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CUPRINS/CONTENTS

Articole / Papers

L. STAMATOPOULOS & N. EVELPIDOU – <i>River-bed evolution during the Holocene in Kalavrita region (Northern Peloponnese, Greece)</i>	5
Mihai IELENICZ, Smaranda SIMONI (TOMA) – <i>The Valley System Evolution in Romania</i>	9
Maria RĂDOANE, Ionuț CRISTEA, Nicolae RĂDOANE – <i>Geomorphological Mapping. Evolution and Trends</i>	19
Virgil SURDEANU, Olimpiu POP, Marius DULGHERU, Titu ANGHEL, Mioara CHIABURU – <i>Relationship between trees colonization</i>	41
Karel KIRCHNER, Lucie KUBALÍKOVÁ – <i>landslide and debris-flow activity in the sulphur mining area of Calimani Mountains (Romania). Evaluation of geoheritage in the western part of National Park Podyjí, Czech Republic</i>	51
Florina GRECU, Cristina GHIȚĂ, Emil CÎRCIUMARU – <i>Land Vulnerability to Geomorphological Hazard Induced By Pluviometric Criteria (Romanian Plain)</i> ..	59
Gabriel MINEA, Liliana ZAHARIA – <i>Geomorphological impact of floods in the Bâsca Catchment (Romania)</i>	67
Sandu BOENGIU, Cristiana VÎLCEA, Mihaela LICURICI – <i>Landslides in the Plain Sector of the Jiu Valley</i>	75
Alexandru NEDELEA, Anca MUNTEANU, Răzvan OPREA, Laura COMĂNESCU, Robert DOBRE – <i>Cryo-nival modeling system. Case study: Făgăraș and Piatra Craiului Mountains</i>	83
Iulian SĂNDULACHE – <i>Planation surfaces in the Bistricioara catchment (Eastern Carpathians)</i>	91
Dinu OPREA GANCEVICI, Ionuț CRISTEA – <i>On periglacial processes and landforms in the Brodina River Basin (Obcinele Bucovinei)</i>	99
Smaranda SIMONI (TOMA) – <i>The Role of the Periglacial Processes in the Present Morphodynamics of the Doamnei River Basin (the Făgăraș Mountains)</i>	109
Maria ALBU DINU – <i>Călmățui (Teleorman) Hydrographic Basin – Morphometric Analysis Elements</i>	123
Robert DOBRE – <i>Use a GIS techniques to identify areas to consider when designing the Comarnic – Sinaia motorway sector so as to meet sustainable development requirements</i>	131

Planation surfaces in the Bistricioara catchment (Eastern Carpathians)

Iulian SĂNDULACHE

Abstract: The study reveals the spatial distribution, the absolute and relative altitude, as well as the present state of conservation of five planation surfaces identified in the Bistricioara catchment (Eastern Carpathians). At the same time, we have attempted to draw a parallel between the absolute age of these planation surfaces and of the erosion levels in the study area, on the one hand, and the geochronological timescales proposed by other researchers (David, 1945; Posea, 2002) for areas lying closer to or farther from the Romanian Carpathians, on the other hand. It is important to say that these timescales also take into account the sequence of orogenic phases on the Romanian territory in the second half of the Mesozoic.

Keywords: Bistricioara catchment, planation surfaces, valley shoulders, spatial distribution, geochronological timescale

Rezumat. În studiu sunt redate distribuția spațială a celor cinci suprafețe de nivelare identificate în bazinul hidrografic Bistricioara (Carpații Orientali), altitudinea absolută și relativă la care acestea se desfășoară, gradul de conservare în care acestea se află în prezent. De asemenea, s-a încercat o paralelă între vârsta absolută a suprafețelor de nivelare și a nivelelor de eroziune de pe teritoriul analizat și schemele geocronologice încercate de alți cercetători (M. David, 1945, Gr. Posea, 2002) pentru zone mai apropiate sau mai îndepărtate din Carpații Românești, ținând cont și de succesiunea fazelor orogenetice de pe teritoriul României în a doua jumătate a Neozoicului.

