"Babeş-Bolyai" University Cluj-Napoca
Faculty of Geography

PhD Thesis

PIULE – IORGOVANU MOUNTAINS
Geomorphologic study

Summary

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Key words: ***Piule-Iorgovanu Mountains, Southern Carpathians, glacial landforms, exokarst, endokarst, leveled surfaces, geomorphologic evolution, underground flow***

CHAPTER I – INTRODUCTION

I. 1. Geographic position and limits

Piule-Iorgovanu Mountains strech between 22°48’ - 22°59’ long E and 45°16’ - 45°20’ lat N. It makes part of the larger mountain group of Retezat-Godeanu situated in Western part of Southern Carpathians, situated almost in its center. The summit of Piule, of 2081 m represents the highest point of these mountains.

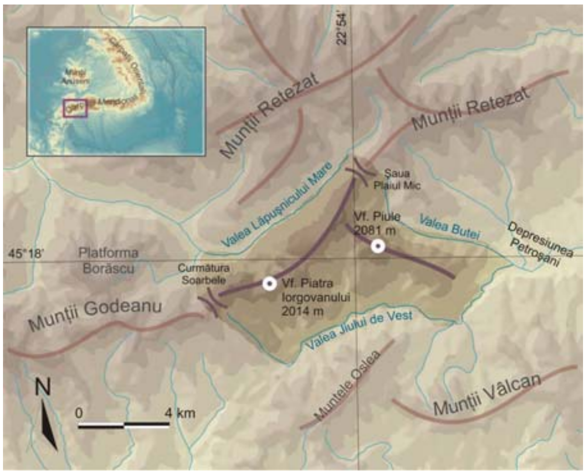


Fig. 1 – Position and limits of Piule-Iorgovanu Mountains

The entire surface of the massive covers no more than 45 km^2, being comparable with other similar massives from Romananian Carpathians – Cozia, Latorița, Piatra Craiului. Its area represents 0.27% of that of Southern Carpathians.

I. 2. Background research

The region analyzed here has never been before the object of a detailed study or of an integrated one, the reasons being its position in the center of the mountains with a rather difficult acces. Only once with starting the coal minning in Petroşani Depression the region has been studied geologicaly in more detail. On a whole, the data have not been gathered togheter in a unique study. The geologic data have been used to explain the general structural and petrographic setting of Southern Carpathians.

CHAPTER II – GEOLOGIC SETTING AND PALEOGEOGRAPHICAL EVOLUTION

II. 1. Lithology and structure

The main geologic components of these mountains are the limestones that give the massive a strong particularity over the neighborough units.

The main structures that form the tectonic setting in the area are the: **Danubian Autochtone** and **Getic Nappe**. Each of these comprises the cristaline base and its sedimentary blanket. In Piule-Iorgovanu Mountains appear predominantly the formations of Danubian Autochtone.

Paleogeographic evolution

The main stages of evolution of these area is strong related with the evolution of the Western part of Southern Carpathians.

The evolution of Piule-Iorgovanu Mountains was an alternance of predominance of tectcnic factors and erosional factors, which in time had antagonic actions. The tectonic factors tended to raise the area, while the erosional ones lowered it. Each stage of evolution (tectonic or erosional) has left its own trases, which are more or less visible in function of their strenght.

CHAPTER III – PRESENT DAY MORFOLOGIC CONDITIONS

The main climatic elements taking into analysis are temperature, rainfall and wind regime. **Temperature** is of great importance, for it determines the existence and alternance of frost cycles, the intensity of alteration processes, the status of rainfall, biotic activity etc.

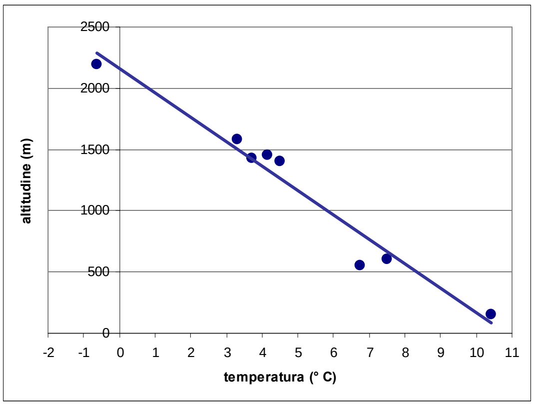


Fig. 2 – Mathematical regression between altitude and teperature

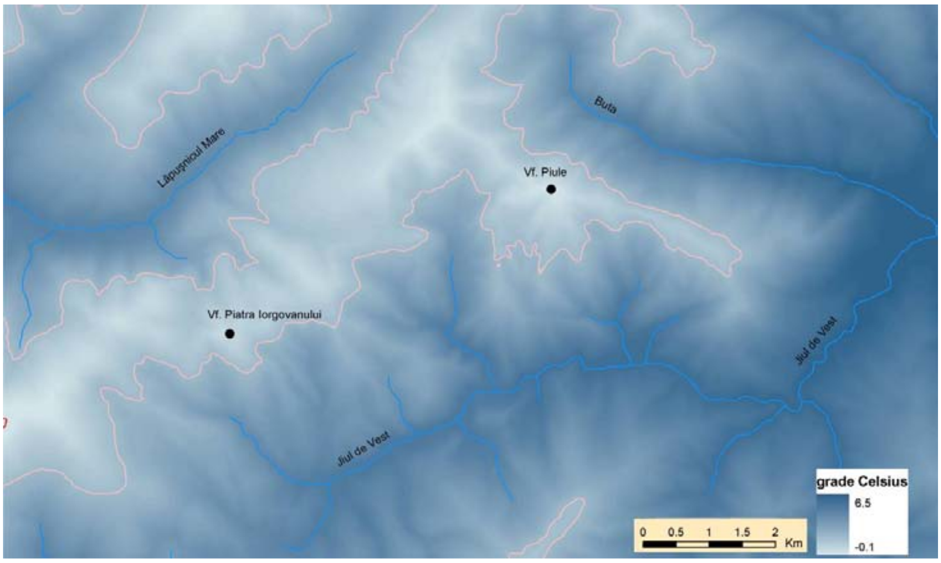


Fig. 3 – Map of mean annual temperature (in pink: isotherme of 2° C)

The rainfall, through its quantity and quality, besides of temperature, has a great influence over the torrential and fluvial processes, taking into account that water and snow are the main factors or modeling. This is more important to take into account because the area is made up of limestone, that react to water not only through erosion, but also through corrosion. It is clearly stated that the intensity of karstic processes in an area is strong related with the quantity of rainfall (Bleahu, 1974).

Fig. 4 –Peltier diagram for alteration processes

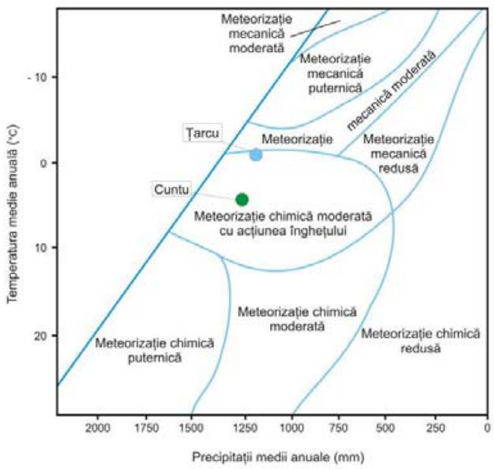
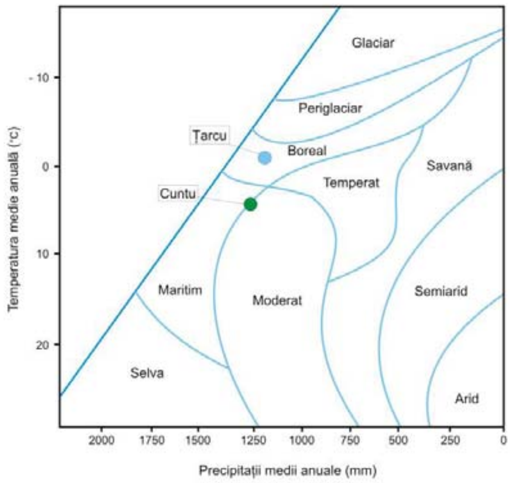


Fig. 5 – Peltier diagram for type of climate



Considering the type of climat associated to bioclimatic areas, the alpine zone falls into the boreal climat, while the forest zone is at the limit between the moderate one and the maritime one.

CHAPTER IV – MORPHOGRAPHY AND MORPHOMETRIC ANALYSIS

IV. 1. Morphography

Piule-Iorgovanu Mountains presents theirselves as a main interfluve which forms the devide between Jiu catchement are in South and Lăpuşnicul Mare in North. This interfluve continues the main ridge of Retezat Mountains which links the main ridge of Godeanu Mountains.

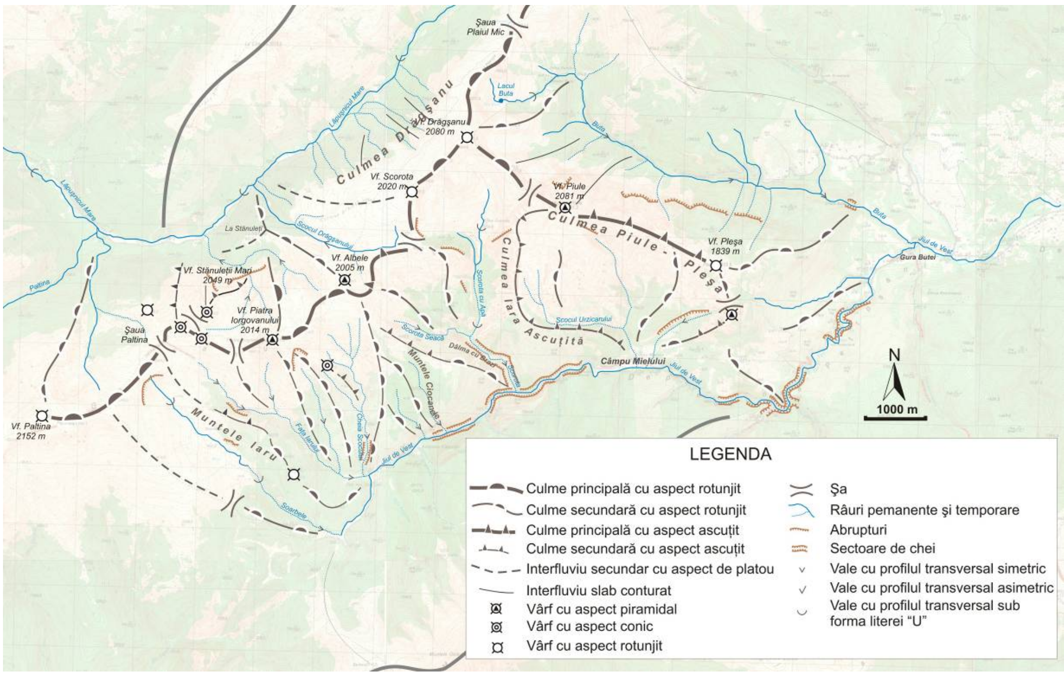


Fig. 6 – Morphographic map

The main ridge has a NE-SW direction and makes the link between the summit of Custura (2457 m) in Retezat Mountains and summit of Paltina (2149 m) in Godeanu Mountains. Between these two summits Piule-Iorgovanu Mountains form a lower sector, mainlz having the aspect of a leveled surface dotted with insular summits. From this 13-14 km long ridge divert on both sides secondary ridges.

