BABEȘ - BOLYAI UNIVERSITY
FACULTY OF GEOGRAPHY

PHD THESIS

RELATION RELIEF – TOURISM IN MĂCIN MOUNTAINS

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KEY WORDS: landscape, attractive morphology, geomorphosites, inventory, assessment, distribution of geomorphosites, Măcin Mountanis, tourism, tourism activities, geotouristic map, geotouristic trails, geotourism.

CHAPTER I. INTRODUCTION

The present paper aims to analyze how the morphology, through its aesthetic, scenic and scientific valences constitutes an element of attractiveness and contributes to the development of tourism and its specific activities in Măcin Mountains.

The overall objective of the study is to establish the role of the relief in the development of tourism. The specific objectives are: the development of an adequate methodology for inventory and assessment of geomorphosites within Măcin Mountains; highlighting the geological and geomorphological features of study area (for understanding the full range of geomorphological forms and processes); establish the role of Măcin Mountains morphometry and morphology in tourism development; highlighting the role of the relief as attractive resource, landscape background for touristic activities and support for tourism infrastructure; highlighting the types of tourism induced by the landscape; identifying, inventory and assessment of geomorphosites; achieving the geotouristic map of Măcin Mountains (for the promotion of geomorphological heritage).

CHAPTER II. GENERAL ISSUES

2.1 I INDIVIDUALISATION OF STUDY AREA

2.1.1 Geographical position

Our study area (with an area of 568.8 km²) is situated in the South - Eastern Romania, in the North-Western part of Dobrogea Plateau. The boundaries of the area are clearly expressed in the territory from morphologic and tectonic viewpoint. The northern boundary corresponds morphologically, to the floodplain of Danube River (and its associated ponds and channels) and tectonically, to the Galați - Sf. Gheorghe fault. The western limit is reprezented by the foodplain of Măcin Branch. The southern limit corresponds morphologically, to Iaila River and tectonically, to Peceneaga – Camena fault. In the eastern part, the study area is delinead (from North to South) by the Luncaviţa, Taiţa and Lodzova valleys (Coteţ şi Popovici, 1972). Tectonically, the eastern limit overlaps to Luncaviţa – Consul fault (figure 1).

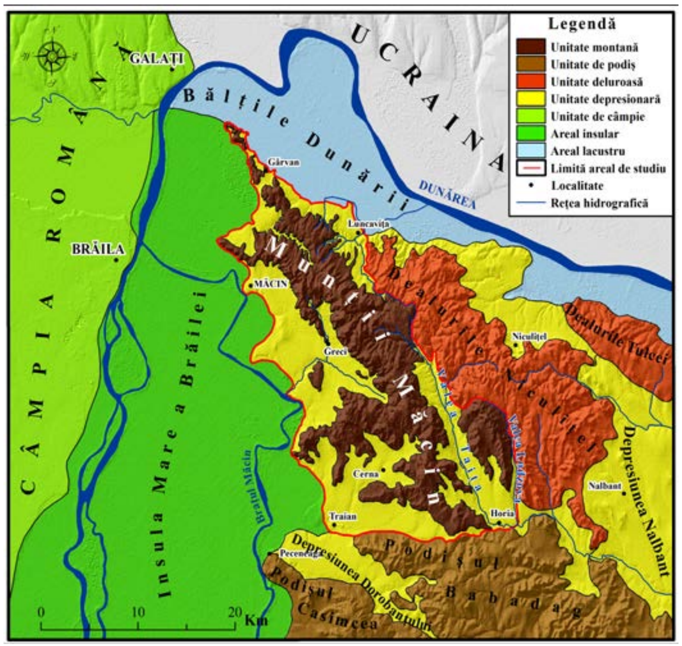

Fig. 1 Geographical position of the study area

2.1.2 Morphological units and subunits of the study area. Between the limits described above are comprised the following major morphological units: Măcin Mountains, western basins (Măcin - Greci și Cerna - Mircea-Vodă), northern basins (Jijila și Luncavița) and eastern basins (Nifon - Horia). The morphological subunits are not generally accepted in the scientific literature (Vespremeanu, 2003; Popescu and Ielenicz, 2003;

Burcea, 2008; Badea, 2010). Therefore, we made a new delimitation of the mountain area. This contains 10 morphological subunits: Greci, Pricopan, Bugeac, Orliga, Megina, Priopcea - Chervant and Boclugea – Coșlugea ridges; Cerna Hills, Muchia Lungă Hill şi Carapelit Hill. Also are included the inselbergs within the western, northern and eastern basins area (figure 2).

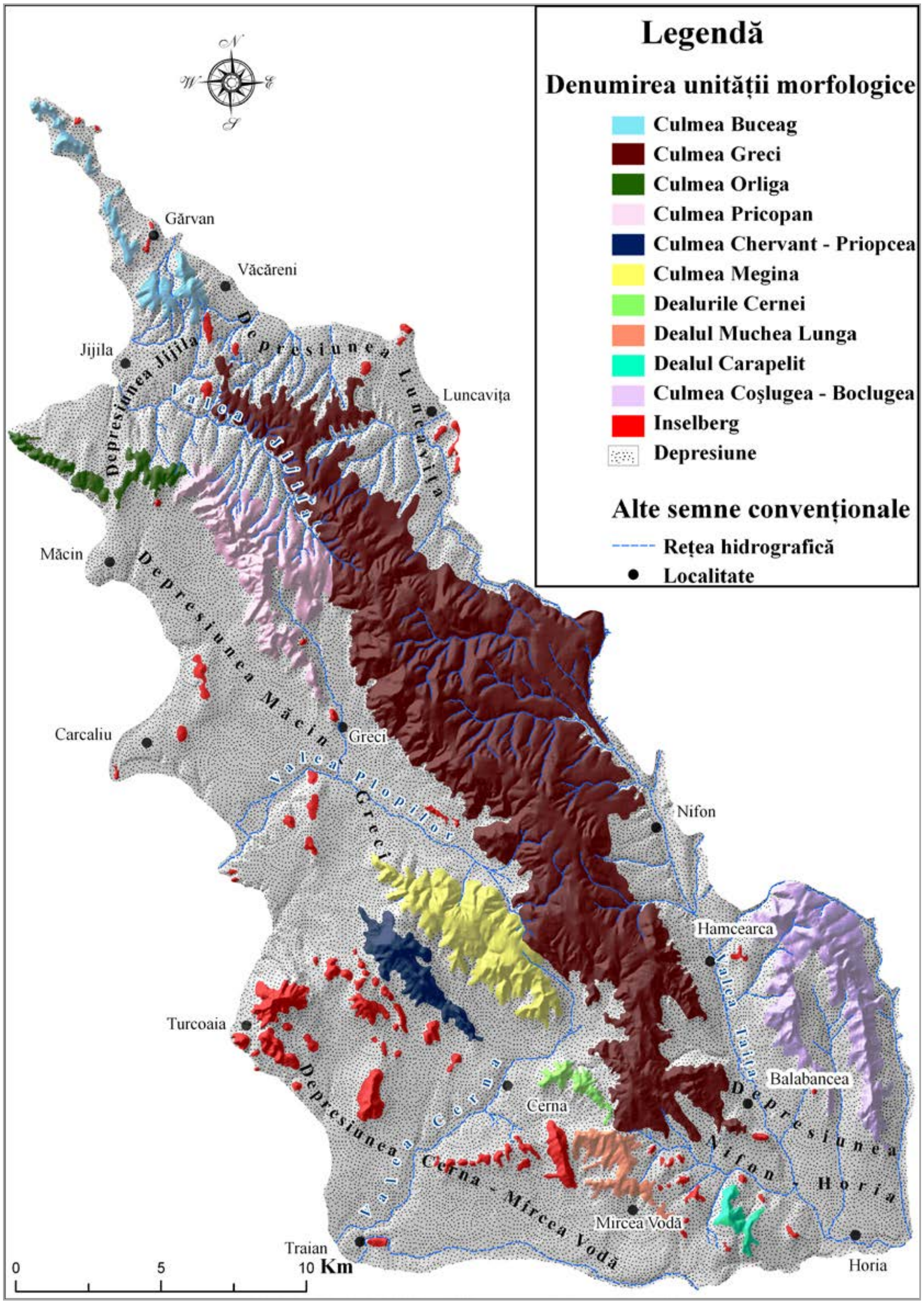

Fig. 2 Morphological units and subunits of the study area

2.2 HISTORY OF LANDSCAPE AND TOURISM RESEARCHES IN MĂCIN MOUNTAINS

2.2.1 History of landscape researches

The first observations on Măcin Mountains landscape come from the end of XXth century and are realized by the geologists (Peters, 1867; Mrazec and Pascu, 1896; Murgoci, 1912 etc.). The studies undertaken by the geologist and geographers (de Martonne, 1924; Brătescu, 1928; Nordon, 1930; Mihăilescu, 1938, 1944) during the 1867 – 1944 period focuses on landscape evolution.

The 1944 – 1990 period keeps the previously established trend and focuses on the study of erosion surfaces and terraces (Nedelcu and Dragomirescu, 1965; Mihăilescu, 1966; Coteț, 1966, 1969; Roșu, 1969; Basarabeanu and Marin, 1978; Ielenicz, 1988). In this period are carried out the first observations on landforms resulting from torrential (Basarabeanu, 1969, 1970, 1973), weathering (Vespremeanu, 1969; Posea et al., 1974) and pedimentation processes (Posea, 1980a, 1980b, 1983; Popescu, 1988). Also were performed the first general geomorphological maps of the study area (Coteţ, 1960; Nedelcu and Dragomirescu, 1965; Coteţ and Popovici, 1972).

Researches from the 1990 – 2012 period are focused on issues related to the existence (Ielenicz, 1993, 1996; Ielenicz and Burcea, 2000) or inexistence (Vespremeanu, 2003) of erosion surfaces; on landscape evolution (Popescu and Ielenicz, 2003). In this period are carried out studies related on landforms resulting from suffosion (Ielenicz et al., 2001) and weathering (Vespremeanu, 2004; Vespremeanu - Stroe et al., 2010, 2012) processes. During this period appears the first geomorphological study of the study area.

2.2.2 History of tourism researches

Researches regarding tourism phenomenon are not numerous. The most important contributions are made by Albotă (1987), by achieving the first tourist guide, the first marks of the hiking trails and the first tourist map of Măcin Mountains. General issues related to tourism phenomenon in the study area are made by Simionescu, (1971), Coteţ and Popovici (1972), Popovici et al. (1984), Andreescu (1990) and Ionaşcu (2007).

2.3 INTERCONDITIONALITY BETWEEN RELIEF AND TOURISM

Landscape, through its morphometrical and morphographical features may determine tourism. The tourist activities can have a positive influence upon the landscape (by protecting landforms under a system of protected areas) or a negative one, by destroying the attractive morphology through uncontrolled planning actions.

Landscape, through its aesthetical and morphometrical characteristics constitutes ***"touristic resource"***, representing the "main offer" of a region (Reynard, 2004). When the landforms does not generate tourist flows, the morphology has the role of ***landscape background***. In this hypostasis, the morphology contributes to creating of the geographic identity of a tourist destination (Cocean şi Dezsi, 2001, 2009). The superior capitalization of touristic resources is made by fitting tourism infrastructure (Reynard, 2004). Thus, landscape become the support for tourism infrastructure and the entire range of tourist activities.

2.4 GEOMORPHOSITES

Geomorphosites constitutes a new domain of research in studying the relation between relief and tourism and focuses on capitalization of the scientific and educational features of the landforms. Geomorphosites are representative landforms for the forms of the same category, which "*presents importance for understanding the Earth history*" (Grandgirard, 1995, 1997, 1999) and "*allow the knowledge of the temporal and spatial evolution of an area; the understanding the role of rocks and surface processes in the genesis of the landforms*" (Straseer et al., 1995). This characteristics constitutes the scientific side of a landform and the main criterion in consider it a geomorphosite. The aesthetic, cultural, ecological and economical features completes the basic characteristic (scientific) and increases the attractiveness of a geomorphosite (Quaranta, 1992; Panizza and Piacente, 1993; Panizza, 2001).

Studies on identification of geomphosites in order to protecting and preserve it are made for the first time at the begining of '77 in Great Britain, being than extended in countries like Spain, Switzerland, Italy, Germany, Romania (since 1995) etc. Studies on identification of geomphosites in order to capitalize it through (geo)tourism are made since 2000 (Italy).

A disputed problem is represented by geomorphosites assessment, in this sense being realized a significant number of qualitative (Panizza and Cannillo, 1994; Bertachini et al., 1999, Grandgirard, 1999 etc.), and quantitative (Rivas et al., 1997; Bonachea et al., 2005; Coratza and Giusti, 2005; Bruschi and Cendrero, 2005; Carcavilla et al., 2005; Reynard et al., 2007; Pereira et al., 2007 etc.) methodologies. A less investigated domain is related to mapping geomorphosites. Studies regarding mapping geormophosites were made especially by the italian (Castaldini et al., 2005) and swiss (Regolini-Bissig, 2011) researchers.

In Romania, the study of geomorphosites is of recent date (2007), studies in these sense being made by researches from Oradea University (Ilieş and Josan, 2007, 2008, 2009; Ilieș et al., 2011), Bucharest University (Comănescu and Dobre, 2009; Comănescu et al., 2009, 2010, 2012a, 2012b; Comănescu, 2010; Ielenicz, 2009 and Posea 2012) and Cluj – Napoca University (Surdeanu el al., 2011; Cocean and Surdeanu, 2011; Cocean, 2011).

CHAPTER III. METHODOLOGY

The approach of an interdisciplinary issue has required an analyses according to two domains of research: Geomorphology and Geography of Tourism.

3.1 Investigation methods on landscape has considered the full range of principles, methods and work techniques. These were completed with specific methods of work represented by: geological maps (1:50000), topographical maps (1:25000); ortophotos (1:5000), thematic maps (Nedelcu and Dragomirescu, 1965; Coteţ and Popovici, 1972; Posea, 1980, 1983; Popescu 1988; Ielenicz and Burcea, 2000; Burcea, 2008) and digital data base available online (Google Earth, www.geospatial.org). These were complemented by specialized software for the digital mapping (ArcGIS) and profiles achievieng (Global Mapper and ArcGIS).

3.2 A particular attention was granted to the **geomorphosite investigation methods** (inventory, assessment and mapping).

3.2.1 The inventory method is the scientific approach through which were identified landforms with potential to become a geomorphosite. The methodological procedure was divided by us into three phases: documentation (study of geological and geomorphological literature; field observations; achievieng the geomorphological map of the study area); geomorphosite identification stage and the inventory stage (collecting data necessary for the assessment process and completing the inventory form).

3.2.2 Assessment methods in the scientific literature. Although there have been made numerous attempts, so far has not been developped a generraly accepted assessment method. Of international recognition enjoys only 6 assessment methods elaborated by: Coratza and Giusti (2005); Serrano and Gonzalez - Truebba (2005); Bruschi and Cendrero (2005); Pralog (2005, 2006), Reynard et al., (2007) and Pereira et al., (2007).

Given that none of the methods mentioned above is not entirely suitable for geomorphosites assessment within Măcin Mountains, was made a method which corresponds to our study purpose.

3.2.2.1 The **proposed method** allows us to assessment the scientific features of a geomorphosites and in the same time, of those characteristics that contribute to the increasing of the attractiveness of a geomorphosite. The method comprises five main stages called "values": scientific value (VsG), educational value (VdG), aesthetical value (VeG), cultural value (VcG) and touristic value (VtG). Each stage/value was detailed on assessment criterion. The latter were represented by "result indicators", which were assigned numerical values on a scale from 0 to 1.

