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PETROGRAPHICAL RELIEF ON THE SOUTHERN SLOPE OF THE FĂGĂRAŞ MOUNTAINS (THE ARGEŞ BASIN, ROMANIA) – PREMISS FOR IDENTIFICATION OF GEOMORPHOSITES

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Abstract: It is therefore the relief in its relationship with petrography. On the valley of the Argeş River, in the mountains sector, the morphology of the area consists of metamorphic rocks and it is often monotonous. The differential erosion creates ridges and grooves parallel to the schistosity. The shales are soft hollows. Marble and gneiss are resistant surfaces. At a fine scale, the differences favour the destruction of the metamorphic rocks. The slope and the deformation of these rocks guide their morphological evolution. The presence of the limestones (on small surfaces) reflects in the relief by specifc forms: avenas, small caves, but also by the specific morphology which it imposes to the pre-existent forms of relief (glacial cirques, valleys etc).

Key words: petrographical relief, crystalline, ruiniphorm relief, pyramidal peaks, petrographical cliffs, block fields, geomorphosites, Făgăraş Mts, Romania.

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1. INTRODUCTION

The present paper aims at studying the petrographic relief from the representative mountainous space of Romania, by means of the superlatives it holds. The petrographic relief imposes within the analysis of the specialists in Geography in general and of the geomorphologists in particular, from several reasons:

- the rock and its reaction to the external agents represents an essential factor in the relief's dynamic
- the genesis of the relief is strongly influenced in time and space by the type of rock
- the forms of petrographic relief represent some of the most important natural touristic objectives, and this way they achieve economic value, too.

Rocks introduce among the most various aspects in the geographical landscape, conditioning the genesis (structural factors, lithology, agents, past and present climat), the evolution and the external aspect of the relief forms, through their physical and chemical properties which determine it to respond differently to the action of modeling agents.

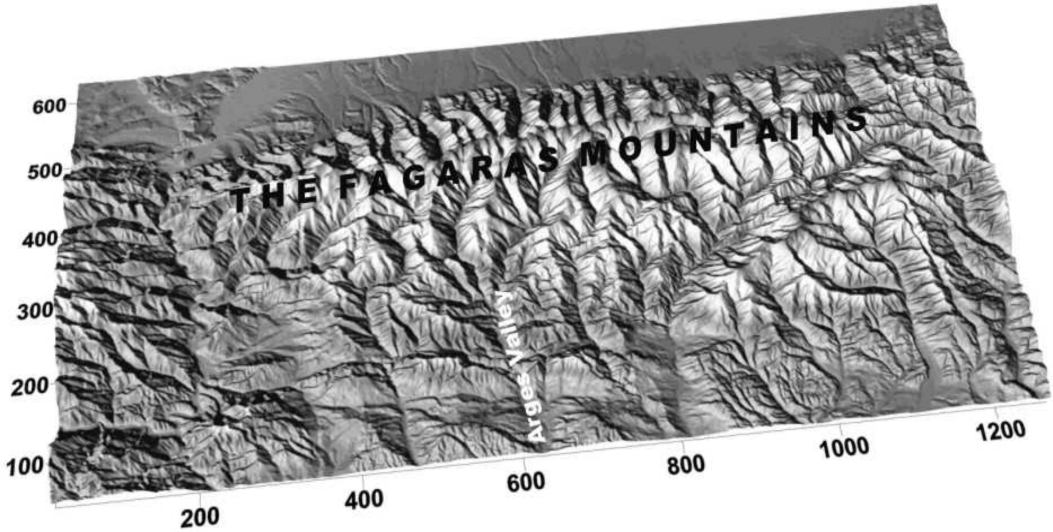

Figure 1. The geographic position of Argeş Valley

The study area covers the mountainous sector of Argeşului Valley carved into the southern slope of the Făgăraş Massif between two of the most representative Peaks of the Carpathian Mountains – Negoiu (2,535 m) and Moldoveanu (2,544 m) (figure 1).