1. Location and general data

The Bistricioara catchment lies in the central-northern part of the Eastern Carpathians and covers an area of 781.3 km².

The geological structure is dominated by old epi- and mesometamorphic crystalline rocks, which are found on 73.1% of the area. These are followed by Cretaceous flysch (sandstones, clay schists and marly limestones accounting for 13.5%), Pliocene sedimentary rocks (sands and clays amounting to 4.42%), Neogene volcanic rocks (especially andesites, with a share of 3.2%) and the Mesozoic sedimentary formations of the metamorphic unit (dolomites, sandstones and wildflysch, spread on 2.91% of the territory). As far as the present and Quaternary alluvial deposits are concerned these account for 2.8% of the area.

2. Planation surfaces

The careful analysis of topographic maps, geomorphologic profiles and panoramic photos, as well as the investigations conducted in the field have allowed us to separate in the catchment five planation surfaces and two valley shoulders, which

are shown on the geomorphologic units map (Fig. nr. 5).

In order to identify the planation surfaces we have used both figures and names, the latter borrowed from the areas where these surfaces are most conspicuous: S₁ (*Grintieșu Mare*, lying at 1650-1750 m), S₂ (*Harlagia*, 1500-1600 m), S₃ (*Făget-Mezovești*, 1200-1450 m), S₄ (*Malnaș-Dosu Cheosrezului*, 1000-1250 m) and S₅ (*Frasinul*, 850-1050 m altitude).

As for the valley erosion levels, these have been divided into two categories: the upper shoulders (140-250 m relative altitude) and the lower shoulders (80-130 m).

Our analysis reveals that the planation surfaces identified by us are closest to the model proposed by David (1949) for the Bistrita Mts.: *Poiana Ciungilor* surface, of Helvetian age, lying at 1500-1600 m, corresponding to S₂; *Bâda* surface, of Sarmatian age, lying at 1300-1450 m, matching our third surface; *Dornelor*, of Pontian age, lying at 1150-1280 m, corresponding to S₄; and, particularly for the Borsec-Bilbor area, the Pliocene levels *Hazanez*, at 1150-1250 m, also corresponding to S₄, and *Verofeny*. The altitude of the latter has not been mentioned, but it has been credited with a large extension on a mountain ridge developing east of

Borsec. This erosion level, which tilts to the east and lies at 930-1050 m, corresponds to our fifth surface (S_5).

Beside the aforementioned surfaces one must also take into account the *Grințieșu Mare* surface, found only in the massif it was named after, at 1650-1750 m altitude. It corresponds, at least in terms of altimetry, to „ S_1 ” (equivalent to the „Borascu” surface in the Southern Carpathians), which, according to Posea (1997), cuts the Paleogene crystalline massifs except the Rodna Mts. at elevations of 1600-1800 m.

As far as the age of the mapped planation surfaces is concerned, for the moment we prefer to rely on the parallel made with the datings accomplished by David (1949) and Posea (1997).

The only places where we could venture to date a planation surface are the Văcăria Mts., lying north-northwest of Bilbor, and the northern and northwestern parts of Mount Șapte Izvoare, which is in the Borsecul de Sus area. As it results from geological map scale 1:200000 (Comitetul de Stat, Institutul Geologic, 1968), in the Văcăria Mts. the S_4 surface seems to cut the biotite, amphibole and pyroxene andesites, which belong to the Upper Pliocene, or, according to the map's authors, even to Lower Quaternary.

If the large quasi-horizontal surface that develops in the Văcăria Mts. between 1100 and 1260 m were the result of a leveling process, then the corresponding S_4 surface would seem to belong to Lower Post-Quaternary. However, this is hardly possible because during Quaternary Era the Carpathians witnessed the deepening and branching of the river systems to the detriment of the existing planation surfaces. Therefore, the issue is still debatable, at least until a geological map of scale greater than 1:50000 for the Bilbor area is published, which will make possible to decide whether the northern branch of the planation surface in the Văcăria Mts. was shaped on crystalline schists or on biotite, amphibole and pyroxene andesites.

