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LITHOLOGICAL CHARACTERISTICS AND STRUCTURAL IMPLICATIONS FOR THE RELIEF WITHIN THE GILORT BASIN (ROMANIA)

CARACTERISTICI LITOLOGICE ȘI IMPLICAȚII STRUCTURALE ÎN ASPECTUL RELIEFULUI DIN BAZINUL GILORT

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Abstract: The study highlights the structural and lithological implications within the three morphological sectors of the Gilort hydrographic basin. Within the mountaineous sector, there are mostly obsecvent glacial cirques, since this versant, although developed on the southern flank of the main ridge anticline, descends northwards, towards the glacial cirques Groapa Mândrei-Mohoru, situated southwards of the main ridge. The obsecvent character of the cirques causes a steep aspect of the slopes and the emergence of some shelf counter-slope. Within the Subcarpathians sector, most of the landslides occur on the strata end of cuestas or subsequent at the upper parts of the torrential valleys. The typical example of landslides along the cuestas can be found along the Giovria valley, where there are also some forms of slope undercutting due to torrential erosion within Pliocene deposits, alternating with marls, clays and sands, gathered in a folded and faulted structure (Câlnic anticline). Within the piedmont sector, the slopes of the valleys that cut through the Jiu Hills are heavily affected by present modelling process, and the river beds are drown in alluvia. On the left slope of the Gilort river basin, the neotectonic movements and modelling agents dug out strips of Romanian deposits. The predominantly clayish facies of these formations has caused recent landslides on the deforested slopes from the Vladimir basin, while the relief on Pleistocene sands and gravels is affected by ravines (the left slope) and landfalls with large steep slopes (right slope).

Key-words: *petrographic and structural relief, cuestas, present geomorphological processes, the Gilort*
Cuvinte-cheie: *relief petrografic și structural, cueste, procese geomorfologice actuale, Gilort*

I. INTRODUCTION

The Gilort hydrographic basin covers an area of 1358 sqkm, the river flowing generally from north to south on 116 km, with a hight difference of 2412 m (from 2518 m to 106 m). The area that is drained by the river overlaps three major morpho-structural units, distinct from the genetic, evolution, morphological, morphometric and bio-climatic point of view. Thus, almost a quarter of the basin overlaps the mountain sector, 38% the Subcarpathians and the remaining 37% the piedmont sector (Fig. 1). These are, from north to south,

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the Parâng Mountains (its southern slopes), the Gorj Subcarpathians and the Getic Piedmont (the Jiu Hills and Olteț Piedmont).

Table no. 1. Geographical location and share of relief units within the Gilort hydrographic basin

Basin sector	Coordinates				Area	Share of the basin area
	S	N	V	E		
Montain	45^{0}10′	45^{0}21′12″	23^{0}28′15″	23^{0}46′15″	342 sqkm	25 %
Subcarpathian	44^{0}54′	45^{0}10′	23^{0}24′52″	23^{0}47′04″	512 sqkm	38 %
Piedmont	44^{0}35′36″	44^{0}54′	23^{0}20′13″	23^{0}36′17″	504 sqkm	37 %
Total basin	**44^{0}35′36″**	**45^{0}21′12″**	**23^{0}20′13″**	**23^{0}47′04″**	**1358 sqkm**	**100 %**

The mountainous unit covers an area of 342 sqkm from the Parâng Mountains, where several sectors with distinct traits can be found:

The sector of high mountains, with glacial and periglacial relief developed on the Danubian Authochtonus, where granitoid intrusions prevail. At the Gilort springs, there are nine glacial cirques, most of them obsecvent ones, located around some short glacial valleys. The morphology of these valleys if characterised by the appearance of some thresholds, steps, digging depressions, debris cones, nival and fluvial streams, gorge mini-sectors. Within the Gilort basin, the cirques are frequently situated at 2000 – 2100 altitude and only exceptionally can be found at 1900 m (Marinescu, 2007). Within this sector, the altitudes above 1750 m prevail, while 16 peaks from the main ridge exceed 2000 m.

The sector of high mountains, where Borăscu complex is well preserved and is best developed. It can be found especially in the north-eastern part of the basin, around Iezer, Dengheru, Păpușa, Cioara, Galbenu, Mușetoaia peaks, some of them looking like some pyramids, while others are rather round tops, peaking over almost horizontal surfaces, at the upper level of interfluves, and displayed in two steps: Borăscu I (2000–2100 m) and Borăscu II (1750–1900 m).

The sector of middle high mountains, characterised by the longes interfluves in Parâng, sometimes reaching 10 km long. These interfluves preserve the largest Râu-Șes levelling surface, with two steps: 1500–1650 and 1400 m.

The Subcarpahtian unit covers 512 sqkm (38%) and belongs to the Gorj Subcarpathians. The relief is made up of depressions and longitudinal hills, almost parallel to the southern flank of the Parâng massif. As morphological traits, we mention the succession of depression couloirs (Oltenia Subcarpathians Depression, Câmpu Mare Depression) and Subcarpathians hills, which are well individualized (D. Copăcioasei, D. Hăieştilor, D. Ciocadiei, D. Seciului, D. Cârligeilor, D. Bechenilor).

