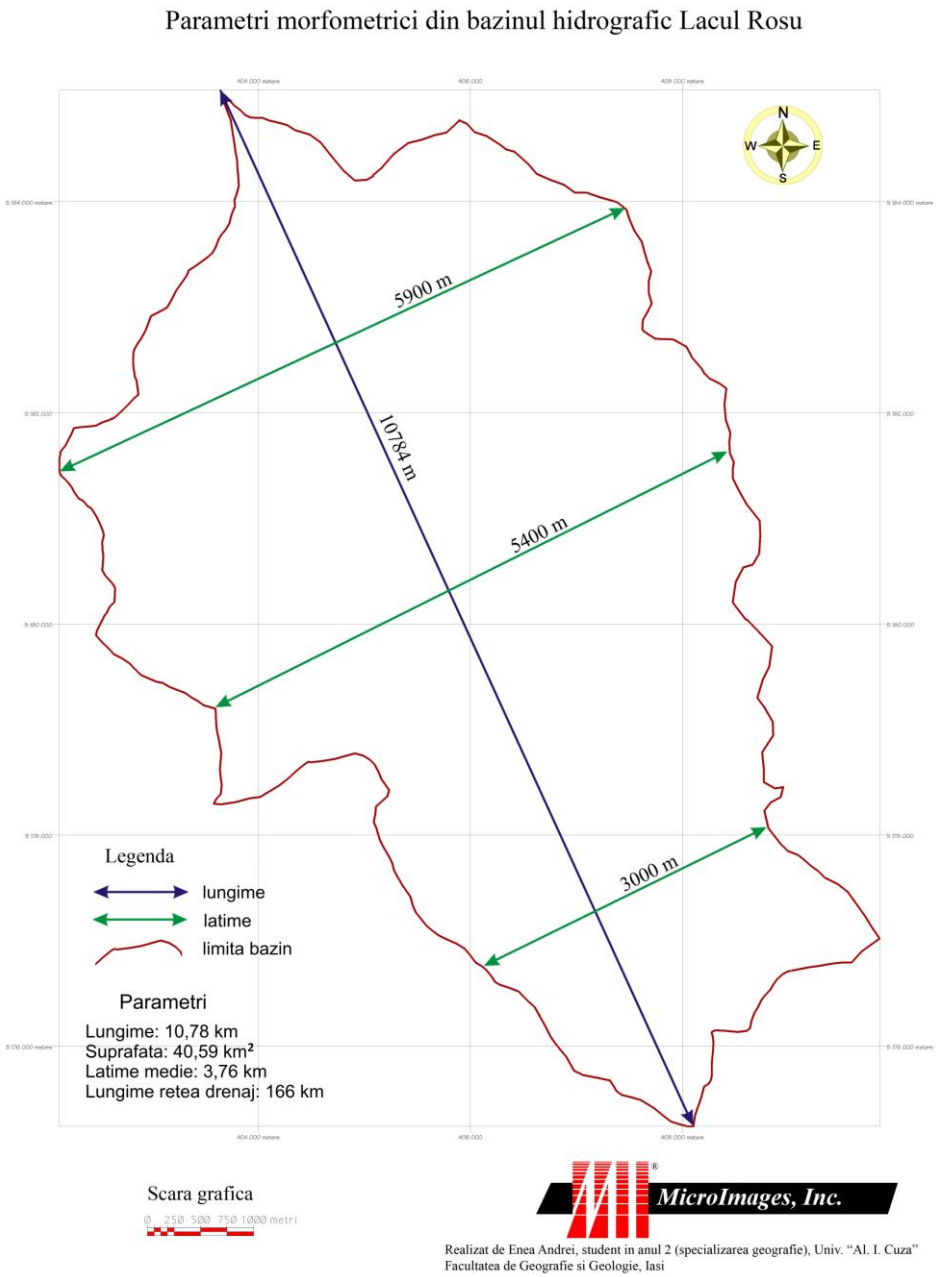