Scientific value (VsG) is the cumulative result of the following criteria: "geomorphological importance" (Ig), "scientific notoriety" (Ns) și "ecological importance" (Ie) of a geomorphosite. The *geomorphological importance* comprise the following criteria: "genesis" (Ig1), "age" of lithological formations (Ig2), "dynamics" (Ig3), "reprezentativeness" (Ig4), landform "frequency" in the study area (Ig5), "rarity" (Ig6), " morphological variety" (Ig7) și "degree of conservation" (Ig8). The *scientific notoriety* is expressed by "scientific degree of knowledge" (Ns1) and by "genesis or evolution model" of a landform (Ns2). The *ecological importance* is given by the presence within the geomorphosite of important "flora (Ie1) and fauna species" (Ie2), a large number of "ecosystems" (Ie3), which reflects the "current state of site protection" (Ie4) and the "protection regime within it" (Ie5).

The scientific value (VsG) of a geomorphosite is expressed as follows:

$$\mathbf{VsG = Ig + Ns + Ie}$$

where: Ig – geomorphological importance și $Ig = Ig1 + Ig2 + Ig3 + Ig4 + Ig5 + Ig6 + Ig7 + Ig8$
Ns – scientific notoriety $Ns = Ns1 + Ns2$
Ie – ecological importance $Ie = Ie1 + Ie2 + Ie3 + Ie4 + Ie5$

Educational value (VdG). In this stage the landform is perceived as an instrument - "educational model" (Vd1) that can be used to explain some landforms of the same class. Depending on this value it can determine the "suitability of a landform to be exploited by educational itineraries" (Vd2). The total result is obtained in this stage by summing the two criteria (Vd1, Vd2) described above.

Aesthetic value (VeG) is expressed by the "geomorphosite position within the major morphological units" (Ve1), "physical appearance" (Ve2), "the spatial extension of micromorphology within the study area"

(Ve3), “landscape energy” (Ve4), “morphological contrast” (Ve5), “chromatics” (Ve6). The aesthetic value of the geomorphosite is perceived as a summum of the criteria described above.

Cultural value (VcG) is rendered by the presence within the geomorphosite of the “historical objectives” (Vc1), “religious edifices” (Vc2), „cultural manifestation” (Vc3) and „customs, traditions and traditional occupations” (Vc4) that creates the geomorphosite identity.

Touristic value (VtG) is given by the degree of “accesibility” (Vt1), “proximity of major roads” (Vt2), “proximity of accommodation units and public food units” (Vt3) and the “proximity of services centers” (Vt5); by the existence of „tourism infrastructure” (Vt4) within the site, of „viewpoints” (Vt6); likewise the „number of tourist activities” that can be practiced within the site (Vt7). The touristic value results by summing the criteria described above.

The total value of a geomorphosite (VsG) is expressed as follows:

$$\mathbf{VTG = VsG + VdG + VeG + VcG + VtG}$$

Where: VsG - scientific value
VdG - educational value
VeG - aesthetic value
VcG - cultural value
VtG - touristic value

3.2.3 The mapping method was used for achieving the geotouristic map of Măcin Mountains. It was based on the model developed by Castaldini et al., (2005), which consists in a simplification of a classical geomorphological map. This is supplemented with touristic information.

CHAPTER IV. GEOLOGICAL FEATURES OF MĂCIN MOUNTAINS

From geologic viewpoint, our study area belongs to the Northern - Dobrogea Orogeny and is an Alpine orogeny developed on a folded and distorded foundation resulted during the hercynic, caledonian and assyntic orogenesis and completed in neochimmeric orogenesis (Ionesi, 1994).

Măcin Mountains is characterized by a great lithological diversity (figure 3). Are comprised:

- metamorphic rocks represented by Proterozoic and Paleozoic mezometamorphic crystalline schists (amphibolites, gneiss, micaschists, quartzite, limestone) and Paleozoic epimetamorphic crystalline schists (quartzite, muscovitic schists, phyllite);
- Paleozoic sedimentary rocks reprezented by Cerna formation (Silurian limestones, sandstones, marls and clays), Bujoare formation (Devonian limestones and sandstones) and Carapelit formation (Carbonifer sandstones and conglomerates);
- Paleozoic igneous rocks reprezented by intrusive rocks (granites and granodiorites). Crystalline schists and Paleozoic sedimentary rocks are pierced by the intrusive rocks bodies;
- Mezozoic sedimentary rocks (Cenomanian limestones and conglomeratic limestones);
- Quaternary sedimentary rocks (loess and loess deposits; eluvial, delluvial, colluvial, proluvial and alluvial deposits).

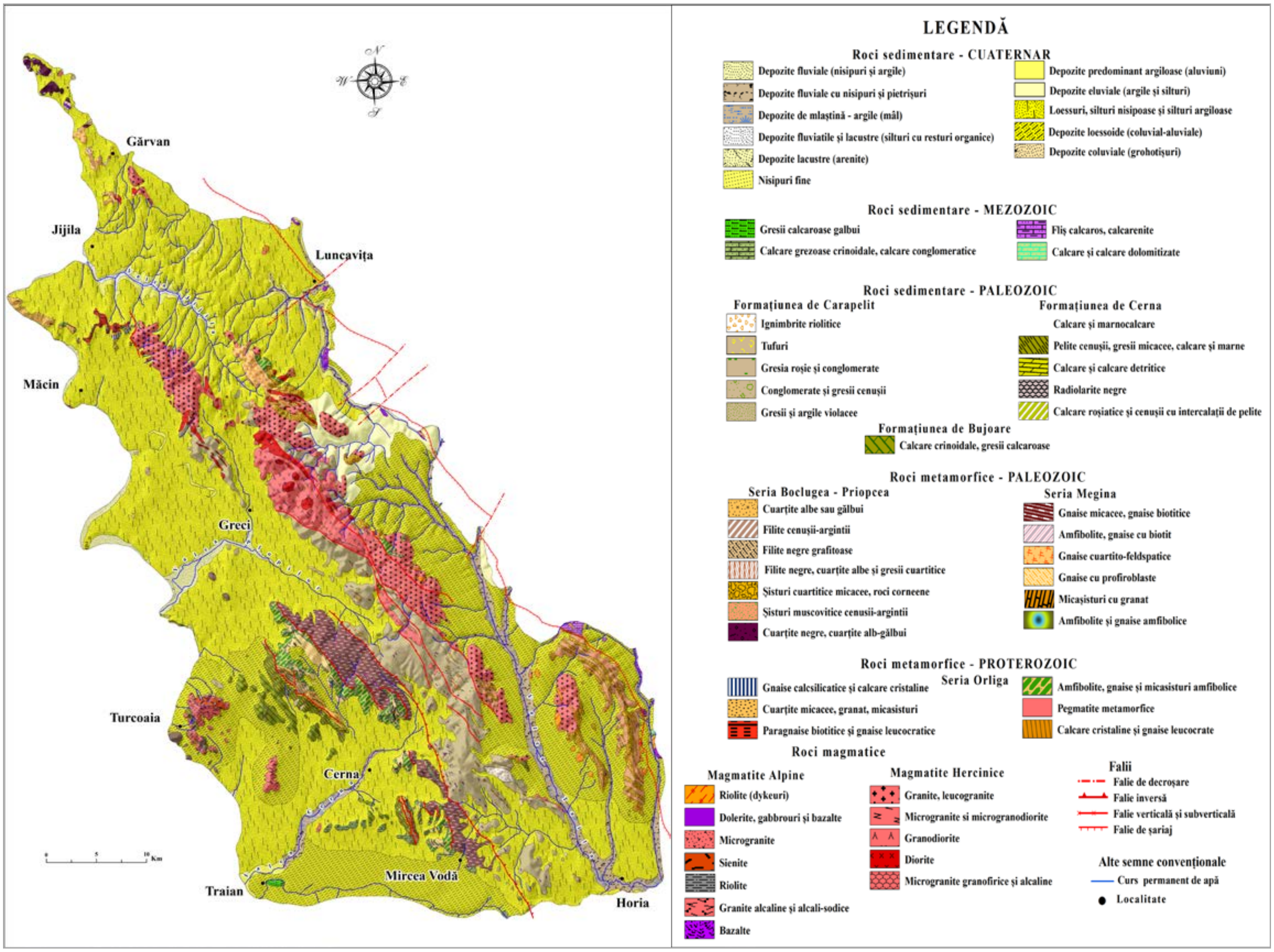

Fig. 3 Litologic map of Măcin Mountains (Măcin and Priopcea sheets - 1:50000)
(edited by Romanian Geologic Institute)

CHAPTER V. MORPHOMETRICAL AND MORPHOLOGICAL FEATURES ALE MĂCIN MOUNTAINS

The long time evolution has led to the shaping in the area of a large peneplain (Murgoci 1912, 1914; de Martonne, 1924; Nordon, 1930; Mihăilescu 1938, 1944) or pediplain (Posea, 1980b, 1983, 2005; Ielenicz and Burcea, 2000).

In the contemporary configuration of Măcin Mountains are found a great variability of relict forms: posthercynic erosion surfaces; residual “alpine” ridges (de Martonne, 1924); ridges smoothed by erosion; pediments coverd by loess deposits; isolated or grouped inselbergs; torrential and suffosion valleys; weathering micromorphology etc. The morphological diversity makes from Măcin Mountains an area with "an original facies, different from what is found in Romania and in Central Europe morphology" (the Martonne, 1924).

The contemporary shaping stage, insignificantly influences the Măcin Mountains morphology. An important role in the shaping process has the human factor (through mining) and, in a lesser degree, the geomorphological factor (torrentiality, suffusion, subsidence etc.).

5.1 MORPHOGRAPHICAL AND MORPHOMETRICAL FEATURES

The long time evolution of Măcin Mountains landscape is reflected in current morphography (through the predominance of long and bevelled interfluves and convex slopes) and in morphometric parameters values (through the predominance of lower altitudes and relief energy - under 100 m). Along with the long time evolution, the lithology and structure determined the predominance of slopes with lower declivity (less than 6º). Slopes orientation is in relation to the orientation of general structure. Predominant are slopes with south (18%) and south-west (16,3%) exposure.

5.2 GENETIC TYPES OF LANDFORMS

5.2.1 Structural landscape

The morphological characteristics of our study area are determined by the configuration of the hercynic and neocimmeric structure (Nedelcu and Dragomirescu, 1965), which is reflected in the territory by the North West - South East orientation of peaks and valleys. General aspects of the landscape are imposed also by the main (morphologically expressed by an anticline) and secondary (two anticlines - Megina and Taiţa and an syncline structure - Carapelit) tectonic elements. Valleys are generally developed on the axis and the flank of the anticlines and synclines, the morphologically materialization consisting in longitudinal valleys (Luncavița, Taiţa, Jijila, Puturoasa valleys etc.). An exception are the Cerna and Greci valleys, which are transversal valleys (Popescu and Ielenicz, 2003).

5.2.2 Petrographic landscape

5.2.2.1 The **relief developed on igneous rocks** is very well represented in the Măcin Mountains due to the large spatial extension and variety of eruptive rocks (granite, granodiorite, diorite, dolerite, riolite). Different size of granite bodies, has determined the development of landforms with various sizes. The large igneous rock bodies (laccolith) creates frequently long ridges (over 15 km – Greci Ridge); while the small igneous rock bodies creates inselbergs, developed within the northern, western and eastern basins (Iacobdeal, Piatra Roșie, Măcin, Pietrosul, Gâlma Mare etc.) (figure 4).

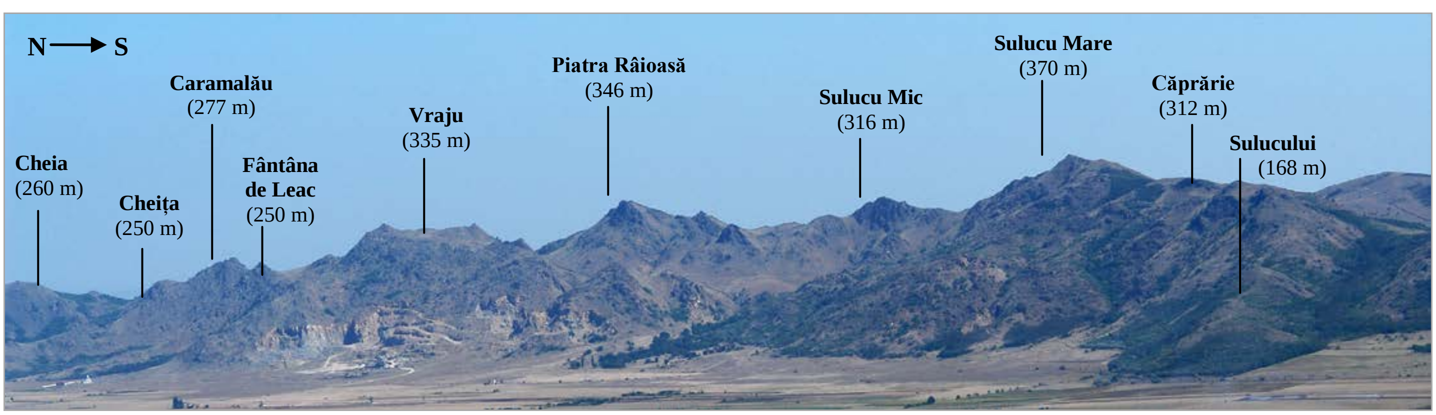

Fig. 4 Morphology developed on granites in Pricopan Ridge (overlooking the western slope of the ridge)

From morphologic viewpoint the landscape developed on granites is different. Within the study area occur: sectors of massive and prolonged ridges with smoothed interfluvs and convex slopes (Megina Ridge, Coșlugea Ridge etc); residual ridge (Pricopan and Greci ridges) with pyramidal peaks and steep slopes, strongly affected by weathering processes; isolated (Iacobdeal) or grouped inselbergs (Piatra Roșie, Iglicioara Mare, Dealul lui Manole) situated in the western part of Cerna - Mircea Vodă basin.

5.2.2.2 The **relief developed on metamorphic rocks** is not unitary. It varies according to the structural and mineralogical composition, degree of metamorphism and schistocity specifics to crystalline schists. The mezomethamorphic crystalline schists creates a predominantly hilly morphology, reprezented by smoothed peaks and convex slopes (Sărărie – Orliga Ridge, Cerna Hills, Muchia Lungă Hill etc.). The epimethamorphic crystalline schists determine imposing forms, represented by residual ridges (Priopcea and Chervant – Banului Ridges) (figure 5).

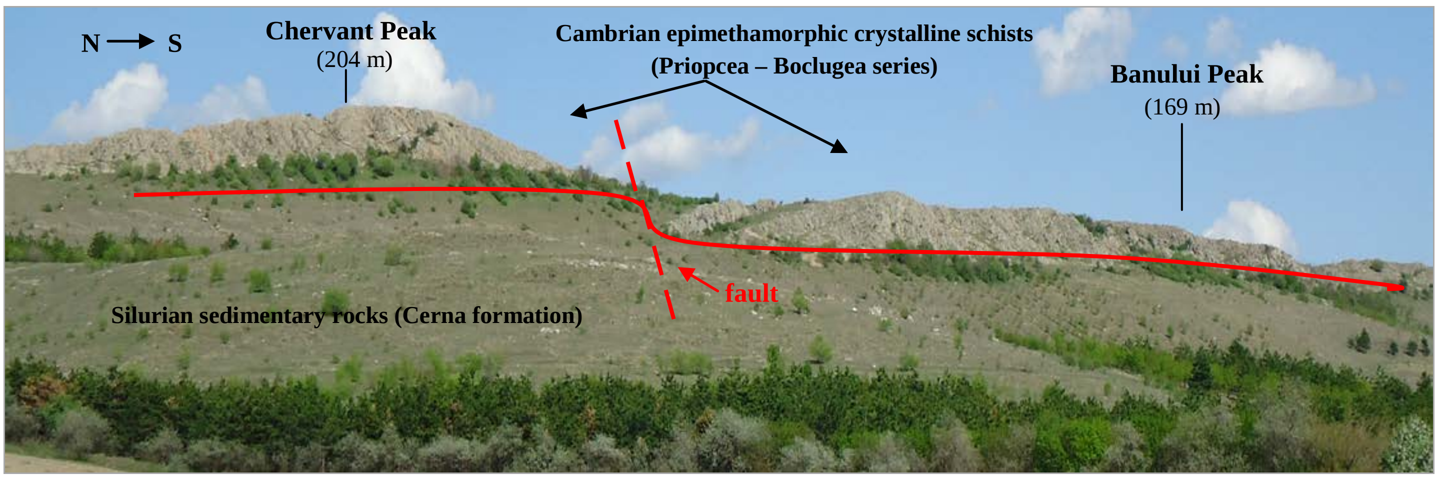

Fig. 5 Morphology developed on epimethamorphic crystalline schists in Chervant – Banului Ridge

5.2.2.3.1 Relief developed on Paleozoic sedimentary rocks

Silurian limestones, marls and clays creates a hilly morphology with lower altitudes (under 100 m), slopes with lower declivity and frequently covered by forest vegetation.