One can make the remark over the assimetry between the two parts of the ridge: the northern part is very steep over the Valley of Lăpuşnicul Mare, the southern part consisting in smoother slopes. The northern and eastern part overlaps a cuestã.

IV. 2. Morphometry

Hipsometry

Piule-Iorgovanu Mountains have an altitudinal range of 1241 m, between the Piule Peak (20181 m) and he confluence between Jiul de Vest and Buta (840 m), placing these mountains in the middle altitudinal class of Carpathians. Only the closeness of Petroşani Depression makes the altitudes to lower in the SE part.

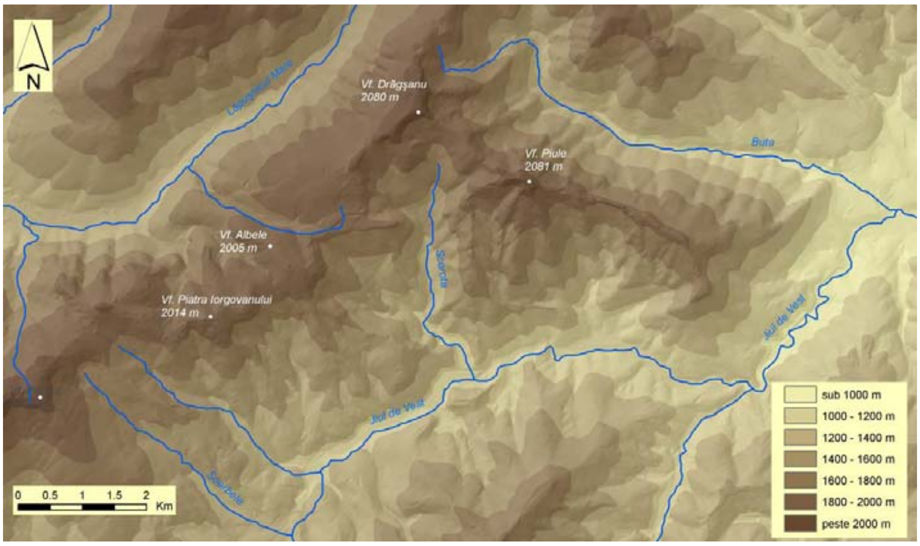


Fig. 7 – Hipsometric map

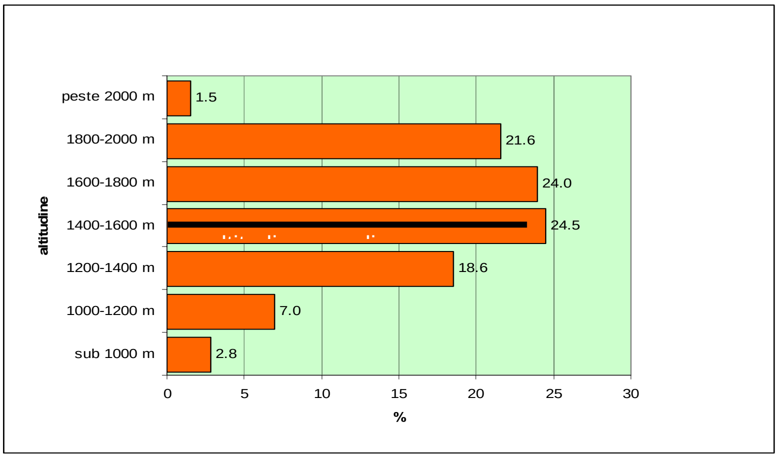


Fig. 8 – Hipsometric diagram

The solpes

The slopes analysis was made both in terrain and laboratory. The solpes map resulted in laboratory using as source of modeling the topographic map at scale 1:25.000. The digitized contour lines were interpolated, the result being the Digital Elevation Model. The model was later processed with ArcGIS – ArcMap 9.1 and Idrisi Andes softawares in order to obtain the slopes map. It consists on a raster file, with a 4.2 m resolution, sufficient to permit a fine change of slope on small surfaces and highlight the morphometric characteristics of middle-sized landforms.

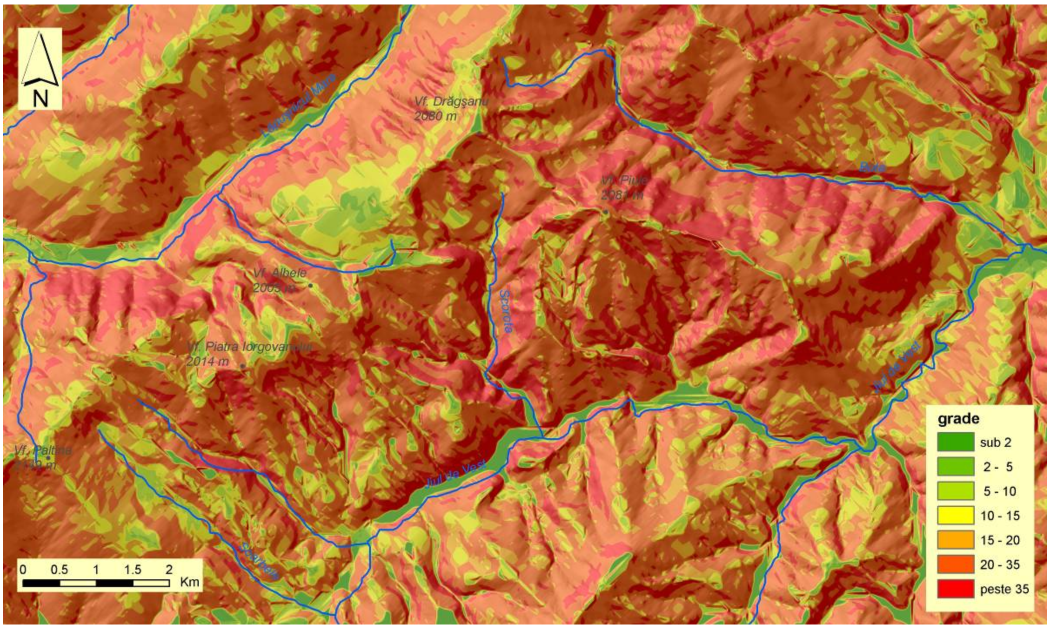


Fig. 9 – Slopes map

The average slope calculated for the whole area is 24.34°.

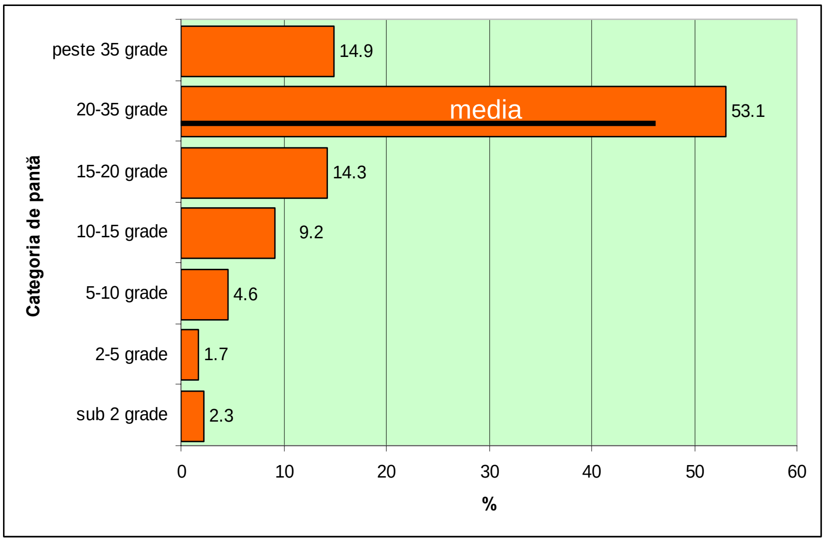


Fig. 10 – The procentual distribution of slope categories

The larger part of the mountain area is occupied of surfaces with slopes with value over 20° that make more than 50% of area. On limestones these slopes are due both to lithology and structure.

Fragmentation of relative altitude

The calculation of this parameter can be done using two methods: using hydrographic basins and rectangular arbitrary chosen.

The first method has the advantage to being applied to natural existing features where the erosion take places. The disadvantage of it consists in the difficulty of choosing the right size of the basin. When the basin order is smaller the result is a high number of inter-basin areas. The second method has the advantage that the mountain area is covered with 1 km side tiles, which assures a more homogenic sampling. Another advantage consists in the possibility of an easy comparision of this parameter in different zones of the same unit consisting in different lanforms type, different geology, and structure. By using this method we can eliminate the scale effect induced by the first method where the the results is made of basins with different area. The disadvantage of this method states in the fact that the tiles are arbitrary chosen, they having no natural correspondent.

We calculated this parameter in ArcGIS-ArcMap 9.1 software, using the application ArcToolbox.

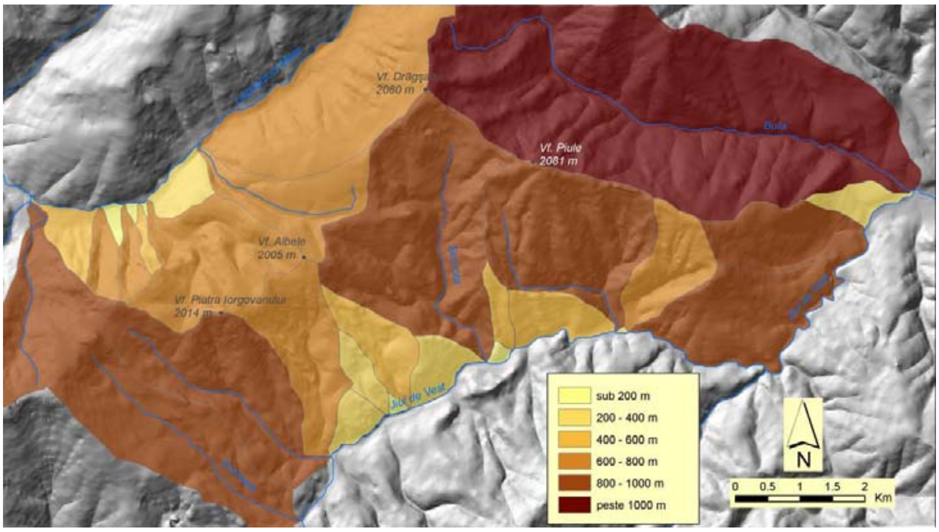


Fig. 11 – Fragmentation of relative altitude map on hydrographic basins

The easy correlation that we can made here is between the size of the basin and the value of the parameter, both rising in the same time.