The cross-cutting valleys from the foothill depression, penetrating through the inner Subcarpathian hills (the Larga, Blahniţa, Cărpiniş, Ciocărzeaua Radoşului, Gilort, Galbenu valleys) have an epigenetic and antecedent character (Popescu, 2000).

The narrowing and deepening of the valleys when crossing the inner hills are one of the main arguments for the antecedent hypothesis within a sector that uplifted toward the end of the Lower Pleistocene. The current geomorphological processes are quite varied and frequent on the areas where clays, marl and marls and sands abound.

The piedmont unit covers an area of 504 sqkm (37% of the basin area). The Gilort forms the limit between two piedmont units southwards of Târgu Carbunești: the Jiu Hills and Amaradia Hills (the Olteț Piedmont), forming a large valley couloir 55 km long and 1.8 – 3.8 km wide, with terraces on the left bank. The piedmont basin has an asymmetrical shape, with a maximum width of the right slope (15 km), at the spring wells of the tributaries that cross the Jiu Hills, while the maximum width of the left slope in the Amaradia Hills reaches 6.5 km.

The right slope of the basin within the piedmont sector belongs to the Jiu Hills, which appear as long hills, tilting from north-west to south-east, between the Cioiana valley in the north and the place where the Gilort flows into the Jiu in the south. The slopes of the valleys that cross the Jiu Hills (Valea lui Câine, Groşerea, Sterpoaia, Purcaru, Socu) are affected by present modelling geomorphological processes, while the riverbeds overflow with alluvia.

The left bank of the basin includes the Amaradia hills. The neotectonic movements and modelling agents brought to daylight the Romanian deposits, which appear as strip extending from the confluence with Vladimir rivulet to Târgu-Cărbunești in the north-eastern part, where it is best developed. The predominantly clayish facies of the Romanian formations leads to recent landslides on the deforested slopes Vladimir, Boziana, Tudoreasa, Valea Mare and Stefanesti valleys, while on Pleistocene sands and gravels near the valley of the Gilort there are several ravines (left slope) and collapsing, with large steep slopes (right slope).

II. DATA AND METHODS

Based on the geological maps, 1:50,000 and 1:200,000, there were made geological cross-sections for each of the three morpho-structural sectors: Carpathians, Subcarpathians and piedmont sector (three cross-sections for every sector) and the stratigraphic columns of the deposits were highlighted in the key points of these sections. On the field, we tried to identify every facies and highlight the deposits and erosion relict forms where the those particular formations and associated present geomorphological processes are found.