2. METHODOLOGY

The below mentioned methodology was used during the study of the petrographic relief in the area. We therefore analyzed Topographic Maps at a scale of 1:25,000 and 1:5,000, correlated aerial photographs, the Negoiu and Cumpăna Geological Maps at a scale of 1:50,000, various satellite images. The study area was mapped considering both the information available in lab and the field survey. Slope processes from above forest limit and fluvial processes occurring in the forest belt were photographed and measured. Fully aware that a serious analysis of the petrographic relief in the area requires great insight on the area's geologic and geographic features we studied the available literature. From the morphodynamic point of wiew (fluvial, glacial and crionival agents) rock imposed itself by a great morphological variety. This one also imposed an analysis of the relief forms for each petrographical type. The petrographic relief is a relief of high spectacularity, many of the forms of relief which appear being comprised in the category of the geomorphosites (Panizza, M., 2001), having new valences due to their perception by the human society (figure 2).

Geomorphosites are systems that resulted from the interaction of passive internal and active external agents over time and territory. Geomorphosites bear great importance in understanding the paleogeomorphological evolution of the local area and more.

The value of a geomorphosite is very important considering their future protection and touristic capitalization. Establishing their value is certainly in most cases subjective but it's very useful in comparing small areas especially when the evaluation process is made by the same researcher. The value attributed to geomorphosites has two large components: the scientific value and additional values (cultural-historic value, environmental, economic, cultural and aesthetic) (Reynard, E., 2007; Reynard, E., Coratza, P. Regolini-Bissig, G., 2009).

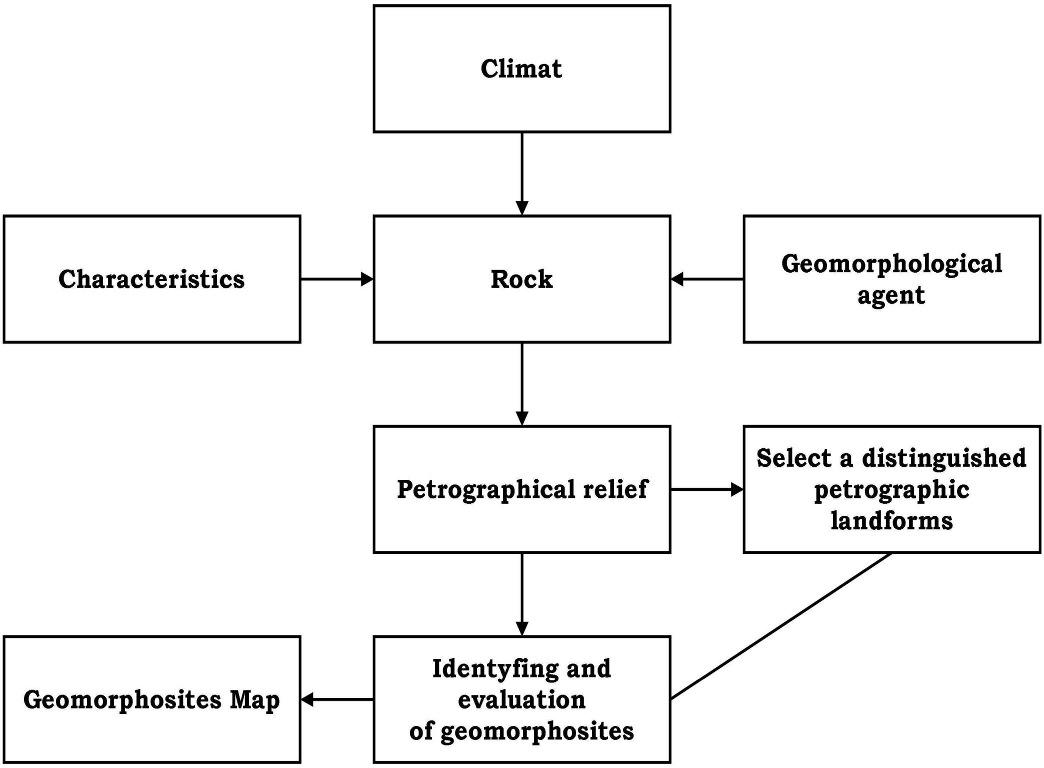

Figure 2. The relation between rocks and geomorphosites

Learning more about geomorphosites is important not only for geomorphologists, who are more interested in their scientific value, but also for experts in tourism geography that appreciate their aesthetic value and their importance as tourist attractions or for experts in environmental geography and biogeography who value their ecological significance. Should such a study acquire a more commercial value with the purpose of generating income then it becomes of relevance for economists, authorities and businessmen (Coratza, P., Giusti, C., 2002).