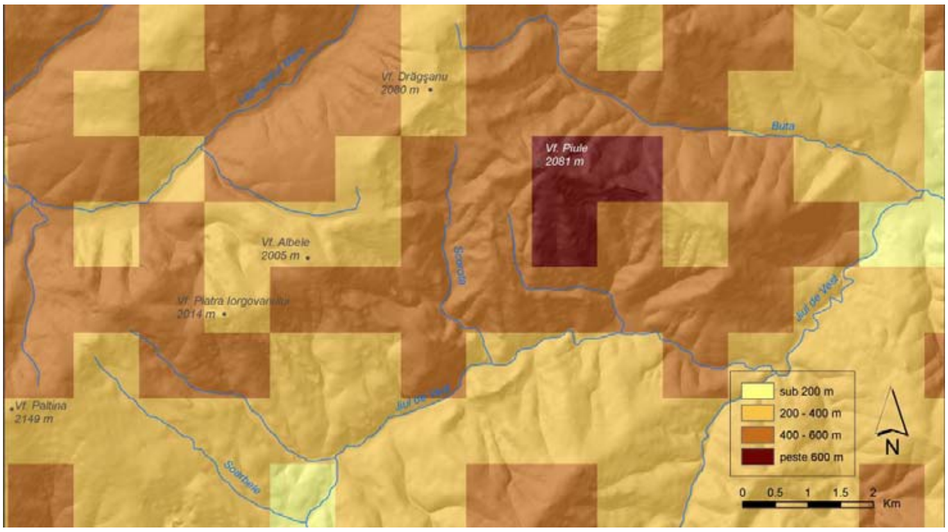


Fig. 12 – Fragmentation of relative altitude map on tiles

Drainage density

This parameter has been calculated using two methods: on hydrographic basins and on tiles with 1000 m side (1 km^2 area). This parameter was calculated in ArcGIS – ArcMap 9.1 software and ArcToolbox application.

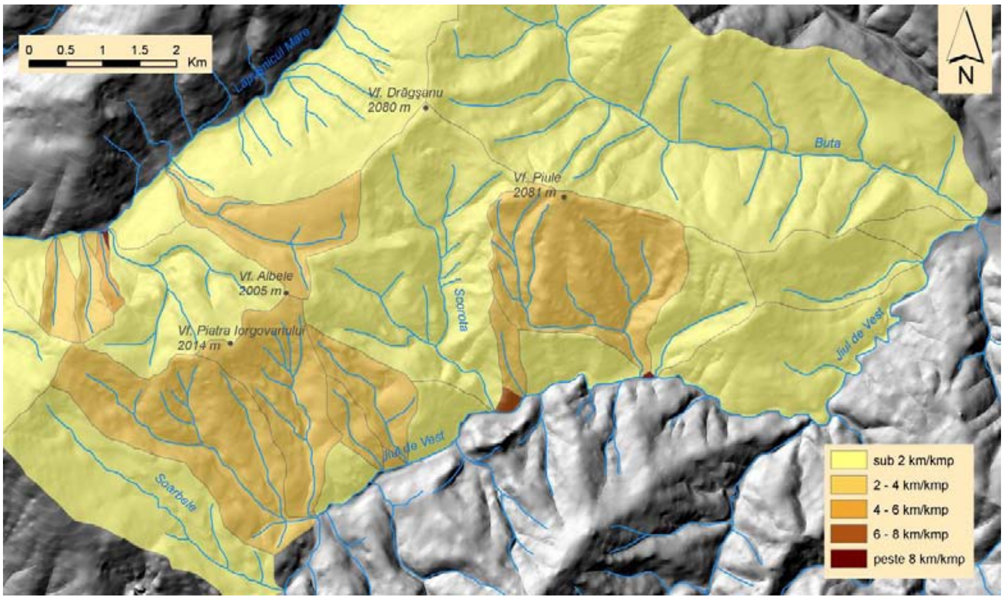


Fig. 13 – Drainage density map on hydrographic basins

The first method does not make evidence of lithologic disparity that can strongly influence the genesis and development of hydrographic network. As larger the basin is, the highest the possibility that its lithologic disparity is.

For the whole study area the average value of drainage density is 2,6 km/km^2, standard deviation being of 2 units, that denotes the influence of interbasinal surfaces.

For a finer representation of this parameter we used the utilities of ArcGIS – ArcMap 9.1 software, making use of the *Line density* function from the *Spatial Analyst Tools* from *ArcToolbox*.

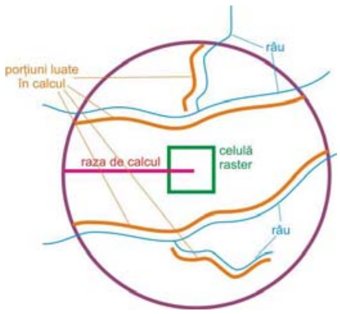


Fig. 14 – The calculus method of line density using ArcGIS softare

The advantage of this method is theat we can highlight a very fine variation of this parameter to the value chosen by us. The resulted map used a 37 m size of the cell (default value, representing the shortest value of the digitized river sector divided by 250) and as ray of search the value of 1000 m.

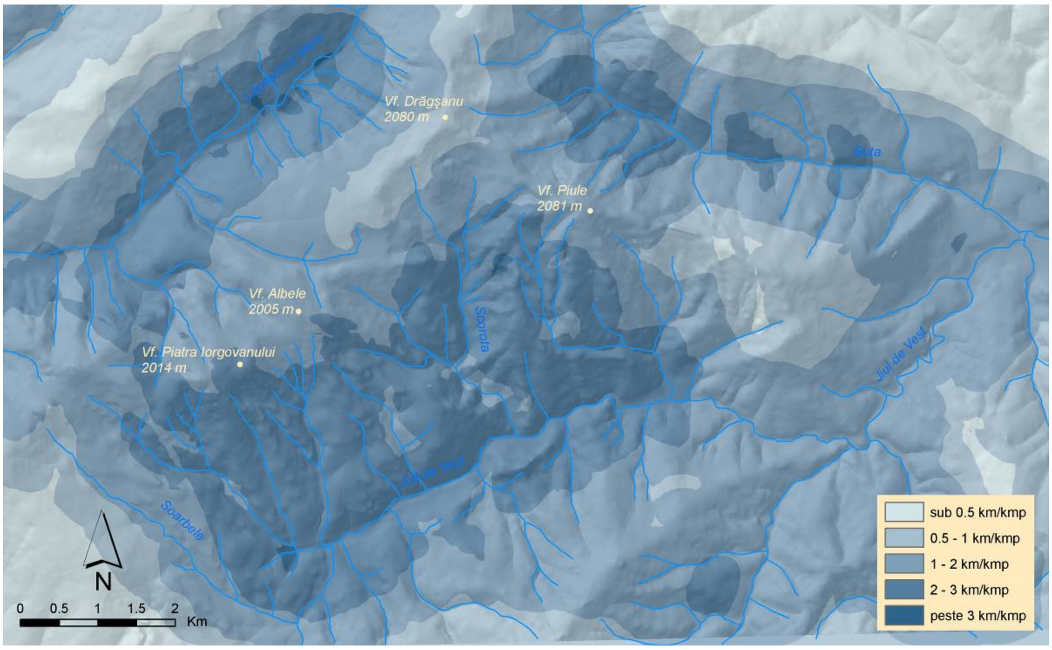


Fig. 15 – Drainage density map (tiles method)

The average drainage density value over the whole area is 1.3 km/km^2, with a value of 0.78 units for standard variation.

Slope angle (aspect)

Aspect has a great importance over the quantity of sunlight received by the slopes, the latter influencing other morphologica processes.

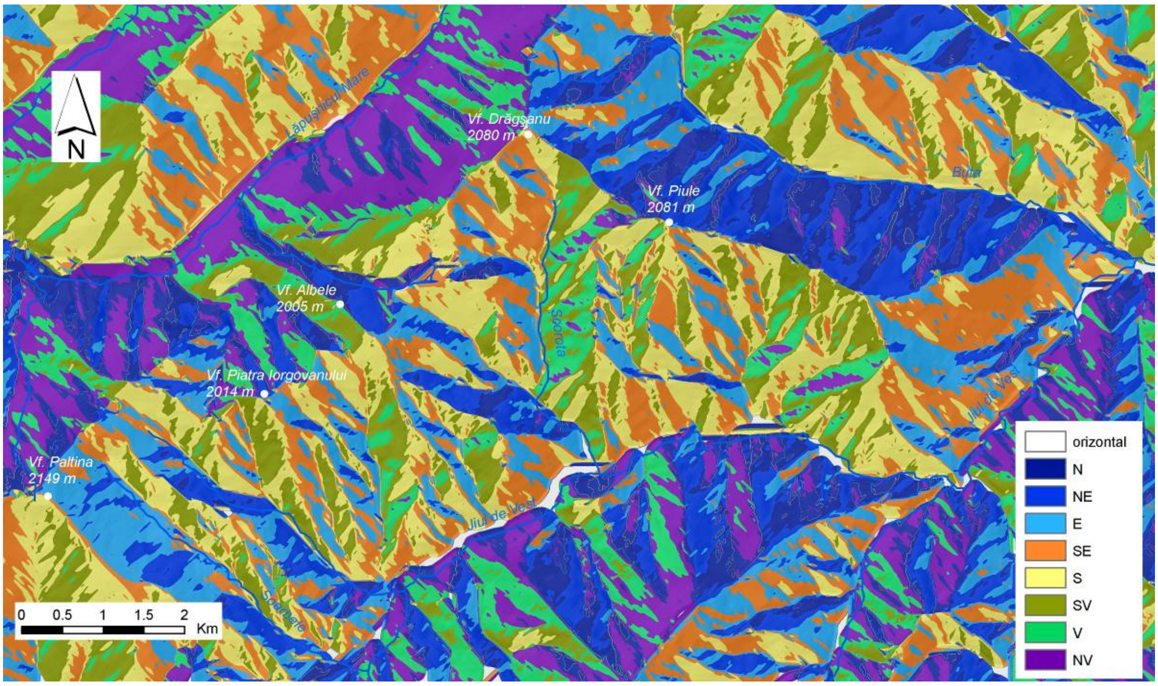


Fig. 16 – Aspect map

Ilie (1970) considers that karstic processes are more intense on south slopes, because here the snow can melt during warm episodes during winter, more water being so disponible to flow and react with the limestone and the supply with water being so more constant that on northern slopes.

CHAPTER V – GENETIC TYPES OF LANDFORMS

V. 1. Structural and lithologic landforms

V. 1. 1. Structural landforms

They is related to the main geologic structures that compound the frame of Piule-Iorgovanu Mountains – Getic Nappe and Danubian Autohtone with their sedimentary blanket. The limestones have the shape of a large trough on whose shaft set the trace the river Jiul de Vest. The direction of the shaft is SW-NE with a dip towards SW. The water flowing underground follows the same direction, coming out again to surface in Cernii Spring. Piule-Iorgovanu Mountains occuy the northern flank of the trough. Due to this placement one can consider that these mountains form a large monocline with a SE and S dip. The value of dipping varies between 30°-60°. This situation gave birth to two types of structural landscape: a large cuesta in north and north-east and face layers on the southern part.