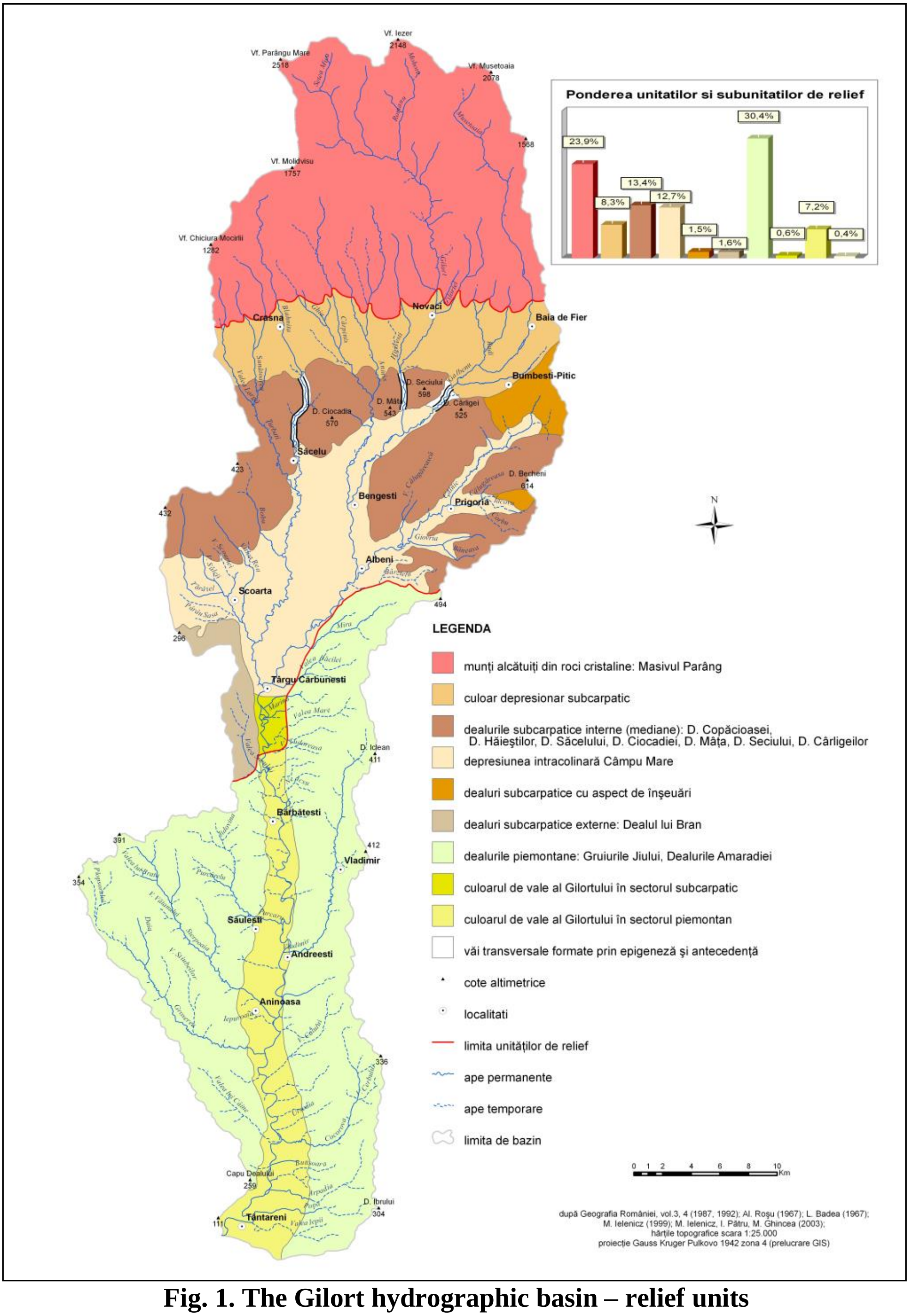

Fig. 1. The Gilort hydrographic basin – relief units

III. RESULTS AND DISCUSSIONS

The mountain sector of the basin is mostly covered by the formations from the Danubian Autochthonous (Fig. 2). The Gilort and some smaller tributaries (Romanu, Pleşcoaia, Setea Mică) have the springs on the southern slopes of the Parâng Mountains, where Paleozoic magmatites predominate, called *Parâng type granitic rocks* (Pauliuc, 1937) and sporadically covered by glacial deposits. These granitic rocks pierce through Drăgşan series along Parângu Mare – Gruiu – Pâcleşa – Ieşu - Setea Mare – Mohoru – Urdele - Dengheru peaks.

Most of the glacial cirques are obsequent, since this slope descends northwards, toward Groapa Mândrei-Mohoru cirques, despite being developed along the southern flank of the anticline of the main ridge. The obsequent character of the cirques gives a steep aspect to the origin slopes and emergence of counterslope thresholds.

The rivers cross a narrow strip of amphibolits, only 600-800 wide, belonging to the cristaline series of Drăgşan. The amphibolitic complex forms a continuous are on the east-west direction, between Tărtărău and Păpușa-Galbenu Peaks. Southwards, there is a 1-2 km wide strip made up of the chlorite-sericite crystalline schists that form the upper part of Drăgşan series, with chlorite-sericite- quartz schists in the west and intercalations of green schists along the Daltău – Cioara – Mușetoaia peaks.

Southwards, the Lainici –Păiuș series includes granite rocks in gneiss facies (Șușita granite) which form a continuous strip with west-east orientation, almost 5.5 km wide (Muncel - Zănoaga Peaks alignment), followed by the crystalline schist from the Lainici-Păiuș series (Stăncești Larga – Cerbu alignment); in the southern part, there are Tismana granitoids (Stănceşti Larga –Frunţi – Ţancurile Pleşii alignment). The entire complex of crystalline rocks from the Lainici-Păiuș series, magmatites and granites (which cover larger areas southwards) is 8-11 km wide.

The granitoids are found within three alignments:

a. Parângu Mare – Ieşu – Setea - Mohoru – Dengheru Peaks, where granitoids in gneiss facies appear, alternating with massive granitoids (in the central part of the main ridge), that penetrate the Drăgşan crystalline series (fig. 3);

b. Sușița valley – Sadu – Nedeiu Peak, which can fe tracked from the Suseni Valley (Vulcan Mountains) through the Jiu Gorge up to the Olteț valley, and includes the Șușita plutonic body, piercing the Lainici-Păiuș crystalline series; this is predominantly made of granodiorites and granite.

c. Stăncești Larga – Cărpiniș – Novaci – the Olteț Valley, where there are several magmatic bodies, such as Novaci and Cărpiniș: Novaci granite (Trifulescu, 1964) and Tismana type granite (γ).