3. LITHOLOGICAL OUTLINE

In the northern part of the Făgăraş mountains are detach three important complexes: chloritous, quartzous, calciferous. The part of contact with the Autochton is formed of mezo and catametamorphic crystalline rocks (Săndulescu, 1984), made up of mica-schists, gneiss, amphibolite, pure marbles etc

A characteristic for the analysed space is represented by the disposal of the petrographic complexes in parallel fasciae in the direction east-west (Balintoni, I., 1997). The entire massif is crossed by old acid and basic veins. Out of an executed north-south profile, it can be noticed a sequence of petrographic types. Nearby the main peak of the Făgăraş mountains there are mica-schists, paragneiss with garnet-bearing gneisses and pure marbles which form the Şerbota Zone. To the south of the main peak there are sericitous, chloritous and amphibolic schists, graphitous phyllites and quartzites, namely to the Vemeşoaia Zone. To the south of this zone the degree of metamorphism increases, and the rocks belong to Series of Cumpana, which comprises the Zone of Măgura Câinenilor and the Zone of the gneiss of Cumpana (Pană D, 1990). To the south of the mentioned series, there appear tertiary deposits (Neozoic) which belong to the Loviştei Depression (figure 3).

The Argeş Basin in the mountain sector, with the two springs Capra and Buda, represents the most extended unitary crystalline region of the Carpathians. Intercalation of the two big units (Făgăraş and Getic), also introduces various, morpholitologic landscapes, imposed by sedimentary crystalline rocks with different features.

The crystalline rock extension could suggest a potential relief monotony, while the great diversity of forms shows the differentiations between crystalline the rocks properties of and the multitude the agents and modeling processes. Petrographic erosion outliers are numerous in this entire mountainous area. Physical weathering is specific to crystalline schist and slightly consolidated conglomerates from the Lovistea depression, whereas dissolution and disintegration characterize the dolomites and the crystalline limestone, linear erosion being first of all specific to gravel and sands, superficial landslides, while sheet erosion is specific to marlous facies and marl-claying from the Arefu depression (Bravard, Y., 1980).

Spatially, they occupy various surfaces, being more obvious on limestone and amphibolites than on gneiss and mica-schist. The lithological character of some modeling steps is more obvious on the harsh rocks (amphibolites, quartz- mica schist and crystalline limestone). This feature can be observed in the Capra and Buda basins and there is more difficult to identify it in Lovistea depression and around the Vidraru lake. On the whole, the crystalline shale in the Făgăraş unit, is distinguished by gneiss, paragneiss and mica-schist to which many intercalations of crystalline limestone, amphibolites and quartzite are added (Mutihac V, 2004). On a various structural tectonic background, petrography has a great heterogeneity (figure 3).

