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## ASPECTS CONCERNING SOME OF THE GEOMORPHOSITES WITH TOURIST VALUE FROM VÂLCEA COUNTY (ROMANIA)

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**Abstract**. The paper is dealing with geomorphosites and tries to evaluate them from a selected area. Based on an assessment formula, we selected geomorphosites from the northern Vâlcea County. The method evaluates the touristic value and takes into account four values: scenic, scientific, cultural and economic. Based on this, we have evaluated almost 30 sites which have a score that ranges between 0.15 and 0.85. Many geomorphosites took high and medium values, but because it is very difficult to reach them or they are not included in touristic paths, the sites are not so much visited. In the end, few geotouristic paths with high density of geomorphosites are lined out.

**Key words**: geomorphosites, geodiversity, geotourism, cultural geomorphology, geoturism map

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#### **INTRODUCTION**

In present days the concept of biodiversity and conservation of biological diversity is a very important issue in the ecological sciences (Primack et al., 2008). As in the last decade the geodiversity concept started to have an important role, papers refer to geodiversity conservation, geotourism, geoparks and geomorphosites, as they are more numerous.

Geodiversity is defined as geological (rocks, minerals, fossils) and geomorphological diversity (relief forms, geomorphic processes) and it also comprises the characteristics of the soil (Gray, 2005). The evaluation of geodiversity takes into account values like intrinsec, cultural, estetic, economic, functional and scientific (Gray, 2004). Geomorphosites can be defined as, "*landform with particular shape and semnificative geomorphic feature, which induces the cultural status*" (Panizza and Piacente, 2003). From this, the cultural geomorphology starts to be outlined as a distinctive discipline of geomorphology, which studies the geomorphic components from an area that gathers landscape features and the interaction with historical, archeological and architectonical sites (Panizza and Piacente, 2003).

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How do geomorphosites help the tourism development? Many protected areas or national parks appeared due to the valuable species of flora and fauna, but most of the tourists who visit this kind of natural area are interested in landscape, which includes peaks, ridges, bizarre relief, canyons, gorges, caves and others. This is the case of Cozia National Park, which has been declared a protected area especially due to the endemic and rare species of flora, but tourists generally visit geomorphosites as Doabra Snails, Țurțudanu Peak, Lotrișor Fall, Gardului Fall, Stone Gate, Bețel Falls, taffoni from Doabra and Glodului Valleys (called by the local inhabitans Rock with Holes), Teofil Tower and Olt Gorge.

#### STUDY AREA

Vâlcea County is located in the central part of Romania (figure 1) and has 5365 km<sup>2</sup> and it is spread on 110 km length and 70 km wide. Natural landscape, flora and fauna led authorities to declare several protected areas, and consequently today there are two national parks, 29 natural reserves and natural monuments according to the law 5/2000. Besides these, nine sites of community importance, two special conservation areas and three special protected areas (birds protection) where declared in 2007, areas which are part of the Natura 2000 network.



Figure 1. The position of Vâlcea County in Romania

At the level of Vâlcea County, many studies have revealed from one hundred years ago the geologic structure (Mrazec and Murgoci, 1898; Murgoci, 1908; Popescu-Voitești, 1915). In present days the major geologic units are relatively clearly delimited and defined with some doubts. Geology and geomorphology vary from north to south.

The eastern sector of the mountains belongs to Danubian Autochthonous generally formed from granite and old sedimentary rocks which were partially metamorphosed during the Mesosoic tectogenesis. The most part consists in crystalline rocks and from tectonic point of view it belongs to Getic Nappe and Supragetic Nappe. The Supragetic Unit is overlapping the Getic Nappe, the contact between them being clearly in Valea lui Stan, where a sedimentary rock package (conglomerates and limestone from Werfenian and Triasic) are caught in the middle and crushed (Lupu et al., 1978). On the surface of these units a bank of conglomerates, sandstone and breccia from Upper Cretaceous follows (Szasz, 1976).

