

CONSIDERATIONS UPON THE RIVER SYSTEM IN THE NORTH OF THE SUCEAVA TABLELAND

Dinu OPREA-GANCEVICI

Key words: metamorphite, river system, Quaternary paleodirections.

Cuvinte cheie: metamorfite, rețea hidrografică, paleodirecții cuaternare.

ABSTRACT:

The paleoevolution of the river system in the Moldavian Tableland has undergone at a theoretical level two successive hypothetical directions.

The former direction, formulated in the first half of the XXth century, alleges the existence of a river system, with a transverse character, that prolonged to the east the Carpathian river systems. Specialists of this theory, Tufescu V. (1932), M. David (1933, quoted by V. Băcăuanu - 1973) and Gheorghe Nastase (1946, quoted by V. Băcăuanu - 1973) based their design on the presence of horizons of gravels with Carpathian elements on some interfluves to the east of the Siret valley, and the existence of some saddles, Loznica, Bucecea and Ruginoasa, located on the left side of the same river.

The latter direction, diametrically opposite, supports the idea of evolution of the river system consecutively with the Sarmato-Pliocene Sea pulling back to the south. The hypothesis is supported and substantiated by I. Sîrcu (1955), C. Martiniuc and V. Băcăuanu (1960), V. Băcăuanu (1968, 1973). In this context it is considered that the Prut and Siret rivers carved the oldest valleys in the tableland. The authors explain the erosional genesis of the saddles arguing their inability to create transversal rivers on the basis of continuity upstream and downstream the saddles of terrace levels with relatively high altitudes, which proves the flow continuity on consequent valleys.

The research carried out along the Suceava river valley and the immediate interstream area in order to create a scenario of the valley paleoevolution highlighted the presence of crystalline lithotopes in the petrographic structure of the accumulation deposits. The presence of such petrographic elements contradicts the present-day alluvia sources of the rivers that could have transported them: Suceava or its tributaries Soloneț, Ilișasca, Șcheia. The rivers spring either from the Carpathian flysch or from the former area of platform sedimentation.

We consider that the current Soloneț, Ilișasca, Șcheia streams and valleys and, through generalization, Sucevița and Solca, have nothing in common with the Carpathian Sarmatian paleosystem that built the Suceava Piedmont. The superior flows on the eastern slope of the Obcina Mare can be accounted through a normal regressive evolution, and the current saddles are the consequence of selective erosion. The old Carpathian system changed probably because of the Wallachian movements, only Moldova and Suceava maintained their former Carpathian flows.

The current system didn't go beyond the Suceava Valley in the east, therefore we can appreciate that the river with the same name installed itself previously. The relative altitude of the oldest terrace is of 180 – 190 m, which is attributed, according to the same morpho-chronological scheme, to the Superior Pleistocene. By comparing the absolute altitudes of the Suceava terraces to those of the hills which preserve piedmont deposits and also to the average altitude of the latter as compared to the adjacent valleys we cannot but wonder upon the age of the landforms in the north of the Tableland.

We continue to be very much interested in the evolution of the river system as a whole in the north of the Moldovenesc Tableland, especially taking into account the interesting remarks made by professor Tufescu (1985) on some deposits situated east of Bucecea saddle, where he identified elements of Mesozoic sediments.

1. Introduction

The paleoevolution of the river system in the Moldavian Tableland has undergone at a theoretical level two successive hypothetical directions.

The former direction, formulated in the first half of the XXth century, alleges the existence of a river system, with a transverse character, that prolonged to the east the Carpathian river systems. Specialists of this theory, Tufescu V. (1932), M. David (1933, quoted by V. Băcăuanu - 1973) and Gheorghe Nastase (1946, quoted by V. Băcăuanu - 1973) based their design on the presence of horizons of gravels with Carpathian elements on some interfluvies to the east of the Siret valley, and the existence of some saddles, Lozna, Bucecea and Ruginoasa, located on the left side of the same river. Present valleys, the Prut and Siret, would be the result of the successive captures produced northwards to the detriment of the initial system.

The latter direction, diametrically opposite, supports the idea of evolution of the river system consecutively with the Sarmato-Pliocene sea withdrawal to the south. The hypothesis is supported and substantiated by I. Sîrcu (1955), C. Martiniuc and V. Băcăuanu (1960), V. Băcăuanu (1968, 1973). In this context it is considered that the Prut and Siret rivers carved the oldest valleys in the tableland. The authors explain the erosional genesis of the saddles arguing their inability to create transversal rivers on the basis of continuity upstream and downstream the saddles of terrace levels with relatively high altitudes, which proves the flow continuity on consequent valleys.

The interfluvial gravels on the left side of the Siret River are considered by M. Macarovici (1946, quoted by V. Băcăuanu - 1973) to have coast features, being subjected to transport by the sea currents. V. Băcăuanu (1973, 1980) assigns the gravels to horizons interpolated with Sarmatian clay deposits that have nothing in common with terrace deposits of with hydrographic transversal flows. C. Grasu and his collaborators (2002) explain the presence of such gravels through the process of progradation to the south-east of the Siret paleodelta (figure no. 1).