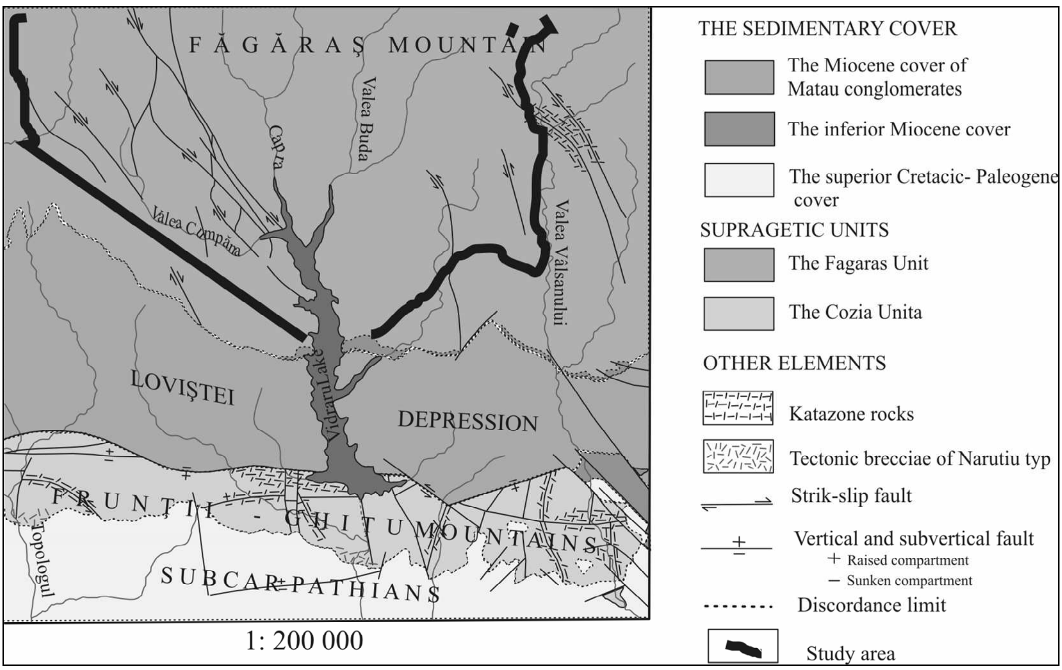

Figure 3. Geologic map of Făgăraş Mountains
(modified from the Geological Map of Romania, 1:50.000 – Cumpăna, Dimitrescu et. al, 1985)

4. PETROGRAPHICAL ASPECTS OF RELIEF

4.1. Gneiss, paragneiss, mica-schist and amphibolites relief

Their hardness and massiveness imposed the relief on these rocks, kept fragments of the planation surfaces and also forms of the glacier relief (cirques, valleys, glacier replates, moraines) or Pleistocene periglacier forms (pyramidal peaks, peaks, fossil sliderocks). On the contrary, the schistosity plans of rocks, their slighter hardness and high gelivity degree favoured the periglacier and crionival processes, their products representing the main accumulations from the glaciers cirques and valleys (cones, talus and debris mantles, torrents, and debris flows, striate soils, reestablished stones etc.) (Bravard, Y., 1980). At the same time they generated a residual relief of needles, cliffs and towers (Paltin, Arpas Tower, Cleopatra Needle) (Popescu, N., Ielenicz, M., 1981).

Gneiss, rocks rich in feldspars and quartz, with a mechanical, relatively high rate of weathering and alteration, of component minerals. In the presence of water, feldspars easily deteriorate, causing thick deterioration of calcrete, especially on the plan surfaces. Gneiss form microrelief on rock slopes. In the ocular and bedding gneiss, characteristic for the south sector (Ghitu-Albina-Fruntii), Argeş and Limpedea gorges were cut rendering a wild aspect to the landscape. Plagioclase paragneiss or gneiss are similar to gneiss (Nedelea, A., 2005).

Amphibolites are relatively resistant to mechanical weathering, imposing themselves by threshold slopes, petrographic cliffs, sharp peaks and strongly inclined slopes. Glacier modeling formed well outlined cirques, with abrupt sides. Amphibolites show a massive character as Vanatoarea lui Budeanu and Iezerul Caprei peaks, situated on two intercalations like these, giving them a pyramidal aspect. When the amphibolite intercalations appear on slopes, especially in glacier cirques and valleys they form cliffs, having accumulated at their base rocks falls, usually of big size (figure 4).

Figure 4. Amphibolite block side in the Raiosu area

In these cases where amphibolite bars pass the glacier and fluvial valleys, they impose themselves by structural petrographical threshold slopes (Nedelcu, E.,1959).