Devonian limestones determine grouped rounded inselbergs (bornhartds) separated by large saddles and with lower altitudes (figure 6); and miniature residual ridges shaped by differential erosion (figure 7).

Carbonifer conglomerates and sandstones creates a varied morphology: prolonged ridges with smoothed interfluvs and slopes covered by forest vegetation (the south sector of Greci Ridge between Stâna Oancei Peak and Siliștea Peak); dome inselbergs (disposed around Carapelit Hill); residual erosion witnesses with ruiniphorm peaks and steep slopes (Ioaneș Peak – 302 m, Secaru Peak – 309 m); gorges (Chediu Gorge) etc.

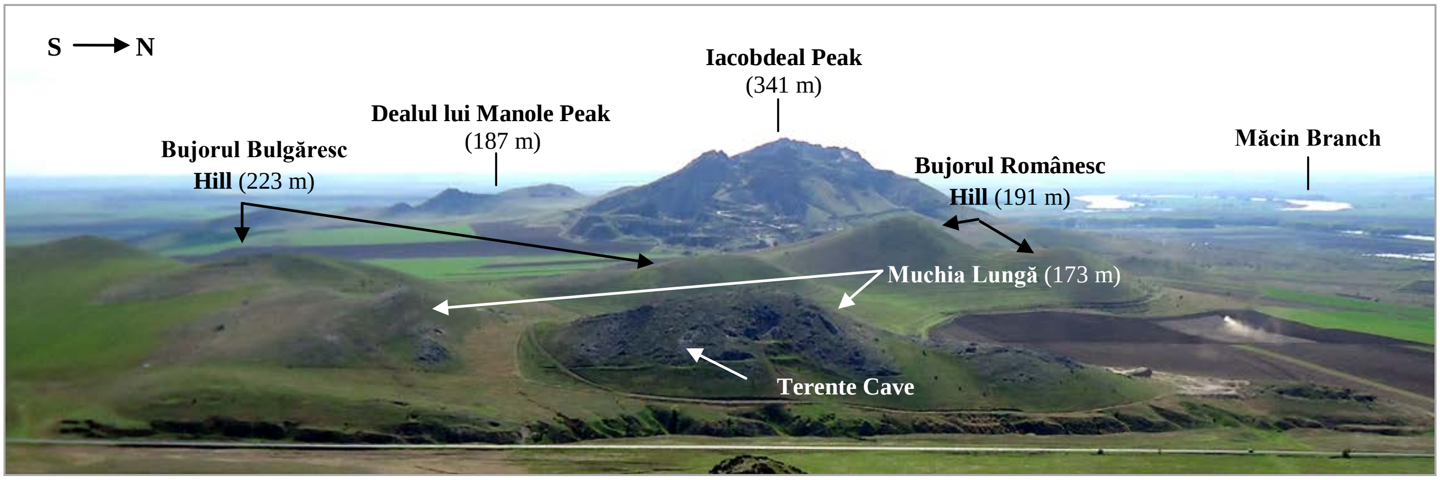

Fig. 6 Morphology developed on Devonian sedimentary rocks - in Muchia Lungă and Bujoare Hills (panoramic view from the western slope of Priopcea Peak)

Fig. 7 Miniature residual ridge developed on Devonian limestone – at the south of Muchea Lungă Hill (view from the Chervant – Banului Ridge)

5.2.2.3.2 The **morphology resulted on Mezozoic sedimentary rocks** (Cenomanian limestones) is less represented in the territory than the morphology resulted on Paleozoic sedimentary rocks and is characterized by dome inselbergs (Pietrele Cerdak inselbergs).

5.2.2.4 The **relief developed on loess and loess deposits** is very well represented in the Măcin Mountains area due to the large spatial extension and thickness (5 – 30 m) of those deposits. It characterized through a variety of forms generated by subsidence processes (subsidence steps; vertical walls with 25 – 30 m height; steps) (figure 8); suffosion process (boreholes and flues, caves, tunnels, suffusion valleys etc.) and torrential – suffusion processes (torrential – suffusion valleys with 2 km lenght and 15 – 25 m depth) (figure 9).

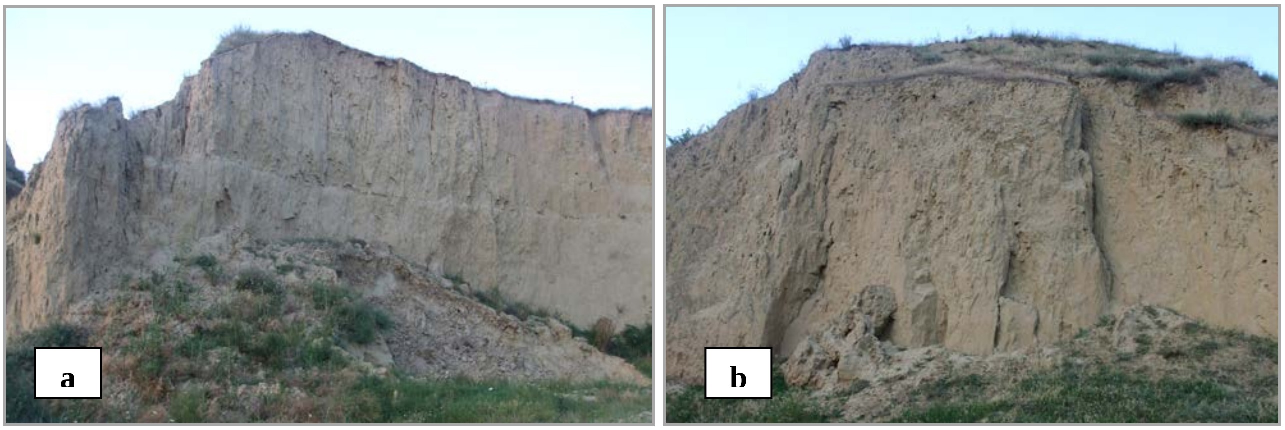

Fig. 8 Vertical walls (a and b) situated in the north of Turcoaia settlement

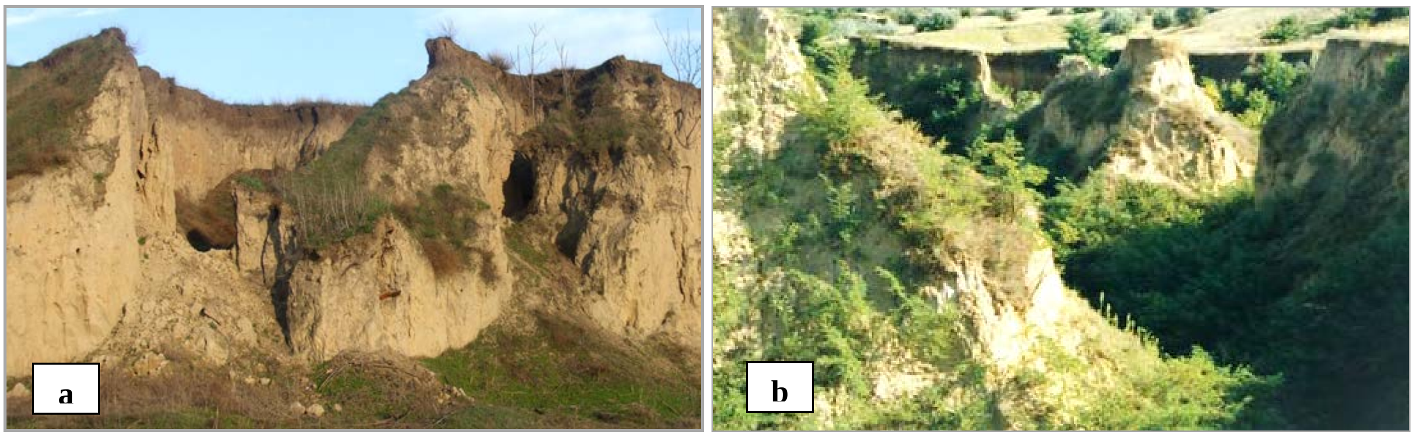

Fig. 9 Suffosion flue on the northern slope of Danube (a);
Torrential – suffosional valley developed on the north slope of Văcăreni inselberg (b)

5.2.3 Sculptural landscape

5.2.3.1 Erosion surfaces are represented by ***Măcin surface*** situated (between 280 – 350 m) in Greci Ridge (Teica Peak and Negoiu Peak), Pricopan Ridge, Priopcea Ridge etc.; and ***Niculiţel surface*** (between 180 – 260 m) situated in Megina Ridge, Carapelit Hill, Negru Hill etc. (Ielenicz and Burcea, 2000).

5.2.3.2 Denudation landscape

Surface erosion is manifested (with different intensity) over the entire surface of Măcin Mountains area, being favorised by the torrential regim of precipitation. Areolar erosion ("splash") also affects large areas in Pricopan Ridge, Priopcea – Chervant Ridge, Greci Ridge, Boclugea Ridge etc.

Linear erosion. Gullies appear on slopes covered with friable deposits in Priopcea Ridge, Megina Ridge, Coşlugea Ridge etc. Ravines have a high spatial spread in the study area. We can notice their concentration on the western side of the area, on the western slopes of Orliga Ridge, Buceag Ridge, Megina Ridge, Priopcea Ridge, Pricopan Ridge) (figure 10). Torrents are developed mainly in the north and east of the study area, in Buceag Ridge, Luncavița basin (Gărvan Valley), Sărărie Ridge; on the slopes of Iacobdeal inselberg (Măgăreți Valley) etc.

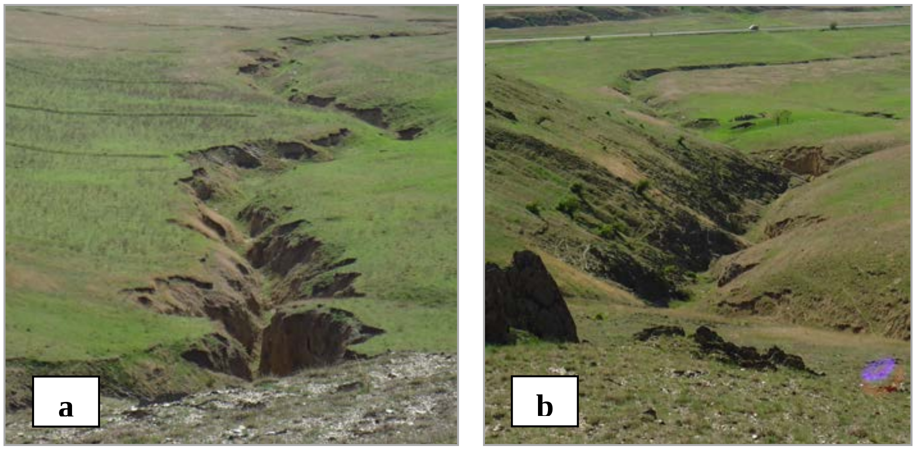

Fig. 10 Ravines developed on the western slope of Priopcea Peak (a and b)

Accumulation forms resulted from linear erosion processes are represented by proluvial cones. They are found at the contact between mountain area and basin areas; and at the contact between basin areas and floodplain areas (the Danube floodplain, the Taița floodplain, the Luncaviţa floodplain) (figure 11 – geomorphological map).

5.2.4 Periglacial landscape

5.2.4.1 Residual relief is very well represented in the study area, being mainly resulted by weathering processes (to which are added differential erosion processes). The most spectacular residual relief is resulted on igneous rock, especially on granites: steep slopes, ruiniphorm peaks, residual ridges and micromorphology (rounded rocks, spherical rocks, tors, figurative rocks) (figure 12).

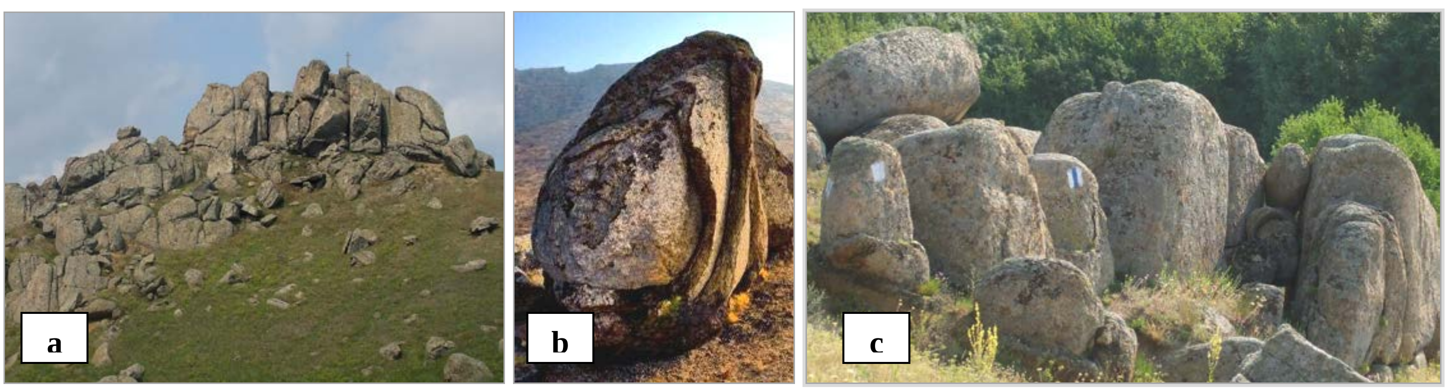

Fig. 12 Ruiniphorm peak – Caramalău (Pricopan Ridge) (a) weathering micromorphology (b and c)

5.2.4.2 Accumulation relief is represented by: rock fields (Pricopan Ridge), debris (Priopcea Ridge, Greci Ridge, Pricopan Ridge), granitic arenas (Greci Ridge and Pricopan Ridge), eluvial, delluvial, colluvial and proluvial deposits; and pediments (in northern, western and eastern basin areas).

5.2.5 Anthropogenic relief is represented, in a very large extent, through quarries (Izvoarele quarry – Pricopan Ridge; Iacobdeal quarries; Morsu Valley quarries - Greci Ridge etc.) and mining dumps of various sizes and origins (Iacobdeal). Anthropogenic intervention on the landscape is determined also by riverbeds impoundment and river dams (on Luncaviţa, Cerna, Taița).