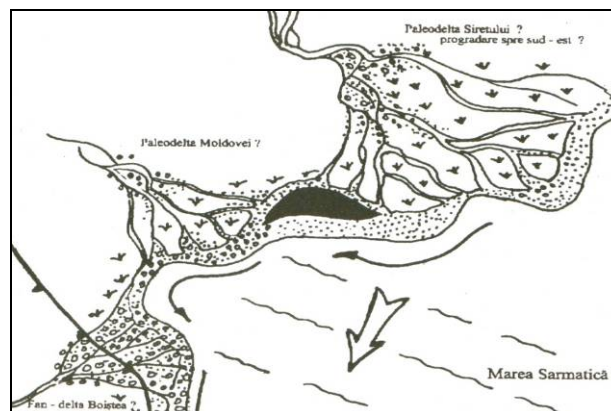


Fig. 1. The scheme of the evolution of paleodelta rivers in the north of the tableland (according to Crina Miclăuș, 2002).

V. Tufescu (1085) resumes the issue of the gravels located on the interfluvies at the east of the Siret valley (Bucecea saddle) and beyond specifying some locations,

we consider interesting the appreciation of the petrographic aspect: “river gravel, with well rolled elements consisting of Carpathian, Cretaceous and Paleogene flysch and also of Mesozoic Rarau cuvete (sandstones, black shales, Verfenian conglomerates, Urganian limestones, etc). Mesozoic sediments surely seem to be an interesting element in the construction of transversal river system hypothesis, but probably cannot be related to the genesis of Bucecea saddle). We do not intend to address this hypothesis offered by professor Tufescu, our study is limited to the problem of evolution of the river system for the neighboring region, located to the west – Suceava Tableland. But the suggestion made by Tufescu about the characteristics of the gravels in the interfluves was a real urge and a way to follow in the research we do in our area of study.

2. Area of study

The area of interest corresponds to the north of the Suceava Tableland, between Moldova and Suceava river valleys (figure no. 2). Westwards it contacts the narrow strip of Peri-Carpathian Miocene age over which the Obcina Mare orogen overthrusts.

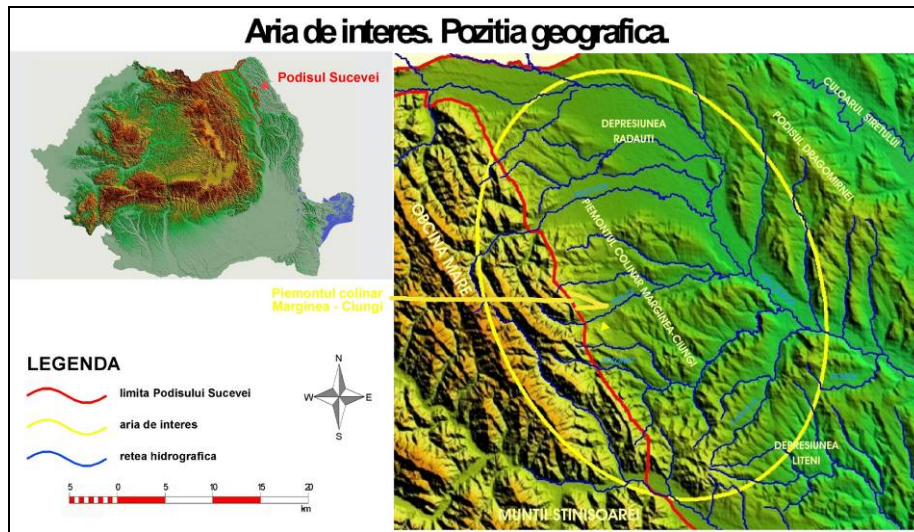


Fig. 2. The geographic position of the interest area.

From a geostructural point of view, the study area overlaps the Moldavian Platform deposits, which have a monocline character and a lithofacies predominantly made of sand and clay presenting thin sandstone intercalations. There is also a general layer inclination from NW to SE of about 5-8 m/km. There is also a secondary fall of the layers to the west, following the collapse by degrees under the Carpathian orogen of the shield foundation.

The region corresponds to the oldest Carpathian piedmont, put in place in the Sarmatian – Pliocene interval and fragmented in Quaternary (Pop, Martiniuc 1971). The piedmont debris currently appear in the form of isolated patches, identified at the

top of the some interfluvies which usually align the highest altitudes. We mention just a few: Fătului (535 m), Volovăț (511 m), Lupului (507 m), Zamca (541 m), Piscul Vulturului (505 m), Ciungi (689 m), Socu (609 m) etc. The morphological character is induced by the monocline structure of the platform sedimentary. Such valleys created by the tributaries of the Suceava River (Sucevița, Solca, Soloneț, Ilișasca, Șcheia) have a subsequent character, obviously asymmetrical, cuesta fronts appearing on the right side.