If the surface were shaped on andesites, we would deal with a volcanic structural surface, but if it were shaped on crystalline schists then things get complicated. This happens because S_4 (developing on crystalline rocks, according to the geological map scale 1:200000) passes without any break of slope into the quasi-horizontal surface shaped on the biotite, amphibole and pyroxene andesites of the Văcăria Mts. This would mean that the respective level was cut after the andesite formation, i.e. in the Quaternary Era.

Another dating can be accomplished to the north of the Mount Șapte Izvoare, where the Pliocene molasse from the Borsecul de Sus, settled

during the Dacian period, fossilizes the S_5 surface, which should therefore be older. This is a very interesting thing in case we admit the Pontian age of the S_4 surface, according to the David's model (1949). Consequently, it would result that S_4 and S_5 were formed during the same interval (Pontian), which seems rather odd, and therefore it would be wiser to consider that S_4 must be a little bit older (for the time being its age has not been thoroughly established).

Grințieșu Mare surface (S_1) is found, as mentioned before, only in Mount Grințieșu Mare, at elevations of 1640-1750 m, having the appearance of long ridges that stem from Grințieșu Mare peak running to the west, southeast (with rougher relief) and north (quasi-horizontal and very expressive). Given the high altitude and the limited extension it is likely that S_1 (*Grințieșu Mare*) is a simple altiplanation step, which remains to explain later. If it were a planation surface, then, according to the scheme presented further, it was shaped in Oligocene-Aquitianian.

Harlagia surface (S_2) appears only on the northern water divide of the Bistricioara catchment, in three places: the Harlagia, Bâta Verde and Stârca mountains. The greatest development, however, and the most conspicuous appearance are specific for the Harlagia summit, where its genesis through planation processes is undeniable. At this locality, it unfolds between 1500 and 1587 m, on a length of 4.7 km, having widths ranging from 150 to 700 m and a remarkable flatness – fig. nr. 1.

To the east, in Mount Bâta Verde, S_2 is also very expressive (a remarkable flatness), stretching along 2.5 km and having a width of 100-250 m, while in altitude it climbs from 1500 to 1611 m.

On the southwestern side of Mount Grințieșu Mare (Mount Stejei-Stârca) S_2 develops between 1580 and 1632 m altitude, keeping its remarkable flatness. Here, the length is 1.8 km, whereas the width ranges from 60 to 250 m.

In all the above cases, S_2 develops on crystalline schists.

In Mount Măgura (made up of calcareo-dolomitic rocks) one can see a small smooth area developing to the northeast of the Magura peak (1548 m) at 1500-1530 m altitude, slightly tilting from southwest to northeast. It is likely that this area were an altiplanation or a lithological surface. In Mount Comarnic (made up of limestones) one can notice a small plain (7.3 hectares) lying at elevations of 1500-1520 m. Here, too, it is possible to be in the presence of a lithological surface. Speaking of age, we might consider it Miocene and therefore most likely shaped between the Styrian (Burdigalian) and Moldavian (Sarmatian) uplifts.