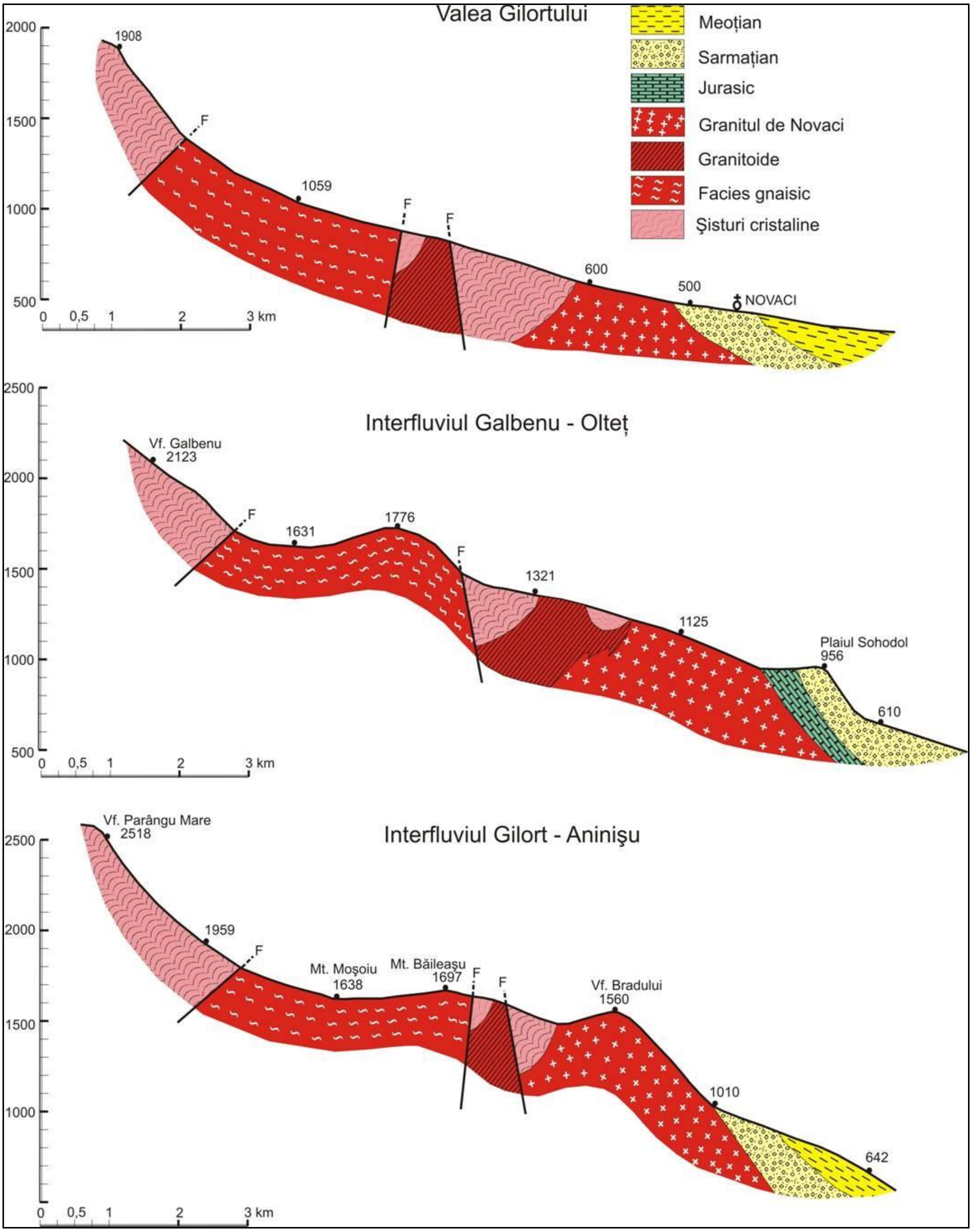

Fig. 2. Geologic cross-sections within the mountain sector of the Gilort basin

Fig. 3. Granits and massive Parâng type granitoids in the central part of the massif

On these Tismana type granites, south of Măgura Peak (1161 m), on Gilort – Galbenu interfluve, there are the largest areas with gruss (granite arena) within the Gilort basin (fig. 4), as a result of rock resolution under the complex action of insolation and gelivation.

Erosion removed much of the sedimentary cover of the Danubian Autochthonous, and there are only some patches of it north of Cernădia, between Gilorțel and Cernăzioara valleys, and along the Galbenu Valley, north of Baia de Fier. They are made up of Jurassic and Cretaceous deposits.

The lower Jurassic (Liasic) is present at Cernădia, with quartz sandstones, clay schists monocline and transgressive deposited on the fundament (Huică, 1965). There are also another two patches that date from Liasic, between Crasna and Stăncești, made up of micro-conglomerates, sandstones and clay schist with mineralisation and colads, with transgressive character, belonging to Schela formation (Zberea, 1962).

The medium Jurassic (Dogger) can be found at Baia de Fier, where there are some karst rocks on top of some hard yellowish lime sandstones (Huică, 1965).

The upper Jurassic (Malm) – Lower Cretaceous is found north of Cernădia, between the Gilort and Cernăzioara valley, transgressivly along Baia de Fier – Polovragi alignment, with massive white limestones, while at Baia de Fier there are limestones with Calpionella alpine, where frequent landslide surfaces are found, as a result of the pressure they suffered when the Getic Drifting Nappe covered them, before being eroded (Codarcea&Drăghici, 1996). The strata are

350 m thick, the Muieri Cave having four levels within these tithonic sediments (Ilie&Lupu, 1963).