The Subcarpathians are generally made of soft rocks as conglomerates, sandstone, marls and dacite tuff. From case to case, these layers are folded or contrary, horizontally or monocline. Finally, the Getic Piedmont structure consists in unconsolidated rocks as sand, gravel and clay which in the north part are monocline and as we go south they become horizontal. This distribution of the different kind of rocks from north to south is obviously in the spatial distribution of geomorphosites and its genesis.

The relief has different morphologies directly related with the lithology and geological structure and it was influenced in the geologic past by the changes that have occurred in the climate. For example, at the origin of the Lotru and Latorița rivers, during the Pleistocene epoch the glaciers shaped the initial valleys and transformed them into an interesting glacier complex. The landscape consists in glacier cirques and valleys, ridges, pyramidal peaks and steep slopes (Ilinca, 2010). In the karst area as Târnovu Mountain, Găuri Mountain and few sectors from Latoriței ridge were formed by many types of microrelief endokarst and exokarst. In the Lotrului and Căpățânii Mountains, on the area where cretacious rocks occur (conglomerates, brecia and sandstone) the relief became interesting, because there are many cliffs which people associated with something from the nature, for example Doabra Snail.

# INVENTORING THE GEOMORPHOSITES – A KEY TO DEVELOPMENT OF TOURISM

In the Vâlcea County geomorphosites take the first place in terms of tourists' interest. Our case study is extended especially on the northern part of the Vâlcea County, and includes both mountain and hilly region. We selected many sites from Lotru hydrographic basin, Cozia Mountains and Subcarpathians. The karst area from the Buila-Vânturarița Ridge was excluded due to geomorphosites' density. A database was created and includes fields with name, exact position, administrative unit, geomorphological unit, type, lithology and rock age and if they are included or not into a protected area.

We count both notorious and almost unknown geomorphological sites and classify them according to the genesis. Many interesting but almost unknown geomorphosites were labeled because of the high importance they may have to the tourism development. Also the distance from the nearest settlement or road is very important when we are dealing with tourists, because this influences the category of people that are capable from physical point of view to reach that target. For example, a geomorphosite located at 5 km distance from the nearest road is very easily reached by a young man while for an old man over 70 it is almost impossible to get to it.

The inventoried sites have different genesis, many of them being formed under lithological or differential erosion (Doabra Snaill, Pyramids from Stăcioiu Valley and Slătioara) and limestone dissolution (Târnovu Stone, Milky Cave, Găuri Cave) all mentioned before in other materials (Niculescu, 1955; Iancu, 1970; Ploaie, 1983). What is interesting is the genesis of *"Trovanții"* from Costești, for which some geologists (Țicleanu et al., 2003) suggested the paleoseismic origin.

#### VALUING THE GEOMORPHOSITES (GEOMORPHODIVERSITY)

Many of the papers that are dealing with geodiversity and geomorphodiversity and try to assess their values, are speaking about the same characteristics which must take into account: intrinsic, aesthetic, cultural, economic, scientific and educational value (Gray, 2004). Those values are difficult to weight, because there is not an objective reason to do that (Pralong, 2005).

*The aesthetic or scenic* value is the most important attribute of the geomorphosites for tourists, as because of them it may or not become a tourist attraction. Therefore, the

geomorphosites must meet some features: rareness, originality, hugeness, imposing or ressembling a common object or being, in our case giant snail or small pyramids.

The scientific value of the site is generally important for a small group of researchers, but it is necessary to evaluate and protect them because they can tell stories about Earth history. In our case bad-lands from Stăncioiului Valley can be a laboratory for students that want to learn about geomorphological processes. Also, Trovanții from Costești can reveal the environment and factors that cause their formation. According to Țicleanu et al. (2003) the factor that leads to the trovanți formation is a paleoseismic one, so if we identify this rock eggs and relate them to the geologic formation age, we can reconstruct the paleoseismic events.

*Cultural and historical values* refer to the historical and archeological discoveries directly related to a particular geomorphosite, but also refer to legend within which the site plays an important role. For example, at the Milky Cave entrance, there were found the oldest ceramic fragments from the Lotrului Valley, which belong to the Neolithic Age (Bardaşu and Simeanu, 1973; Petre-Govora, 1976). So, if the cave is only 22 m length and conserves very small pariental flow, it has a very high importance due to its role in the human history on this area. As regards legends or mythology, the Cozia Peak occupies a top spot, because some historians link this mountain with Dacians' Sacred Mountain, called Kogaion.