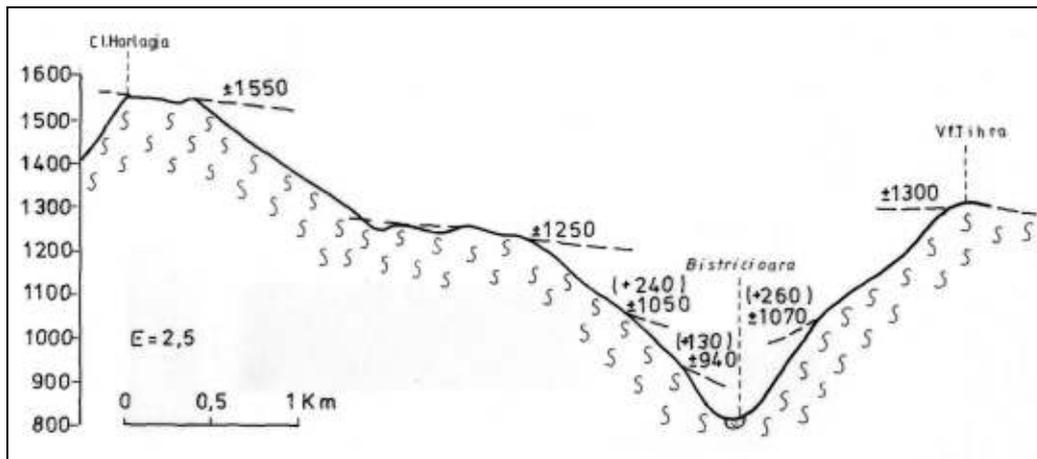


Fig. 1. Surfaces S_2 and S_3 in the Harlagia-Mezovești sector

Făget–Mezovești (S_3) surface knows the greatest development in the Bistricioara catchment, as it is also the case of S_4 (Malnaș–Dosu Cheosrezului). In many cases, it is the highest surface (towering over the surrounding areas), but sometimes it is dominated by other summits or peaks. The most typical development is in the Arcoza–Făget–Mezovești ridge, where it resembles a genuine water divide plateau, rising above the neighboring areas, and ranging in width from 250 to 650 m. In this massif, the surface climbs from 1160 m in southwest to 1337 m in the extreme north-northeast (Mezovești peak), probably due to the more accelerated neotectonic uplifts that affected the area.

This surface dominates other areas as well, such as Mount Alunișu Mare (from a height of 1420–1447 m), Mount Vamanu (from 1360–1418 m), and especially the ridge between Vamanu and Harlagia mountains (from 1260–1440 m), a place where it is wider than 1 km.

S_3 also appears as a dominant step in the following mountains: Mount Batca Arsurilor (calcaro–dolomitic), where it lies at 1340–1384 m, having a lithological character and exhibiting

similar features with the surface belonging to Mount Comarnic (uplifted plain); Mount Sitaru, where it lies at 1200–1317 m, developing on crystalline rocks; Preluca Ursului ridge (at 1320–1439 m), developing on the crystalline rocks and sienites that underlie the mountains situated at the headwaters of the Corbul and Rezul Mare rivers; Mount Cheosrezul Mare (at 1280–1491 m), particularly the ridge that branches off to the northeast and the mountain lying west of the Făgețel peak (1382 m), partly developed on sienites; Mount Făgețel and the ridges that stem from it to northeast and east, where the surface lying at 1180–1382 m has an extensive development especially to the east of Făgețel peak – fig. nr. 2; Piciorul Cuților (at 1200–1367 m); Muntele Nou–Vf. Deșelat ridge (at 1300–1482 m), lying exclusively on sienites and exhibiting an almost perfect flatness; Vf. Deșelat–Hedieș ridge (at 1380–1450 m); Șumuleu–Călugărul Mic interfluvie (at 1220–1320 m); Mount Câmpul Bârsanului (east of Mount Făgețel), at 1220–1293 m, with a clear development (which explains the determinative *Câmpul*, meaning flat land); and Mount Cal (at 1220–1319 m), where the surface develops on Cretaceous sandstone flysch.



Fig. 2 – S_3 and S_4 in the area of Mount Făgețel

S_3 appears as a subordinate step (towered by ridges or peaks belonging or not to higher planation surfaces) in many areas, such as: Mount Pietra Lăptăriei (at 1230-1400 m), the secondary ridges that stem to the west from Mount Lupăria (at 1200-1280 m, with clear development), the ridges descending to the southeast from the eastern extremity of Mount Harlagia (at 1200-1370 m), some ridges branching off from Mount Vithavaş (at 1200-1380 m), the ridge that stems to the west from Harduga peak (at 1260-1300 m) cutting the Bistra strata (sandstone flysch), the Grinţieşu Mare–Preluca Dreptului summit (at 1340-1402 m), very conspicuous and developed on crystalline rocks and partly on porphiroide gneisses, etc.