Based on observations of the psamitic deposits located on the interfluvies of the tableland in the vicinity of the Obcina Mare orogen, Barbu and his collaborators (1966) make some assumptions on the paleoevolution of the river system. They consider that these deposits are deltaic constructions of Volhinian age of some paleorivers which had their origins much westwards than the current ones. The petrographic analysis of the accumulative suggests the existence of some paleocourses (Paleo-Soloneț, Paleo-Clit, Paleo-Sucevița) not exceeding the flysch area to the west. The only exception is Moldova river, in whose paleodelta, Ciungi Massive, metamorphic elements were identified on a proportion of about 2-3% (Barbu and collab. 1964). On the basis on these elements the authors consider that the origins of this river did not go beyond the eastern slope of the Marginal Syncline. The authors consider that the Volhinian piedmont deposits go beyond eastwards close to the present valley of Suceava. Only a few locations: Leahului Hills, Bradet, Colnic, Horodnic, Cioata, Crîngești, Codru, situated on the right of the Suceava river, are estimated to have controversial deposits as origin:

- piedmont - according to the authors mentioned above
- fluvial river - N. Macarovici (1964), Sîrcu I. (1965), Martiniuc C. (1965, quoted by Barcu and collab.)

Also, I. Donisă and collaborators (1973) consider the formation of piedmont gravels between Moldova and Suceava rivers, by a transversal paleo-system, – Sucevița, Clit, Solca, Soloneț, that functioned during the Sarmatian- Superior Pliocene interval.

3. Atypical petrographic characteristics in some accumulative deposits

Our research made along Suceava valley, and also in the interfluvies in the region in order to create a paleoevolutive scenario of the valley, revealed the presence of crystalline lithotopes in the petrographic structure of different accumulative structures. The atypical petrography is generated by the current extension of the Suceava river system in the orogen area only in the flysch region. If initially the identification of some crystalline elements in the extra-Carpathian river bed of Suceava did not appear very interesting to us, such factors being mentioned also by Barbu N. (1976) on the upper course, the identification of metamorphites in the slope terraces, generated questions related to possible source areas and to the hydrographic system that caused the transport. The location and the characteristics of deposits containing metamorphic elements were considered in another material (Oprea 2008). We mention the crystalline elements identified in the river bed of Suceava, in the terraces of 60 and 100 m in Monastery and Viei Hills (on the left of the Suceava district in the area of Burdujeni quarter), then those on the upper courses of Soloneț, Ilișasca rivers (on Vărvata tributary, with origins in Ciungi and Socu hills), in Costișa hill (included in the cuesta front that forms the southern border to Ilișasca

system) and last but not least those in Osoiu hills (424 m south of Soloneț) and Șcheia hill (438 m north of the Șcheia brook)- figure no. 3. We consider the two last locations very important for the outline of some paleoevolution scenarios of the river system development because of the many and various metamorphites present in psephito-psamitic deposits located at the upper part, over 8% in Osoiu Hill, respectively about 2.5% in Șcheia Hill (Oprea, Florea 2008).

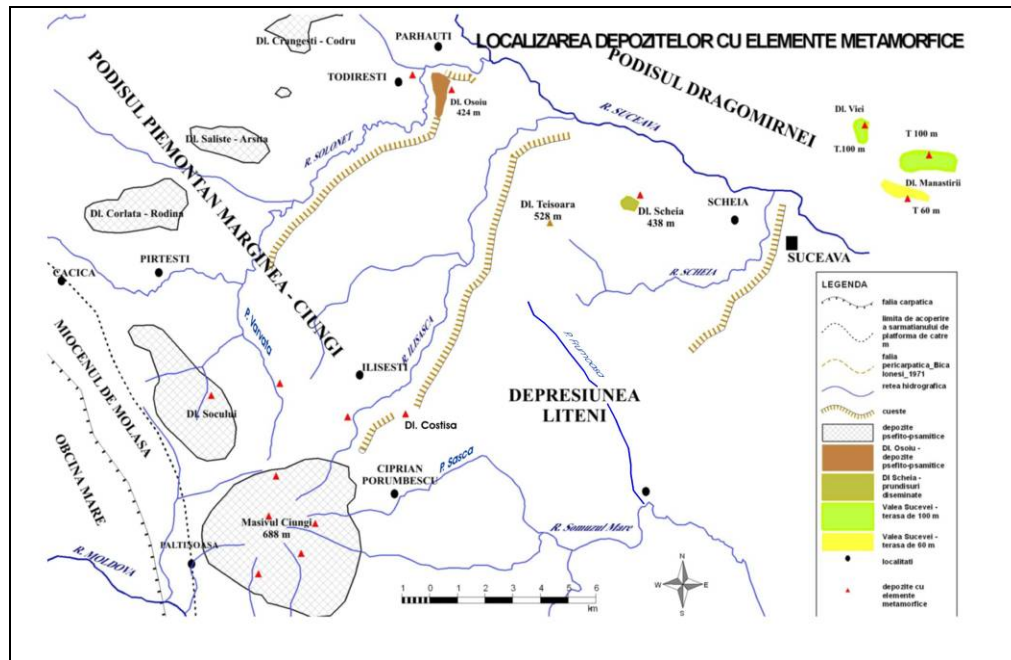


Fig. 3. Location of the sites with metamorphic rocks.