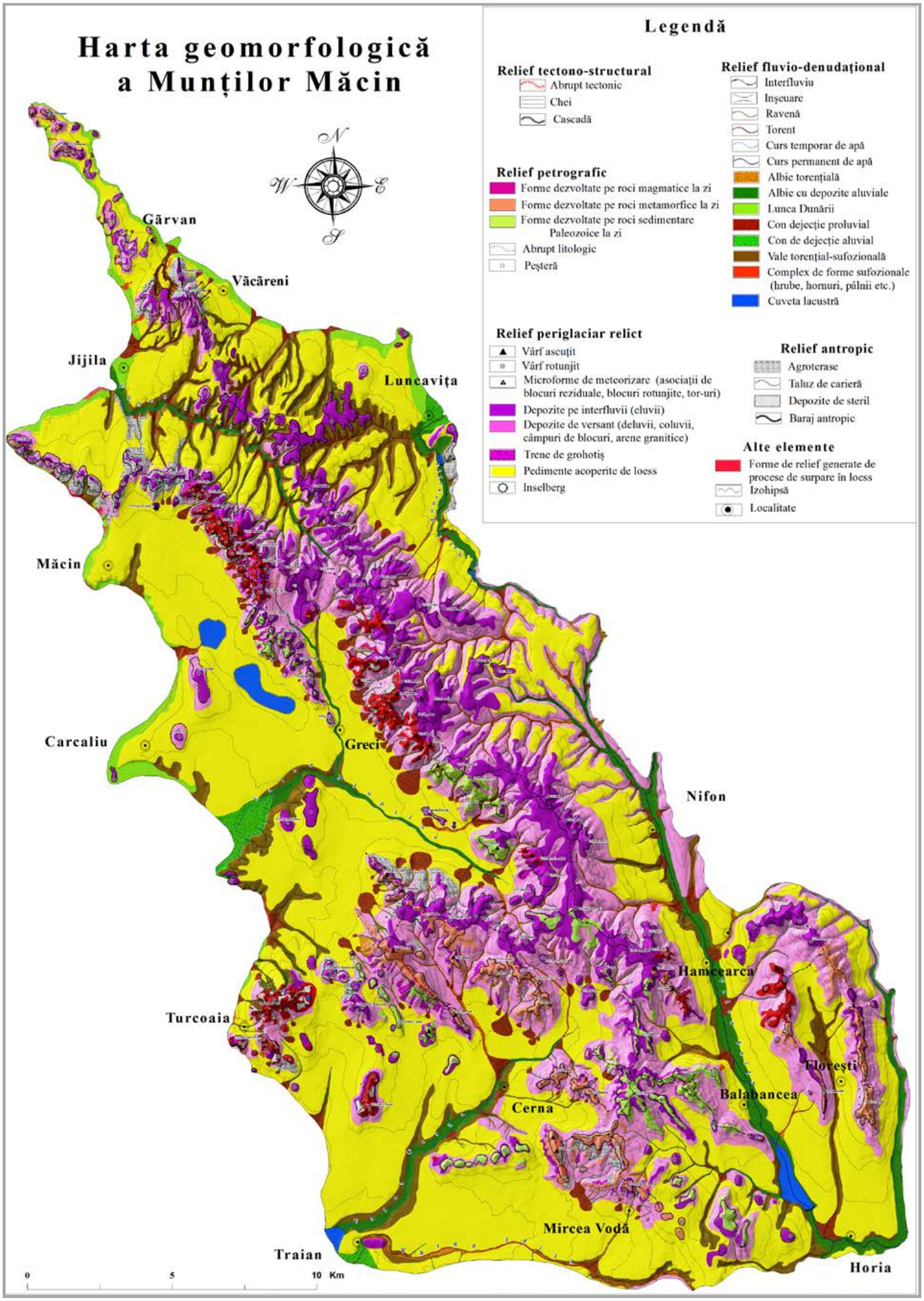

Fig. 11 Geomorphological map of Măcin Mountains

CHAPTER VI. THE ROLE OF MĂCIN MOUNTAINS RELIEF IN TOURISM DEVELOPMENT

6.1 THE IMPORTANCE OF MORPHOMETRICAL AND MORPHOLOGICAL FEATURES IN TOURISM

The morphometric and morphological components of the Macin Mountains landscape are closely related with tourist attraction, but contributes differently to the development of tourism.

6.1.1 The importance of morphometry in tourism development

6.1.1.1 Hipsometry. The upper altitudinal levels (specific of peaks and ridges) are pole of touristic attraction for mountain hiking. The distribution of altitudinal levels in the study area enables the visual perception over the surrounding morphology, representing natural viewpoints.

Depending on the position in territory, the height in comparison with the surrounding morphology, the panorama offered by the opening angle and the distance of visual perception, the viewpoints from Măcin Mountains are of: major importance (Țuțuiatu Peak, Priopcea Peak, Moroianu Peak etc.), regional importance (Sulucu Mare Peak, Iacobdeal inselberg etc.) and local importance (Cozluk, Școlii Hill etc.) (figure 13). These (viewpoints) also have a role in diversifying the local touristic activities.

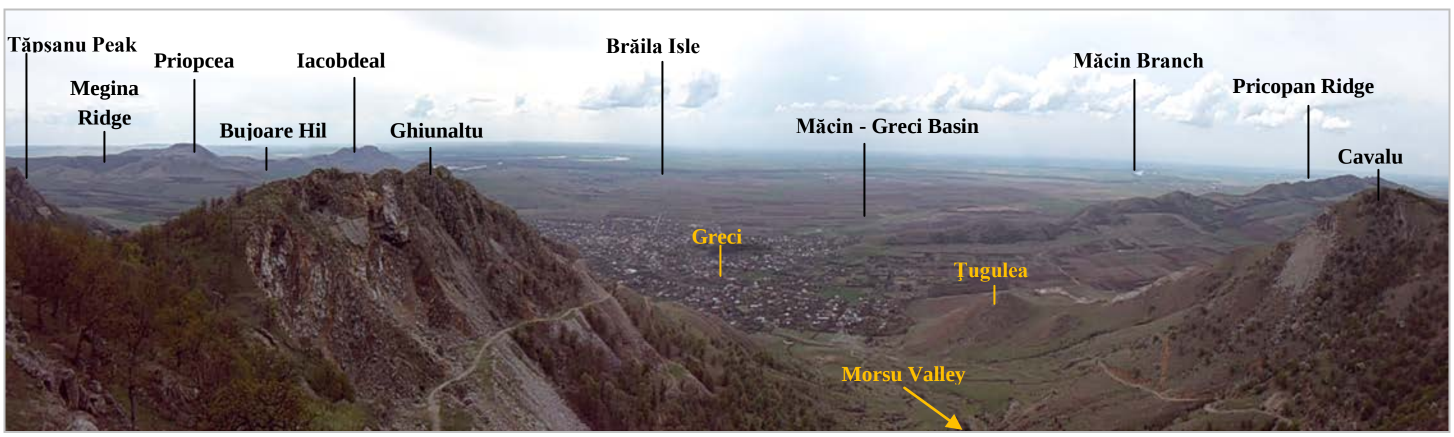

Fig. 13 Panoramic view of the Țuțuiatu Peak – viewpoint of major importance

On the other side, areas with low altitudes and low relief, specific for saddles are favorable areas for placing communication infrastructure (DN 22D - in Priopcea saddle).

6.1.1.2 Fragmentation depth plays an important role in identifying areas spectacular from touristic viewpoint and also, the favorable areas for placing the touristic equipment. In Măcin Mountains, areas with values of fragmentation depth between 200 - 250 m/km² presents a particular spectacularity: Chediu Gorges, Cartalu Peak, Ghiunaltu Peak etc. The relief energy influences the length of time in crossing the hiking trails. The predominance of lower relief energie is reflected through mountain hiking trails with low ("Măcin Stories" trail) and medium ("Țuțuiatu" trail, "Pricopan" trail) degree of difficulty. The surfaces with values of fragmentation depth under 50 m are favorable areas for placing the touristic infrastructure and for tracing cyclotourism trails with low degree o difficulty (Măcin – Horia – Luncavița cycle route).

6.1.1.3 Declivity is a useful parameter for indicating the attractive areas from scenery viepoint and also favorable areas for practicing recreational tourism activities. Strongly inclined slopes - over 42 ° (Piatra Râioasă Peak, Moroianu Peak, Ioaneș Peak) and vertical walls offers a note of spectacularity. The vertical walls of Călcata Peak, Piatra Râioasă Peak, Sulucu Mic Peak etc. are favorable areas for climbing activities. The declivity and lenght of climbing routes are useful factors in determining their degree of dificulty.

6.1.1.4 The touristic role of **slope exposure** is reflected in indication of favorable places of placing the accommodation infrastructure within basin areas (hotels, guest house etc) and mountain space (campings). For the latter ones, the most favorable areas are slopes with south-western, southern and south-eastern exposure.

6.1.2 The importance of morphology in tourism development

The Măcin Mountains morphology has significant importance for tourism development, constituting an attractive resource through a series of particularly features like: landform appearance, rarity, inedited, morphological complexity, morphological diversity, spatial extension of micromorphology and morphological contrast.

6.2 LANDFORMS WITH TOURISTIC ATTRACTIVENESS IN MĂCIN MOUNTAINS

The main morphological attractions within the Măcin Mountains are: ridges, peaks, steep slopes, inselbergs, gorges, waterfalls, fluvial harbor and microphorms. Are included also the anthropogenic landforms like quarries and dam lakes.

6.2.1 Ridges constitutes touristic resource through their morphometrical features (dimensions, fragmentation degree) and morphological features (longitudinal profile, steep slopes, residual peaks, micromorphology). In our study area are invidualised ridges developed on igneous rocks, especially granites (Pricopan and Greci ridges) and on metamophic rocks, especially quartzite (Priopcea Ridge and Chervant – Banului Ridge). They are either unitary, elongated and well individualized in the Măcin Mountains landscape (Chervant - Banului Ridge), either separated by saddles (Pricopan and Greci ridges) (figure 14).

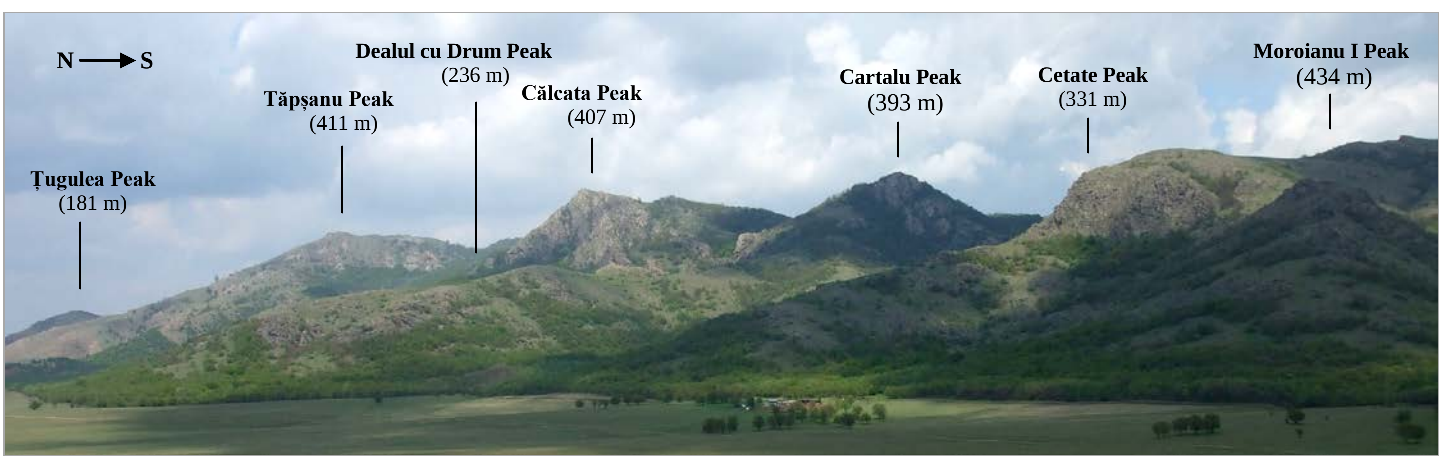

Fig. 14 The central sector of western slope of Greci Ridge

6.2.2 Peaks determines an spectacular scenary due to their massiveness and higher altitudes in comparison with the surrounding morphological units, constituting important objectives of touristic interest. They have touristic attractiveness through their morphometrical features – especially altimetric characteristics (Ţuţuiatu Peak - 467 m, Cavalu Peak - 430 m, etc); aesthetic features (Ghiunaltu Peak, Vraju Peak, Caramalău Peak, Ioaneș Peak etc.) and the possibility of interception the surrounding morphology offered by these (Ţuţuiatu Peak, Tăpşanu Peak, Sulucu Mare Peak, Priopcea Peak etc.) (figure 15). Those peaks are also constitutes favorite destinations for trekking and climbing.

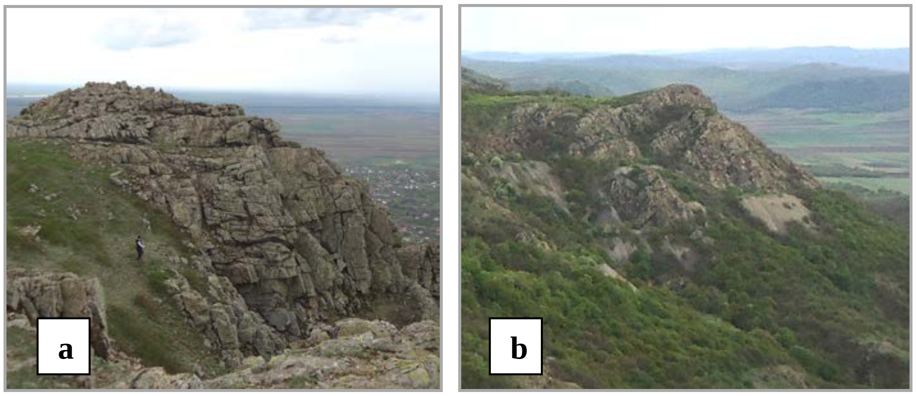

Fig. 15 Ghiunaltu Peak (a) and Tăpşanu Peak (b) in Greci Ridge

6.2.3 Steep slopes. The biggest relief energy and therefore, the highest attractiveness have the steep slopes (specific of peaks, ridges and gorges) within the mountainous area. The most spectacular steep slopes are found in the central-western part of Greci Ridge: the southern slope of Moroianu I Peak (of over 270 m relief energy), western steep of Cartalu Peak (over 210 m relief energy), north-western slope of Cetate Peak (of over 150 m relief energy) etc. The steep slopes within inselbergs across the basin areas (eastern slope of Piatra Râioasă, western slope of Colina Dălchii etc.) has role in scenic diversity due to their lower relief energy (under 50 – 70 m) in comparison with steep slopes within the mountainous area.

6.2.4 Inselbergs have touristic attractiveness through the morphological contrast induced within the basins landscape; the chaotic spread and distribution in the territory (isolated or grouped); the aesthetic morphology; variety of microforms etc. Depending on their morphological features we can distinguish inselbergs that constitutes touristic resources (Pietrele Mariei, Colina Dălchii, Cerna Hill etc.) and inselbergs with role in diversifying the landscape (Dealul Școlii, Piatra Râioasă, Dealul lui Manole, Iacobdeal) (figure 16).

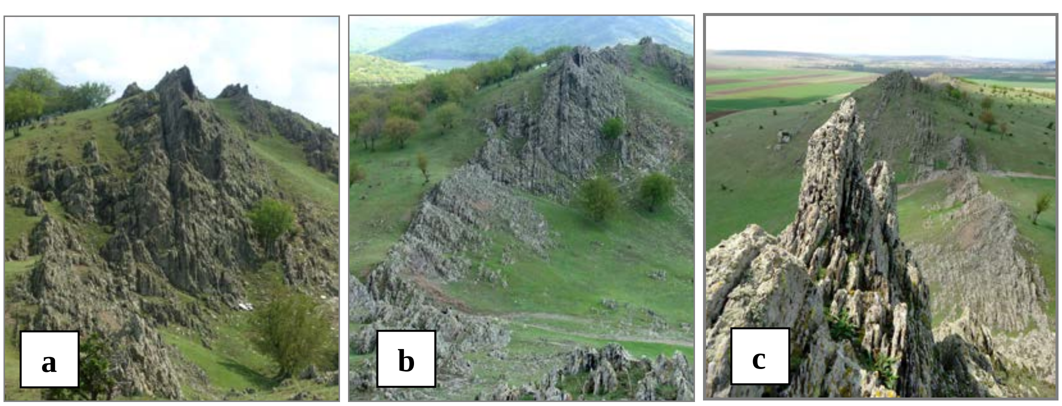

Fig. 16 Pietrele Mariei inselberg – seen from the north (a și b) and south (c).

6.2.5 Gorges impresses through their narrow cross section, vertical walls, level difference from the valley thalweg, waterfalls etc. The most spectacular gorge sector in Măcin Mountains is created by Chediu River, on the southern slope of the Moroianu Peak and northern slope of Ioaneş Peak (figure 17).