**Figure 2.** Spatial distribution of the selected geomorphosites related with their genesis. The anthropic type refers to man made sites, which were carved in the rock. Site number 24 represents in fact a place with two monk cells, carved in a hard and massive sandstone and site number 25 is a waterfall made from economic reason (the water stream was diverted into a tunnel and on the old riverbed people built a road to transport the timber harvesting). The names of geomorphosites are listed in the table 1.

No.	Geomorphosite name	T.A.U.	Geomorpho- Logical unit	Туре	Lithology/age		
1.	Găuri Cave	Voineasa	Parâng Mts.	Р	Crystalline limestone/Paleozoic		
2.	Gâlcescu Cirque	Voineasa	Parâng Mts.	Α	Granite/Precambrian		
3.	Boroncioaia Fall	Malaia	Latoriței Mts.	Р	Crystalline limestone/Paleozoic		
4.	The Stone with Holes	Malaia	Latoriței Mts.	Р	Crystalline limestone/Paleozoic		
5.	Moara Dracilor Fall	Voineasa	Parâng Mts.	Р	Granite/Precambrian		
6.	Pietrile Peak	Voineasa/ Malaia	Latoriței Mts.	Р	Crystalline limestone/Paleozoic		
7.	Turcinu Portal	Malaia	Latoriței Mts.	Р	Crystalline limestone/Paleozoic		
8.	Hanged Water Fall	Malaia	Latoriței Mts.	Р	Crystalline limestone/Paleozoic		
9.	Târnovu Stone	Malaia	Căpățânii Mts.	Р	Crystalline limestone/Paleozoic		
10.	Milky Cave	Malaia	Latoriței Mts.	Р	Crystalline limestone/Paleozoic		
11.	Milky Cave Portal	Malaia	Latoriței Mts.	Р	Crystalline limestone/Paleozoic		
12.	Stone with taffoni (Glod Valley)	Brezoi	Lotrului Mts.	Р	Conglomerates, brecia, sandstone/Senonian		
13.	Stone with taffoni (Doabra Valley)	Brezoi	Lotrului Mts.	Р	Conglomerates, brecia, sandstone/Senonian		
14.	Doabra Snails	Brezoi	Lotrului Mts.	А	Conglomerates, brecia, sandstone/Senonian		
15.	Ţurțudanu Peak	Brezoi	Lotrului Mts.	Р	Conglomerates, brecia/Senonian		
16.	Bețel Fall 1	Brezoi	Lotrului Mts.	Р	Conglomerates, brecia/Senonian		
17.	Bețel Fall 2	Brezoi	Lotrului Mts.	Р	Conglomerates, brecia/Senonian		
18.	Needles Rock (Călinești Valley)	Brezoi	Lotrului Mts.	Р	Conglomerates, brecia/Senonian		
19.	Lotrișorului Ridge	Brezoi	Cozia Mts.	Р	Gneiss/ Upper Precambrian		
20.	Cozia Peak	Brezoi/ Călimănești / Sălătrucel	Cozia Mts.	Р	Gneiss/Upper Precambrian		
21.	Stone Gate	Brezoi	Cozia Mts.	Р	Gneiss/ Upper Precambrian		
22.	Gardului Fall	Călimănești	Cozia Mts.	Р	Gneiss/ Upper Precambrian		
23.	Sanctum from Turnu Monastery	Călimănești	Cozia Mts.	Р	Massif limestones/Senonian		
24.	Teofil Tower	Călimăneși	Cozia Mts.	Р	Gneiss/ Upper Precambrian		
25.	Traian Emperor Table	Călimăneși	Cozia Mts.	Р	Gneiss/ Upper Precambrian		
26.	Lotrişor Fall	Călimănești	Căpăţânii Mts.	Р	Upper Precambrian		
27.	Pyramids from Stăncioiului Valley	Râmnicu Vâlcea	Vâlcea Subcarpathians	Р	Sand and gravel/Miocene		
28.	"Trovanții" from Costești	Costești	Vâlcea Subcarpathians	Р	Sand/Pliocene		
29.	Pyramids from Slătioara	Slătioara	Vâlcea Subcarpathians	Р	Sand and gravel/Miocene		

Table 1. The selected geomorphosites from Vâlcea

Note: T.A.U. = Territorial Administrative Unit; P = punctual; A = areal.