The presence of these petrographic elements contradicts the current alluvia sources of the rivers that could carry them: Suceava, Soloneț, Ilișasca, Șcheia. The rivers have their source either in the Carpathian flysch, or in the former sedimentation area of the platform. These field observations were the first arguments that led to the exploration of a number of paleogeomorphological considerations to support the explanation of the presence of metamorphic elements in various fluvial deposits.

4. Paleogeomorphological considerations

The existence of the crystalline elements in the flood-plain, in the valley bottom terraces, and in the slope terraces of the Suceava River, despite the small number of elements generates questions regarding their origin and transport. So, to create some paleoevolutive scenarios we will consider the petrographic characteristics of the accumulative deposits and the structural monoclinial features of the platform. We will seek an accurate explanation for each location where we identified gravels with crystalline elements:

a) The existence of metamorphites in the flood-plain and valley bottom terraces is explained by the current origins of the Suceava River. Today it gathers its waters through Izvorul, Plaiul and Aluniş springs. The first have springs on the northern slopes of Hrobi and Bobeica peaks. They have Albian conglomerate horizons with crystalline elements, which are geologically associated to Teleajen Nappe, from the internal flysch (Dimian 1968).

b) For the 60 and 100 m terraces of Burdujeni, Viei and Manastirii Hills the origin of the crystalline elements supports multiple hypothetical views:

- their presence could suggest a Paleo - Suceava, which could have origins more westwards than the present ones. This course could have drained the same Albian conglomerates, but its superior sector underwent a process of capture in favor of Cîrlibaba river (Oprea, 2008);

- the crystalline could have been reshuffled from the terrace of 120 m from the junction of Suceava with Solonet;

- the shuffled crystalline from Scheia hill, a possible confluence terrace of Suceava with Scheia -160 m relative altitude;

c) The crystalline elements from Osoiu and Scheia Hills, through their diversity, seem not to have been transported by Suceava River. Their presence on the right of the Suceava River at a relative altitude of 160 m and 120 m (altitudes that allow us to associate them with possible confluence terraces) suggests the likelihood of transversal paleocourses, tributary of the Suceava River (the highest terrace has the relative altitude of 180 - 190 m). The presence of the metamorphites would indicate origins of these paleosystem that would have transcended the Upper Pliocene - Lower Pleistocene origins of a paleo- Moldova. The statement is based on research results conducted in Ciungi by Barbu and collab.(1964) and, respectively by Crina Miclaus (2001). The former author notes few crystalline elements (2-3%) and only gneisses specific to the eastern area of the marginal syncline. The latter author does not identify any crystalline element or sedimentary elements specific to the marginal syncline in the two analysis places: on the Hozoaia brook and at La Țigani cliff. Hence, the conclusion is that Moldova entered the Mesozoic crystalline area late in the Higher Pliocene, although sedimentation is considered to have begun in the Lower Sarmatian (Barbu and collaborators 1964).

We find it still difficult to sustain and even admit that the prospect of some paleocourses that should have more advanced valleys than that of Moldova developed in orogen, so that the presence of crystalline elements must have other explanations.

Should these gravels be the result of river transport imposed by a Paleo-Suceava? We believe that it is very unlikely that Suceava could have drained the drained the crystalline diversity of the Eastern Carpathians. Could they be alluvial deposits of a paleo-Moldova? There are pros and cons. In support of this hypothesis should be:

- The position of the deposits from Osoiu an Scheia Hills, with about 20 or 18 km to the ENE as compared to that of the Ciungi Massif, which would support a transversal course of the Pleistocene Moldova to Suceava Valley;

- The variety of crystalline elements, explained for a Paleo-Moldova which drained the western edge of the Marginal Syncline at the end of the Pliocene,

The listed arguments become almost zero if we take into consideration the fact that for the downstream sector of the Ciungi Massif, Moldova has terraces whose

heights exceed the absolute altitude of Scheia Hills - 438m, respectively Osoiu Hills - 424m.

We will try an individual analysis of the deposits in the two sites, taking into account the morphostructural evolution of the Tableland after the Wallachian movements that are said to have generated the monoclinical structures as a result of the tectonic movements produced from NW to SE.