Fig. 4. Petrographic erosion outliers (granites) and granite arena (gruss) formed due to the rock resolution of Tismana granites southwards of Măgura Peak

The upper Cretaceous, including only Turorian – Senonian levels, is the last Mesozoic formations with wildflysch deposits, made up of a predominantly clayish mass, where the lime schists and sandstones are subordinate (Huică, 1965; Codarcea, Drăghici, 1966). They are found between the valleys of Gilorțel and Olteț. The wildflysch deposits include clays with exotic limestone blocks, highly tectonized by the same agent.

The upper Sarmatian has a transgressive character. The Sarmatian transgression deposited at the Parâng margin gravels, hoarse sands, conglomerates that are found above Novaci depression, along the Scărița, Gilorțel, Hirișești, Aniniș and Crasna valleys. Due to the subsequent modelling, these deposits were uplifted, thus appearing as a porch where Gornovița surface was carved. Currently, Sarmatian deposits are found in the southern part of the Parâng Mountains, up to 970 m altitude, on the interfluve between the Hirișești and Aniniș valleys.

The structure of these deposits is highlighted north of Baia de Fier, where on top of the crystalline that is found in the river bd of the Galbenu river there are Jurassic limestones, and Tortonian marls and Sarmatian conglomerates are trangressively laid upon them.

At the end of the Sarmatian, Parâng massif enters an eolian modelling regime, the Quaternary deposits having a continental character (fluvial, glacial, lacustrine).

Within the Gilort hydrographic basin, the deposits within the Subcarpathians area lay over the crystalline Mesozoic deposits in the bedding, beginning with the Eocene ones (Fig. 5).

At Băile Săcelu, within the thalweg and on the slopes of the Blahnița valley, there are grey conglomerates with clay-sand matrix, with crystalline, sandstones, black clays and eruptive rocks elements. Gr. Ștefănescu (1884) and Gh. Murgoci (1908), considering the numerous nummulites, claimed they date back to Eocene, while I. Popescu-Voitești (1935) argued that they are Burdigalian conglomerates. The incertitude regarding their ages resides in the fact that the nummulites may be reshuffled just like in other Acvitanian deposits that reshuffle organic debris from Eocene deposits.

The Badenian deposits are generally covered by transgressive Sarmatian depostis, that lay directly on top of the crystalline Mesozoic ones, except for a small enclave east of Novaci, where there are Badenian deposits, where the stratigraphic column shown in Fig. 8 was established (Zberea et.al., 1981).

Badenian is also signalled in the western part of Cernădia settlement, where there are breccias that are the oldest tertiary deposits in the southern part of the Parâng mountains. The Lower Badenian includes breccia conglomerates along the Cernădia and Cernăzioara valleys, laid in the excavations of the Jurassic limestrones, followed by small conglomerates and marls (Popescu, 1955).

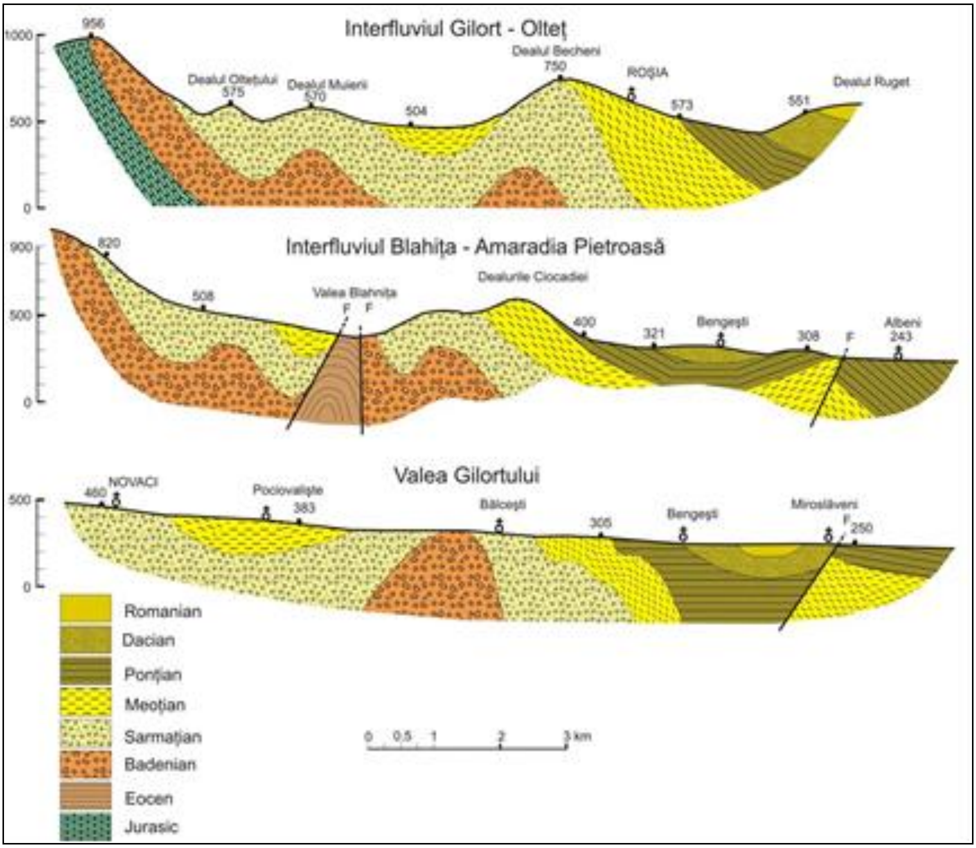

Fig. 5. Geological cross-sections within the Subcarpathians sector of the Gilort basin

