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The occurrence of flint in north-eastern Romania in the context of local prehistoric habitations

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Abstract: *The occurrence of flint in north-eastern Romania in the context of local prehistoric habitations*. In the north-eastern part of Romania, along the Prut river valley, are known geological deposits which containing flint. Although there are many scientific books and studies about the geology of the region in which are presented aspects relateding to flint and its occurrence in the area, they do not provide the information required for a correct interpretation in relation with the use of these important natural resources by the prehistoric communities. Based on researches, the present study highlights a large morphological variety of flint occuring on the Prut Valley, in terms of its color and physical properties. It is also pointed that flint presence in the area is both in relation with the primary geological deposit, where it was formed from Cretaceous time, and with the layers in which it was later redeposed in respectively Badenian levels, in Quaternary-Pleistocene terraces and recent alluvial deposits.

Key-words: raw material, north-eastern Romania, Prut Valley, flint occurrence, prehistory

1. **Introductory aspects**

While reconstituting the existing natural framework in a certain moment or historical epoch is a difficult scientific activity, sometimes impossible to achieve without the help of modern technologies, highlighting the mutual relations and interactions between the natural environment and the prehistoric human communities presents a double difficulty: one related to the identification of the elements highlighting these aspects of the natural environment and the other related to the material endowment available to the researcher in his approach, allowing him to process the available data in order to obtain real information.

To what extent was the evolution of the human society, in one historical epoch or the other, marked by the variation of the factors of the natural environment, how did it adapt to the changes encountered, what were the behavioral modification allowing the adaptation to the new environmental conditions, how did the human communities modify the natural environment to their benefit, did man borrow from nature the ideas that lay at the basis of his spiritual manifestations, these are just a few of the questions that the researchers have tried to answer in time.

The geological makeup of the area is a major impact factor for understanding the interaction between man and the environment, because it represents the bedrock on which the geographic evolution of the region has been based, which generated the dispersion of the natural resources and their accessibility.

Certainly, the approach of these issues represents itself the subject of numerous researches and hypotheses still under analysis, which, even now, almost 150 years after their debut in the area analyzed by us are neither exhaustive, nor fully clarified or certain. However, next we shall approach these issues through the prism of our research area, namely from the perspective of the prehistoric habitations of the area[1]. For the prehistoric human communities were important those resources from the surface of the ground or

immediately next to it, yet their geographic distribution and their occurrence took place according to strict geological rules.

Just as interesting is the evolution of the acceptance of the term outcrop, because by comparison to the present sense the geologists have given it (large reserves, economic efficiency etc.), the outcrop of the prehistoric man represent more often than not local accidents or secondary concentrations, which sometimes have not even been noticed or described in the geological studies. Last, but not least, equally important is the superposition of the above-mentioned reality over the one related to needs of resources different for the modern man by comparison to the prehistoric man.

2. Geology of the region

To understand the general geological context of the region, in relation to our topic, namely the way of exploitation of the resources of this area by the prehistoric communities, next we shall present the most important elements. The data presented next are a synthesis of the main information from the specialized Romanian geological literature.

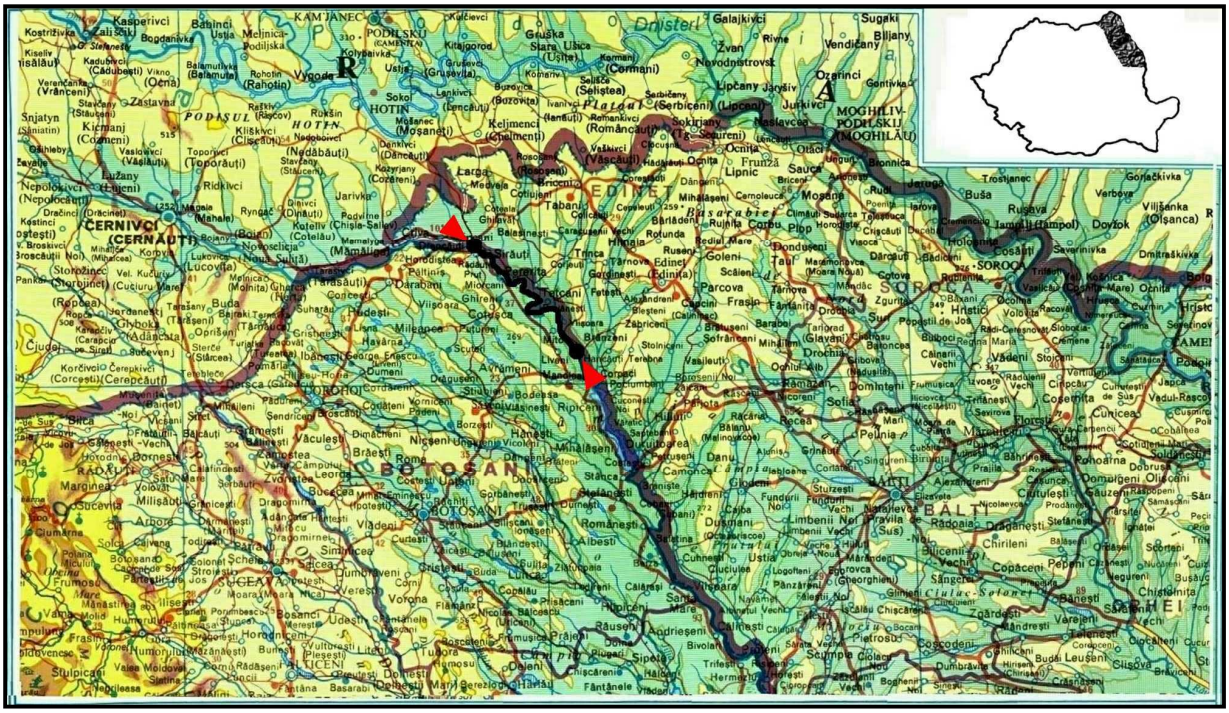

Fig. 1 - Physical map of Romania, with researched area.