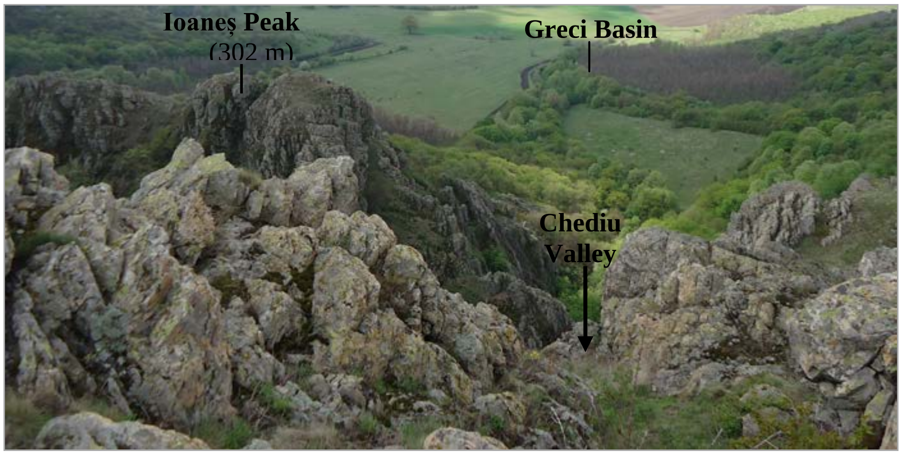

Fig. 17 Chediu Gorges (view from northern side of Moroianu II Peak)

6.2.6 Waterfalls, as elements of tourist attraction, registers a concentration in the central - western sector of Greci Ridge, between Căpușa and Ioaneș peaks. The most representative from touristic viewpoint are: the waterfall on the Carada river (between Moroianu I and II peaks) with a level difference of 12 – 13 m is the highest natural water fall in Dobrogea; and the waterfall on the Chediu river with a level difference of 4 - 5 m. Attractive from touristic viewpoint are the two waterfalls formed on Avion river (6 m and 1.5 to 2 m water fall) and the waterfall on the Racova river (with a water fall of about 7-8 m).

6.2.7 The touristic role of **Traian fluvial harbor** derives from it scenic valences and ecological importance conferred by the presence of a large number (over 100) of strictly protected bird species. Traian lake is an area of great interest for birdwatching and fishing.

6.2.8 Micromorphology resulted, mainly, by weathering processes is distinguished from aesthetic viewpoint between all forms of relief within Măcin Mountains. In our study area there is a large number of microform, inedited from physiognomic viewpoint: blocks of rock chaotically distributed in the teritory (upright, overturned, grouped or dispersed), spherical rocks, exfoliated rock, figurative rocks (sfinx), tors and oscillating stones (figure 18). Micromorphology, inselbergs and pediments constitutes emblematic landforms for Măcin Mountains, their role of touristic resource being undeniable.

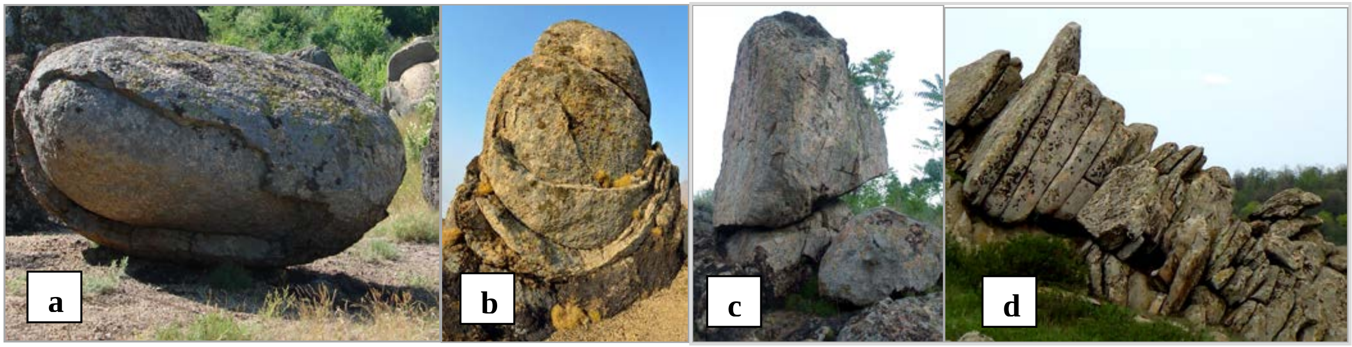

Fig. 18 Exfoliated rocks (a), oscillating stone (c) and tor (d)

6.2.9 Anthropogenic landforms with touristic attractiveness

Anthropogenic morphology presents also attractive valences, being touristic resource through some lakes and quarries. From among lakes which presents tourist attractions in Măcin Mountains we distinguish dam lakes on the Taița river (downstream of Balabancea settlement) and Luncavița river (downstream of Luncavița settlement) and anthropogenic lakes, generated in quarries (Iacobdeal lake, on the eastern slope of inselberg homonymous) (figure 19).

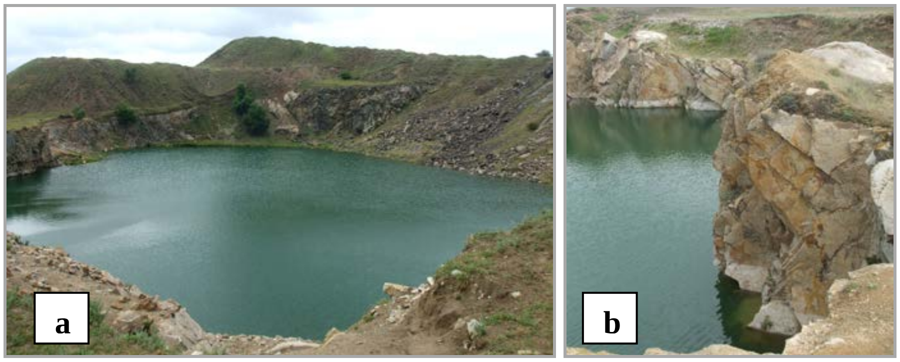

Fig. 19 Iacobdeal anthropogenic lake, developed on the eastern slope of inselberg homonymous (Turcoaia)

A high attractiveness degree have also inactive quarries, especially those resulted through granites mining activities. These become, through a series of particularities (vertical walls over 5.6 m in length, stability walls etc.), suitable destinations for all types of climbing (sports, bouldering and initiation). Such forms are found in the Pricopan Ridge and Ridge Greeks area.

6.3 THE MĂCIN MOUNTAINS RELIEF - LANDSCAPE BACKGROUND FOR TOURISTIC ACTIVITIES

When morphological components is not the main reason for the trip and it is motivated by other attractions that make tourist offer of Măcin Mountains, the morphology has the role of landscape background. In this position, the relief constitutes the secondary attribute in tourism development.

In Măcin Mountains we exemplified a number of situations in which relief has the role of landscape background:

- for anthropogenic sites: archaeological sites, historic sites, religious sites etc.;
- for touristic infrastructure (accommodation units and restaurants) and recreation infrastructure;
- for social activities: festivals, pilgrimages etc.;
- for human activities: customs, traditions, traditional costumes, cuisine etc.;
- for other touristic activities which are not directly influenced by the morphology or cultural sites of Măcin Mountains (transit travel).

6.4 THE MĂCIN MOUNTAINS RELIEF – SUPPORT FOR TOURISM INFRASTRUCTURE

Besides attractive resource and background landscape functions, the landscape has an important role in supporting the tourism infrastructure. The components of tourism infrastructure facilitates the development of tourism activities. Are included: accommodation units, restaurants and public food units, transports and tourism infrastructure.

6.4.1 Accomodation units

Most of the accommodation structures are recently edified or are under construction. Accommodation infrastructure is poorly represented, insufficiently, with a reduced accommodation capacity and a minimum degree of comfort. This situation is generalized to the entire area of Măcin Mountains. Based on field inventory was done the following classification of accommodation units:

6.4.1.1 ***Accomodation structures that currently exist in the study area.*** We identified 7 specialized accommodation structures represented by: hotels (1), motels (1), halting places (1) and guesthouses (4), with a total number of accommodation of 148 places. The distribution of specialized accommodation units is patchy. There is a concentration of it within the study area in Carcaliu, Horia, Hamcerca and Luncavița settlements. The specialized units have a single comfort class (2 stars), which reflects a low level of facilities and services that it provide. The unspecialized accommodation units are represented by 12 guestrooms (24 places) within family household. The non permanent accommodation units are represented by 6 specially equipped campsites within the mountain area.

6.4.1.2 ***Accomodation structures currently under construction between 2012 –2015.*** At the last field campaign (July 2012) where under construction 9 accomodation structures: 2 motels with 20 accomodation places (in Turcoaia and Luncavița) and 7 pensions with comfort class of 3 and 4 stars. Is noted a tendency to build this accommodation units in the settlements which already have accommodation structures (like Turcoaia) and a lack of initiative to build in areas without such facilities (Hamcearca, Horia, Carcaliu settlemets). At the end of 2015 will be settlements in which will function even 8 accommodation structures (Luncaviţa), while in others will have no such perspective (Horia, Hamcearca, Cerna).

6.4.1.3 ***Accomodation structures out of service*** constitutes, through rehabilitation and modernization works, an important potential for increasing the accommodation capacity and for diversification of accommodation units within the study area. We identified three halting places and a cottage (Mitrofan cottage), with the possibility of reintegration into the tourist circuit.

6.4.1.4 ***Accomodation structures situated in the vicinity of study area*** constitutes an alternative of accommodation spaces present in the area. Accommodation possibilities exist in close proximity of the area at: Isaccea, Brăila, Galați and Tulcea cities.

6.4.2 Restaurants and public food units

The existing public food structures (10 units) within the Măcin Mountains have a total capacity of 1192 places and are represented by: classic restaurants (1000 places), pension – restaurants (50 places), wine cellars (67 places) and brasseries (75 places). In the study area the public food structures are of large capacity (over 200 places) and small capacity (under 25 places). The highest capacity of dining places (567 places) and a diversification of public food structures is recorded in Măcin city.

6.4.3 Transports

In the Măcin Mountains are two types of communication paths: waterways and roads. *Navigation* on the Danube is currently well developed both in terms of fluvial transit (from Brăila and Galați) and recreation transport (with boats on the Danube and Măcin Branch).

Roads are the main routes of access within the Măcin Mountains and are well represented by: European Road (E 87 - Gărvan - Tulcea), national road (DN 22D – Măcin - Horia), county roads (DJ 222A - Luncaviţa – Horia; DJ 222H - DN 22D – Greci; DJ 222K - DN 22D – Turcoaia; DJ 222 B - Cerna - Traian), local roads (Jijila – Greci; Greci - Nifon, Cerna - Balabancea) and exploitation roads (of quarries within Pricopan Ridge). We have noticed an increased accessibility potential and a road network well represented, but with a low degree of modernization.

6.4.4 Tourism infrastructure

6.4.4.1 The **existing orientation and information touristic infrastructure**

Information touristic infrastructure is represented by:

- “Cetăţuia - Valea Fagilor” research and information centre – mainly dedicated to research programs, seminars, awareness and information with the local population etc.
- infokiosk - an specialized equipment which stores a lot of information on natural and anthropogenic sights; accommodation and public food structures; touristic infrastructures etc. within Măcin Mountains;
- Măcin Mountains model - offers an overview of the main peaks and hiking trails within mountain area;
- informative panels (30 panels) - depending on the nature of information contained are: general panels, panels for touristic trails (length of trails, degree of difficulty, touristic map of route) and thematic trails.

Orientation touristic infrastructure is less represented in the teritory or is tottaly missing for some sights (like accommodation structures). In the study area were identified orientation infrastructure just for: anthropogenic sights (religious, historical and archaeological sites); public food structures (for restaurants with large capacity) and for hiking trails (markings on trees and rocks, arrows and altitudinal milestones).

6.4.4.2 Orientation and information touristic infrastructure under construction and development (2012 - 2015). In present are under construction 5 information centres, 2 infokiosks, 4 informative panels and 30 markings in mountain area.

CHAPTER VII. TYPES OF TOURISM INDUCED BY MĂCIN MOUNTAINS LANDSCAPE

7.1 Recreational tourism

7.1.1 Hiking is practiced within the study area on the 7 homologated mountain trails: “Pricopan”, “Țuțuiatu” and “Dealul cu Drum” (vizează vârfurile cu cele mai mari altitudini din Dobrogea), “Cozluk”, “Vinului Valley”, “Crapcea” and “Măcin great loop”. Also is included the "Măcin stories" educational thematic route, outlined in the central - western side of Măcin Mountains.

The hiking trails have low and medium difficulty degree due to the Măcin Mountains morphological configuration, with low altitudes and low values of morphometric parameters. These features make possible to practice trekking by a wide range of tourists. The reduced length of the hiking routes (below 18 km) offers the possibility for crossing it in short time period (few hours).

7.1.2 Climbing. Although represents a relatively recent activity (which appeard at the begining of ’80 within the study area), Măcin Mountains constitutes a national recognised climbing destination, due to the type of rock in which the routes are configured (granites). Climbing is practicing in all its forms (sportive climbing, bouldering and initiation climbing) in inactive quarries and steep slopes within the mountain area (figure 20). The total numebr of climbing routes is 73 distributed as it follows: 24 in inactive quarries (within Pricopan and Greci ridges) and 49 in petrographic or tectonic steep slopes (concentrated especially in Greci ridge).

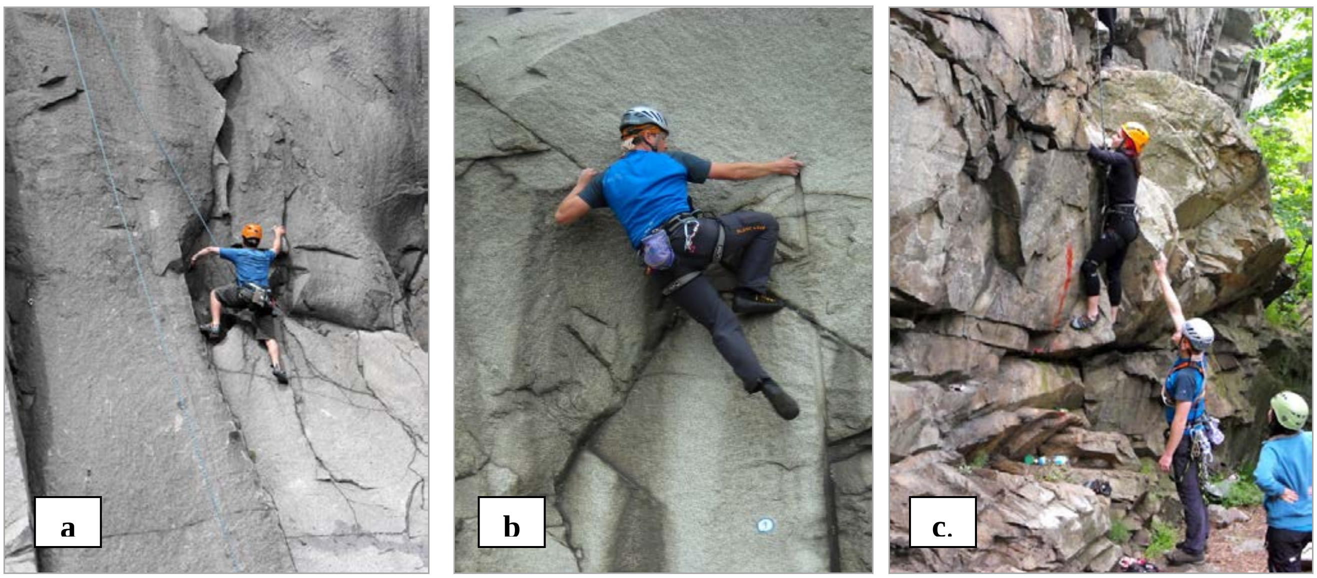

Fig. 20 Sportive climbing (a); bouldering (b) and initiation climbing (c) in Memorial Quarry (Greci Ridge) (Marian Anghel fotography)

7.1.3 Cycling is practicing on non-homologated and unmarked trails. The existing trails are overlapping on major road axes (European, national, regional roads) and secundary road axes (forest roads, touristic trails). Depending on major types of roads, the cycling trails within Măcin Mountains are classified (cf. HG 108/2007) in: highway trails (one trail), mountain trails (7 trails) and mixed trails (figure 21).