Fig. 6. Săcelu grey-conglomerates with crystalline elements, sandstones and eruptive rocks

Upper Badenian can be found in Plesa hill and Cernăzioara valley, where there are limestones, along the Rudi and Gilorțelul Mare valleys – compact marls, and the Scărița Valley – sands, rotten limestones and compact marls, transgressively deposited over the Autochthonous crystalline (Popescu, 1955, Tudor, 1955).

The lower and intermediate Sarmatian is found in the northern part to the Subcarpathian depression, including marls and minced gravel, along the Cernăzioara, Aniniș valeyes and in the heartland of Novacii Ungureni village (Popescu, 1995, Tudor, 1995).

Badenian deposits including sandy marls with thin intercalations of gravel and fossiliferous limestones are also found along the Scărița valley, a left tributary of the Gilort (the confluence is at Novaci) and along the Gilorțel valley, east from Novaci (Tudor, 1955).

Sarmatian strata between Crasna and Cărpinișu lays trangressively over the crystalline schists, and from there eastward, up to the end of the Gilort basin, overlaps granitoide rocks. These deposits include poorly cemented gravels, intercalated with sands and marls (Fig. 7). They were thoroughly analysed at Cernădia, east of Novaci, and at Polovragi.

Southwards from Novaci depression, Ciuperceni – Ciocadia – Săcelu anticline is found, which includes Eocene conglomerates (Fig. 6), as well as the Badenian deposits mentioned above, with two outcrops, that overlap the both flanks of the intermediate Sarmatian deposits, made up of sandy marls, sands and gravels.

Fig.7. Sarmatian deposits transgressively deposited over the crystalline schist on the southern slope of Parâng Massif (Gilorțel and Scărița valleys)

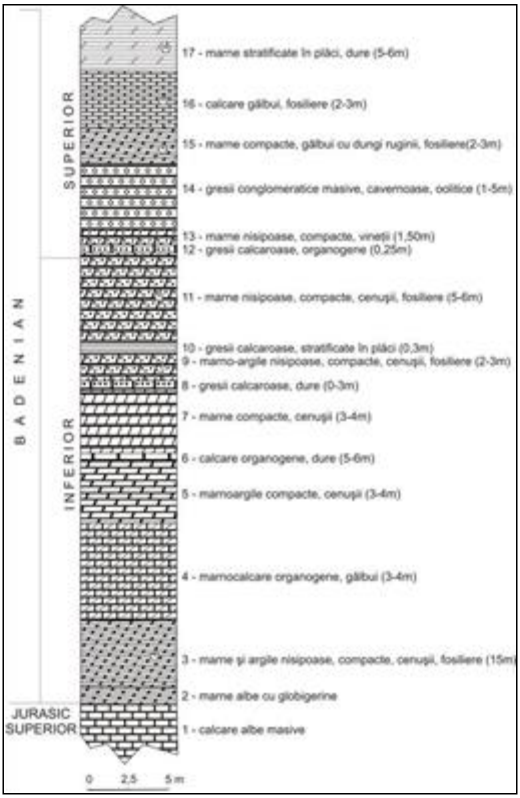

Fig. 8. The stratigraphic column of the Badenian deposits at Novaci
(according to the Geological map, 1: 200,000, Tg.-Jiu sheet)

Finely layered marls intercalated with sands and sandy marls, dating since the upper Sarmatian cover Novaci depression and the southern part of Ciocadia – Săcelu anticline.

Meotian includes sands and sandy marls (Fig. 10-11), intercalated with gravel containing typical salmastre fauna, covered by sandy marls with sands, followed by sands including fresh water fauna such as *Unio, Viviparus and Radix*, then an oolitic sandy level and sands with salmastre fauna.

A characteristic cross-section (Bercia et.al., 1968) presents the succession of Meotian deposits within the Prigoria valley (Fig. 9).

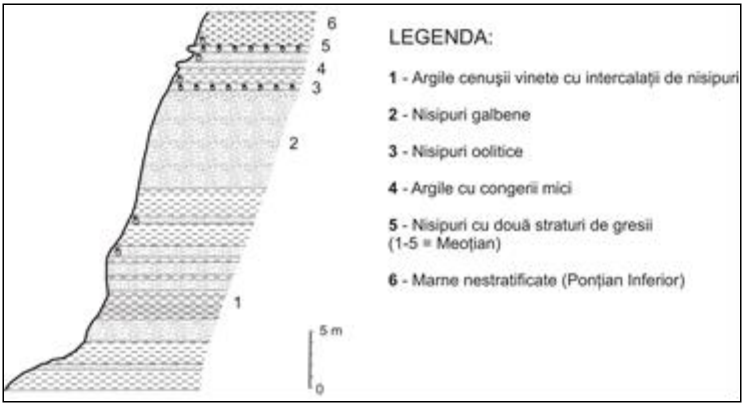

Fig. 9. The succession of Meotian deposits within the Prigoria valley
(according to the Geological Map, 1:200,000, Tg.-Jiu sheet)