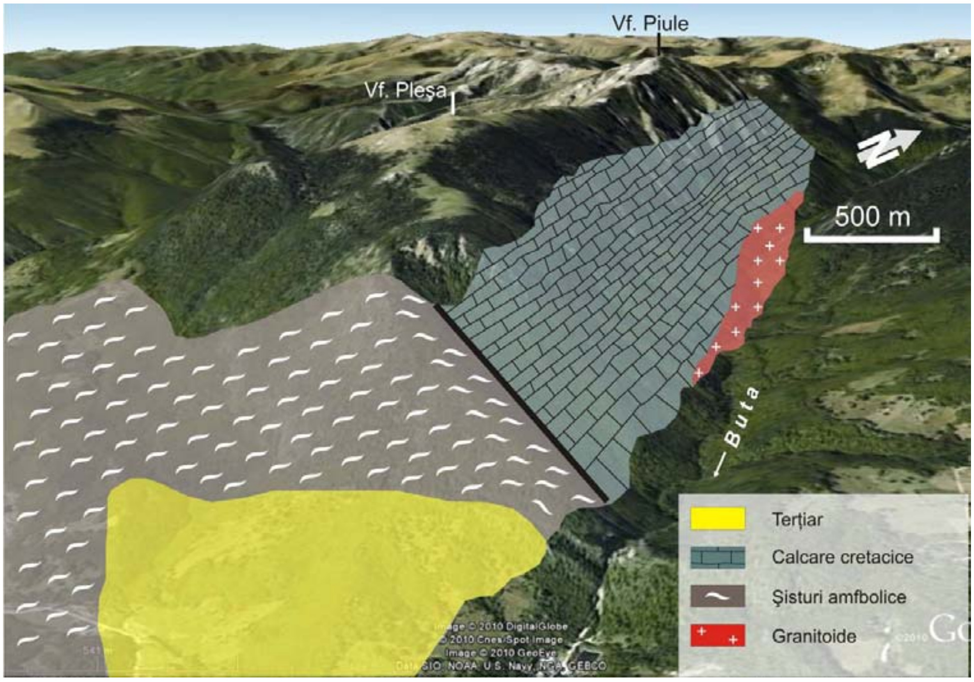


Fig. 17 – The structural context in the case o NE cuesta

This cuesta has an erosional character. There were found no major faults to be implied in the individualize the cuesta.

V. 1. 2. Lithologic landforms

The main rocks that compound the Piule-Iorgovanu Mountains are the crystalline schists and the Mesozoic limestones.

Lanforms developed on crystalline schists

They occupy two areas: Drăgşanu ridge entirely and the southern part of Piule-Pleşa ridge. The first area is made of amfibolitic schists and sericitic-cloritic schists. The ridges are smooth without any major morphologic accidents. Relative altitude has an average value of 200-400 m, that denote the large extent of the leveled surfaces. Dranaige density has also low values, around and below 1 km/km^2.

Lanforms developed on limestones

They occupy the largest area of these mountains. Their presence makes these mountains being apart over the neighbours. A particularity of these limestones is that they are to be found at high altitude, in the area of alpine karst. This type of karst has here the best representation.

The number of underground cavities is large, due to the large area that the limestones occupy, to the thicknes and the purity of limestone. Goran (1982) inventorizes more than 250 caves and shafts in these mountains. This large number is in strong relation with the intensity of tectonization of the limestone that offer a large variety and possibility for water to get in. It exist also an inconsistency between the surface and underground drainage of water.

The karst can be considered as a suspended autigen type by the relation they have with the non-soluble rocks around and as uneven type in the contact area with the cristalinne of Drăgşanu ridge.

The limestones strech over more than 1100 m altitude difference that makes the potential of karstification to be very large.

Exokarst

The karren have a large distribution over these mountains. They make part of a large range of types. The largest number of these forms has been met in the Piatra Iorgovanului – Stănuleți – Albele area, the Cerna-Jiu area, the area of Piule Peak towards Pleşa Peak. The types or karren identified here include tabular karren, rectangular karren, liniar karren.

Fig. 18 – Rectangular karren in Stănuleți area

A particular variety of karren that we met here is wall karren situated on surfaces with steep slope. They are to be found on limestone rocks without vegetation (e.g. Piatra Iorgovanului).

Their genesis is without doubt the result of corrosion but for those with a liniar shape we can invoke also the erosion, since because of the steep slope the contact between the water and rock is limited, the water tents to flow rapidly off the rock, in the meantime excerting an erosional work. According to Choppy (1992) the wall karren represent climatic indicators. This kind of forms is specific to limestone areas that are covered a part of the year with snow, they being carved by the melting water.

Fig. 19 – Wall karren on Piatra Iorgovanului

The sinkholes appear mainly in Piatra Iorgovanului – Stănuleți – Albele area, as well as in the source area of Soarbele valley and Cerna-Jiu Pass.

In Soarbele Saddle the sinkholes are numerous making a sinkholes field. Their sizes are modest: 4-8 m diameter, 1-4 m depth; during winter one can find here snow that contribute to their evolution.

Fig. 20 – Sinkholes field in non-soluble deposits in Soarbele Saddle

We consider the genesis of these sinkholes being later to the deposition of the glacial material or resulted from the gravitational processes generated by a periglacial climat. During that time the ground was frozen its behavior being close to that of a hard rock. In these circumstances the cracks were filled with ice, the melting water flowing at the surface instead of sinking into the ground. In the meantime it is highly possible that the glacial material to mold the sinkholes later formed to their deposition than to mold the sinkholes already formed, in this case being the possibility that the material to fentirely fill the sinkholes.

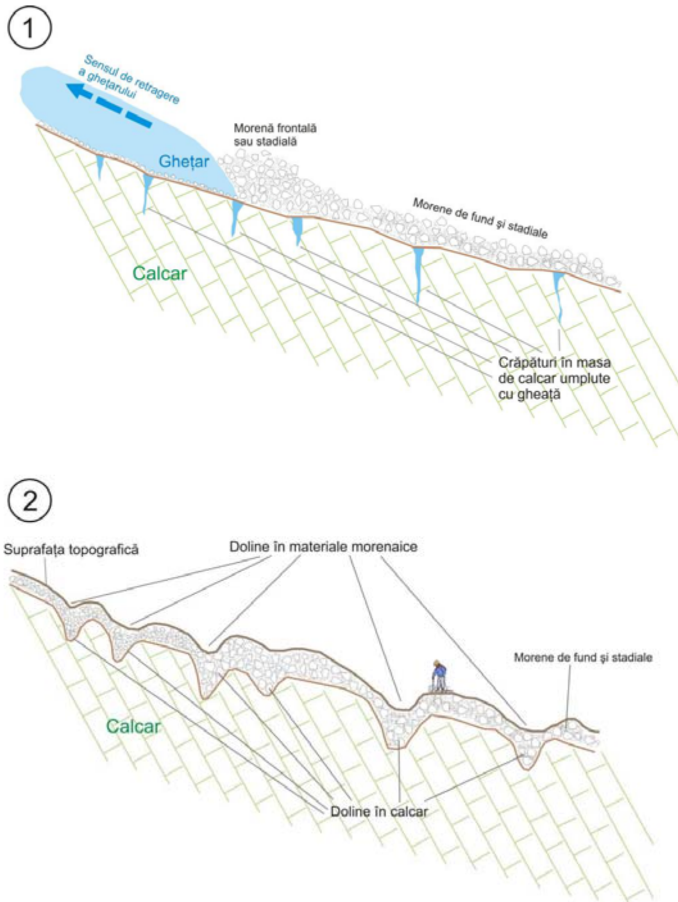


Fig. 21 – The genesis of the sinkholes in the glacial material

Gorge aalleys and sectors can be found on almost every part of these mountains.

The Valley of Cheia Scocului can be considered as a typical case. To present it is a dry valley having on the walls traces of water flow in a period where the water was more available than today. The study of its longitudinal profile offers us the possibility to decipher its evolution.

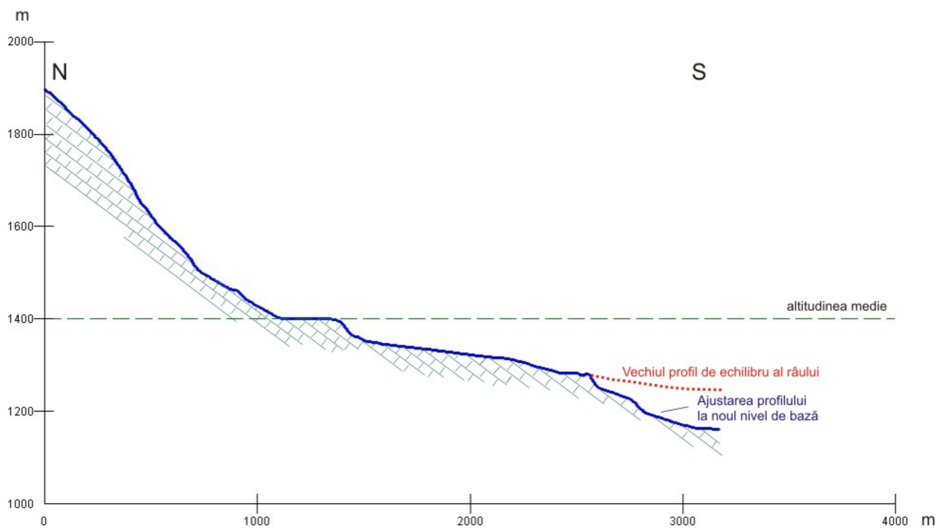


Fig. 22 – Longitudinal profile along Cheia Scocului Valley

We consider that the sector between 1400 – 1300 m altitude represent a part of the equilibrium profile of the river at that time. This profile was continuing at the same slope until its confluence with Jiul de Vest, represented on the figure in red line. Later, after the deepening of the

Jiul de Vest valley, the river that flowed on Cheia Scocului Valley began to readjust its own longitudinal profile to the new altitude of confluence through remontant erosion. This could happen only when there was permanently flowing water on the valley.

Permanent water can be testified by the presence of wall marmite. The water came probably from a source more constant than the rainfall, most probably from melting water coming from the source area of the valley, where it could exist patches of firn, even ice, in Găuroane cirque. As the adjustment of the longitudinal profile of a river begins from confluence to source, the first part that adjusted was the inferior part of the valley. Here, the river deepened more, the erosion advancing towards upstream. At a time in past, the source of water reduced or disappeared and the valley was left dry, so the remontant erosion stopped or reduced drastically. We consider that the point situated around 1300 m altitude, on the longitudinal profile, where there is a transition from the smooth to steep slope, constitutes the point to which the remontant erosion stopped because of lack of water. So, this point could be the morphologic witness to flowing change on the valley, determined to its turn to the climate change.

Karstic leveled surfaces

The leveled surface between Albele and Piatra Iorgovanului can be considered as a karstic leveled surface for following reasons: the limestone layers are monoclinic as laying out and the surface cut them under a different angle, that excludes a structural surface. This leveled surface continues also beyond limestones on other type of rocks, what shows that it makes part of a larger modeled area.