*The social and economic values* refer to the benefit of the local community. Foster (1997) remarks that people have attempted to put a financial value on geodiversity. Besides their beauty, geomorphosites have nothing to do with purely economic sector. However, geomorphosites have an economic value because in many parts of the world they are profitmaking, due to the tourists which pay a ticket to see a particular and interesting geomorphosite. An interesting example from the world is the platform from Grand Canyon (*"Skywalk"*), which allows tourists to step on more than 20 m and have an overview of the landscape.

To evaluate the importance of geomorphosites from an area, we use the method described by Pralong (2005). The method is used to evaluate the tourist value ( $V_{tour}$ ) of each geomorphological site according to the following formula:

$$V_{tour} = \left(V_{sce} + V_{sci} + V_{cult} + V_{eco}\right) / 4,$$

where:

 $V_{sce}$  = scenic or aesthetic value,  $V_{sci}$  = scientific value,  $V_{cult}$  = cultural and historical value,  $V_{eco}$  = social/economic value.

The method described above and others were recently used to evaluate many geomorphosites from Romania (Comănescu et al., 2009; Comănescu and Dobre, 2009). Some of the geomorphosite characteristics are given in the table 1 and the score obtained for each geomorphosite is shown in the table 2.

No	Coomombosito namo	Scenic Scientific		Cultural	Economic	Global
110.	Geomorphosite name	value	value	value	value	value
1.	Găuri Cave	0.2	0.4	0	0	0.15
2.	Gâlcescu Cirque	1	1	0.5	0.5	0.75
3.	Boroncioaia Fall	0.75	0.1	0	0	0.2125
4.	Stone with Holes	0.1	0.2	0	0	0.075
5.	Moara Dracilor Fall	0.75	0.1	0	0	0.2125
6.	Pietrile Peak	0.5	0.25	0.25	0.25	0.3125
7.	Turcinu Portal	0.5	0.4	0	0	0.225
8.	Hanged Water Fall	0.75	0.75	0	0	0.375
9.	Târnovu Stone	1	1	0.4	0.4	0.7
10.	Milky Cave	0.3	0.25	1	0	0.3875
11.	Milky Cave Portal	0.3	0.25	1	0	0.3875
12.	Stone with taffoni (Glod Valley)	0.5	0.75	0	0	0.3125
13.	Stone with taffoni (Doabra Valley)	0.6	0.8	0	0	0.35
14.	Doabra Snails	0.8	0.8	0.5	0.25	0.5875
15.	Ţurţudanu Peak	1	0.5	1	0.25	0.6875
16.	Bețel Fall 1	0.7	0.2	0.2	0	0.275
17.	Bețel Fall 2	0.8	0.2	0.2	0	0.3
18.	Needles Rock (Călinești Valley)	0.6	0.2	0.2	0	0.25
19.	Lotrișorului Ridge	0.6	0.5	0	0	0.275
20.	Cozia Peak	1	0.5	0.75	0.75	0.75
21.	Stone Gate	1	0.8	0.8	0.8	0.85
22.	Gardului Fall	0.8	0.5	0.5	0	0.45
23.	Sanctum from Turnu Monastery	0.75	0.1	1	0	0.4625
24.	Teofil Tower	0.75	0.75	0.75	0	0.5625
25.	Traian Emperor Table	0.5	0.15	0.75	0	0.35
26.	Lotrișor Fall	1	0.25	0.25	0.25	0.4375
27.	Pyramids from Stăncioiului Valley	1	1	0	0	0.5
28.	"Trovanții" from Costești	1	1	0.5	0.5	0.75
29.	Pyramids from Slătioara	0.4	0.6	0	0	0.25

Table 2. Scoring the geomorphosites

From all these sites the most visited are: Trovanții from Costești, Gâlcescu Cirque, Cozia Peak, Gardului Fall, Sanctum from Turnu Monastery (figure 3) because they are very known from touristic guidebooks but also the difficulty to reach them is not so high. A lot of sites can be easily observed from cars like many sites located along Olt Gorge. In the opposite side, there are many sites that are visited only by the passionate tourists who have also a good physical condition, a good touristic map but also small, but very interesting sites that benefit of no advertising. We can cite here Doabra Snails, many walls with taffoni and honeycomb and many huge falls (figure 4).