Thus, from the perspective of the geological units, the area under analysis is situated in the north-east of the Moldavian Platform (Fig. 1, 2), one of the oldest continental platforms, partially representing the south-western margin of the East European Platform on the territory of Romania.

The Moldavian Platform comprises in its structure two components, different as origin and evolution: the bedrock and the sediment cover, erosion opening at the earth surface only a part of the formations of the sedimentary cover. The oldest geological deposits showing up at the surface of the ground are the Cenomanian and Badenian ones and are situated in the north-east of the region, in the riverside of Prut River, while in the rest of the Moldavian Platform only geological formations belonging to the Sarmatian are open (Fig.3-4).

2.1. The bedrock of the Moldavian Platform. It represents a mobile geosynclinal stage, which has undergone intense geodynamic processes (orogeneses, metamorphism, magmatism), concluded by an orogenetic system, followed by several emergence stages that peneplainised the Orogen. By its lithology and age, the bedrock of the Moldavian Platform is similar to that of the

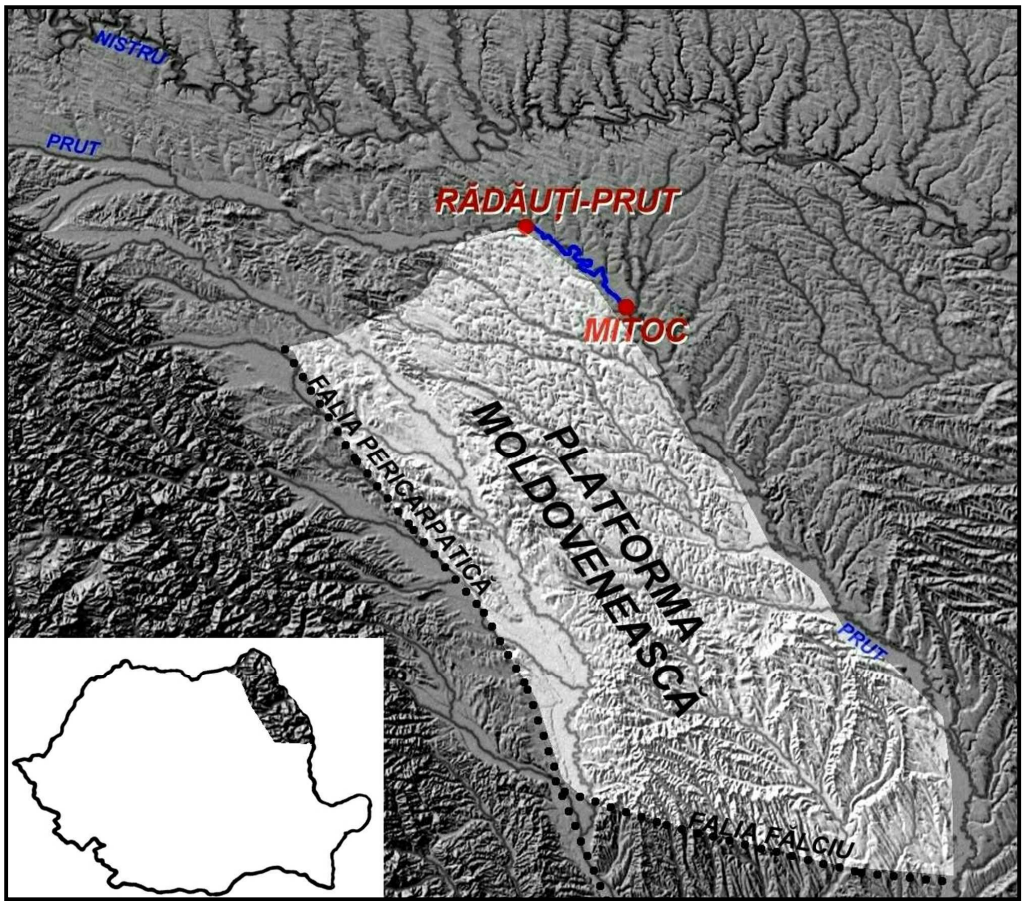

Fig. 2 - Map of Romania, with geological units.

Bug-Podolian sector.

The bedrock was reached only by deep drilling, being constituted of metamorphic and magmatic rocks, such as paragneiss and quartz-feldspar gneiss, basalt or pink granite with muscovite and biotite, some researchers attributing to it as well some lithological sedimentary formations made up of sandstones and clays.

The age dating indicates values between 1,280 and 1,448 million years (on biotite) or between 1,005 and 1,593 million years (microcline) and these represent the age of the last geodynamic movements occurred on the level of the Middle Proterozoic 1,600 million years ago, which affected the bedrock, and not on the level of the Early Proterozoic, which occurred much earlier, namely 2,300-3,000 million years ago.

2.2. The sedimentary cover of the Moldavian Platform. It is made up exclusively from sedimentary deposits whose thickness varies between 2,500 and 6,000 m, this being the result of three megacycles of sedimentation, interrupted by three emergence stages, yet there may be as well other short interruptions, general or only local.

The Paleozoic formations, attributed to the Upper Vendian - Devonian sedimentation megacycle have been reached only by numerous drillings, being deposited in facieses similar to those opened by the Dniester River at Soroca (Republic of Moldova). The Paleozoic appears almost uniformly on all the surface of the Moldavian Platform, with small variations of thickness, lithology and fauna content. In it, numerous sedimentation periods have been recorded, yet interrupted by the emergence ones.