The age of the third surface is probably post-Moldavian (post-Sarmatian), but surely younger than the Attic orogenic phase.

Malnaş - Dosu Cheosrezului surface (S_4) is well developed in the Bistricioara catchment and, as we have already seen, it is comparable in extent to S_3 . Unlike S_3 , however, it covers large areas in the flysch sector, too, but is seldom dominant. Such places where S_4 is dominant are the following: Preluca–Capu Corbului summit (Vin–Corbu interfluve), where the surface cuts the epimetamorphic crystalline rocks at 1120-1178 m altitude and shows distinctive features and a remarkable flatness; Corbu–Asod interfluve, where it is less conspicuous than in the previous case and develops at 1000-1187 m; Bărbântii peak area, where the surface lies at 1160-1263 m resembling rather an intervening ridge (even though the respective summits have an almost ideal degree of flatness); Văcăria Mts., situated north of Bilbor, where S_4 develops at 1060-1230 m on mesometamorphic crystalline rocks connecting farther with the large structural surface coming from the south, which is underlain by biotite, amphibole and pyroxene andesites; Piciorul

Bilborului (The Bilbor Spur), where the surface develops also on crystalline rocks, at about 1120-1169 m, being extremely flat and smooth; and Răchitiş summit, where the surface is 1100-1159 m high, being well developed on epimetamorphic crystalline rocks.

Otherwise, one can say that S_4 occurs as a subordinate altimetric level. It can be seen as valley shoulders at the Bistricioara headwaters, on the left of the stream (at 1200-1260 m), in the form of longer or shorter summits gently descending from Mount Harlagia to the southwest and south (having an expressive look on the left side of the Huruba), but staying at altitudes of 1220-1250 m (Fig. nr. 1).

S_4 appears as well in the extreme east of the Mezoveşti Ridge (at 1180-1268 m), being well developed and expressive, on the summit that separates Cupaş 1 and Cupaş 2 streams (at 1020-1099 m), where it is also very conspicuous, and on some short spurs that descend from the Arcoza-Făget summit to southeast (at 960-1180 m) – fig. nr. 3.

However, the clearest development of this planation surface is specific for the Malnaş–Dosu Cheosrezului summit (from which it derives its name), where it looks like a long (more than 3 km) and remarkably smooth table land, shaped entirely on epimetamorphic crystalline rocks, with widths ranging from 100 m to 1 km. The whole surface dips gently on a south–north direction from 1283 to 1080 m.

Between Corbu and Rezu Mare, S_4 occurs sporadically and on limited areas, except for the Asod–Putna interfluve (southeast of the Tulghes–Centru), where it looks typical and expressive, developing on mesometamorphic crystalline rocks at 1040-1173 m altitude.

S_4 is well developed on the Rezu Mare–Putna interfluve as well, cutting the crystalline rocks at 1120-1236 m, where it resembles a slightly rounded and long summit (called Culmea Putnei).