Figure 3. The global index of the selected geomorphosites

Many of the selected sites are integrated into a protected area, and only eight sites fall outside protected areas. Few of them are very fragile and ephemeral shapes that in the case of Pyramids of the Stăcioiului Valley, which is in fact an area with very interesting bad-lands, fored in the two kinds of unconsolidated rock.



Figure 4. Doabra Snails and Stone with taffoni

A similar criteria to evaluate geomorphosites was developed by Reynard et al. (2007) who propose two values sets: scientific and additional (cultural, economic, aesthetic and ecological value). The method is much more comprehensive than others and allows quantifying almost all values associated with geomorphosites and clearly differentiates between scientific value and other values. In the table 3 and 4 there are shown the scores resulting from the application of this method.

		Scientific value						
No.	Geomorphosite name	Integrity	Represen- tation	Rarity	Paleo geographical value	Total		
1.	Găuri Cave	1	0.75	1	0.5	0.81		
2.	Gâlcescu Cirque	1	1	0.75	0.75	0.88		
3.	Boroncioaia Fall	1	0.5	0.75	0.1	0.59		
4.	Stone with Holes	1	0.25	0.1	0.25	0.4		
5.	Moara Dracilor Fall	1	0.6	0.5	0.1	0.55		
6.	Pietrile Peak	1	0.4	0.2	0.1	0.43		
7.	Turcinu Portal	1	0.5	0.5	0.2	0.55		
8.	Hanged Water Fall	1	0.5	0.5	0.2	0.55		
9.	Târnovu Stone	1	0.8	0.6	0.2	0.65		
10.	Milky Cave	1	0.5	0.2	0.5	0.55		
11.	Milky Cave Portal	1	0.5	0.5	0.5	0.63		
12.	Stone with taffoni (Glod Valley)	1	0.8	1	0.7	0.88		
13.	Stone with taffoni (Doabra Valley)	1	0.8	1	0.7	0.88		
14.	Doabra Snails	1	1	1	0.8	0.95		
15.	Ţurţudanu Peak	1	0.7	0.5	0.8	0.75		
16.	Bețel Fall 1	1	0.5	0.25	0.1	0.46		
17.	Bețel Fall 2	1	0.5	0.25	0.1	0.46		
18.	Needles Rock (Călinești Valley)	1	0.5	0.25	0.25	0.5		
19.	Lotrișorului Ridge	1	0.4	0.25	0.5	0.54		
20.	Cozia Peak	1	0.6	0.1	0.75	0.61		
21.	Stone Gate	1	1	1	0.75	0.94		
22.	Gardului Fall	1	0.7	0.25	0.25	0.55		
23.	Sanctum from Turnu Monastery	1	0.8	0.75	0	0.64		
24.	Teofil Tower	1	0.3	0.1	0.25	0.41		
25.	Traian Emperor Table	1	0.3	0.1	0.2	0.4		
26.	Lotrișor Fall	1	0.1	0	0	0.28		
27.	Pyramids from Stăncioiului Valley	1	1	1	0.5	0.88		
28.	"Trovanții" from Costești	1	1	1	0.75	0.94		
29.	Pyramids from Slătioara	1	0.5	0.75	0.5	0.69		

**Table 3.** Geomorphosite assessment according to Reynard et al. (2007) method – scientific value

Scientific value is ranging between 0.28 and 0.94. For "*integrity*" all geomorphosites receive a maximum score because the most part of them is integrated into a protected area or because that specific site is in a good state of preservation due to the isolation or heavy accessibility. "*Representation*" and "*rarity*" scores greatly vary due to the nature of the sites. For example a cliff with many taffoni took high score because this kind of forms is only a few in the surface of county and relatively rare in the country. Although the Lotrișor Fall is visited annually by many tourists, the site has a very low score at this sub-criterion, because it is a man-made waterfall.