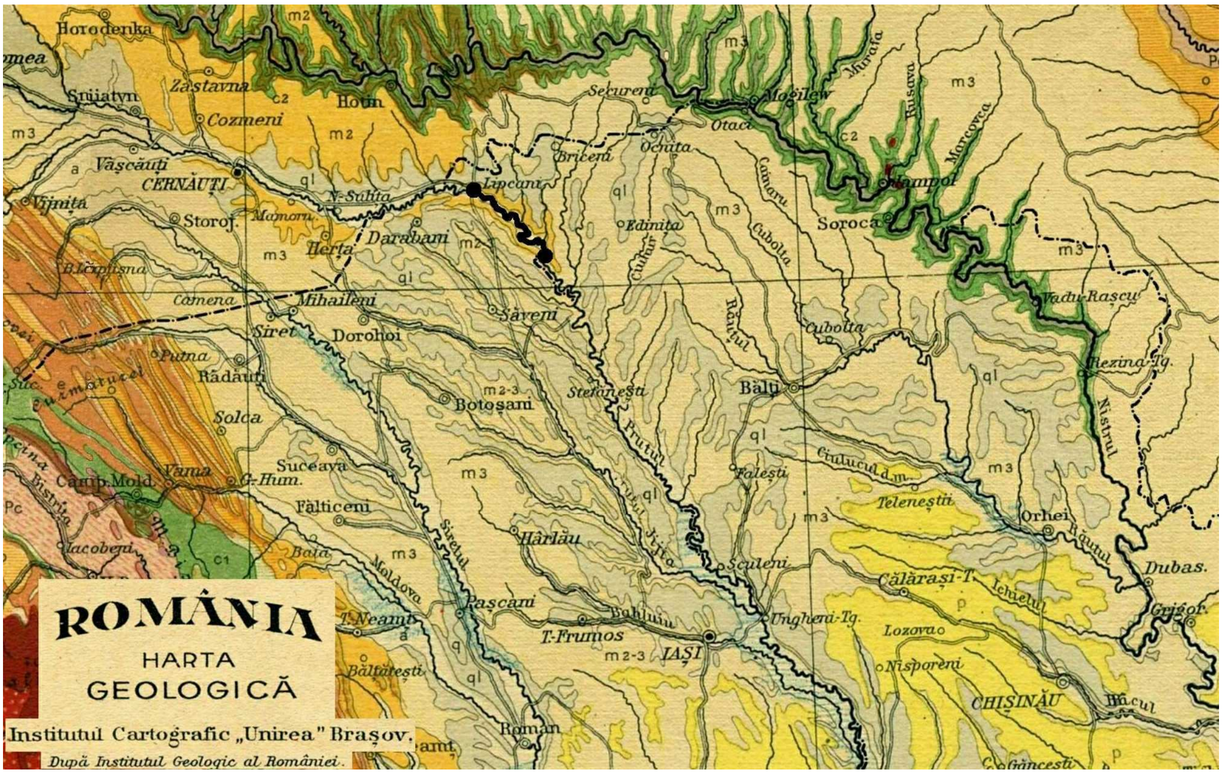

Fig. 3 - Extract from Geological Map of Romania at 1: 2,250,000, printed by Cartographic Institute *Unirea* Braşov (undated).

From a stratigraphic perspective, its deposits are attributed to the Upper Vendian, Lower to the Lower Devonian. After this sedimentation period follows a period of erosion/emergence of these formations, one of the longest of the periods of this kind (of about 240 million years), starting on the level of the Devonian and continuing during most of the Mesozoic. This removed the Paleozoic sedimentary deposits, realizing a peneplainisation of the zone, which, in the areas with limestones, also generated a karstic paleorelief.

Another sedimentation megacycle is the one that started towards the end of the Mesozoic, with the Cretaceous, and which continued, with numerous interruptions and discordances, produced by emergences, up to the level of the Middle Eocene, lasting about 80 million years. Probably there were stages when only certain areas were under the water, where a modeled paleorelief was generated, whereas in the areas situated above the water there was a hydrographic network oriented mostly NE-SW, in the northern half, and

Cambrian, Upper Ordovician, Middle and Upper Silurian and

E-W, in the southern half. The existence of these paleoreliefs was highlighted by the interpretation of the data obtained from drillings and seismic investigations.

The oldest Cretaceous formations are those sedimented starting with the Valanginian, continuing with the Barremian-Aptian and Upper Albian and can be met only in drillings. Only the formations of the Lower and Middle Cenomanian are open by erosion at the surface of the ground, being met in the north-east of the Moldavian Platform, especially in the banks of Prut River. Situated transgressively over the Aptian deposits in the north and in continuity of sedimentation in the south of the Moldavian Platform, the evolution of these deposits was marked as well by the presence of a marine transgression over the whole platform, occurred on the level of the Lower Cenomanian and which lasted until the Middle Cenomanian.

The Cenomanian deposits are made up of a

lower level, with microconglomerates, sandstones with phosphates, sands and glauconitic sandstones, up to 80m deep, which have not been opened by erosion, and an upper one, opened by erosion, made up of chalky limestones with siliceous concretions, up to 10m thick. This upper level of the Cenomanian, with siliceous concretions, is the first geological level of interest for the archeological research, as we shall see.