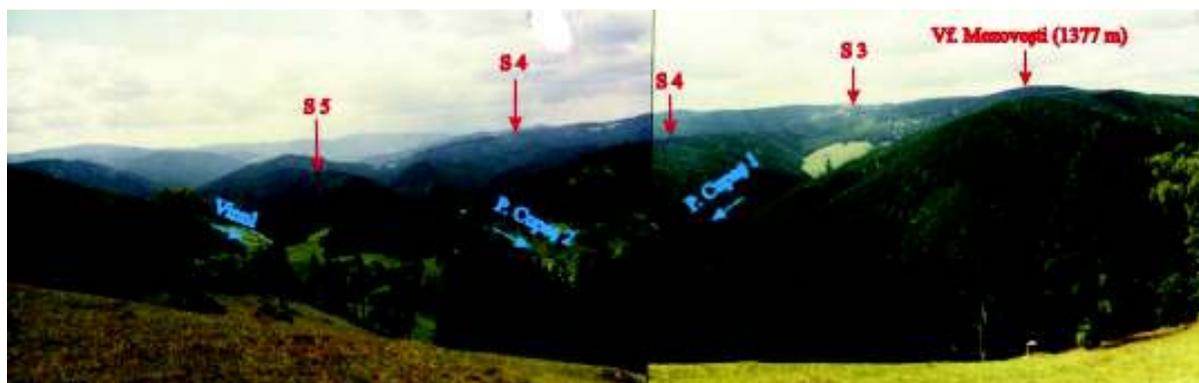


Fig. 3 – Planation surface complex in the Cupelor catchment

In the Putna's upper catchment (including the entire basin of the Putna Întunecoasă) S_4 appears at elevations ranging from 1100 to 1280 m in the form of headlands (or spurs), shaped in sienites on the southwest and in epi- and mesometamorphic crystalline rocks on the rest of the territory.

It can also be seen, having approximately the same features, on the spurs descending from Mount Vithavaş to the west, northwest and north, at 1070-1185 m altitude. North of the Şumuleu, it occurs in scattered and small-size patches lying at 1040-1140 m on the Şumuleu–Călugarul Mic interfluve and at 1000-1040 m on the Balaj–Marcu interfluve, as well as on the summits lying north of the Marcu. Throughout this area, it is very difficult to make a clear distinction between S_4 and S_5 , because the difference in elevation between the two is only several tens of meters.

The flatness of some spurs lying between 840 and 1000 m, which dip gently from east to west (towards the Putna) in the Marcu–Şumuleu sector, on the right side of the mentioned river, and from southeast to northwest in the region lying southwest of the Rezu Mare–Putna junction, allows us, however, to delimit the S_5 surface. As a matter of fact, it is found at rather similar elevations throughout the entire catchment.

S_4 also appears on the southeastern divide of the Pintec catchment and in the high extremity of the Piciorul Sandului, at 1040-1139 m, cutting the flysch formations represented by the Sinaia strata. Here, the features of a planation surface are more obvious, unlike the sector Obcina Târşoasei–Obcina Boiştei (shaped on the Sinaia strata, too), where, although it comes out in quasi-horizontal summits, those summits are in fact intervening ridges, which remind us of the so-called "lower lithological level" of the Ceahlau Mts. identified by Stănescu (1980). In the Obcinele Târşoasei and Boiştei the surface lies at 1060-1112 m in the surroundings of the Rotunda peak, and at 1100-1200 m, farther to the south (Obcina Târşoasei).

North of the Rotunda peak (1112 m), i.e. within the Obcina Boiştei, even though the summit is quasi-horizontal and long (hence the name of *obcina*) it cannot be considered a planation surface, but rather an intervening ridge (the so-called *gipfel* mentioned by Sârcu in 1958).

Between Muncelul and Valea Seacă S_4 appears as spurs, often highly inclined ($10-15^\circ$) and lying at an altitude of 1000-1200 m, which proves its advanced degree of degradation.

From Valea Seacă eastward (north of the Bistricioara), both in the Crystalline-Mesozoic and in the flysch domains, S_4 occurs (as it has been the

case with the previous sector) as small-size patches, lying at an altitude of 1000-1240 m. In this area, although it is dominated by peaks like Magura (1548 m) and Hurduga (1384), S_4 occupies in many cases the main interfluves, which are the highest in the flysch unit. Consequently, it is found at 1020-1200 m on Pietrele Vinete, Smida Grasului, Mount Răchitiş, Grinţieşu Mare–Grinţieşu Mic interfluve and the Măluşteţul summit, in the latter case being well developed (180-200 m wide and 1.35 km long).

As for the age of this surface we consider it post–Meotian, but no older than the Rhodanic phase (Romanian).

Frasinul surface (S_5) has a limited extension in comparison with S_3 and S_4 , developing pre-eminently in the flysch area, i.e. in the Pintec and Putna catchments, in the territory situated north of Borsec and, sporadically, on both sides of the Bistricioara, along the stretch between the Valea Seacă and Putna rivers.