The alluvial deposits located at the top of the Osoiu hill, on the right of Solonet, right near the confluence with Suceava, at first glance appear to be remnants of a terrace of confluence of the above mentioned rivers. These deposits are up to 1.5 m thick, are placed horizontally and contain metamorphic clasts and Mesozoic sediments - about 8%, which suggest the idea of a Paleo-Soloneț which would have drained since the Middle Pleistocene, at least the eastern area of the crystalline axis. Although at the sources, at the level of the Nun Obcina (Obcina Mare's eastern branch, the left side of the Humor valley, morphologically assigned to the Pliocene Mestecanis area), a wide saddle can be identified at an altitude of about 775 m, is unlikely to have been functional at the time of the deposits accumulation in Osoiu hill, which are much younger. Also, because we cannot find a similar saddle on the right slope of the Humor valley, we consider that a paleocourse that would have passed through the already mentioned saddle couldn't have had its origins very far to the west from the eastern extremity of the Obcina Mare, therefore it's very unlikely that it could drain the crystalline area. Then it is very unlikely that two paleovalleys (Solonet and Moldova) could have evolved in a parallel direction at a distance of about 13 km from the eastern area of the crystalline as far as the entrance into the platform. If we remove the Paleo-Carpathian course hypothesis for the metamorphites in the above mentioned terrace, we must find another source. Our opinion is that they have been reshuffled from the the Socu – Ciungi hills. The identification of a terrace on the left of Solonet, 20 -25 m near Osoiu Hill, of metamorphic gravels, strengthens our opinion about the source area. The crystalline of 25 m from the Todirești terrace is relatively new and it could be shuffled through Vărvata, a right tributary of Solonet, which, together with its tributaries drains Igoaia, Ursoaia, northern and north eastern slopes of the Socu– Ciungi area (figure no. 6). In the upper beds of these courses we can identify metamorphic elements.

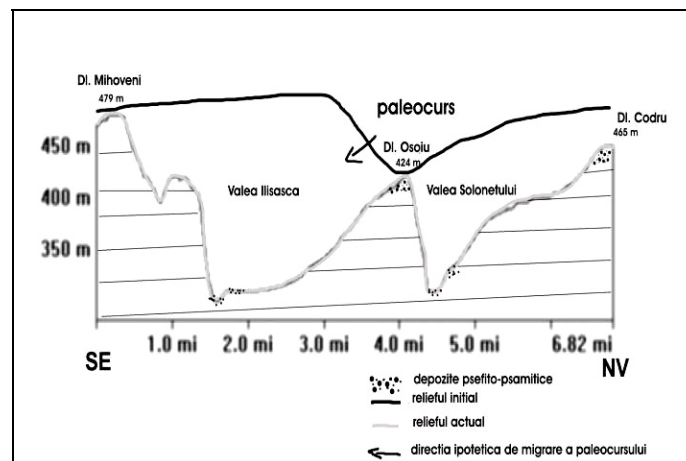


Fig. 4. Topographic profile between Codru (NV) și Mihoveni (SE) Hills.

However, there is one more interesting aspect! Osoiu Hill is on the right side of Soloneț. Corroborating this aspect with theoretical developments of subsequent valleys – on the reverse of the layer, under monoclinal conditions in the Moldavian Tableland, we might appreciate that the alluvial deposits do not belong to a Paleo-Soloneț, but to a river that migrated according to the layers inclination to the south (figure no. 4).

This might be Ilișasca (Ilișești) river, which is currently draining the western slopes of the Ciungi Massif. Crystalline elements were identified on the upper course. In a statistical evaluation of the petrographic characteristics of the Ilișasca river bed deposits, at 393 m altitude, we identified out of a number of 182 cobbles, 4 metamorphic elements, 22 items from the Mesozoic sedimentary, 26 quartzites, 4 Sarmatian sandstone and 126 flysch elements (figure no. 5).

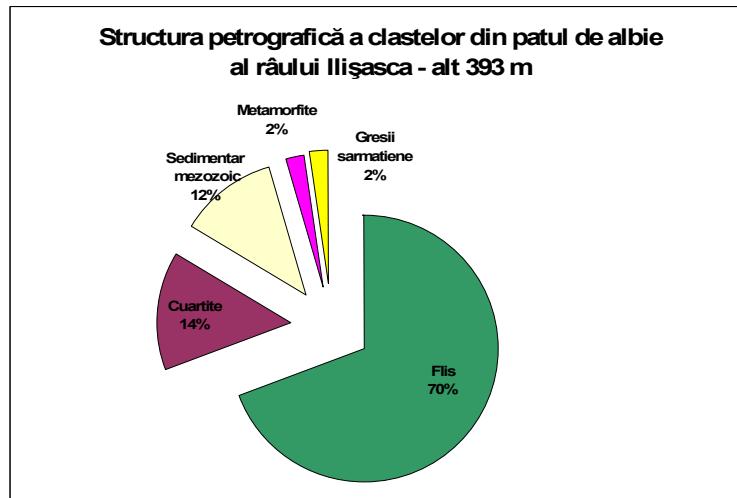


Fig. 5. Petrographic structure of the river bed deposits on the upper course of Ilișasca.