Another level of the Cretaceous, the

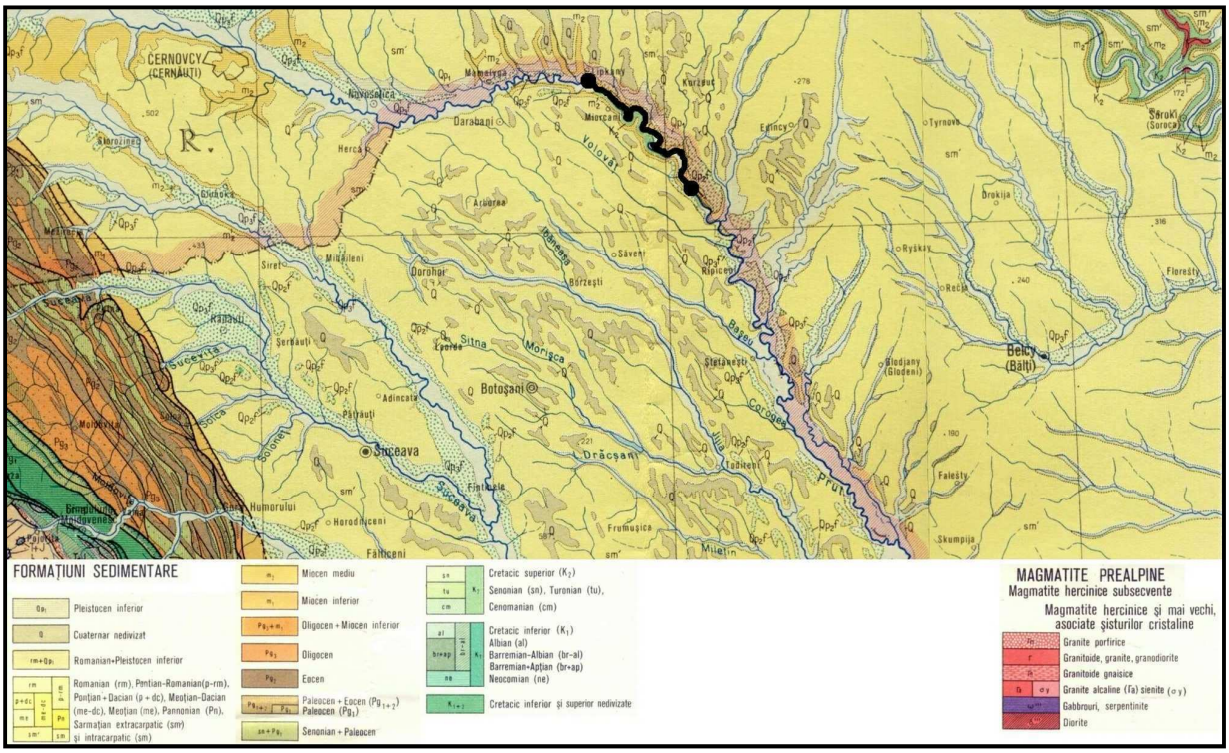

Fig. 4 - Extract from Geological Map of Romania at 1: 1,000,000, printed by the Geography Institute, 1978.

Senonian, was reached by a series of drillings and is met only in the west of the Moldavian Platform.

The deposits attributed to the Neozoic start with a series of lithological formations met only in drillings, which can sometimes be up to 100 m thick, and whose age has not been fully elucidated so far, being attributed to the Paleocene and to the Eocene.

With the Badenian starts the last sedimentation cycle, called the *Upper Badenian - Meotian*, whose duration was the shortest, namely 7 million years. It begins with a series of sedimentary formations deposited transgressively over the previous ones. According to some authors, on the level of the Middle Badenian, and according to other authors, later on, during the Upper Badenian, a marine transgression occurred, comprising the whole present area of Moldova and leading to the depositing of a larger volume of sediments whose thicknesses are higher in the west, of maximum 450m, separated into three distinct lithological units reflecting the evolution of the sedimentation.

The first of them, known as the infra-anhidritic (detrital) formation, represents the lower horizon that marks the transgression of the Badenian, with thicknesses of up to 130m, made up of sandstones and sands, with intercalations of marls and limestones. One should note that the deposits made up of sandstones contain reworked flints from the Cenomanian deposits, which in certain areas gradually become flint agglomerations, which have been opened by erosion in the banks of Prut River.

To the west, in between Rădăuţi-Prut Commune and Crăiniceni Village, there appear, but only in drillings, deposits formed of coarse sandstones with flints, which then, towards Suhărău begin to get separated, in the lower part in deposits of sandstones with flints, and in the upper part in conglomerates with flints (as one can note in between Teiasa and Bajura) and white sands of Alba-Miorcani. In the area of the Hudeşti deposit, the drillings have brought to light white sand deposits containing in their basis flint agglomerations, but which have not been opened by erosion. The flint agglomerations found between Teiasa and Bajura are caught in a fossiliferous limestone which appears as a conglomerate with passages to microconglomerates and then to white sands, but they do not come up to the surface either.

A second lithological unit of the Badenian, the anhidritic (evaporitic) formation is made up of anhydrite and gypsum, with some intercalations of clays, marls, limestones and even tuffs of a volcanogenic-sedimentary nature, and its thicknesses range between 30 and 60 m, which denotes the fact that there were also areas that were emergenced. According to certain authors, in this formation, met only in drillings, along the present line comprised between the localities Păltiniş – Hudeşti – Ibăneşti, one can meet grey-yellowish limestones, sometimes arenaceous, accompanied by rare fragments of flints (coming from the lower horizon) or a series of siliceous agglomerations and flints, coming also from the lower horizon, which were deposited over lagoon deposits.

The third lithological unit, the **supra-anhidritic formation** (clay-marl-limestones), concludes the Badenian succession and is made up of clays and grey marls, arenaceous limestones, whose total thickness is maximum 250 m. In the north-east of the Moldavian Platform, due to the low thickness of the sea, a series of sandy limestones with *lithothamnium* have been deposited, with thicknesses of 10-20 m, as one can note in the geological formation showing up at the surface in between the communes Crasnaleuca and Rădăuţi-Prut, while from here towards Suhărău, they are replaced by calcareous marls with *lithothamnium*.

Geological formations belongig to the Sarmatian are met the most often, as they appear at the surface throughout the area of the Moldavian Platform, even though a part of them can be found as well deeper, in the margin of the Orogen or even caught beneath it.