Fig. 10. Meotian marls within the Subcarpathians area, along the Ciocadia and Câlnic valleys

Fig. 11. The Gilort riverbed at Jupânești, including sandy clays and Meotian marls

The Pontic deposits cover a large area of the Gilort basin, including characteristic greyish-bluish marls, that gradually turn into sandy marls intercalated with clayish sands, followed by marls and sometimes sandy clays and fossiliferous sands.

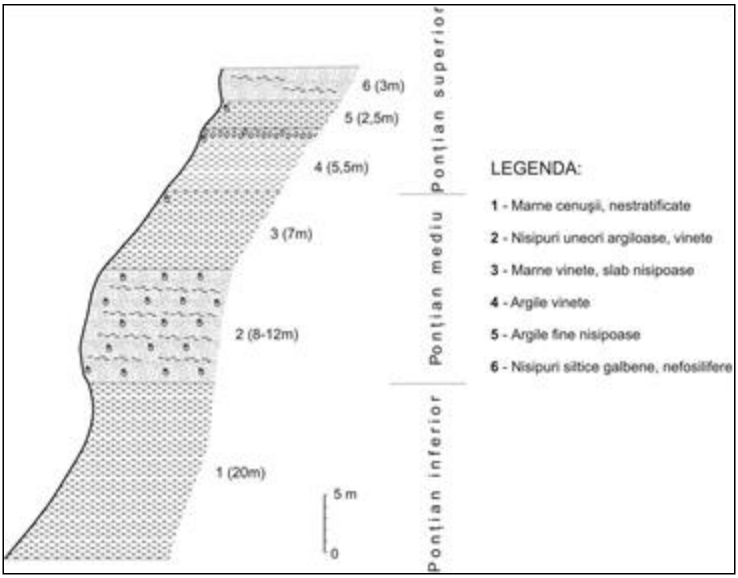

Fig. 12. Succession of Pontian deposits along the Bobaia valley
(according to the Geological Map, 1:200,000, Tg.-Jiu sheet)

Fig. 12 presents the succession of Pontian deposits along the Bobaia valley. Apart from the hills north of Scoarța and Bobu, the slopes of the Negoiești and Hârnea valleys date back to the Pontian. The sands from the upper Pontian are 25-

30 m thick and just like the Dacian sands that cover them are affected by landslides, due to blue clays.
Dacian can be found overlapping the Pontian deposits between Scoața – Bobu – Bengești. A good profile can be found at Bengești (Fig. 13).

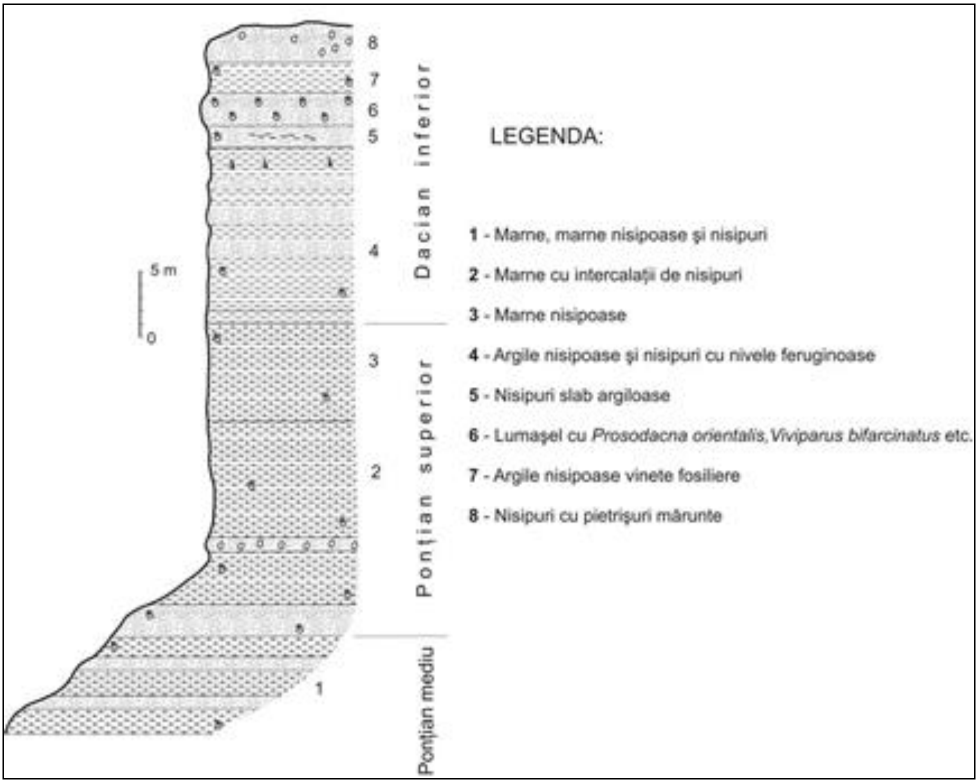

Fig. 13. Succession of Pontian and Dacian deposits at Scoarța
(according to the Geological Map, 1:200,000, Tg. Jiu sheet)

On the southern slope of the Hârea valley, there are the last Pontian deposits, with the same lithology as the Bobaia cross-section.