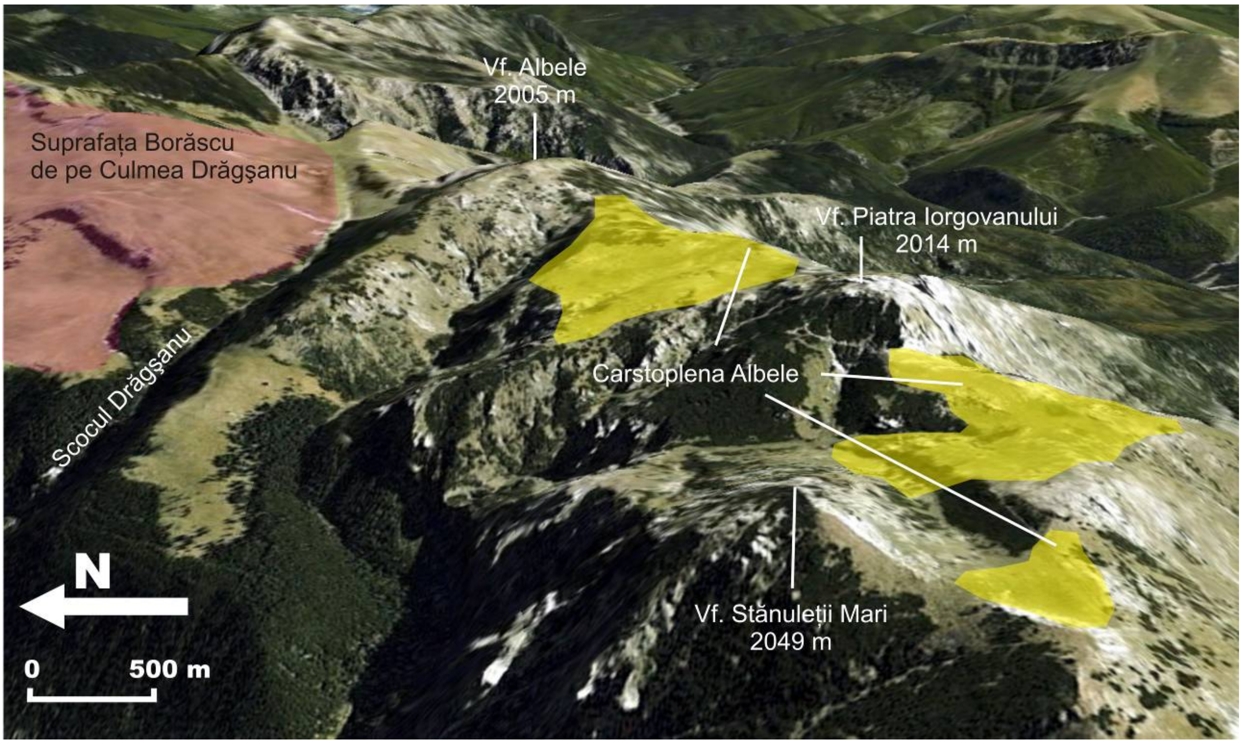


Fig. 23 – Karstic leveled area (in yellow) and Borăscu (in red)

Its forming age must be the same as the leveled surface Borăscu.

The underground water transfer points are landforms with hydrologic function.

In 2008 we made an electrical tomography investigation using a PASI equipement in order to measure the electrical resistivity to such a point in the Jiul de Vest thalweg.

Fig. 24 – Underground water transfer point on Jiul de Vest

The aim was to find out wheter it was possible to infer using this technique the frame of this water passing underground. The method was used with success in identifying sinkholes under a layer of soil (Zhou et al., 2000, McGrath et al., 2002, Ioannis et al., 2002, Gibson et al. 2004). The principle consists in measurment by the instrument of the rock resistance using the formula

$$R = \frac{Voltage}{Amperage}.$$

The data were subsequently processed using the RES2DINV software for generating the model. We used a dipole-dipole methode this offering the best resolution.

The investigation was performed in November 2008 in a period when there was little water in the Jiul de Vest thalweg. The underground transfer point was placed in the middle of the profile and the electrodes were one meter spaced, obtaining a 4 meters depth.

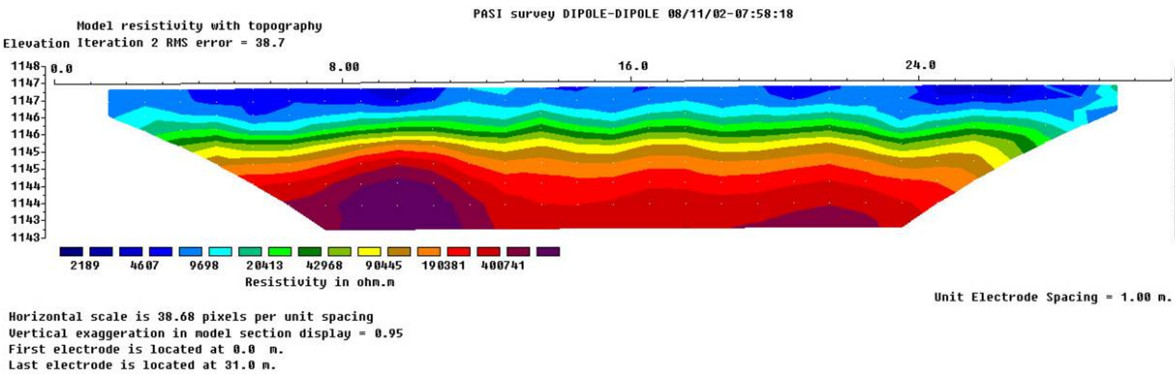


Fig. 25 – The model of geologic resistivity for the Jiul de Vest underground transfer point

Endokarst

Most cavities are weak developed both in terms of depth and length. They are situated between 1100-1200 m altitude where they seem to form the general level of genesis and development of caves. There can be found also other leves of development. Between these leves there are some altitudinal differences that can be interpreted as being formed by the tectonic uplifts.

As the limestones cover an aproximately surface of 40 km^2, the resulting cave density is around 6.25 caves/km^2.

The shafts were identified in large number, most of them situated at an altitude higher than 1500 m. most of them presents no water flow trase towards them, fact that indicate a later opening at the surface. They are mainly formed along a fault inside the rock, that opened at the surface later, by collapse. The region with the highest number of shafts is the Stănuleți area and the area between Scorota de Est and Soarbele.

The caves are more numerous in the are of confluence between Scorota and Jiul de Vest, in Dâlma cu Brazi Ridge –Ciocanele Mountain and Iara Ascuțită. This high number set evidence over the permanent flowing of water in the area.

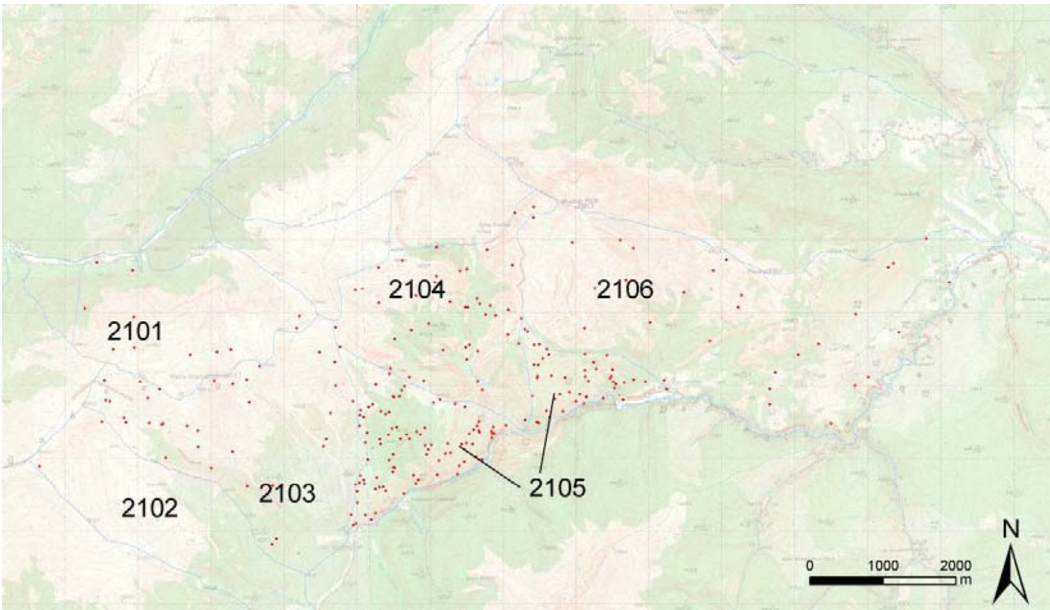


Fig. 26 – Cave density on basins (dot method) (2101 – Lăpuşnicul Mare, 2102 – Soarbele, 2103 – Fața Iarului, 2104 – Scorota, 2105 – left slope of Jiul de Vest between Câmpuşel and Câmpul Mielului, 2106 – left slope of Jiul de Vest between Câmpul Mielului and Buta)

Karst genesis

We consider the age of the vertical cavities (shafts) more recent than it was previously stated. Their genesis was lead by the presence of fractures in the rock and layer limits (faces), the rich quantity of rainfall and by the cool climat that favorised a high alternance of frost cycles. Because many of the shafts have no trace of water flow leading towards them, we state that they were previously formed inside the rock, their opening at the surface being later formed.

Underground water flow

The water that flow at the surface in the Jiul de Vest basin is almost entirely transferred into underground and from here leaded to the basin of Cerna, where it come again at the surface in the Cerna spring. The water transfer between the two basin is made along the Cern-Jiu fault system (Povară, 1976, Ponta et al., 1984).

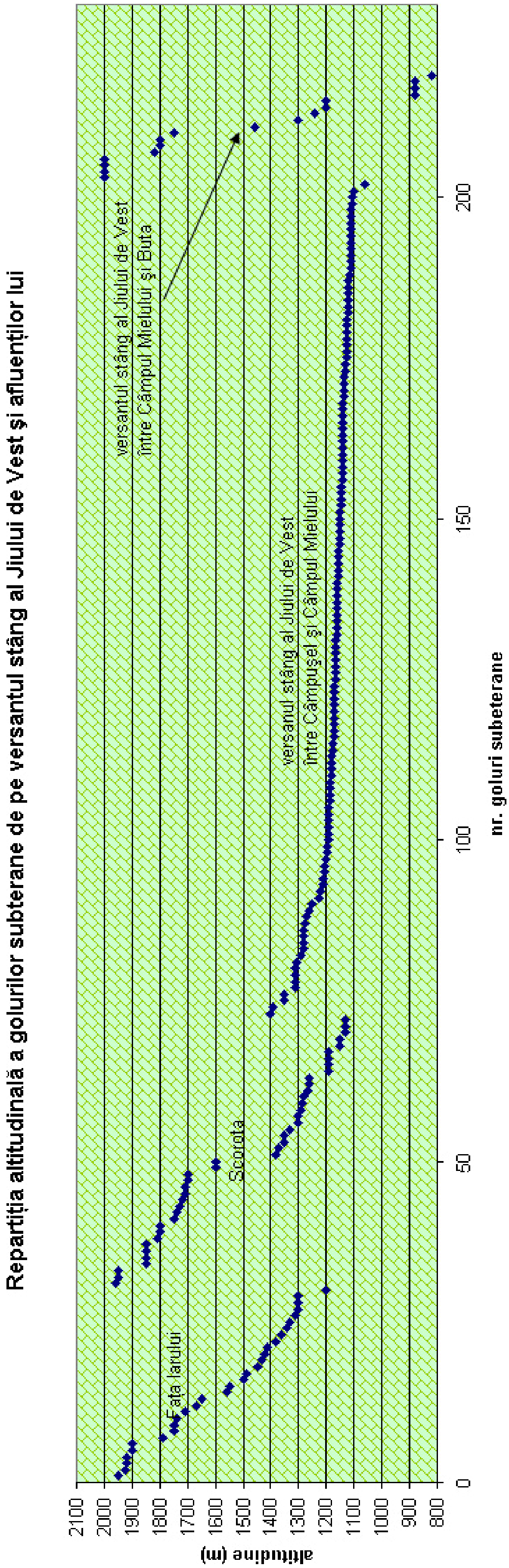


Fig. 27 – The caves along the left slopes of Jiul de Vest valley and its tributaries

V. 2. Denudational landforms

The leveled surfaces represent the final result of an erosional cycle. The external agents of erosion bring an initially rough surface to an leveled one. These surfaces form in a long period of time under constant tectonic condition. Subsequently, through tectonic movement's reactivation these surfaces can be displaced by line of faults, some of them being lowered and fossilized under younger sediments, other raised at high altitude being again attacked by erosion which tend to fragment them..