S_5 has an almost ideal development (at an elevation of 880-948 m) on the interfluve lying upstream the Bistricioara–Pintec, a long (1.3 km) but narrow (80-120 m) crystalline summit, and also in the Pintec catchment (on Piciorul Sandului, at 900-1000 m). In the latter case, it cuts the Sinaia strata generating a tableland that continues upstream, passing through a slight break of slope into S_4 .

In the lower stretch of the Bistricioara catchment (downstream of the Pintec), S_5 occurs frequently as an erosion level (Posea, 1968; Ielenicz, 2004). This happens on Dealul Bradului (at 860-960 m), on Culmea Răchitiş (at 830-930 m), on Dealul Frasinul (at 850-940 m), on the right interfluve of the Pârâul Duruitorul (at 900-940 m), on the left interfluve of the same creek (at 820-940 m), and on the last eastern spur of the Bistricioara catchment, which descends from Culmea Măluşteţu (at 800-900 m) – fig. nr. 4.



Fig. 4 – Frasinul surface (S_5) on Dealul Bradului

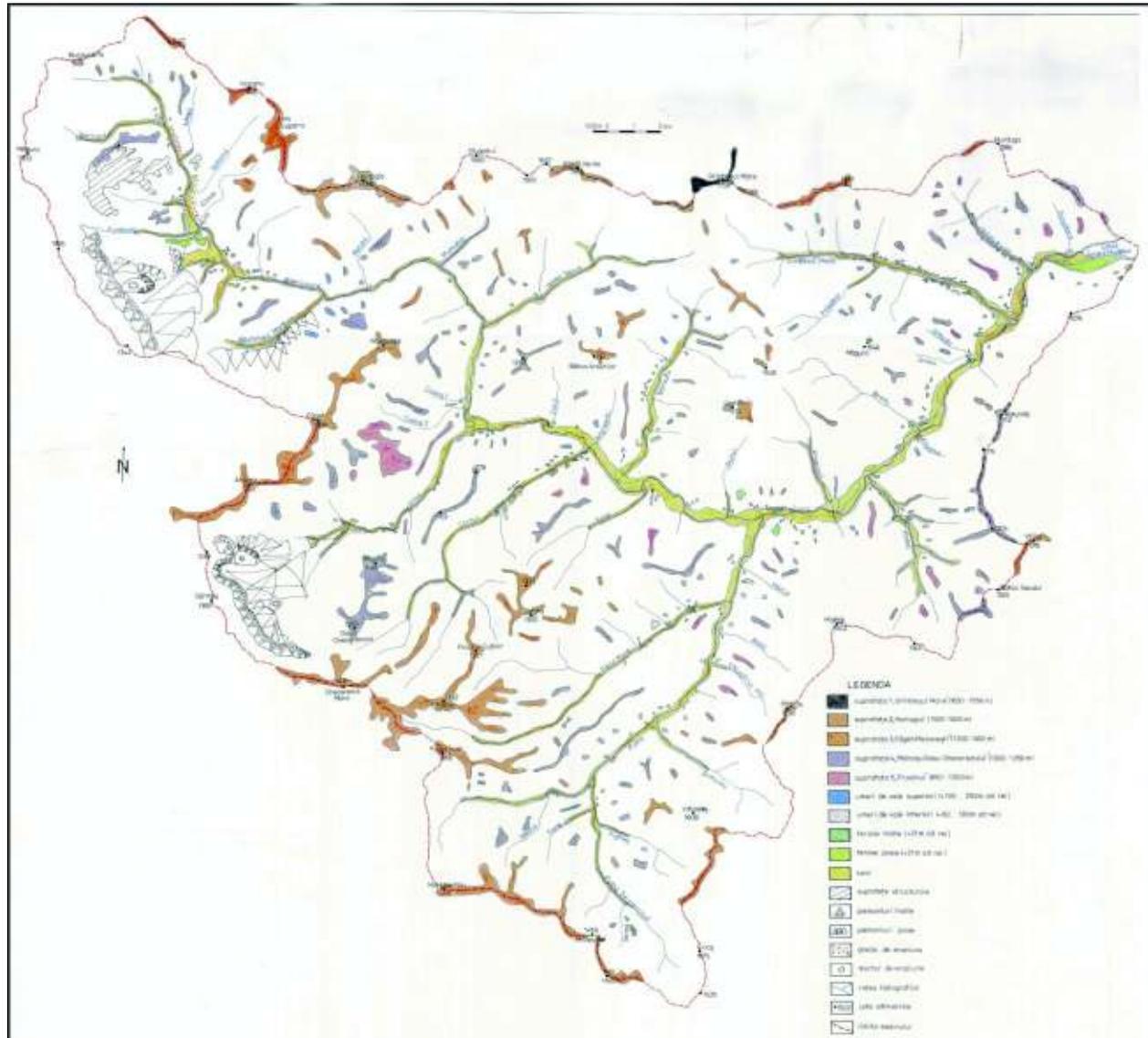


Fig. 5 – The Bistricioara catchment – Geomorphologic units map

In the first three cases, it has the appearance of gently inclined tablelands, which get slightly wider downstream (especially on Dealul Bradului and Dealul Frasinul). On Dealul Frasinul, it is better developed upstream, on a length of 1.3 km, getting increasingly narrow in the same direction. On the right interfluvium of the Pârâul Duruitoar it takes the shape of a suspended bridge, remarkably smooth and flat, while in the last two cases it appears as relatively steep spurs ($10-20^{\circ}$), which descend from Culmea Măluștețu to the Bistricioara river.

In all these cases, S_5 makes the connection between the planation surfaces and the erosion shoulders, being itself in some areas a level of erosion shoulders (Posea, 1986; Ielenicz, 2004).

In our opinion, this surface was shaped during the interval between the Rhodanic and Wallachian orogenic phases.

The erosion shoulders (or valley shoulders) are an undeniable presence on most major valleys.