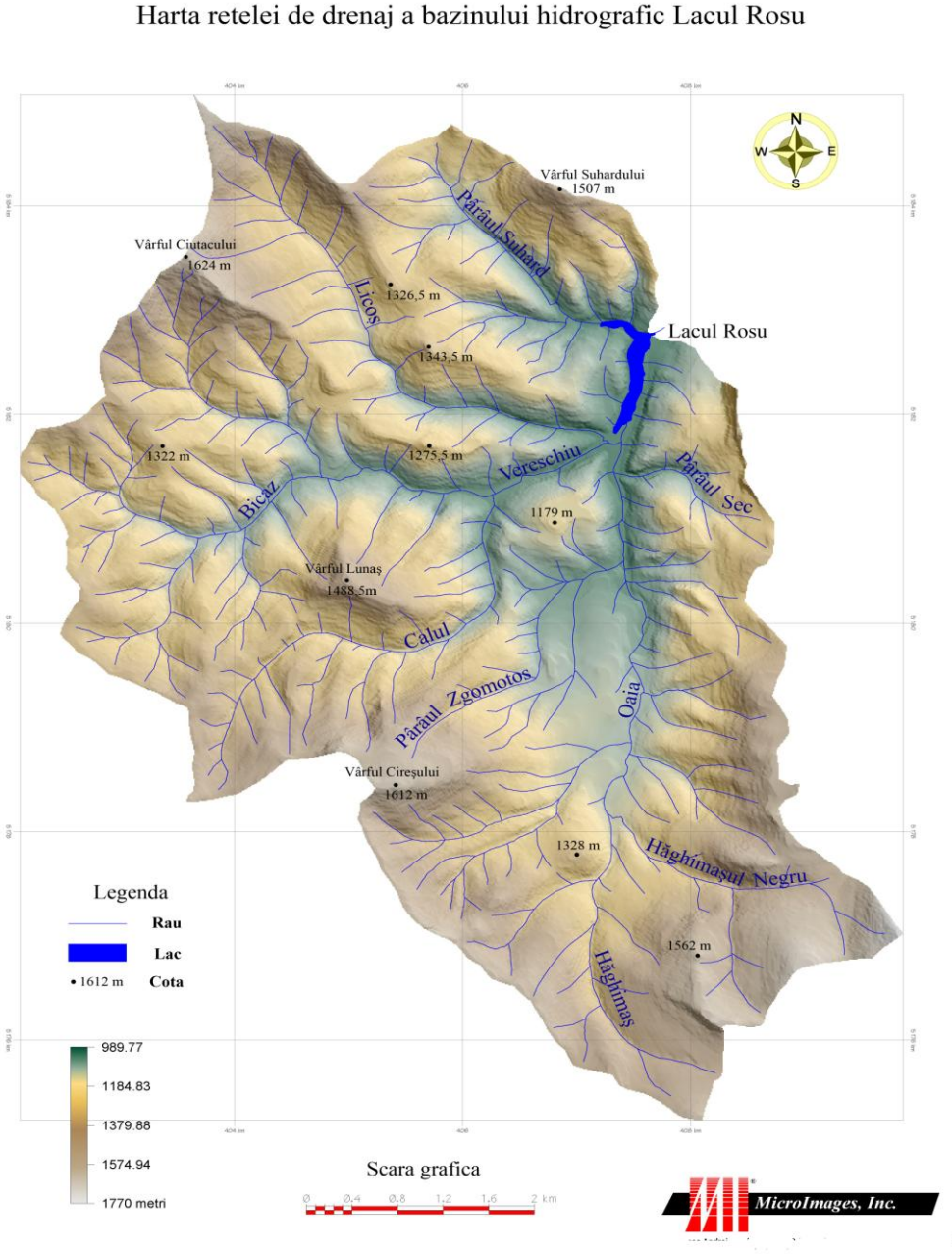