The presence of crystalline elements in both paleo-junction (Osoiu Hill) with Suceava River and on the upper course proves an old course which probably did not exceed the contact area between the two structural units, the Carpathian orogen and the platform kratogen. It developed according to the trend imposed by the Piedmont relief topography, but also by the layers inclination, to the south, together with the displacement of the watershed. The same evolution characteristics can be attributed to Soloneț river whose course subsequently moved from the Crângești-Codru hills (with gravels whose controversial origins are considered to be either fluvial or piedmontal) and from Poieni hills (with a fluvial gravels horizon of about 40 cm thick) to the current position. The lack of metamorphic elements in the locations mentioned above suggests a Paleo-Soloneț, which started draining the Ciungi-Socu area relatively late, as proved by the gravels with crystalline elements in the terrace of 25 m from Todirești. The saddle from the current origins could be attributed to a paleo-Soloneț, but it is very unlikely that it ever exceeded Obcina Mare. It is possible that the superior sector of the supposed paleoriver was cut by the

current Humor River, left tributary of the Moldova River. But do exclude the origin of selective erosion caused by the erosive regression of platform Solonet platform.

The psephite deposits in Șcheia hill - 438 m absolute altitude, cannot be seen as a distinct horizon. They appear scattered on the surface and can be seen in the soil matrix (about 30-40 cm), and on top of clay deposits, probably Sarmatian. These gravels are located horizontally at about 1.9 km west of the Suceava riverbed and at a relative altitude of about 160 m of the thalweg of the Scheia river, its current course being located to the south of the mentioned deposit, and the headwater on the southern slope of Teișoara hill. We already expressed our opinion upon the origin of this valley (Oprea, 2001). Discrepancy can be noticed between the current flow of the river and changed appearance of the valley. The presence of gravels in Scheia Hill (Carpathian metamorphic elements - about 2.5%), - figure no. 6, then the morphographical characteristics of the valley, its continuity aspect and the almost imperceptible transition in the neighbouring basin - Șomuzul Mare, through a very large saddle, are arguments that advocate for the hypothesis of a paleocourse more important as discharge and geomorphological expertise.

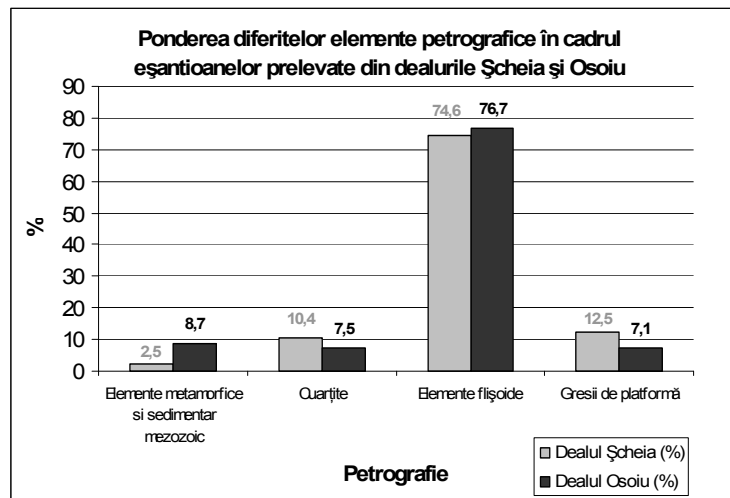


Fig. 6. Ponderea diferitelor litologii în depozitele psefite – psamitice din dealurile Osoiu și Șcheia.

Was there once a Paleo-Șcheia which could drain the Mesozoic crystalline area? We exclude this hypothesis and believe that the gravels from Șcheia Hill are actually shuffled. If we draw an axle line on the center of the valley westwards valley, it would section the Ciungi Massif, and this is precisely in our view the source area (fig. no. 6). This paleocourse with the valleyhead the alluvial cone of Moldova is supported by the identification at the top of some interfluvies situated between the Ciungi hill and the western extreme border of some gravel deposits containing metamorphic elements (Costișa Hill, to south of Ilișești town), and which may be associated to the route of an ancient course. The reconfiguration of Paleo-Șcheia was made for the benefit of Șomuzul Mare tributaries, also recognized as very aggressive upon neighboring basins - Moldova (Martiniuc, 1956) and in the present case Șcheia-Suceava (through Humăria, Cimbrina, Pripasna tributaries) – figure no. 7.