Piule-Iorgovanu Mountains, the upper part of the main ridge present a leveled surface situated approximately at 1900 m altitude both on limestones and crystalline schists.

At a lower altitude, around 130-1500 m, other leveled surfaces could be inferred.

Tabel 1. Area occupied by the leveled surfaces

Level	Area (ha)
Drăgşanu-Albele (Borăscu)	700
Ciocane (Râu Şes)	150

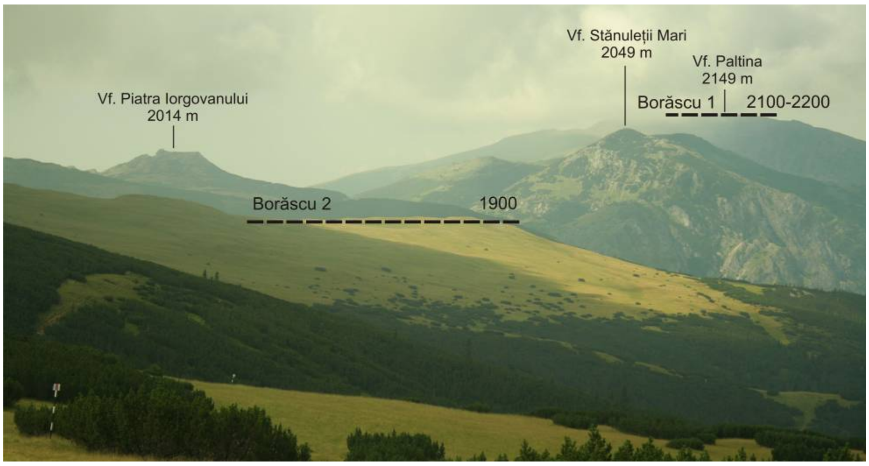


Fig. 28 – Leveled surface Borăscu on Drăgşanu ridge

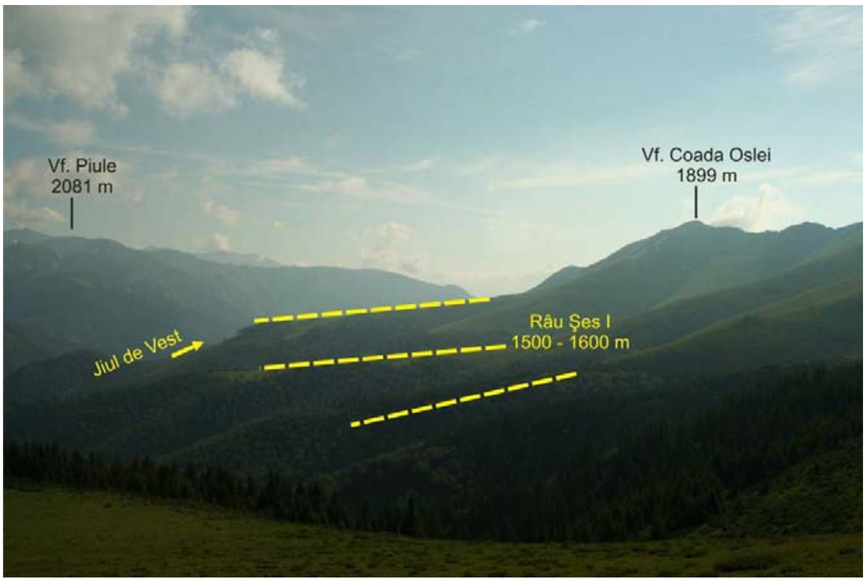


Fig. 29 – Leveled surface Râu Şeson Oslea Mountain

V. 3. Fluvio-torrential landforms

It is the result of water action which by erosion, transport and accumulation has created a wide variety of forms, from torrents to valley network. The processes associated to sheet flow are more efficient on meadows where the soil is thinner and without the protection of deep rooted vegetation. We identified some of this kind of lanforms, the most representative being the raven *Bolboroşi*.

Fig. 30 – The erosional form on Drăgşanu ridge

The age of most valleys is rather recent – Pliocene-Quaternary. The genesis of some large valleys can go in the past as far as Miocene, the time when the leveled surfaces began to form. They have inherited in part the trace of faults.

V. 4. Glacia landforms

V. 4. 1. Erosional landforms

The glacial cirques and valleys are rather modest in dimensions compared to the same kind of forms in neighbor mountains. For a better view over these forms we determined the morphometric variables of them (Ardelean, 2005) using the methodology proposed by Evans & Cox (1974, 1995). The delineation of cirques was made using topographic maps at scale 1:25,000 under terrain observations.

Tabel 2. Morphometric variables of glacial cirques in Piule-Iorgovanu Mountains

Variable \ Cirque	Scorota Est	Scorota Vest	Buta	Pustnicu	Soarbele
Minimum altitude of bed (m)	1720	1720	1600	1670	1700
Maximum altitude of bed (m)	1950	1830	1800	1900	1750
Mean altitude of bed (m)	1835	1775	1700	1785	1725
Altitude of ridge on median axis (m)	2040	1930	2020	1990	1960
Maximum altitude on ridge (m)	2050	1940	2050	2010	1960
Mean axial altitude (m)	320	210	420	320	260
Maximum oscillation of bed (m)	230	110	200	230	50
Length of median axis (m)	592	755	1084	1026	723
Maximum wide (m)	500	750	800	400	725
Elongation coeficient	0,84	0,99	0,74	0,39	1,00
Length / wide ratio	1,18	1,00	1,35	2,56	1,00
Perimeter (m)	2250	2500	3200	3000	2250
Cirque bed area (km^2)	0,27	0,2	0,4	0,35	0,08
Cirque area (km^2)	0,37	0,43	0,6	0,4	0,37
Index of roundness	0,65	0,68	0,75	0,53	0,65
Relative aspect	SE	SE	E	E	SE
Cirque azimuth	163	152	83	90	125
Bed mean slope (^{o})	15	12,5	17	15,5	8,7

The cirques with larger dimensions were developed on the southern slope, here the preexistent network of rivers being more favorable. Valleys on the southern slope are longer, their longitudinal profile has a lower slope and their superior parts are to be found close to the highest part of the ridge, at higher altitudes. All the cirques have a SE or E aspect.

V. 4. 2. Accumulation landforms

The moraines are the main forms of accumulation. They have been well kept of the erosion in this area.

There have been identified different types of moraines : end moraines, stadial moraines, lateral moraines, ablation moraines. Stadial moraines are found in a better shape of preservation than other types, being the last formed.

V. 4. 3. Regional aspects

Scorota basin

The glacial cirques here are situated at the end of Scorota Valley in the SE part of Drăgşanu ridge, under the summits of Drăgşanu (2080 m) and Scorota (2020 m).

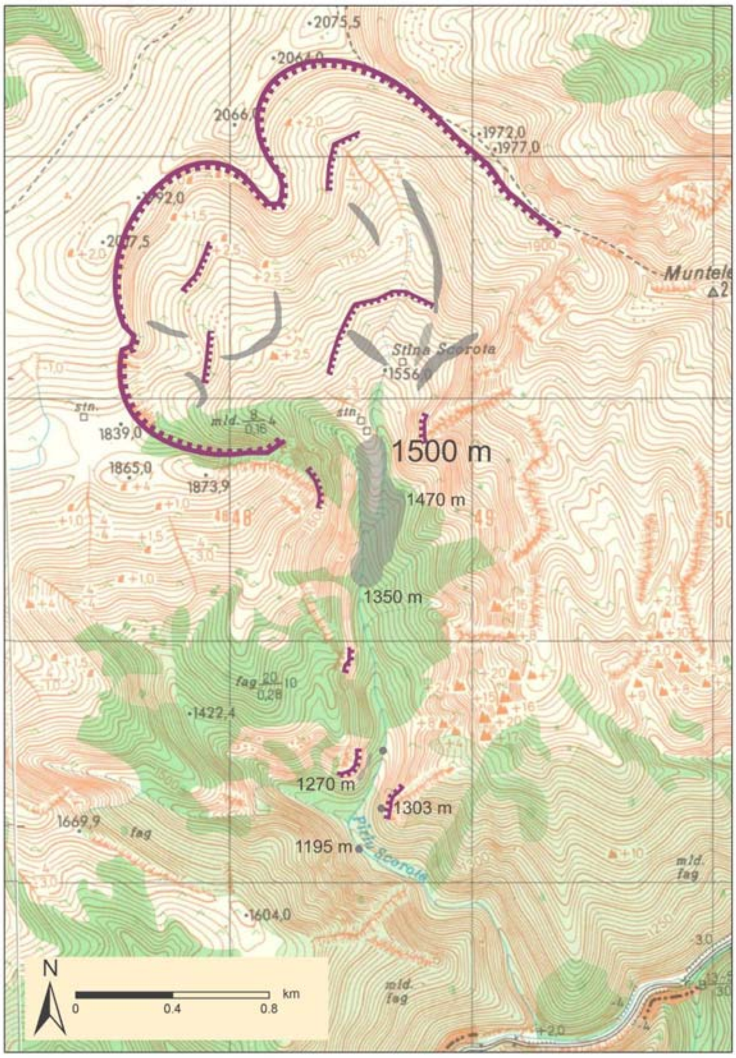


Fig. 31 – Glacial landforms on Scorota Valley

Good evidence of the glaciar presence along the valley can be met at the confluence of the Scorota valleys, where we identified eratic blocks with metric dimensions at an altitude of 1270 m (40 m relative altitude) on the right slope and at 1303 m (60 m relative altitude) on the left slope of the valley.

Fig. 32 – Eratic block made by crystalline schist at 1303 m altitude on the left slope of Scorota cu Apă

Soarbele cirque and valley

They are to be found east of Paltina Peak, having a NW-SE aspect.