Lithologically, during the Sarmatian, there has been an accumulation especially of clays, siltites, marls, sands and secondarily sandstones, oolitic limestones, sandy-limestones, tuffs etc., whose thicknesses vary in between 800 m in the east and 2600 m in the west, distributed geochronologicaly on all the four sub-tiers of the Sarmatian, namely: Buglovian, Volhinian, Basarabian and Chersonian. Although these deposits have been investigated thoroughly, for more than a century, being the object of numerous studies, communications and specialized works, there are still interpretations on certain aspects, which differ from one researcher to the next.

Regarding the description of the geological constitution of the Sarmatian formations, we shall content ourselves with reminding the fact that on the level of the Buglovian, on a narrow band, parallel to the Prut river, in between Mitoc and Ştefăneşti, and from here, down to the south, up to the vicinity of Iaşi (as it has been highlighted by drillings), bioherms have formed, made up of tubicolous worms, which represent the southern extremity of a large area, which starts in Brody region in Podolia, and appears as a belt. Bioherms – shapes as lentils up to 2km long, 50-100m wide and 40-60m high, suggest the existence of a heightened shoulder dating since the Badenian, with shallow waters. These bioherms have also been highlighted in the area situated at the east of the Prut.

With the Meotian, the last level of the Miocene, the sedimentation on the Moldavian Platform comes to an end; after it, the waters withdraw southwards, on the Platform of Bârlad, where sedimentation continued as well during the Pliocene.

The Quaternary deposits conclude the geological succession, being represented, principally, by terrace deposits, accompanying the hydrographic network, and loessoid deposits.

3. The geographic framework of the area

The Moldavian Platform, as a structural unit, represents the geological support of the Moldavian Plateau. The relief modelling in the zone of the Moldavian Plateau began with the Mio-Pliocene emergences that have given birth to the Carpathian Rivers, and to Siret and Prut, which later on

developed southwards, following the withdrawal of the coastline.

Due to the Pliocene and Quaternary emergences movements, the activity of the running waters became more intense, and, correlated with other geodynamic processes (slope processes, erosion-sedimentation processes etc.), has led to the destruction of the old plains of marine storage and to their replacement by a derived relief, predominantly sculptural, with a hilly aspect. It is marked by the particularities of the geological substratum and by the geological structure mainly of monocline, which favored the appearance of the asymmetry of the relief forms.

The Moldavian Plain represents the north-eastern part of the Moldavian Plateau, being marked by a relief whose absolute average altitude is situated around 150-200 m, namely 200 m below the neighboring geographic units from the west and from the south.

Covering an area of around 8.000 km square, it neighbors the Plateau of Suceava in the west. In the north and in the east, the limit is given by the Prut River, marking the state frontier between Romania, on the one hand, and Ukraina and the Republic of Moldova, on the other hand. Yet, this represents a political limit and not a geographic one, because to the hilly Plain of Jijia, subunit of the Plain of Moldova, corresponds a similar unit on the other side of the boundary, namely Stepa Bălţilor. To the south, the limit between the Plain of Moldova and the Plateau of Bârlad is given by a high relief tier, also known in geographic literature as the *Coasta Moldavă* (*Moldavian Coast*).

At the surface, in the Plain of Moldova, the erosion opened a series of geological deposits, whose features have been presented previously. The absolute maximum altitude of the relief in the Moldavian Plain reaches the level of 270 m, only on Bodron Hill, west of Mitoc and here and there goes over 250 m. The lowest absolute altitude is recorded in the river plain of Prut, east of Iaşi, namely 32 m.

The topography consists of hills, it is dominated by forms of obvious asymmetry, showing steeper north and northwest slopes and south and southeast slopes with moderate slopes with low inclination . In this unit, the structural forms of relief are few and poorly represented, and one can find only a few *cuesta* on the right side of the Jijia River, in between Corlaţeni and Mândreşti, on the right side of the Başeu, in between Săveni and Vlăsineşti, continued southwards by those in between Hăneşti and Mihălăşeni, on the southern flank of the river Sitna in between Dracsani and Hlipiceni, Miletin Coast and Jijioarei Coast (Gârla Morii), continued eastwards by the alignment Larga Jijia - Popricani - Victoria from the sector of Lower Jijia and the Coast of Bahlui and Bahluiuleţ. To these, one can add as well some areas with secondary *cuesta*, whose appearance differs from that of the opposite slopes.

On top of the hills, bridges or interfluves, loessoid Quaternary rocks have been deposited, on top of which there are mainly chernozems affected by weak and moderate erosion processes. Pluviodenudation and ablation are the main factors degrading the land in the areas with slopes whose inclination goes over $6\text{-}7^0$.

Relief accumulation is represented by terrace deposits, horizontal or slightly sloping bridges and floodplains. The terraces that have been well represented and studied in this geographical unit have some peculiarities. The hierarchy and the development of the hydrographic network, supported by the presence and number of terraces, highlight the leading role played by the river Prut its formation.

Thus, Trifeşti and Probota sector of the Prut River presents seven high terraces with absolute altitudes that reach 150 m, while Jijia and Sitna, in their lower sectors have respectively 5 and 4 terraces, with maximum altitudes of 140 m. An exception is Bahlui River, which has 8 well preserved terraces, whose lengths can reach 6-7 km, an argument in favor of the fact that there were also higher areas that have simply been destroyed by erosion.

The terraces are made up of Carpathian gravels in their basis, as in the case of the terraces of Prut, with loessoid sands and rocks, with thicknesses ranging between 3 and 20 m. Regarding the age of the terraces, the specialists consider that the terraces with altitudes over 140 m can be Pliocenic, those with altitudes ranging between 100-140 m were formed during the Lower Pleistocene, those situated at 50-70 m are formed in the Middle Pleistocene, and during the Upper Pleistocene were deposited the terraces of 30-40 m.