Figure 2 The morphometrical characteristics of the drainage basin of the Red Lake

Figure 3 The morfological and drainage network map of the Red Lake drainage basin



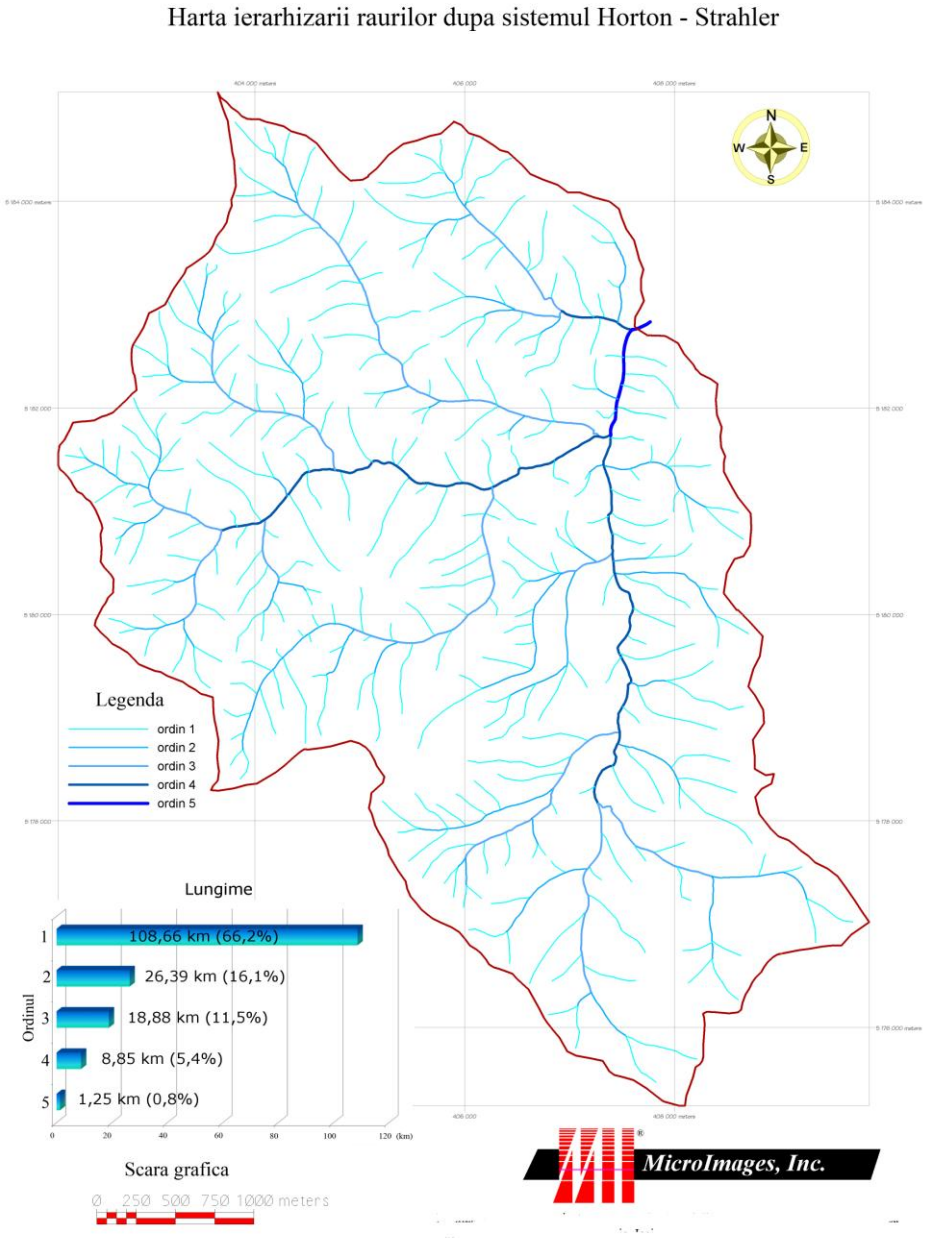


Figure 4 The map of the hydrographic network hierarchy, according to Horton-Strahler

As a consequence of the fact that the Red Lake stretches mainly on a N-S direction, and because of a tall surrounding landscape, the luminosity of the two lateral slopes (eastern and western) are uneven, depending on the hight of the surrounding mountain areas. The water surface doesn't recieve the same amount of energy from the Sun as the

surrounding areas, because the Sun's rays hit the surface of the water long after sunrise, and they end long before the actual sunset.