In our study area are found clycleroutes with easy, medium, and difficult in terms of dificulty degree. These makes trails accessible to a wide range of tourists. Cycling is practiced all year round, on all types of trails (highway trails, mountain trails and mixed trails).

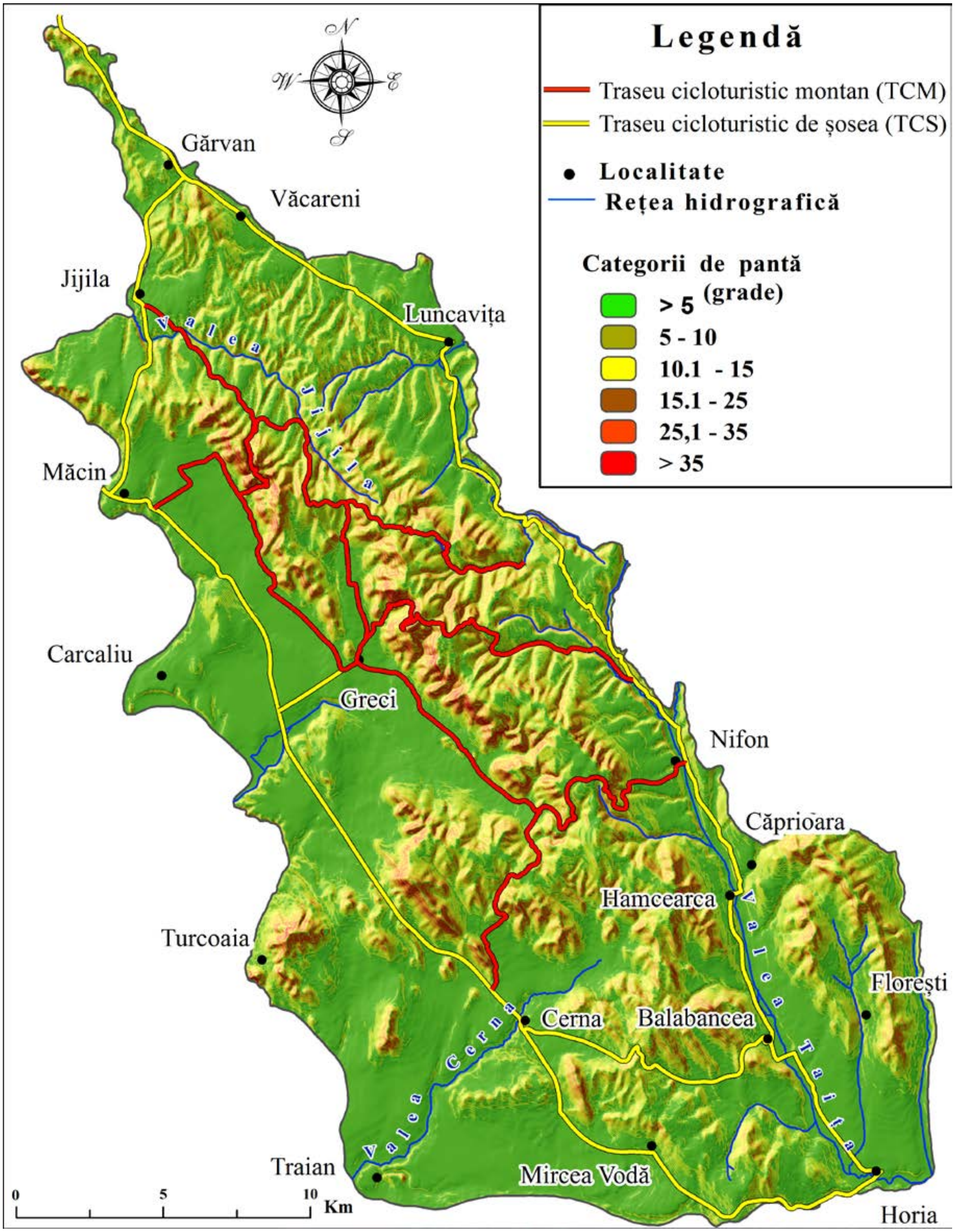

Fig. 21 The cycling routes map of Măcin Măcin Mountains

7.1.4 Equestrian tourism is currently practiced on a single and homologated trail, in Megina Ridge, that passes through the Arsu – Şaua Mare - Arheuziu – Archizel – Lifante – Pietrele Albe – Megina peaks (figure 22).

Fig. 22 Equestrian tourism in Măcin Mountains

7.1.5 Paragliding. The most famous take - off area is Priopcea Peak (figure 23). Its notoriety derives from the takeoff area characteristics: ascendant air currents, area without vegetation obstacles, flattened peak with good visibility to all directions etc. These features beside the numerous landing areas constitutes favorable elements for practicing paragliding. Other zone suitable for this activity are Bujoare Hill (Bujorul Bulgăresc take – off area) and Buceag Ridges (Dinogeția take – off area). Is practiced recreational flight, training flight and initiation flight.

Fig. 23 Paragliding over Priopcea Peak

7.1.6 Overflying with easy flight equipment for morphology observation can be done by using slight equipment such as aircrafts or deltaplans.

7.1.7 Fishing and hunting

7.1.7.1 Fishing is practiced in the study area in natural basins (lakes and channels of the Danube River and Măcin Branch), artificial basins (Luncavița and Taița dam lakes) and in special designed basins (Traian lake). The multitude of basins and the ichthyofauna variety are favorable features for practicing this touristic activity.

7.1.7.2 Hunting is prohibited in the "Măcin Mountains" National Park area (on a surface of 11 151,82 ha). The hunting funds within the National Park have the status of refuge areas for the venison and can be managed only like cynegetic reserve. Hunting is practicing in the study area in 5 hunting funds, within Cerna, Hamcearca, Țiganca, Jijila and Greci settlements.

7.2 Cultural tourism

7.2.1 Scientific tourism is practicing exclusively in the Scientifical Reserves within “Măcin Mountains” National Park area, respectively in “Moroianu” Reserve (293,7 ha) and "Fagilor Valley" Forest Reserve (154,9 ha). Scientific tourism is practiced by a limited number of turists, which are generally persons with a high level of education. The access within these areas is restricted and is done only with the approval of the “Măcin Mountains” National Park Administration.

7.2.2 Ecotourism, along hiking and climbing is one of the more common touristic activity in the area. The large number of protected areas (8 protected areas) within the study area, makes of Măcin Mountains one the first ecotourism destinations of Romania. Although our study area is included, in a large proportion, within protected areas, ecotourism is practiced mostly within the "Macin Mountains" National Park area (on a surface of 11,151.82 ha), due to the concentration here of more than 1770 of plants species (representing over 50% of Romania's flora species) and a large number of fauna species (181 species of birds, 47 species of mammals, 900 species of butterflies, 11 species of reptiles and 7 species of amphibians) (Doniță et al., 2007).

7.2.3 Religious tourism. Although the conditions for practicing religious tourism are varied, the number of tourists in this category is low. The main polarizer pole of tourists flow is represented by “Izvorul Tămăduirii” Monastery (within Măcin city area). It attracts annually between 1000 - 1500 tourists (cf. “Măcin Mountains” National Park Administration).

7.2.4 Viticultural tourism is in an early stage of development activity in Măcin Mountains, but have a very great potential for development due to the existence of all the resources necessary to achieve a complete and complex wine route. The viticultural tourism is facilitated, within the study area, by the existence of one of the oldest vineyards in Dobrogea – “Sarica – Niculiţel” Vineyard, the center of production and bottling (SC Alcovin SRL – Măcin) and two specialized wine tasting units (Terente and Dobrogea cellars) (figure 24).

Fig. 24 Terente cellar (a) and professional wine tasting in Dobrogea cellar (b)

CHAPTER VIII. GEOMORPHOSITES WITHIN MĂCIN MOUNTAINS. INVENTORY AND ASSESSMENT

8.1 INVENTORY, CLASSIFICATION AND DISTRIBUTION OF GEOMORHOSITES

8.1.1 Geomorphosites inventory

Knowing the morphology of the study area allowed us to identify and select those landforms with attribute of geomorphosite (landforms and geomorphological processes representative for their category and important from scientific and educational viewpoint).

Were selected 47 representative landforms (geomorphosites) from among ridges, peaks, gorges, inselbergs and pediments, torrential - suffosion valleys, anthropogenic and natural lakes. The identified geomorphosites were subjected to inventory processes, materialized in an invenventory sheet. This sheet comprises necessary information for assessment processes (general information and specific information regarding the accessibility, conservation degree, touristic infrastructure, viewpoints etc.).

8.1.2 Geomorphosites classification.

Depending on their ***genesis*** the selected and inventoried geomorphosites are classified in *natural geomorphosites* (Vraju Peak, Chervant – Banului Ridge, Traian Lake etc.) and *anthropogenic geomorphosites* (Iacobdeal lake) etc.

In terms of ***dynamics*** of the generating geomorphological process are: *active geomorphosites* (the main generating process cause annual changes in the resulting landform; this constitutes an element of attractiveness from educational and scientifical viewpoint) like Măgăreți and Gărvan valleys; and *pasive geomorphosites* (the main generating process have slow dynamics and generates changes in the resulting landform in geological time) like Vf. Vraju, Vf. Caramalău etc. geomorphosites (Hooke, 1994).

Depending on ***morphological complexity*** (Grandgirard, 1999) in Măcin Mountains are individualized:

- *simple geomorphosites* – are singular or complex landforms generated by a single dominant process: peaks (Cetate, Cozluk, Secaru etc.), (Cetate, Cozluk, Secaru etc.), inselbergs (Carcaliu, Piatra Roșie), lakes (Traian Lake) etc.;
- *complexe geomorphosites* – resulted from the association of morphological elements, generated by the action of factors of different nature. An exemple is the Moroianu II Peak geomorphosite in which the selective erosion created a Sfinx micromorphology, while the linear erosion and tectonics generates an gorge sector (the Chediu Gorges);
- *system geomorphosites* are those geomorphosites that includes other smaller geomorphosites and between which, there is a functional relation. Is the case of Cerna - Mircea Vodă basin, in which are contained other geomorphosites: Bujoare Hill, Piatra Roșie, Iacobdeal, Cernei Hill inselbergs.

8.1.3 Spatial distribution of geomorhosites

The geomorphosites within the study area are distributed in two major morphological units: mountain space and south-western basin area (figure 25).

In *mountain space* the geomorphosites are concentrated in the northern part of Pricopan Ridge (Cheia, Piatra Râioasă, Sulucu Mare peaks etc.); in the central and southern sector of Greci Ridge; in Priopcea –

Chervant Ridge and in the northern part of Megina Ridge (Piatra Greci, Boldea and Sivrica peaks). Isolated are found in the northern part of mountain space, in Buceag Ridge (Bisericuța inselberg and Gărvan Valley), in the central part of Greci Ridge (Stâna Oancei and Vergu peaks) and in the eastern part of the area, in Boclugea Ridge.

In *Cerna - Mircea Vodă basin* are identified the following geomorphosites: Bujoare Hill, Piatra Roșie, Muchea Lungă and Iacobdeal inselbergs; Traian Lake and Măgăreți torrential – suffosional valley.

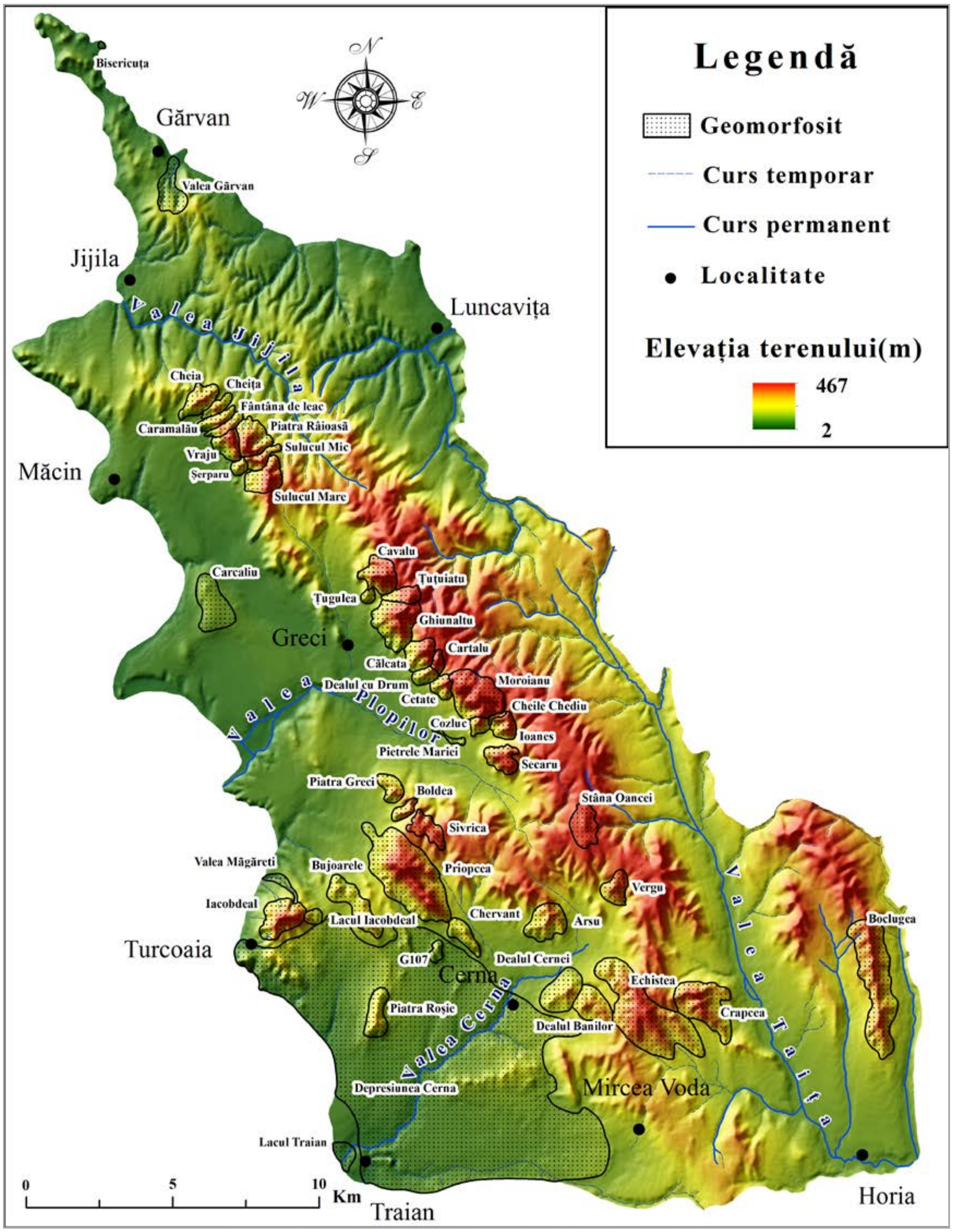

Fig. 25 The map of geomorphosites spatial distribution in the study area

8.2 THE ASSESSMENT OF GEOMORPHOSITES WITHIN MĂCIN MOUNTAINS

The geomorphosites identified in the previous stage were subjected to the assessment process, using the method described in the methodology chapter (chapter III).

The implementation of the assessment method to 47 geomophosites was materialized through an assessment sheet for each geomorfosit. The assessment sheet comprises general information (name, altitude, geographical position, typology, photography and the total value obtained in the assessment process) and the description of means of score awarding within each criterion (table 1).