Dacian is found in the region, from the limit with Pontian up to the limit with Romanian.

The Dacian deposits along the Hârnea and Giovria valleys favour the mass movements, the most important morphological and dynamic slope complex (landslides, ravenes, collapses, mud flows) being found in Prunești hill, near Albeni.

Romanian deposits, made up of sands and some intercalations of lignite in the northern sector and greenish and yellowish clays cover the entire ara of the Gilort basin, from the above-mentioned limit up to the influx.

Fig. 14. Dacian formations within Prunești hill (Câlnic basin) include yellowish clayish fine sands, blue clays, lignite and porcelain-minerals with *Quercus* fossils

These deposits are found in almost all the abruptions along the valleys.

At Tulburea, on the left bank of the Gilort, over the black clays with an intercalation of lignite 0.2 m thick, there are fossiliferous sands 4-6 m thick, followed by 10-12 m of whitish sands, 18-20 m of yellowish sands with cross structure, 5-6 m of black clays and 8-10 m fossiliferous sands. The same whitish and yellowish sands, partially fossiliferous, are found along the Cerului rivulet, Surdumoale and Derș valley near Vladimir village and Câine valley (Fig. 15).

The alluvia deposits from the terraces and flood-plains are the most important Quaternary deposits. In the hills that form the interfluve between Gilort and Amaradia, Pleisotcene includes a lower yellow-brown or reddish clay horizon, then a strata of fine and horse gravels, in which *Elephas (Paleolexodon) antiquus* were found near Răcari. On top of the gravels, there are found yellowish dust-clat deposits, loess-type, dating from the intermediate Pleistocene.

Fig. 15. Leoss-like sandy deposits with *Viviparus bifarcinatus* along the Câine Valley (the Jiu Hills)

On the northern part of the Getic depression, the lower Pleistocene includes gravels with torrential stratification, deposits which appear as smaller or larger patches on the ridges, 2-5 m thick. Such deposits are found in Bălani Hill, north-west of Târgu-Jiu, Bălănești hill and Voitești Hill, between Glodeni and Mușetești.

The deposits of intermediate Pleistocene hold clayish and loess dusts and sometimes sandy clays. These deposits, 5-10 m thick, are generally red. There could be identified as belonging to the intermediate Pleistocene, too, dusty sandy loess deposits, sometimes with a higher clay content. Here, lentils with hoarse sands and fine gravels can be found.

The upper Pleistocene is represented by the deposits on the intermediate terraces, especially those of the Jiu and Gilort rivers.

IV. CONCLUSIONS

The structural influences within the Gilort basin are visible both in the fluvial and the glacial relief (in the higher part of the basin), as well as the levelling surfaces.

The expansion and frequency of emergence of some petrographic relief categories depend on the share of the rock types that are found throughout the basin. Thus, sands and gravels hold the largest share (57.2%) (piedmont deposits and to a lesser extent in the other units), followed by marl clays (13.8%), granite and granitoids (12.2%), crystalline schists (7.8%), comlex of clays, sands and coals (7.8%), limestones (0.78%), clay-marl facies with marl intercalations

(0.22%), loess deposits (0.4%). These deposits host specific current geomorphological processes.

The mountain sector of the Gilort basin is mostly covered by the formations of the Danubian Autochtonous. Its sedimentary cover was largely removed by erosion, so there are just patches north of Cernădia villages, between the Gilorțel and Cernăzioara valleys, as well as on the Galbenu valley, north of Baia de Fier, made from Jurassic and Cretaceous deposits.

The main hydrographic network on the southern slope generally has a transversal character, which is emphasised by the alternance of broader and narrower sectors, mainly as a result of the adaptation of valleys to the nature of the rocks. The adaptation of young valleys to the structure took place on the background of the genesis, conditioned by the slope and water source, which could allow them to adapt.

On the monocline sedimentary formations dating from Sarmatian within the southern part of the Parâng mountains, the valleys are deepening conseventy on a north-south direction, a character reflected by the symmetry of the slopes of the Galbenu, Gilort, Aniniș, Cărpiniș, Crasna valleys. In the northern extremity of the Sarmatian deposits, the valleys still have short epigenetic sectors, where the profile of the slopes changes in the crystalline sector, by a much steeper V-shaped cross-section.

The most important deposits that trigger current geomorphological processes are the Dacian ones along the Hârnea and Giovria Valleys, where there is the most important slope morpho-dynamic complex (landslides, ravines, collapses, mud flow) in strata including alternances of marls, clays, coals and sands with various degree of cementation.

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