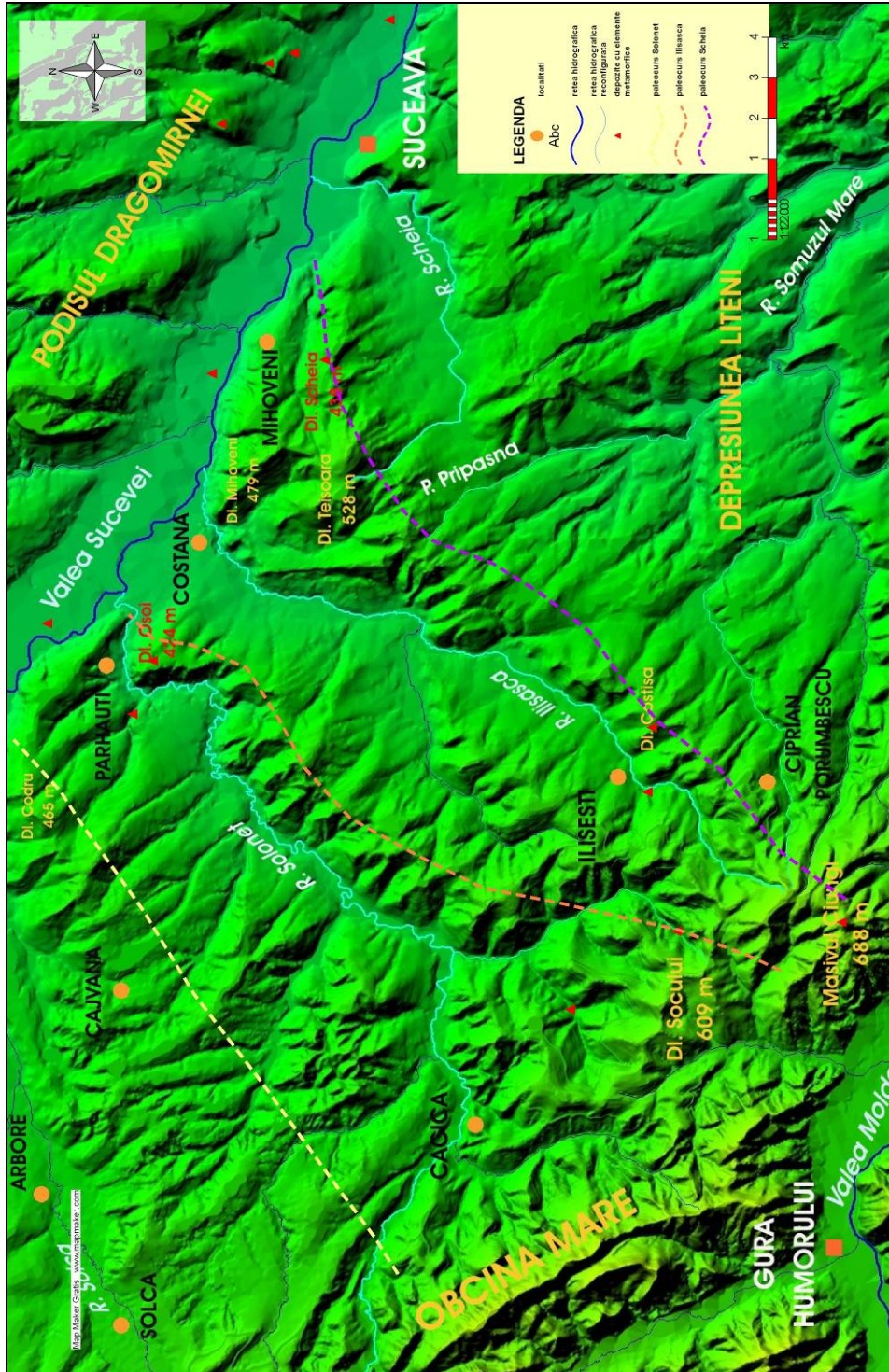


Fig. 6. Morphographic map and hydrographic paleoroutes.

5. Conclusions

The position, the relative altitude, the petrography of the deposits in the Scheia - Osoiu hills and their relations to the Suceava valley and riverbed, support the assessment that the hydrographic network that intersects the Marginea Ciungi piedmont tableland is relatively young, probably installed at the latest early Pleistocene. The arguments in this sense are:

- the relative altitude of these deposits, which we can assign to some confluence terraces, of about 160 m and 120 m and according to the morphocronologic scheme developed by Posea (2002) it could be attributed to the glacial Günz;

- the presence of crystalline elements which we cannot assign to some paleocourses that could have drained the eastern frame of the Marginal Syncline and that could be moved at least parallel to the current valley of Moldova. We consider these elements as being shuffled from the Ciungi - Socu area source.

We believe that the current courses and valleys, Soloneț, Ilișasca, Șcheia, Solca and Sucevița have nothing in common with the Carpathian Sarmatian system that built the Suceava Piedmont. The presence of superior water courses on the eastern slope of Obcina Mare is based on a normal regressive development and the current saddle is actually a consequence of selective erosion. Perhaps the old Carpathian system was reconfigured as a result of the Wallachian movements, only Moldova and Suceava maintaining their previous Carpathian routes.

The current system didn't go beyond Suceava valley to the east, so we can assume that the river with the same name was installed in the previous area of the Suceava Tableland. The relative altitude of the oldest terrace is of about 180-190 m, which is assigned, according to the same morphocronologic scheme, to the Superior Pleistocene. Comparing the absolute altitudes of Suceava terraces with those of the hills with piedmont deposits, but also the relative altitude at which the latter are situated from the limitrophe valleys, we wonder, naturally, about the age of the relief of the northern tableland.

Regarding the overall evolution of the river system in the north of the Moldavian Tableland, we are very much interested in the direction mentioned by Professor Tufescu (1985), on the deposits located to the east of Bucecea, deposits in which he identified elements from the Mesozoic sedimentary.