Table 1. The geomorphosites assessment sheet

<table>
<tr><th colspan="3">The assessment sheet of “Caramalău Peak” geomorphosite</th></tr>
<tr><td colspan="2">Name – Caramalău Peak
Typology – complexe geomorphosite
Altitude – 277 meters
Morphological unit – Pricopan Ridge
Settlement – Măcin, Tulcea county

Total value – 27 points
Scientific value – 12.25 p
Educational value – 2 p
Aesthetic value – 5.5 p
Cultural value – 0.75 p
Touristic value – 6.5 p</td><td></td></tr>
<tr><td rowspan="2">SCIENTIFIC VALUE (VsG)</td><td>Geomorphological Importance (Ig)</td><td>- geomorphosite resulted by the action of 2 dominant morphogenetic factors: lithology and weathering – 0.75 p
- Paleozoica age – geomorphosite generated in Pricopan granites formed after the Carapelit Formation sedimentation (respectively after Carbonifer – Permian age) – 1 p
- slow dynamics, with changes in geological time (the annual weathering rate is very small, visible changes in overall morphology may arise in geologic time) – 0.25 p
- geomorphosite representative at international level due to it morphological and micromorphological diversity generated by weatering processes – 1 p
- within the study area is registred a big occurrence frequency of sites shaped by weatering processes – 1 p
- geomorphosite rare at national level (the resulted morphology is rare at national level) – 0.75 p
- the geomorphosite has 3 elements of geomorphological interest: petrographical steep slope on the western slope of the peak, weathering micromorphology (rock fields, tors, spherical rocks etc.) and ruiniphorm peak – 0.50 p
- the geomorphosite has a very good state of preservation - 1 p</td></tr>
<tr><td>Scientifical Notoriety (Ns)</td><td>- were realized a doctoral thesis on the geomorphology of the area, synthetic scientifical studies that aimed the landscape of the site; and scientifical articles - 1 p
- geomorphosite constitutes theoretical support for the partially explanation of pediplain theory – 0.75</td></tr>
</table>

	Ecological Importance (Ie)	- within the geomorphosite are endangered flora species (brier), vulnerable species (*Silene compacta*, *Allium flavum*, *Campanula grossekii*, *Thymus zgyioides –Scutellaria orientalis*), endemic species for Dobrogea (*Campanula romanica*) and rare species (*Stipa ucrainica* - pannonian-caucasian specie, *Erianthus ravennae* - mediterranean specie) –1 p - within the geomorphosite are endangered and rare fauna specie (*Lacerta trilineata*), vulnerable and endemic species (*Testudo graeca* – turtle – declarated Nature Monument by 13/1993 Law) – 1 p - geomorphosite has 4 ecosystems: rocks, meadows, shrubs and woodlands – 0.75 p - geomorphosite entirely included in a category I (cf. UICN clasiffication) protected area - National Park - Măcin Mountains National Park – 1 p - geomorphosite entirely included in an integrated protected zone within the Măcin Mountains National Park (cf. 552/2003 national decree regarding the inside delineation of national parks) – 0.75 p
DIDACTIC VALUE (VdG)		- geomorphosite is a relevant educational model – for explaining the weathering process and the whole spectrum of landforms resulted from its action – 1 p - geomorphosite is indispensable in establishing educational thematic trails within the study area - 1 p
AESTHETIC VALUE (VeG)		- geomorphosite situated in the high mountain area of Pricopan Ridge – 1 p - spectacular geomorphosite from aesthetic viewpoint due to it diverse micromorphology, steep slopes and ruiniphorm peak – 1 p - the attractive micromorphology has a large spatial extension within the geomorphosite, being distributed on the entire surface of the northern, western and southern slorpes - 1 p - geomorphosite has high relief energy, over 200 m – 0.75 p - geomorphosite has high morphological contrast by relating to the Măcin – Greci basin area – 1 p - geomorphosite has polychrome character due to combining within it of four ecosystems described above – 0.75 p
CULTURAL VALUE (VcG)		- historical sites are missing within the geomorphosite – 0 p - at the foot of geomorphosite is situated the Izvorul Tămâduirii Monastery, built in the last decade of our century – 0.25 p - a cultural event within the geomorphosite – religious pilgrimage – regionaly recognized and occasioned annualy by the Izvorul Tămâduirii religious feast – 0.50 p - within the geomorphosite were not identified ethnographic elements of tourist attraction – 0 p
TOURISTIC VALUE (VtG)		- car access up to the geomorphosite basis – 1 p - modernized national road (DN 22D situated at 3 km away from geomorphosite – 0.75 p - accommodation and public food structures situated at less than 5 km away from site – 1 p - touristic infrastructure very well represented within the geomorphosite area (touristic trail, halting place, campsite, informative panels) – 1 p - Brăila - urban center of services, over 100 000 inhabitants situated at less than 25 km away from geomorphosite - 1 p - geomorphosite offer the possibility to observe the surrounding morphology across ranges of 360 degree over: the vast pediment areas of Măcin –Greci, Jijila and Luncavița basins; over the relief developed on metamorphic rocks in Orliga – Sărărie Ridge; over the relief developed on igneous rock in Pricopan Ridge; over the floodplain and Danube river etc. - 1 p - within the geomorphosite can be practiced 4 tourism activities: birdwatching, hiking, scientifical tourism, ecotourism – 0.75 p

The total score obtained by each geomorphosite allowed us to achieve a value hierarchy (based on a quantitative analysis) of the geomorphosites within the Măcin Mountains (table 2). The place occupied by each geomorphosite in the ierarchy, reflects, in fact, the importance of the geomorphosite and the priorities in their recovery through geotourism.

Table 2. Geomorphosites ierarchy within the Măcin Mountains

No.	Geomorphosites name	Scientific value			Didactic value	Aesthetic Value	Cultural Value	Touristic Value	Total Value
		Ig	Ns	Ie					
1	Caramalău Peak	6	1.75	4.5	2	5.5	0.75	6.5	**27**
2	Fântâna de Leac Peak	6	1.75	4	2	5.5	0.75	6.5	**26.5**
3	Ghiunaltu Peak	6	1.5	4	2	6	0.25	5.25	**25**
4	Vraju Peak	5.5	1.5	3.5	2	5.25	0	6	**23.75**
5	Moroianu Peak	6	1.25	5	1.5	6	0	4	**23.75**
6	Sulucu Mic Peak	5.75	1.25	4.5	1.25	4.5	0	5.5	**22.75**
7	Sulucu Mare Peak	5.25	1.5	4.25	1.25	4.5	0	5.75	**22.5**
8	Cavalu Peak	5.25	1.5	3.5	1.5	5.25	0.25	5.25	**22.5**
9	Călcata Peak	6	0.75	4.25	1.25	5.25	0	4.75	**22.25**
10	Ţuţuiatu Peak	5	1.5	3.5	1.5	5	0.25	5.25	**22**
11	Cheia Peak	5.25	1.75	4.25	1	4.25	0	5.25	**21.75**
12	Chediu Gorges	5.5	1.5	4	2	5	0	3.5	**21.5**
13	Piatra Râioasă Peak	5.75	1.5	4.25	1.5	4	0	4.5	**21.5**
14	Priopcea Ridge	5	1.25	3	2	5.25	0	5	**21.5**
15	Cartalu Peak	5.75	1.25	4	1	4.5	0	5	**21.5**
16	Boclugea Ridge	5.5	1.75	1.75	1.5	5.5	1.5	3.75	**21.25**
17	Cheiţa Peak	5	1.5	4.5	1	4	0	5	**21**
18	Crapcea I and II Peak	5.25	1.25	3	1	4	2	4.5	**21**
19	Chervant - Banului Ridge	5	1.25	3.25	2	4.75	0	4.75	**21**
20	Ioaneş Peak	5.5	0.75	4	2	5	0	3.5	**20.75**
21	Dealul cu Drum Peak	4.75	1.25	4.5	0.75	3.75	0	5.5	**20.5**
22	Cerna - Mircea Vodă basin	4.75	2	1.5	2	2.75	2	4.5	**19.5**
23	Echiştea I and II Peak	5	1.25	3.5	1.25	4.25	0	4	**19.25**
24	Cetate Peak	5	0.75	4.75	0.75	4	0	3.75	**19**
25	Arsu Peak	4.25	1.5	4	1.5	3.75	0	4	**19**
26	Iacobdeal Inselberg	4.75	1.75	0.25	1.5	3.25	2	5.25	**18.75**
27	Pietrele Mariei Inselberg	6.25	1.5	0.5	1.75	4	0.25	4.25	**18.5**
28	Ţugulea Peak	5.25	1.75	1	2	3.5	0	4.75	**18.25**
29	Cozluk Peak	4	0.75	4.5	0.5	4.25	0	4	**18**
30	Secaru Peak	4.25	0.75	4.25	0.5	3.75	0	4.5	**18**
31	Vergu Peak	5	1.25	3.75	1	3.5	0	3	**17.5**
32	Gărvan Valley	5.5	2	0.25	2	2	2.25	3	**17**
33	Cerna Hill	4.75	1.5	0.5	1.25	3.25	1.5	4	**16.75**
34	Piatra Roşie Peak	4.5	2	1	2	2.5	0.25	4.25	**16.5**
35	Sivrica Peak	5	1.5	2.5	1.5	3	0	3	**16.5**
36	Piatra Greci Peak	5.25	1.5	1.25	1.75	3	0	3.5	**16.25**
37	Bani Hill	4.5	1.5	0.75	0.75	3.25	1.5	4	**16.25**
38	Şerparu Peak	4.25	1	2.25	0.5	3	0	5	**16**
39	Boldea Peak	5.25	1.5	1.25	1.5	3	0	3.5	**16**
40	Măgăreţi Valley	5	2	0.25	1.5	1.75	2	3.25	**15.75**

41	Bujoare Hill	5.25	2	0.5	1.5	2.25	0	4	**15.5**
42	Muchea Lungă Inselberg	5	1.75	0.75	1.5	2.25	0	4	**15.25**
43	Iacobdeal Lake	4.25	0.75	0.5	1.25	2.5	2	4	**15.25**
44	Bisericuţa Inselberg	4.75	1.25	0.25	1	1.25	2	4.75	**15.25**
45	Traian Lake	4.25	1.5	2.25	2	0.75	1.5	2.5	**14.75**
46	Carcaliu Inselberg	5.25	2	0	1.75	1	0	4.75	**14.75**
47	Stâna Oancei Peak	4.5	0.75	3.75	0.5	2.25	0	1.25	**13**

Depending on the main types of values, the geomorphosites are classified in sites with scientifical valences (Caramalău Peak - 12.25 p, Fântâna de Leac Peak – 11.75 p), educational valences (Piatra Roșie inselberg, Carcaliu inselberg, Cerna - Mircea-Vodă basin), aesthetical valences (Ghiunaltu Peak, Moroianu Peak, Călcata Peak, Ioaneș Peak, Pietrele Mariei inselberg etc.), cultural valences (Bisericuța inselberg, Fântâna de Leac Peak) and touristic valences (Vraju Peak, Cartalu Peak etc.).

CHAPTER IX. TOURIST RECOVERY OF GEOMORPHOSITES THROUGH GEOTOURISM

9.1 Geotourism represents an "*assembly of services that allow visitors to acquire knowledge and understand the geomorphology of a site (including its contribution to the development of Earth sciences) beyond their simple aesthetic appreciation*" (Hose, 1995, 1996).

Geotourism is, thus, a recreational activity (with strong cultural character) which ensure the knowledge of landforms and processes that generated them; the age and the role of rock in the genesis of landforms etc. For practicing this type of tourism is absolutely imperative to realize interpretative materials and thematic itineraries focused on the most important geomorphological aspects of the Măcin Mountains. The main information support for practicing geotourism is the geotouristic map.

9.2 The geotouristic map of the Măcin Mountains is based on the geomorphological map, achieved in the previous stages of our study (figure 11). The aim was to simplify it and to realize a comprehensive graphic representation of the morphology of tourist attraction.

From the Măcin Mountains geotouristic map (figure 26) were eliminated those landforms that are hardly noticeable in the field by unspecialized people, like: ravines, torents, proluvial and aluvial dejection cones, major riverbeds, alluvial deposits etc. On the resulting map were kept only those landforms easily recognizable in field: ridges, peaks, steep slopes, lakes etc. Some of technical scientific terms were simplified (elluvial, delluvial, colluvial and proluvial deposits), so that it can be understood by all categories of tourists. Thereafter were added tourist information: information centres, anthropogenic sights, touristic infrastructure etc.

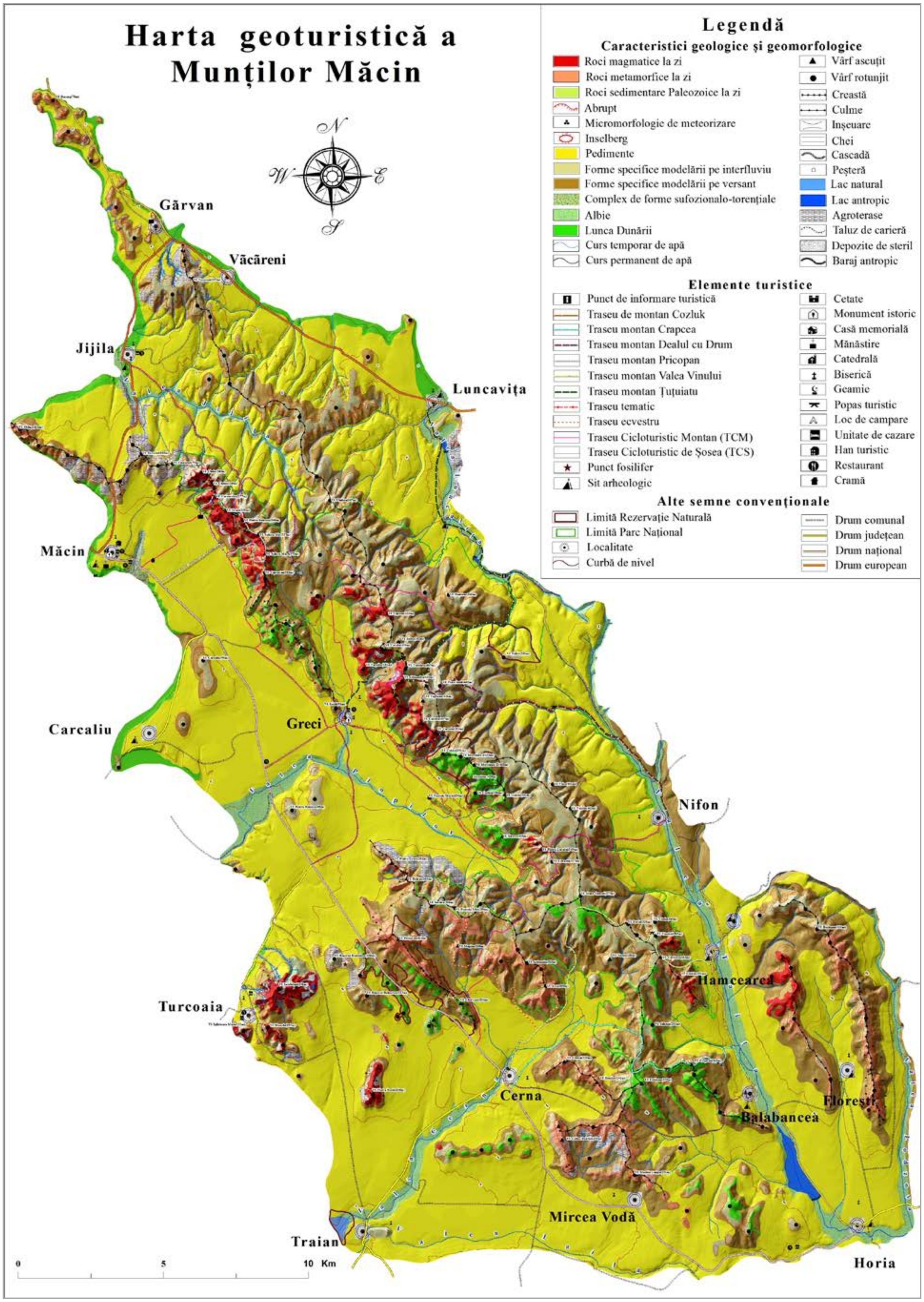

Fig. 26 The geotouristic map of Măcin Mountains

9.3 Proposal for geomorphosites recovery through practicing geotourism

The scientifical importance and the didactic valences of a geomorphosite constitutes favorable factors for the achievement of educational thematic trails that aims the knowledge of the morphological features of the Măcin Mountains through tourism activities (geotourism). Were realized recovery proposal for the first 25 geomorphosites ranked in the assessment process. Their touristic recovery was realized through the proposal of 3 geotouristic routes (Caramalău, Ghiunaltu and Priopcea trails).