Mica-schist have a strong resistance to alteration, but they are easily disintegrated because of the schistosity plans (figure 5) which exhibit a block aspect. Mica-schist are rich in quartz (quartz mica-schist), extremely resistant to alteration and disintegration, forming threshold slopes both in glacier and fluvial forms. The glacier modeling creates in mica schist glacier cirques with moderate slopes, while frost-shattering, favorises their accumulation at the cirques' bottom.

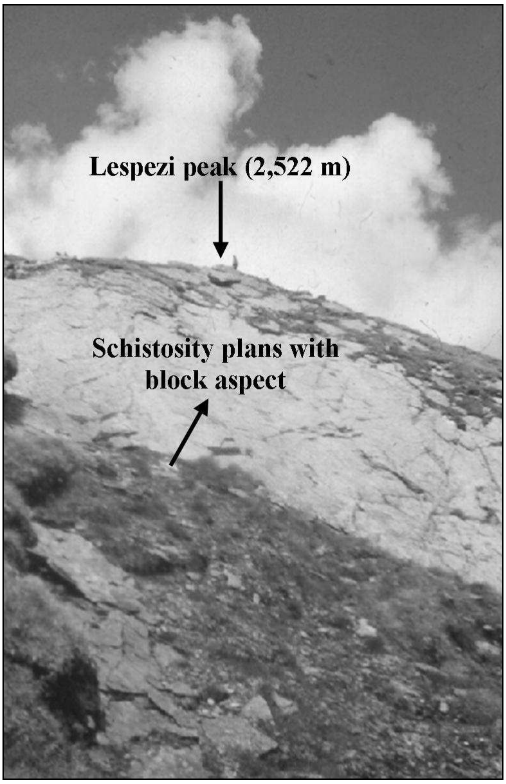

Figure 5. The Lespezi peak shaped in mica -schist

The presence of the crystalline schist determines a typical morphological aspect: massive, monotone, wild, clumsy, well-drained surfaces and accentuated degradation. The accentuated degradation is due to rocks split along the schistosity plans and chemical alteration, of gneiss, paragneiss and mica-schist. The result of this weathering consists in the creation of slide material and of mantle rock, where the gradients allow (Nedelea, A., 2006).

4.2. Relief modelled on limestone and crystalline dolomites

Intercalations of limestone and crystalline dolomites (marbles) induce diversity in the geomorphologic crystalline landscape of the Făgăraş Mountains. Their properties are completely different from those of the crystalline schist (harshness, homogeneity, solubility, great gelivity degree) and impose the apparition of some specific forms similar to the carstic ones. These forms are present in Buda-Raiosu-Museteica area and locally in several valleys (Lespezi, Capra, Paltinu, Podul Giurgiului, Orzaneaua, Izvorul Moldoveanu), where the erosion reveals those intercalations. In Paraul Caprei glacier valley at Piciorul lui Buteanu and in the upper part of Fundul Caprei valley, the presence of the limestone bands, generates the appearance of petrographical abrupt at whose base talus accumulates.

The specific relief of Buda-Raiosu-Museteica peaks, is a ruiniphorm one, with crests, needles, towers, and cliffs (Coltii Raiosului), with thick masses of slide rock, lapies, avens, dolina and carstic springs (figure 6).

İt is worth mentioning that the presence of the limestone in Saua Portita Arpasului (2,175 m) led through dissolution to the formation of a karst window of 1-2 m length, named “Fereastra zmeilor”, of a circular form, having an advanced degree of disintegration and alteration.

Figure 6. Raiosu cliffs – ruiniphorm peak

The influence of the limestone presence is especially found in the glacier relief, by the existence of some round cirques with well outlined sides and thick masses of slide rocks. Another proof is represented by the limestone abrupt (figure 7) and gorges of small dimensions with abrupt slopes, formed by the rivers’ deepening in Postglacier. Older topographical maps show the presence of a glacier lake in Raiosu cirque with a surface of 0,15 ha (Pisota, I., 1971). However, newer maps (since 1975) and the field observations show the existence of this lake.