The main river gathering the waters of the area is the Prut, whose riverside may range

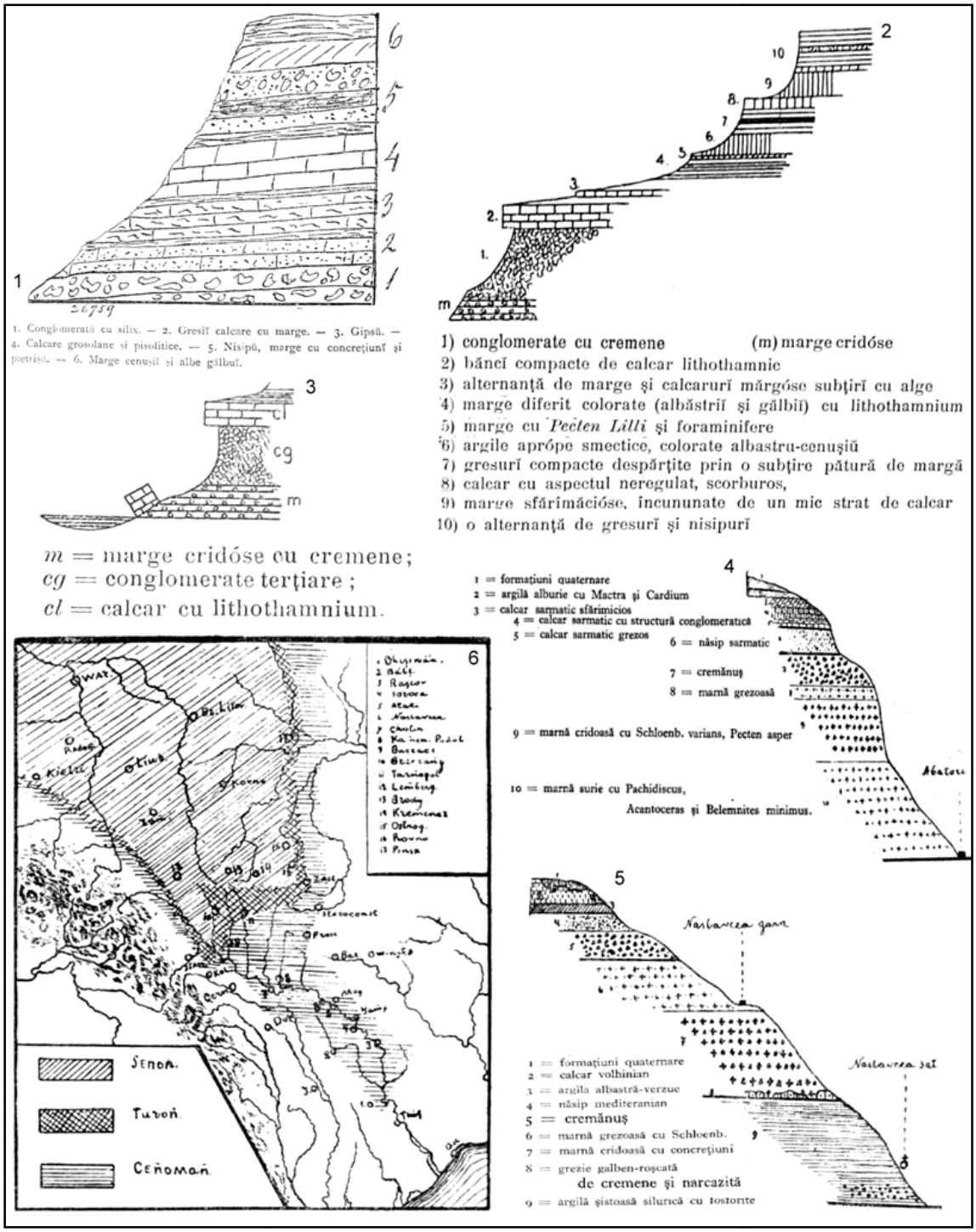

Fig. 5 - Geological profiles from region: 1. Gr. Ştefănescu, 1888, fig. 3; 2. I. Simionescu, 1902, fig. 6; 3. I. Simionescu, 1902, Fig. 1; 4. J. Văscăuţanu, 1923, fig. 2; 5. J. Văscăuţanu, 1923, fig. 1; 6. J. Văscăuţanu, 1923, fig. 3.

between 3 and 7 km in width, but which also has narrow sectors, such as those in between Rădăuţi Prut and Stefăneşti, compared in the geographic literature with some small keys, considering the upstream sector and the downstream sector.

4. A *literature review* on the occurrence of flint in the north-east of Moldova

The first scientific paper that describes in a comprehensive manner both the geological structure and the presence of flint along the Prut Valley and the existence of prehistoric settlements here is the one published in *Anuarul Biuroului Geologicu* (*Annuary of the Geological Bureau*), year III - 1885, no. 1, printed in 1888, signed by Gr. Ştefănescu and entitled *Relaţiune sumară asupra lucrărilor Biuroului Geologicu in campania anului 1885* (Short Relation on the Works of the Geological Bureau during the 1885 Campaign).

Thus, referring to the situation of the Quaternary deposits of Dorohoi, page 20 of the paper, it is mentioned that „in the Prut riverside, at Metocu, were found, on less than two meters from the surface, several worked flint, evidence of a prehistoric settlement"(„în malul Prutului, la Metocu, amu găsitu, la mai bine de două metre de la suprafaţă, mai multe silexuri lucrate, indicele unei staţiuni preistorice")[2].