The geomorphologic units map shows only those shoulders that are clearly expressed in the landscape. Occasionally, we have experienced difficulties in separating the valley shoulders from the high terraces, as it has been the case with the terraces of 120-150 m and 200-240 m from Tulgheș-Centru. However, taking into account their morphology (well developed tops), we have decided to consider them terraces.

The valley shoulders in the study area can be grouped into two categories: the upper shoulders (designated by „ U_1 ” on the map), with a relative altitude of 140-250 m, and the lower shoulders („ U_2 ”), hanging at 80-130 m above the streams.

Most likely, the valley shoulders in the investigated area belong to Lower Quaternary.

3. Conclusions

The planation surfaces in the Bistricioara catchment are better developed in the western part of the territory. This is due to the generally hard metamorphic rocks, but mostly to the delay of erosion occurrence, which depends on the base level represented by the Bistrița River that flows in the extreme northeast. Of the five planation surfaces the most developed are S₃ (at 1200-1400 m) and S₄ (at 1000-1200 m). These can be seen in massifs such as Cheosrezul Mare-Făgetel, Arcoza-Făget-Mezovești, Harlagia-Vamanul, Muntele Nou-Vf. Deșelat etc., where they resemble large vaulted

domes. On the flysch formations on the east the best preserved surface is S₅ (Frasinul), lying at 800-900 m. Finally, the Bistricioara catchment shelters two levels of valley shoulders, at relative altitudes of 140-250 m and 80-130 m, respectively.

By drawing a parallel between the datings accomplished by other researchers and the sequence of orogenic phases of the last part of the Mesozoic, one can adopt the following timescale: S₁ – Oligocene–Aquitian, S₂ – Miocene, S₃ – Meotian, S₄ – Upper Pliocene, S₅ – Villafranchian, while the valley shoulders belong to the Quaternary, which brings them closer to terraces.

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