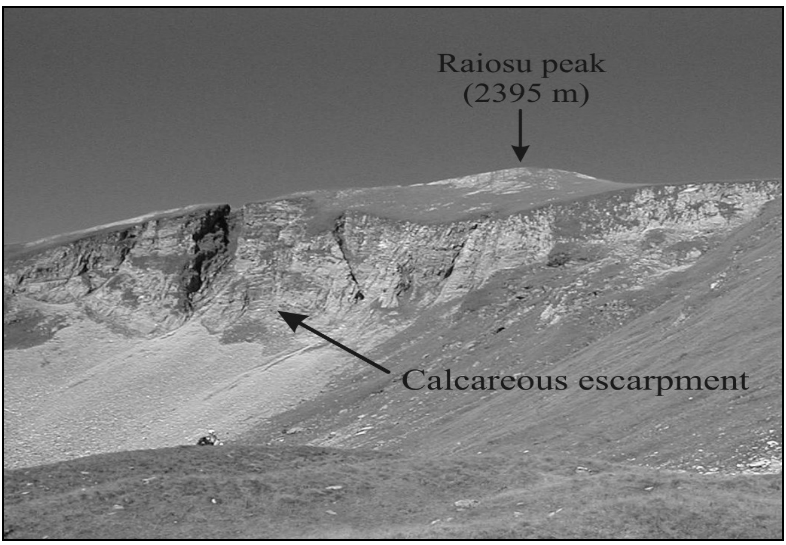

Figure 7. Calcareous escarpament and scree slope under Raiosu peak

The cirque bottom is wet especially in spring, and the lake disappearance may be due to a strong accumulation and to numerous fissures and diaclasis in the crystalline limestone. Among well represented exocarstic forms, there are the lapies, observed in Buda cirque, on Museteica, Mesteacanu peaks, on the plateau under Raiosu peak II, on Raiosu and Museteica valleys (Nedelcu, E., 1988)

These also appear on the slide rocks or on the moutonnée calcareous rocks. Dolines appear in the area of Museteica glacionival cirque or on the slopes of Museteica valley. They can derive from rockfall, dissolution or from lithological contact between limestone and amphibolites.

Endocarst is represented by small caves and pit caves situated in the upper sectors of Museteica and Raiosu valley or in the near proximity of Museteica (2,442) and Mesteacanu (2,255) peaks (figure 8). identified four caves and two pit caves (Nedelea, A., 2006):

- M1 cave from Museteica valley at 2,100 m, on the right slope in a small depression, which acted as a ponor;
- M2 cave from Museteica, at 2,050 m, on the left valley;
- M1-R2 cave situated under Museteica peak at 2,435 m, with specific endocarstic forms;
- M4 (2,411 m) and M5 (2,406 avens from Museteica);
- R1 cave from Raiosu, at 2,265 m, on the left versant of Raiosu valley, the lArgeşt of this complex.

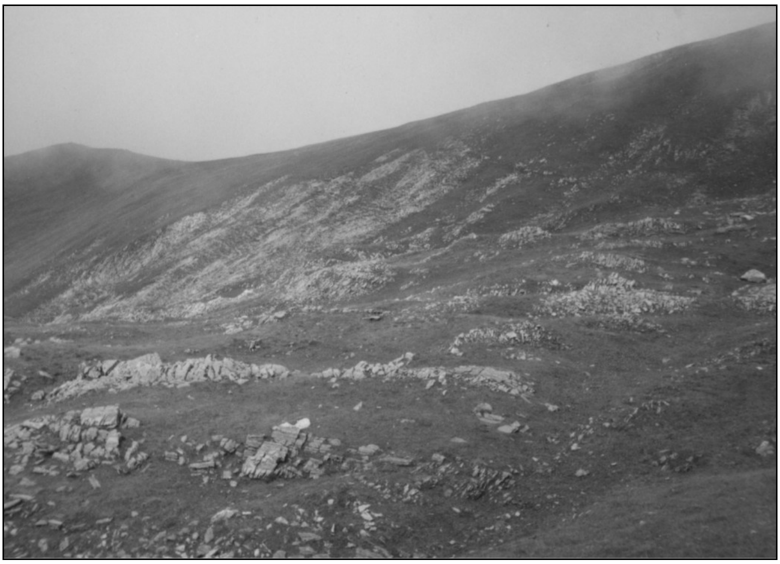

Figure 8. Block field under Museteica peak

To the evolution of these karst forms influences the nival processes by the action of snow compaction and by its chemical aggressiveness; water from precipitations or snow melt become more corrosive at low temperature due to the accumulation of a larger amount of CO_2.