Next, describing the miocene rocks, at page 34, the author mentions that „at Hudeştii Mici or Miorcani can be seen below these pisolitic limestones in Prut riverside at Văraticu village and at Izvoare, berween Hudeşti and Miorcani[3], a conglomerates deposit composed of many fragments and nodules, some of them quite large, of flint *piromaticu (untranslatable word)*, generally gray, cemented with gray *margosu (untranslatable word)* clay" („la Hudeştii mici sau Miorcani se vede sub aceste calcare pisolitice în malul Prutului la localitatea Văraticu şi la Izvoare, între Hudeşti şi Miorcani", unu depozitu de conglomeratu formatu din numeroase fragmente şi nodule, din care unele destul de mari, de silex piromaticu, în generalu vânătu, cimentate cu argilă margosu vînătu") (Fig.5/1), but the stratigraphy is, however, not complete in the profiles analyzed.

In the work published in the year 1897, in no. 1-2 of *Arhiva Societăţii Ştiinţifice şi Literare* (The Archive of the Scientific and Literary Society) of Iaşi, entitled *Crida superioară şi calcarul cu lithothamnium pe malul Prutului (jud.Dorohoi)* (*The Upper chalk and the limestone with lithothamnium on the riverside of Prut (Dorohoi County)*), I. Simionescu describes the geological outcrop situated upstream from Mitoc village, in the point called *Cotul Mic*, where, along an abruption of a few meters from the right side of Prut, he observes a geological series made up of „yellowish-white unlaminated chalky marl" ("marne cridoase de culoare albă gălbuie şi nestratificată") by whose destruction the "rounded flint aligned in parallel series" ("cremenele rotunzite aşezate pe rânduri paralele") become "free and are taken away by the water"[4], contributing to the formation of the alluvial deposits of the region. In the upper side, over this marl, there are limestones with *lithothamnium.*

The same types of geological formations are present, according to the author, on the left side of Prut, "*on a large area, from Teţcani Village up to downstream from Badraz"*. The author identifies in the marl, by microscopic analysis, foraminifers and broken shell fragments, affirming that this rock continues the formations occupying a large area in "*Eastern Galitia and in Russia"*, concluding by attributing the cretaceous age to these deposits.

In the study published in 1902, entitled *Constituţiunea geologică a ţărmului Prutului din nordul Moldovei* (*Geological Structure of the Riverside of Prut in Northern Moldova*), based on more detailed research works, for which he expresses his gratitude for the support offered to Dr. C. I. Istrati, Minister of Education, I. Simionescu details a series of aspects regarding the geology of the region, even from the beginning of the article, at pages 5-6, where he mentions that between Rădăuţi and Mitoc, "flint beads easy peelable are covered with thik lithithamnic limestone layers; that beads are often covered by a flint conglomerate whose elements are little cemented so that they break loose under the action of frost and defrost", as is the case met downstream from "*Miorcani and in the area of Cotul Zamca"*[5] („margele cu cremene uşor de desfăcut sunt acoperite cu bănci grase de calcar lithothamnic; ca margele sunt de multe ori acoperite de un conglomerat de cremene a cărui elemente sunt puţin cimentate aşa că se desprind sub acţiunea îngheţului sau dezgheţului", cum este

cazul întâlnit „în jos de Miorcani şi în dreptul Cotului Zamca") (Fig.5/3).

The author also describes a series of tertiary outcrops along the Prut Valley, beginning with those in the area Mamorniţa, Herţa, Darabani and up to Rădăuţi-Prut, without mentioning the presence of any flint elements.

Continuing the description with the zone south-east of Rădăuţi (p.11 and the next), "*where the Prut suddenly turns towards Sirăuţi Village in Bessarabia"*, and where one can find the oldest geological levels of the region, the cretaceous ones, "represented by greyish-white chalky marl in thin layers and rich in flint pebble, arranged in regular lines", over which there are the tortonian deposits. The author mentions that the stratigraphic series is concluded by the limestones with *lithothamnium*, where, "not rarely, one can notice rounded flint", as it happens in Pădurea Stânca and also that these strata reappear "beyond Văratic Rivulet (Pichet 45 bis)".

Lower downstream, in between Văratic Rivulet (Pichetul 45) and Cotul Zamca, the author describes that in between the chalky bead and the limestone with *lithothamnium* is "intercalated an important conglomerate layer, made up only of slightly rounded flint", with calcareous cement, layers opened as well by Miorcani Rivulet, next to its confluence with Prut. The same series is also encountered southwards, up to the point called *Stadola lui Văsescu*, the author mentioning again the presence of rounded flint in the basis of the limestone with *lithothamnium*[6].

I. Simionescu also describes other outcrops near Crasnaleuca (p.12 and the next), like the ones situated in the middle of Cotul Zamca or the ones from Pichetul 51 bis[7], also presenting a stratigraphic profile (Fig.5/2), where there appears the same stratigraphic series, over the marls appearing conglomerates with flint, a series met as well at Ghirenii lui Curt or lower downstream at Mitoc, and up to Pârâul lui Istrati. This is the southernmost point where one can find both cretaceous marls and limestone with *lithothamnium*.

Towards the end of the article, in the conclusions on the stratigraphy of the area, regarding flint from cretaceous white marls, I. Simionescu mentions that flint has various dimensions, usually "as big as a fist, rarely as big as a head", and various shapes, and irregular surfaces, their color being blackish-dark blue, and their surface altered, almost always white; he also mentions the pre-historic levels noted by Gr. Ştefănescu, which he noticed as well at Mitoc (p.15). Interesting is the fact that he cannot indicate the level of the Upper Cretaceous to which these strata of marls with flint belong, mentioning that in Galitia these limestones can be found in all the three levels of the Upper Cretaceous, while in northern Bessarabia "chalky marls containing much flint" are placed over other marls.