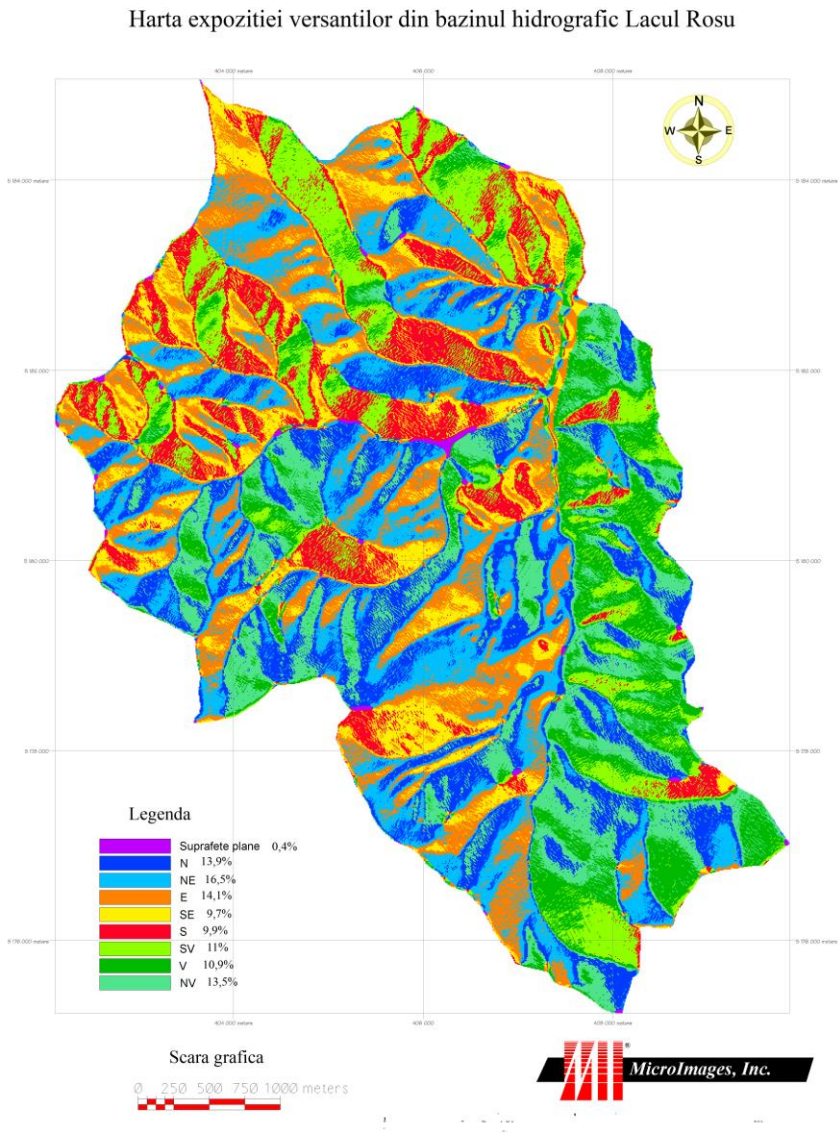


Figure 5 The map of the slope orientation in the drainage basin of the Red Lake

5. Conclusions

The drainage basin of the Red Lake is a young and tipical mountain one. It has altitudes that are above the 1600 m limit.

The basis of the graphic material in the GIS environment consisted in a numeric land model (MNT), obtained through a process of digitising isohypses off of the

topographical maps (at a 1:25000 scale) and by attributing height values to each of them in order to obtain a three-dimensional reference system.

The graphic support made for the Horton Strahler classification involved the association of numeric attributes to the rivers that had been transposed into a vector format, depending on the hierarchy value of each river segment. According to the applied methodology, the Horton-Strahler classification exposes the existence of 5 river ranks in this particular case.

The producing of the slope orientation map for the Red Lake drainage basin, has emphasised the dominance of slopes orientating north-east (16,5%) and east (14,1%).

After the making of the Morphometrical parameters map, a series of aspects have been emphasised, such as: the maximum width of the drainage basin, which is approximately 6 kilometers; the elongated shape of the basin, that does not permit the accumulation of a large amount of water, therefore reducing the chances of major floodings; the overall surface of the basin is 40,59 km^2. This surface is relatively small, in comparison to the surface of the actual lake. This fact contrubutes to the longevity of the lake, because the silting rate is very small.

Taking into consideration the applied methods used to obtain variety of results, we can state that the GIS environment has a crucial importance, as far as data input is regarded and also the analysis, manipulation and handling of hydrological geo-spatial data from the Red Lake drainage basin.

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