REFERENCES

- Barbu N., Ionesi L., Ionesi B.** (1964), *Masivul Ciungilor – caracterizare geologico-geomorfologică*, Analele științifice ale univ. „Al. I. Cuza”, seria nouă, secțiunea II – Științele naturii, b. geologie-geografie, tom X, Iași.
- Barbu N., Ionesi L., Ionesi B.** (1966), *Observații geologice și paleogeomorfologice în zona de contact a Obcinelor Bucovinei cu Podișul Sucevei*, Analele științifice ale univ. „Al. I. Cuza”, seria nouă, secțiunea II – Științele naturii, b. geologie – geografie, tom XII, Iași.
- Barbu N.** (1976), *Obcinele Bucovinei*, Edit. Științifică și Enciclopedică, București.
- Băcăuanu V., Barbu N., Pantazică M., Ungureanu Al., Chiriac D.** (1980), *Podișul Moldovei. Natură, om, economie*, Edit. Științifică și Enciclopedică, București.

- Băcăuanu V.** (1968), *Câmpia Moldovei. Studiu geomorfologic*, Edit. Academiei, București;
- Băcăuanu V.** (1973), *Evoluția văilor din Podișul Moldovenesc*, în *Realizări în geografia României*, Ed. Științifică, București.
- Dimian M.** (1968), *Studii stratigrafice și tectonice în regiunea Lucina-Moldova Sulița-Breaza (Carpații Orientali)*, Dări de seamă ale ședințelor, vol. LV (1967-1968), 5. Tectonică și Geologie generală, București, 1969.
- Donisă I., Barbu N., Ionesi L.** (1973), *Etapete evoluției rețelei hidrografice în Carpații Orientali*, Realizări în geografia României, Edit. Științifică, București.
- Grasu C-tin, Miclăuș Crina, Brânzilă M., Boboș I.** (2002), *Sarmațianul din sistemul bazinelor de foreland ale Carpaților Orientali*, Edit. Tehnică, București.
- Macarovici Nec.** (1964), *Contributions a la connaissance du Sarmatien entre de la vallee du Siret et les Subcarpates*, Analele științifice ale Univ. Al. I. Cuza, seria nouă, secț. II (Științe naturale), b. Geologie – Geografie, tom X, Iași.
- Martiniuc C.I.** (1956), *Cercetări geomorfologice în regiunea Baia-Suceava*, Analele științifice ale univ. „Al. I. Cuza”, secțiunea II – Științele naturii, - Geografie, Iași, 1956.
- Martiniuc C., Băcăuanu V.** (1960), *Contribuții la studiul geomorfologic teritoriului orașului Suceava și al împrejurimilor sale*, Analele științifice ale univ. „Al. I. Cuza”, seria nouă, secțiunea II – Științele naturii, tom VI, fascicol 4, Iași.
- Miclăuș Crina** (2001), *Geologia deltelor relictate extracarpate sarmațienedintre văile Sucevei și Bistriței*, Teză de doctorat, Univ. Al. I. Cuza Iași.
- Oprea D.** (2001), *Considerații geomorfologice asupra bazinului hidrografic al râului Șcheia*, Analele Universității Ștefan cel Mare Suceava, secțiunea Geografie, anul X.
- Oprea-Gancevici D.** (2008), *Aspecte geomorfologice privind o posibilă captare fluvială la obârșia râului Suceava*, Analele Universității Ștefan cel Mare Suceava, secțiunea Geografie, anul XVII.
- Oprea-Gancevici D., Florea F.** (2008), *Asupra unor depozite psefito-psamitice din Podișul Sucevei – la nord de valea râului Moldova*, Comunicări de Geografie, București.
- Popp N., Martiniuc C.** (1971), *Zona de contact între Carpații Orientali și Podișul Sucevei*, Sudii și comunicări, Științe naturale, nr.2, Muzeul județean, Suceava.
- Sîrcu I.** (1955), *Valea Siretului în sectorul raionului Pașcani și problema genezei șei de la Ruginoasa*, Aspecte geomorfologice., Probleme de geografie, vol. II, București.
- Sîrcu I.** (1965), *Terrasses fluviales, surfaces d'érosion local et pseudopenepaines dans le nord du Tableland Moldave*, Analele științifice ale univ. „Al. I. Cuza”, seria nouă, secțiunea II – Științele naturii, b. Geologie – geografie, tom XI, Iași.
- Tufescu V.** (1932), *Captări actuale între afluenții Prutului și ai Siretului*, jud. Dorohoi., B.S.R.R.G., tom LI, București.
- Tufescu V.** (1937), *Dealul Mare-Holm (Observații asupra evoluției reliefului și a așezărilor omenești)*, B.S.R.R.G., tomul LVI, București.
- Tufescu V.** (1985), *Continuitatea pietrișurilor carpatice prin șaua de la Bucecea*, Studii și cercetări de Geologie, Geofizică și Geografie, seria Geografie, tom. XXXII, București.

Dinu OPREA-GANCEVICI
Univ. „Ștefan cel Mare” Suceava
Departamentul de Geografie
E-mail: dinu_oprea@hotmail.com

Translated by Elena Maria Emandi