In terms of additional value the "*aesthetic value*" is by far the highest rated subcriteria, generally for most geomorphosites. The other sub-criteria have very low scores. The Sanctum from Turnu Monastery is the only one site which was scored because it is the single site with religious importance.

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Figure 5. a) Țurțudanu Peak – the Brezoi town icon; b) Pyramids from Stăncioiului Valley; c) Trovanții" from Costești; d) the upper level from the Gâlcescu cirque; e) Moara Dracilor Waterfall; f) Stone Gate; g) Hanged Water Fall.

NT	Geomorphosite name	EV	AV	Cultural value					
NO.	•			R	Н	AL	GH	Ec	
1.	Găuri Cave	0	0.5	0	0	0	0.5	0	
2.	Gâlcescu Cirque	1	1	0	0	0	1	0.5	
3.	Boroncioaia Fall	0	1	0	0	0	0	0.2	
4.	Stone with Holes	0	0.2	0	0	0	0	0	
5.	Moara Dracilor Fall	0	1	0	0	0	0	0.25	
6.	Pietrile Peak	0.5	0.75	0	0.25	0	0	0.25	
7.	Turcinu Portal	0	0.5	0	0	0	0	0	
8.	Hanged Water Fall	0	1	0	0	0	0	0.5	
9.	Târnovu Stone	1	1	0	0	0	0	0.25	
10.	Milky Cave	0.5	0.75	0	1	0	1	0	
11.	Milky Cave Portal	0	0.75	0	1	0	1	0	
12.	Stone with taffoni (Glod Valley)	0	1	0	0.25	0	0	0	
13.	Stone with taffoni (Doabra Valley)	0	1	0	0.25	0	0	0	
14.	Doabra Snails	1	1	0	0.25	1	0	0.25	
15.	Ţurţudanu Peak	1	1	0	0.25	1	0.5	0.25	
16.	Bețel Fall 1	0	1	0	0	0	0	0	
17.	Bețel Fall 2	0	1	0	0	0	0	0	
18.	Needles Rock (Călinești Valley)	0.5	1	0	0	0	0	0	
19.	Lotrișorului Ridge	0.5	0.8	0	0	0	0	0	
20.	Cozia Peak	1	0.8	0	0	1	0	0.75	
21.	Stone Gate	0	1	0	0	0	0	0.5	
22.	Gardului Fall	0	1	0	0	0	0	0.75	
23.	Sanctum from Turnu Monastery	0	1	1	1	0.25	0	1	
24.	Teofil Tower	0.1	0.75	0	1	0	0	0.5	
25.	Traian Emperor Table	0	0.2	0	1	1	0	0.2	
26.	Lotrișor Fall	0	1	0	0.25	0	0	0.5	
27.	Pyramids from Stăncioiului Valley	0	1	0	0	0	1	0.25	
28.	"Trovanții" from Costești	0	1	0	0	0	1	0.75	
29.	Pyramids from Slătioara	0	0.75	0	0	0	0.25	0.1	

Aspects Concerning Some of the Geomorphosites with Touristic Value from...

Tabel 4. Additional value of the geomorphosite

Note: EV = Ecological value; AE = Aesthetic value; R = Religious; H = Historical; Artistic literature = AL; GH = Geohistorical; Ec = Economic.

#### CONCLUSIONS

Geomorphosites have a huge impact on tourist perception. Even if they do not have the same status as biodiversity, the geodiversity components have an important role to the tourism development. Therefore, it is very important to know all interesting geomorphosites, map and include them in the tourist routes. Thematic geotouristic paths based on geomorphosites can be created where high density exists. One thematic path can be created nearly to the Brezoi town, which can include Doabra Snails – Stone with taffoni from Dobra Valley and Stone with taffoni from Glod Valley. A variant of this route can link these geomorphosites with those from Beţele and Călineşti Valley. Two similar paths, part of them are marked tourist route, can be developed in the upper valley of the Lotru as in the upper valley of the Latoriţa. This generally includes traces of glacial landscape, karst and many waterfalls.

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