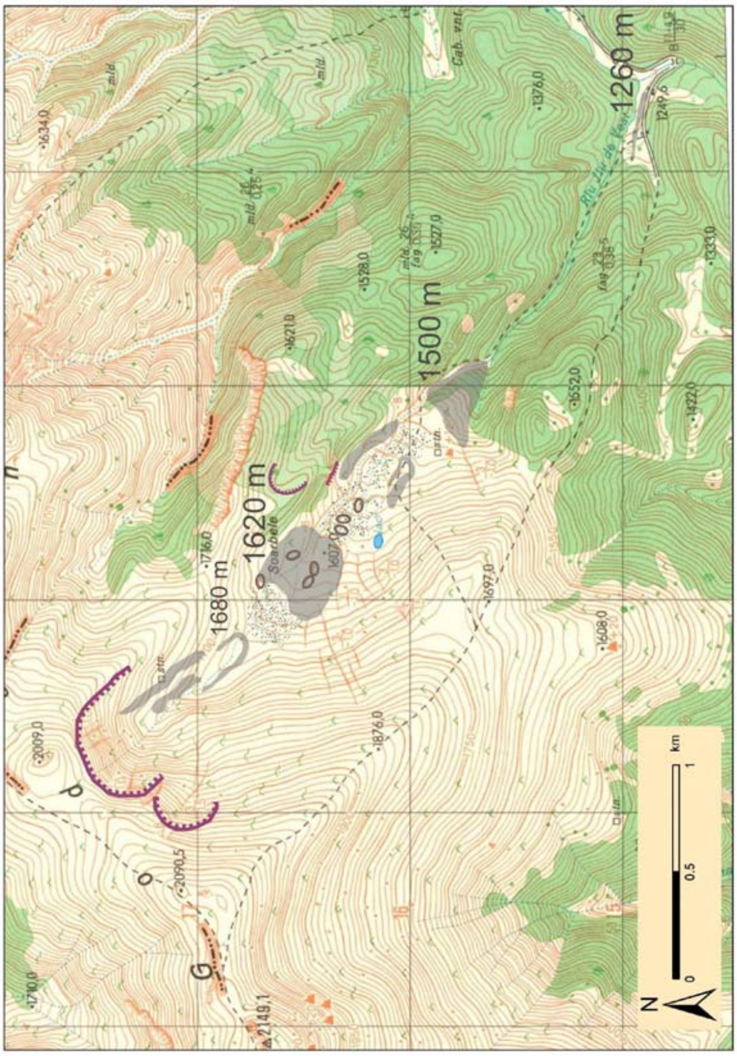


Fig. 33 – Glacial landforms on Soarbele (moraines are in grey)

The lowest glacial deposits identified were at 1260 m altitude at the confluence between Soarbele and Şarba. It is a lateral moraine on the right slope of the valley that still holds in some parts its original morphologic shape, that of a levee with low relative altitudes of 2-4 m and 10-12 m wide.

The blocks of rock at the base of the 1500 m moraine seem to be more altered and to have a lower slope than those that come over. This made us thinking that they might belong to another glacial phase.

For a better understanding of the structure of the 1500 m moraine we investigated it using the geophysical methods. For that we have chosen a small levee that makes part of this moraine.

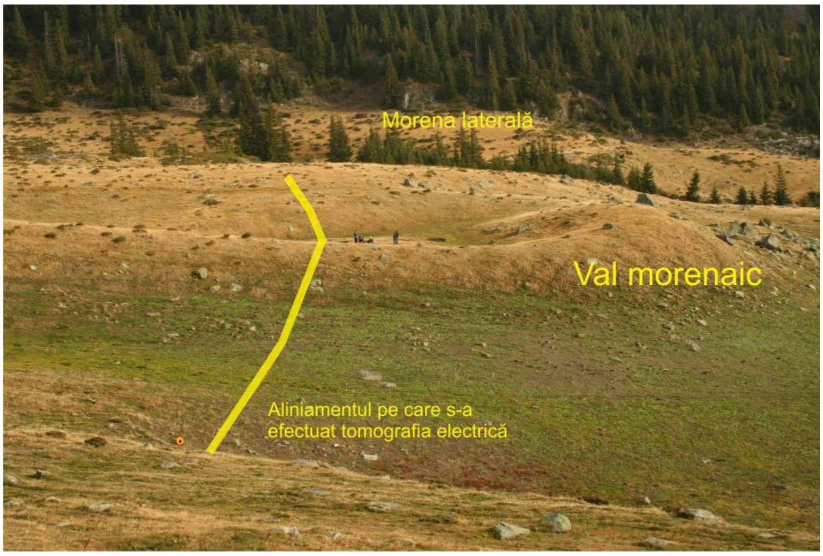


Fig. 34 – The electric tomography investigation site

The method dipole-dipole methode has been used. A number of 32 electrodes have been placed 5 m one of another covering a distance of 160 m. the number and the distance between them allowed the model to be built to a depth of 16-18 m.

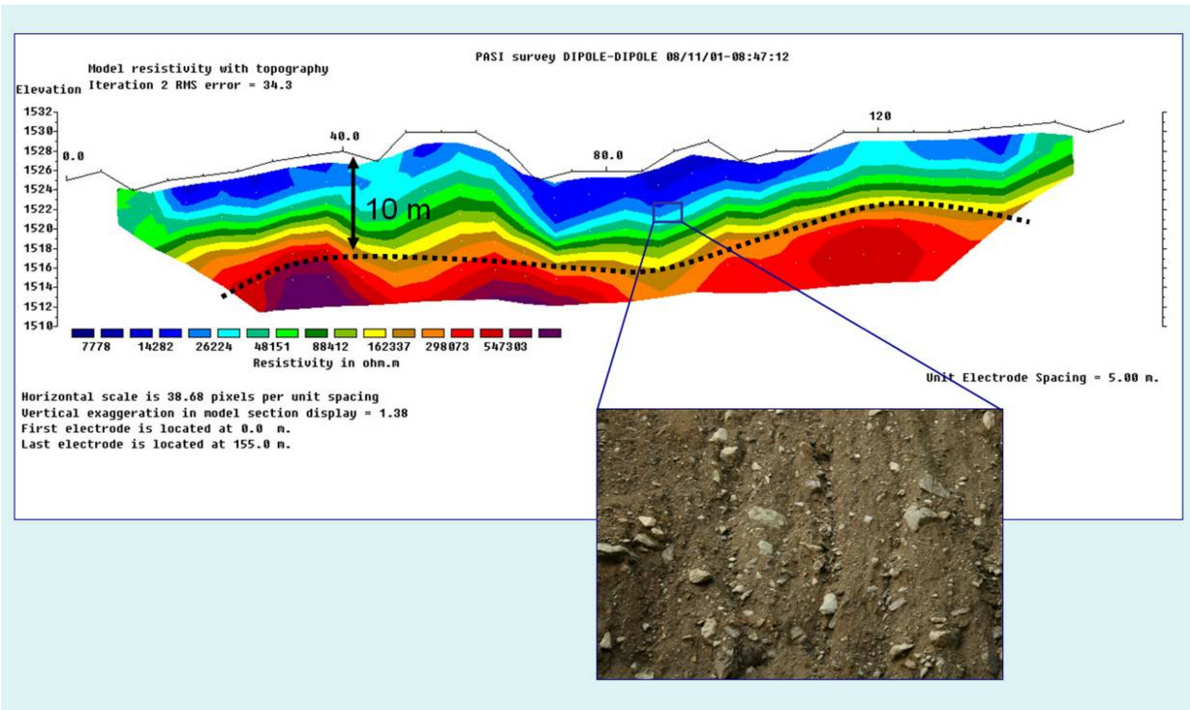


Fig. 35 – Geophysical model of the 1500 m altitude moraine on Soarbele valley

On the model one can see a sharp growth of resistivity placed at approximately 10 m depth (orange – red – indigo), that denotes the existence of compact rocks, with low porosity interpreted here as the base rock. Over the base rok there are the moraine materials that being loose can keep a larger quantity of water that is lower values for resistivity. We can infer the growth for the moraines materials as being around 10 m. This comfort the observation made at a point where the moraine is cut by the river.

The investigation using the georadar (GPR) highlights in the central part of the morain a low area covered by the moraine materials resembling to a sinkhole, fact that entirely comforts the model built by electric tomography.

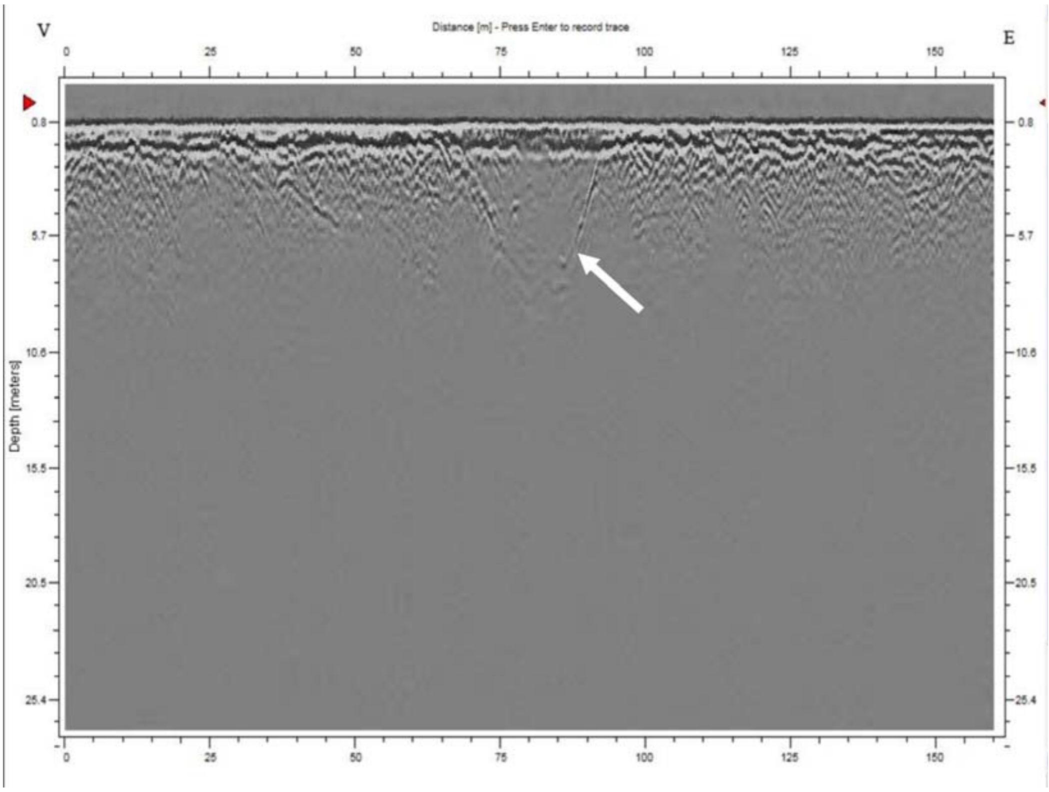


Fig. 36 – Geophisical model using the georadar of the 1500 m moraine on the Soarbele valley (the arrow points the filling of the sinkhole)

Găuroane

It looks like an excavation well delineated at the upper part of the valley, entirely formed on limestone.

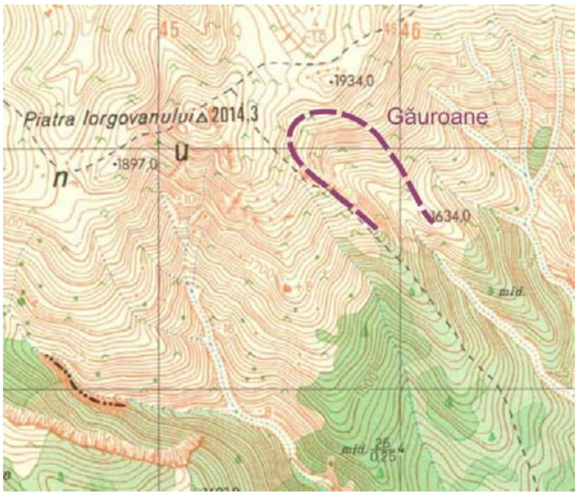


Fig. 37 – Găuroane cirque

There was no moraine identified indide this cirque. The location of the cirque at an altitude of 1650 m – 1850 m put us the question of considering it as a glacio-nival cirque.

V. 5 Periglacial landforms

They are the results of the modeling in the periglacial conditions, the main role here being attributed to the frost and snow.

Slope landforms are found on steep slopes above forest limit.