9.3.1 Geomorphological itineraries. Proposals of educational trails and their touristic planning for practicing geotourism

9.3.1.1 "Caramalău" geotouristic (geomorphological) trail

Describe and acces. The trail comprises the most representative 8 geomorphosites within the Măcin Mountains, tree of it being ranked between first five as importance (Caramalău Peak, Fântâna de Leac Peak and Vraju Peak). The acces is made from the Măcin city. The acces direction is from north to south.

The ***geomorphological and educational importance*** of the site derives from the abundance and variety of landforms gerated by weathering processes. By crossing the trail it can be observed and understand the entire complex of weathering forms specifics to granite rocks: residual inselbergs and bornhartdts, granite blocks of various sizes (diameters of several meters), tors, granite blocks chaotically distributed, spherical rocks, exfoliated rocks, block fields etc.

Trail morphometry. The track was vectorised and then was carried out it longitudinal profile (figure 27). The route has a total length of 14.8 km: 7.7 in mountain area and 7.1 km in basin area.

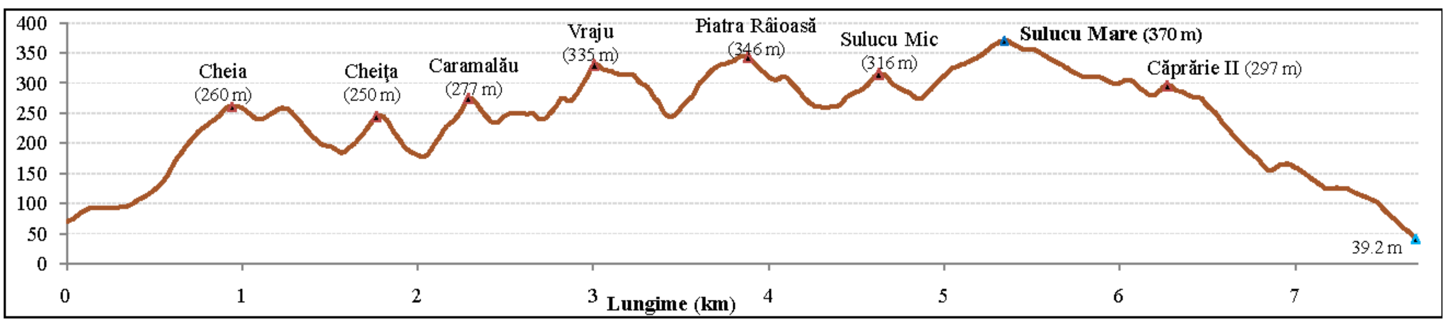

Fig. 27 Longitudinal profile on „Caramalău" thematic trail

The maximum altitude reached within the trail is of 370 m in Sulucu Mare Peak and the minimum altitude of 39,2 m, in the southern side of the trail, respectivelly at the foothill of Sulucului Hill. The maximum relief energy (190 m) is registered in the first part of the route, being reached in ascension to the top of the Cheia Peak (figure 28).

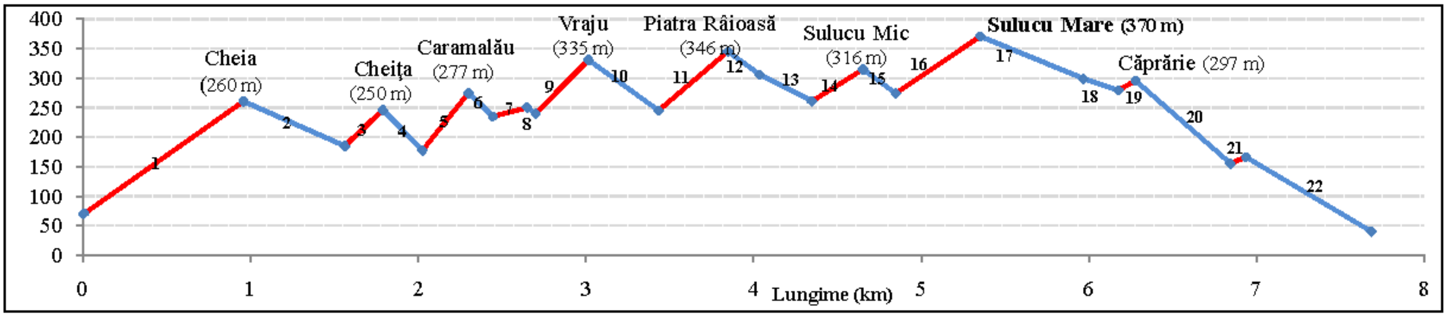

Fig. 28 Segments along the „Caramalău” path

In figure 28, the red lines signify the ascending sectors and the blue lines define the descending sectors within the touristic trail. For each segment was calculated the lengh, level diference and the average declivity (table 3). For the descending sectors, the values obtaind for level diference and declivity were entered with „-” mark (minus).

Table 3. Morphometric features of the „Caramalău” geoturistic trail

Segment in mountain area	Segment lengh (km)	Difference level on each segment (m)	Declivity on each segment (°)	Cumulative distance in mountain area (km)
1	1,0	190	19	1,0
2	0,6	-76,0	-12	1,6
3	0,2	60,8	29	1,8
4	0,2	-67,8	-28	2,0
5	0,3	96,9	32	2,3
6	0,1	-39,9	-26	2,4
7	0,2	15,4	7	2,6
8	0,1	-10,3	-17	2,7
9	0,3	90,8	28	3,0
10	0,4	-85,8	-20	3,4
11	0,4	100,3	28	3,8
12	0,2	-39,5	-21	4,0
13	0,3	-45,3	-15	4,3
14	0,3	54,6	16	4,7
15	0,2	-40,6	-22	4,8
16	0,5	96,1	19	5,4
17	0,6	-71,5	-12	6,0
18	0,2	-19,1	-9	6,2
19	0,1	15,7	15	6,3
20	0,6	-140,3	-24	6,8
21	0,1	10,6	10	6,9
22	0,7	-125,8	-18	7,7

Classification of the route. Knowing the altitudinal difference on the route, allowed us to establish the necessary time of crossing it - 7 h. The time duration of crossing route, the total ascending altitudinal differences (700 meters) and the sustained physical effort (due to high declivity) include the proposed geotouristic route within the medium difficulty degree routes (cf. Law no. 58/1998, with amendments and completions by Law no. 755/2001).

Necessary equipment. For crossing the trail is necessary a medium hiking equipment. ***Seasonality***. The proposed route can be performed throughout the entire year.

The ***planning of trail*** consists in placing information panels along the entire length of it, of viewpoints and of illustrated panels with the sourrounding morphology, of halting places and campsites (figure 29). All the morphological and tourist elements have been mapped. Thus resulted the detalied geotouristic map of Caramalău route.

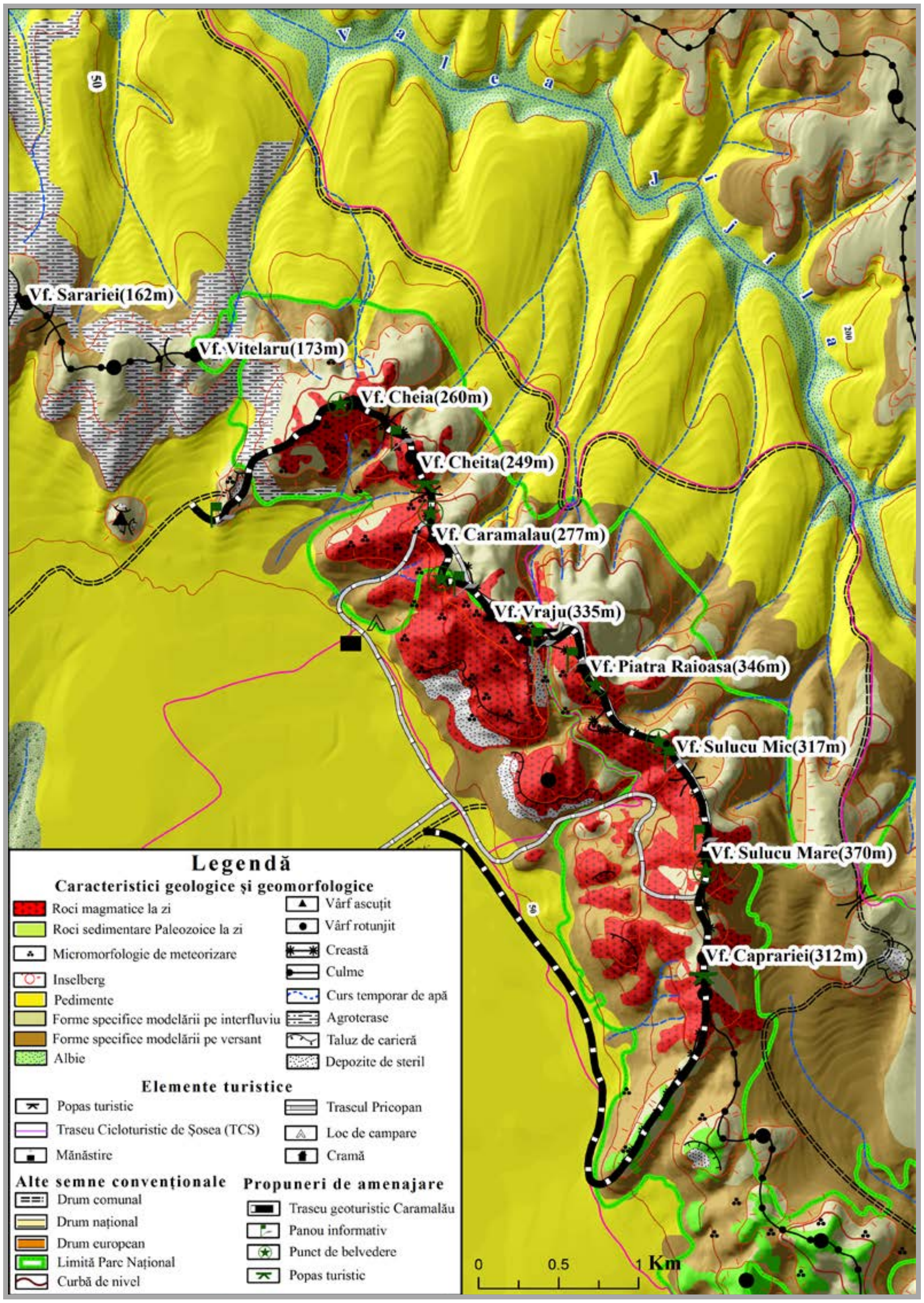

Fig. 29 The geotouristic map of „Caramalău" thematic trail

CHAPTER X. CONCLUSIONS

For achieving our paper objectives has been useful, in the first phase, a clearly individualization of the study area. The lack of a widely accepted regionalization determined us to create a new regionalization of the study area. We identified and mapped in the mountainous area 10 morphological subunits (chapter II).

The approach of a special category of landforms with tourist attractiveness – geomorphosites, determined us to realize a phased structured of actions to be followed in the inventory and mapping of it (chapter II). The subjectivity of the existing assessment methods has imposed the rethinking and designing a suitable methodology to assess the geomorphosites within the Măcin Mountains. The method was structured in 5 phases („values"): scientific, didactic, aesthetic, cultural and touristic.

The touristic attractiveness of the Măcin Mountains landscape is conferred by the morphometric and morphological features (chapter IV). The importance of hypsometry for tourism is reflected by the numerous posibilities to observe the surrounding morphology, in viewpoints of major, regional and local viewpoints. Areas with relief energy over 250 m/km² are spectacular sectors from scenic viewpoint (Chediu Gorges, Pricopan Ridge; central – western side of the Greci Ridge; Priopcea Ridge etc). The high percentage (32.5%) of the surfaces with relief energy between 100 - 200 m / km² determine the predominance of the hiking trails with medium and low difficulty degree. The large spatial extension (61,2%) of surfaces with declivity values under 6° are materialized through cycling routes with low difficulty degree. Steep slopes (over 42°) and vertical walls determined spectacular areas from scenic viewpoint and, in the same time, are favorable areas for practicing climbing.

The morphology increase the attractiveness degree of the study area through the following features: landform appearance, rarity, inedited, complexity, diversity, spatial extension of micromorphology and morphological contrast.

The touristic role of the landscape has tree situations: of attractive resource, of landscape background for touristic activities and support for tourism infrastructure. The Măcin Mountains landscape is an ***attractive resource*** through: ridges, peaks, gorges, waterfalls, inselbergs, fluvial harbor, natural and anthropogenic lakes, and micromorphology.

In Măcin Mountains we also identified a serie of situation in which the morphology play a secondary role in tourism activities development, of ***landscape background*** for: anthropogenic edifices (archaeological, historical and religious sites); touristic infrastructure; for social activities (festivals, pilgrimage etc.); human activities (ethnographic resource) and for other touristic activities which are not directly influenced by the morphology or cultural sites of Măcin Mountains (transit travel).

The landscape perform the role of ***support for tourism infrastructure***: accommodation units, public food units, transports and information and orientation touristic infrastructure. The accommodation infrastructure is minimal (7 accommodation structures), with a reduced accommodation capacity (148 places in specialized structures) and low comfort degree (2*), being distributed excluvelly in the settlements situated on the western side of the study area. In the Măcin Mountains area has been found an insufficient development of the existing public food structures (10 units) with a total capacity of 1192 places.

The road network is well represented in the teritory but has a low degree of modernization. The main acces roads are: 87 European road, 22 D national road and 222A county road; to which are added their ramifications (222H, 222K and 222B county roads) and exploitation roads which facilitates the acces in the mountain space (mainly in Pricopan Ridge). The information infrastructure is represented through "Valea

Fagilor – Cetățuia” research and information centre, to which are added the informative panels within the mountain space. The orientation infrastructure is less represented than the information one, laking for the natural sights and for the accommodation units. A better representation in the territory has the orientation infrastructure within the mountain area.

Between the ***types of tourism*** developed on the study area, the most representative is ecotourism. To it is added hiking and climbing (sportive climbing, bouldering and initiation climbing), but also, several other activities like: cycling, equestrian tourism, paradigling, fishing, hunting; religious tourism, viticultural tourism and scientific tourism.

Knowing the morphology of the area allowed us to identify and select of those landforms which have the attribute of ***geomorphosite***. It has been selected 47 geomorphosites. These were subjected to the assessment process, that allowed us to obtain a hierarchy in terms of their importance and priorities in recovery through geotourism. Also, has resulted geomorphosites with scientific, educational, aesthetic, cultural and touristic valences.

For the promotion of the geomorphological heritage of the Măcin Mountains was realized the ***geotouristic map*** of the area.

Using the assessment results, we realized ***proposal for touristic recovery*** for the first geomorphosites ranked in the Măcin Mountains ierarchy. The recovery consists in their integration within 3 geotouristic trails. For each proposed thematic trail we have specified it geomorphological and educational importance. We also realized a qualitative (descriptive) and quantitative analysis, through which we determined the morphometric features of the thematic trails (profile, lengh, declivity, relief energy). With their help we have established the time duration of crossing the path, the degree of dificulty etc. We realized propopsal for path planning with informative panels, halting place, viewpoints. The geomorphological heritage elements and the touristic elements were represented, for each route, on the detailed geotouristic map.

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