Lithologic contacts impose in the relief through abrupts or knicks along the longitudinal profile of the valleys. The narrow bands of crystalline limestone and dolomites which appear by erosion determine the longitudinal profile of the valleys to have numerous knicks and threshold slopes on which small waterfalls appeared (Izvorul Mircea, Buda, Orzaneaua, Izvorul Moldoveanu, Museteica, Lespezi, Căprioara, Paltinu). Also, the alternation of rocks of different hardness besides glacier and periglacier erosion led to the structural-petrographical threshold slope formation (figure 9) and to the polygenetic saddles (Saua Buda, Ucisoara, Saua Rea, Saua Galbena) (Nedelcu, E., 1959).

The physiognomy of Capra and Buda basins in the southern half of the valley, is given by the high degree of vegetation cover (in order to protect the rock), by the limestone bands disappearance and also by the presence of crystalline rocks from the Cumpana series (linear gneiss in massive facies of gneiss and paragneiss from Valea Bolovanului) which give a monotonous aspect.

Figure 9. Izvoru Moldoveanu -structural-petrographical threshold

4.3. Modeling relief on conglomerates and calcareous sandstones

This is specific to Lovistea Depression and to some restrained areas from Ghitu – Albina. Slightly consolidated conglomerates of miocen-burdigalian age, formed by stones and slightly rolling blocks (fragments of gray, white limestone, crystalline schist, mica-schist, quartz schist), situated in a calcareous base, here and there siliceous, constituted the sedimentary load of Brezoi-Titesti (Lovistea) basin. On a background of the poorly consolidated rocks, conjugated processes of rain wash, corrasion, crionivation and dissolution, created on the structural surfaces an isolated ruiniphorm microrelief. It is not as spectacular as that in the Bucegi or Ciucas Mountains (sandstones resistant to erosion are absent). The heterogeneity of these rocks, in which also appear big blocks of gneiss, mica schist, amphibolites, favours the modeling of some relief forms through differential erosion. Therefore there might appear lithologic steps on gneiss, amphibolites and abrupt on conglomerates, dissolution due to humic acid in soils and due to forests litiera of beech and coniferous. They create microforms of alveolus or hole type which evolve in lithologic steps and benches. The anthropic interventions concerning Vidraru dam's construction and of the two roads which surround the lake, decreased conglomerates' resistance, as they were affected by present day geomorphologic processes: rockfall, rolling, landslides.

Within the Limpedea basin, forms developed on calcareous, senonian sandstones (isolated patches in the frame of Ghitu and Albina Mountains), are met but they are not representative for the studied sector.

5. CONCLUSIONS

Mountains situated in Argeş Basin are characterized by an extremely various morphostructural and petrographical landscape and the landscapes due to glacial and perriglacial processes. The spectacular aspect of the relief is based on the alternation of a great number of structures on a small – sized surface with a diversified lithology (Godard, A., 1983; Ilieş, D.C., Josan, N., 2009).

The tourism potential of this relief is remarkable but limited due to high relief fragmentation and to the low accessibility of the valleys and to the structural lithological abrupt. However the subsequent character of some valley sectors, increased the accessibility of roads and even the development of some specific activities (forest, pastoral and tourism). For example, there are several tourism sites such as Cumpana, Valea cu Pesti, Oticu, Piscu Negru, situated in the subsequent basins. Structural levels, structural controls and structural peaks are reliable places for pastoral shelters and huts but also for roads (e.g. TransFăgăraşan and different forest roads).

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