Rock torrents are mobile accumulations of fragments developed along the steep slopes (over 40°). They are to be found at altitudes over 1800 m, the surce of materials being a wall of rock. We met such landforms on right slopes of Buta valley, under the Piule Peak, in the glacial cirques of Paltina, Soarbele and Scorota.

Fig. 38 – Ploughin block on the leveled surface Borăscu on Drăgşanu ridge

Plane landforms

Snow micro-depressions are the result of snow action on plane surfaces. The main processes implied here are compaction and weathering. Their genesis was possible there where the snow could accumulate for a long time like on some parts of the leveled surfaces. Some of them could be structural conditioned like those situated west of Plaiu Mic Saddle on Drăgşanu ridge.

Fig. 39 – Snow depression on Drăgşanu ridge

The morphogenetic work of snow is very active in alpine area, especially in negative landforms, where it finds favorable conditions for accumulationg and persistence.


Fig. 40 – Depozit de zăpadă pe fundul unei ravene în calcare în etajul alpin (iulie 2010)

CHAPTER VI – ACTIVE GEOMORPHOLOGIC PROCESSES

The main active geomorphologic processes in the area that Piule-Iorgovanu Mountains cover are:

- Weathering and gravitational processes
- Sheet erosion
- Torrential erosion and fluvial erosion
- Periglacial erosion
- Karst modeling

The zoning of active geomorphologic processes

- alpine domain, is present in the upper part of ridges, from 1700 m altitudi until 2081 m; the protection of the forest is almost null. The intensity of the geomorphic processes is high..

- forest domain, comprises the rest of the surface from 1700 m altitude below. The main process here is the alteration. Erosion is strong dimished by the presence of the soil and forest cover.

- underground domain can be considered as a separate domain because of the particularity of modeling. The main process here consists of karstic modeling through corosion.

CHAPTER VII – LANDFORMS GENESIS STAGES

The development history of the geomorphologic landscape in Piule-Iorgovanu Mountains fit to the evolution of the territories around suffering the same transformations during the great tectonic events. For the periods of time closer to present, the evolution can be dechipher more accurately.

Over the time the periods with tectonic turmoil alternated with those with calm, all these events being registered in the resulted landforms.

The beginning of the actual geomorphologic landscape was possible after the region has suffered the major tectonic event – the laramic movements. During the laramic movements the region has been rised, freed from water and the external agents began their work of erosion. The region ows much of its landscape to the modeling produced during the Tertiary. In this period the leveled surfaces formed, the network of rivers grew and at during the Quaternary began the work of glaciers. During all this time the karstic processes were constantly active. At the end of the Quaternary the periglacial processes were the most active.

In the present the largest part of these mountains are in the area of fluvial processes along the karstic ones. Only the upper parts, above 1800 m altitude, experience a periglacial climate and modeling.

CHAPTER VIII – GEOMORPHOLOGIC ZONING

It consists in identification of units and subunits with the same morphologic characters and homogeneous evolution. The small area that these mountains cover makes possible the identification of only three subunits.

Piule-Pleşa subunit, situated in the eastern part; its characteristics combine the presence of an well individualized ridge with low fragmentation with a massive aspect.

Fig. 41 – Geomorphologic zoning of Piule-Iorgovanu Mountains

The leveled surfaces are poor represented here, the steep slopes being by the far the main features. The eastern part of the ridge represent a cuesta.

Drăgşanu subunit, on the ridge with the same name occupies a norther position in the area. Its main characteristic is the large extent of the leveled surfaces.

Albele – Piatra Iorgovanului – Stănuleți – Soarbele subunit covers the western part of the mountains. It is the most complex subunit of the massive, comprising karstic landforms, glacial landforms and leveled surfaces.

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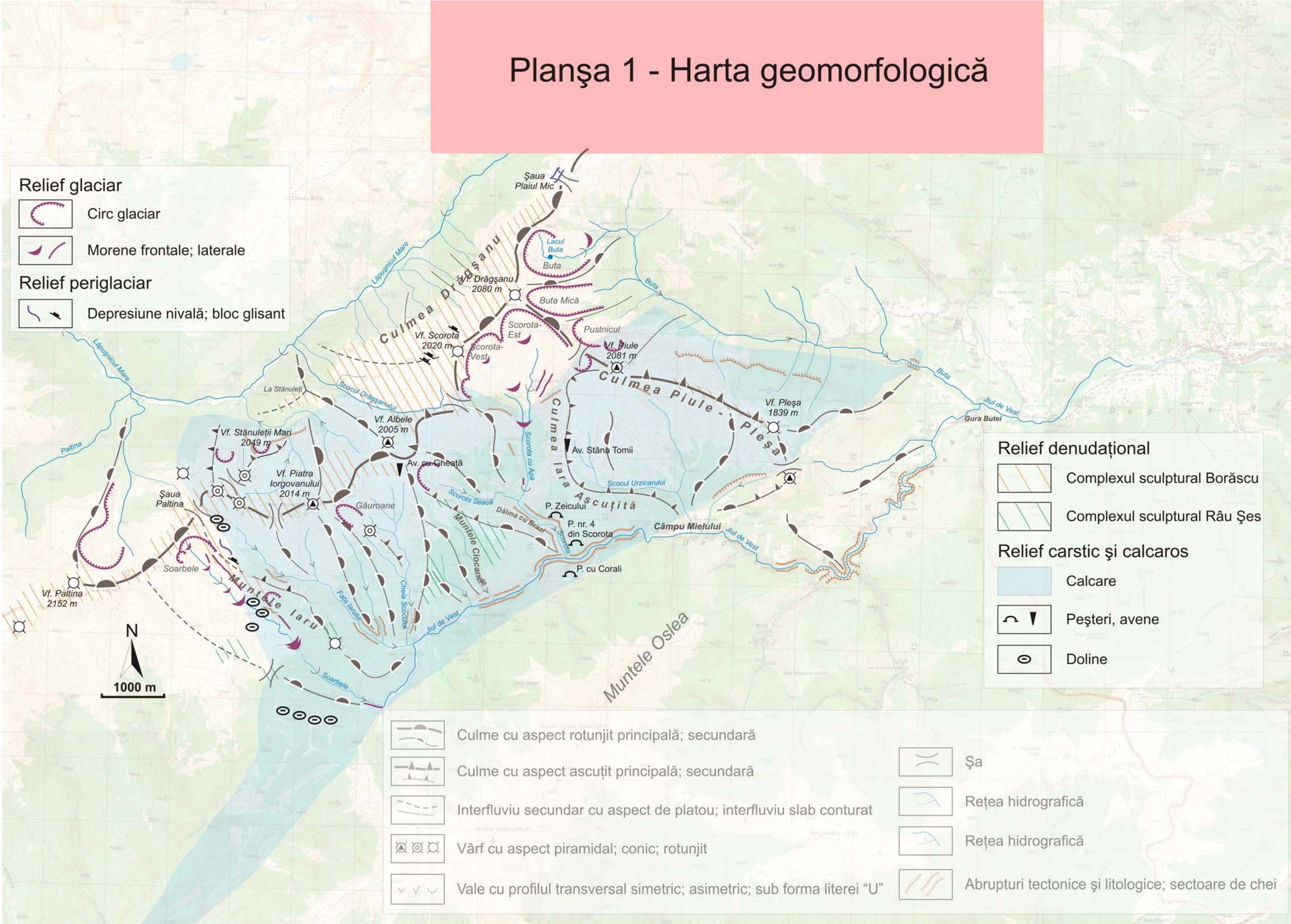
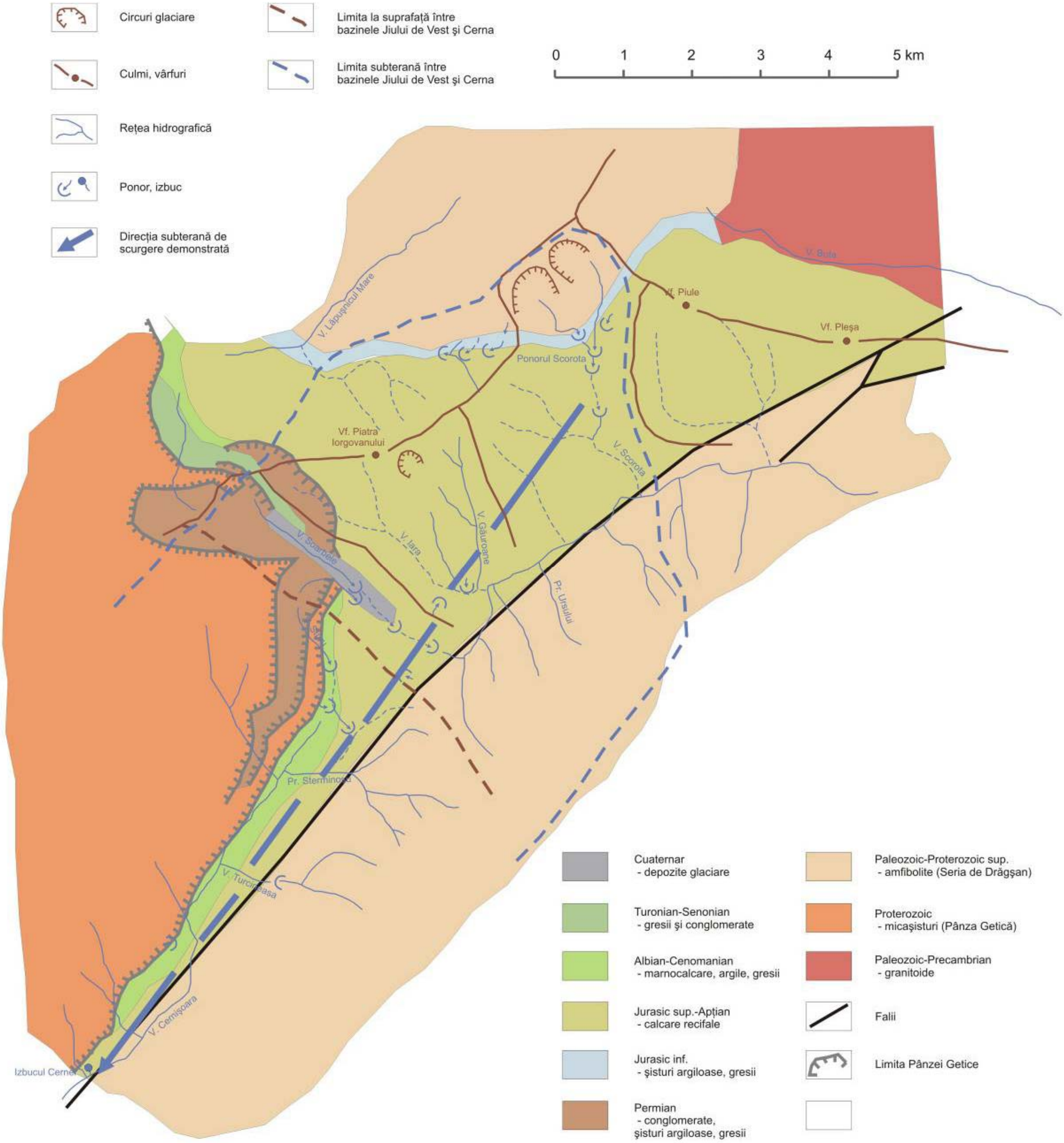
Planşa 1 - Harta geomorfologică





Planşa 2 – Underground drainage direction of water from Jiul de Vest basin to Cerna basin (processed after Ponta et al., 1984)