On the conglomerate with flint appearing in-between Rădăuţi and Mitoc (p.18 and the next), up to 5 m thick, made up of rounded pieces, the author affirms that the material highlights "the beginning of the tertiary marine transgression" and that it" was certainly taken from the cretaceous marls", showing that between this level and the limestone it stands on there is "a close connection", as it is proven by the rounded flint pieces included in the lower area of the limestone layer; he mentions that the age of the conglomerate is lower Tortonian.

At the same time, he also refers to the profile in-between Ivăncăuţi and Cuzlău published by Gr. Ştefănescu, mentioning that although the gypsum layers lie over the layer of conglomerates with flint, the two geological levels are synchronous.

As a general conclusion, I. Simionescu shows that north-eastern Moldova has great geological affinities with the situation present in Bessarabia, Podolia and Eastern Galitia (p.24 and the next), representing the southern extension of the "Russian land", also figuring a model of geological evolution of the region, in which he mentions that after their formation the cretaceous deposits were eroded by "running waters", which generated "an irregular surface", an aspect noticed "in many places in Galitia". The tertiary transgression led to the invasion of the area by marine waters, which initially triggered the erosion of the cretaceous deposits, "heaping up the remaining flint into a conglomerate that would indicate the shoreline" ("îngrămădind cremenele rămase într-un conglomerat care ar indica linia ţărmului").

The geological researches in the region become much more intense after the year 1920. An interesting work on the cretaceous deposits in northern Bessarabia is published in the year 1923 by J. Văscăuţanu, who describes the situation met in several geological outcrops. In the first of them, situated in Naslavcea Village (Fig.5/5), the author

notices the presence of a thick layer, "of 4-5 m of black flint cemented with chalky marl" ("de 4-5 m de cremene neagră cimentată cu o marnă cridoasă"); this flint has a "scaly surface with an irregular outline, rugged or alveolar" („ce prezintă solzoasă cu contur neregulat, colţuros sau alveolar"), coming out easily from the "chalk matrix". Comparing these rocks to those met in the riverside of Prut, the author affirms that the age of these formations "is the basis of the Mediteranean, a material taken from the cretaceous layers".

A second outcrop is situated in the eastern margin of Soroca, next to a confluence of a valley with the Dniester (Fig.5/4). Here, J. Văscăuţanu describes under a level with sand, "a 3-4 m thick layer of flint, identical to that of Naslavcea" („un strat de 3-4 m de cremănuş, identic cu cel de la Naslavcea"), and under them a thin layer of silstone and a 10-12 m thick layer of chalky marl, which under the impact of erosion look like columns and towers.

The author mentions that this chalky marl includes two horizons. The upper horizon present in the upper part of the marl is made up of "flint concretions, lying along an almost straight line" ("concreţiuni de cremene înşirate pe o linie aproape dreaptă"), regarding which a microscopical analysis highlights the mineralogical structure and also the presence of fossils, a fact that, according to the author, would highlight "a phenomenon of metamorphosis of the marl into flint" ("un fenomen de metamorfozare a marnei în cremene"). Fossils present in this horizon, according to the author, would indicate the middle Cenomanian.

The author mentions that these formations observed at Soroca appear as well downstream, up to the point *În Cot*, after which they disappear, although some researchers affirm that they can be met up to the area of Rezina Town, where they appear at 1/2 m over the level of the Dniester. At the same time, the author mentions the fact that, in Bessarabia, cretaceous layers are present both on the riverside of Prut, in between Lipcani Village and Bădragii Noi, along a distance of about 30 km (referring to the 1897 study of I. Simionescu), but also in the points " Bălţi, Ezăreni and Mireni, Kishinev County, where drillings have crossed thick beds of flint and chalk" ("Bălţi, Ezăreni şi Mireni, judeţul Chişinău, unde făcându-se sondaje s-a trecut prin păturі groase de cremene şi cridă").

At the end of the study, the author presents a general map of the east-carpathian area (Fig.5/6), highlighting the distribution of the geological deposits; he affirms that in Podolia, the level of white marl with flint would have been attributed to the Turonian and Senonian, cf. E. Dunikovski in 1884, yet this opinion would have been reviewed later on by G. Ratkevici in 1891, who attributes a Cenomanian age to the marl, sand and flint levels, present "south of the line separating the tributaries of Dniester from those of Bug". J. Văscăuţanu (1923) also mentions a geological profile similar to that of Soroca encountered along Uşiţa Valley.

Interesting is also the work entitled *Geologische Beobachtunngen uber das Miozan zwischen dem Siret und dem Nistru in der Bukowina und in nordlichen Bessarabia* published in the year 1929 by Gh. Macovei and I. Atanasiu who note that in the north of the Moldavian Plateau, the Tortonian is represented by two distinct facies. The podolian facies is characterized by low-depth marine sedimentary rocks with gyps, limestone, sandstone, silliceous agglomerations, while the pre-Carpathian facies is marked by a dominance of clay-marl rocks, slightly arenaceous.

Another work important for the knowledge and the description of the flints in the region is the study entitled *Etude micrographique des roches siliceuses du Cretace du la Valle du Nistru*, published in 1938 by M. Filipescu. He makes microscopic analyses on samples coming from the cretaceous deposits of Naslavcea and Răspotinţi (Hotin County), distinguishing five forms of presentation of the silica:

- siliceous spongolite (*aff. gaize cherteuse - Cayeux*), present at Răspotinţi, are in fact siliceous accidents like *chert* type in which 50% of its mass is comprises of sponges spicules;
- Globular opal in the mass of chalk, in which silica in the form of opal it reaches a percentage of 53% of the rock mass weight;
- Concretions of globular opal in chalk;
- Powder silica with flint nodules, available white chalk, flawed, in which there are gray flint nodules. Microscopic analysis revealed the presence of foraminifera sponges spicules in silica in the form of chalcedony, that makes up the flint.

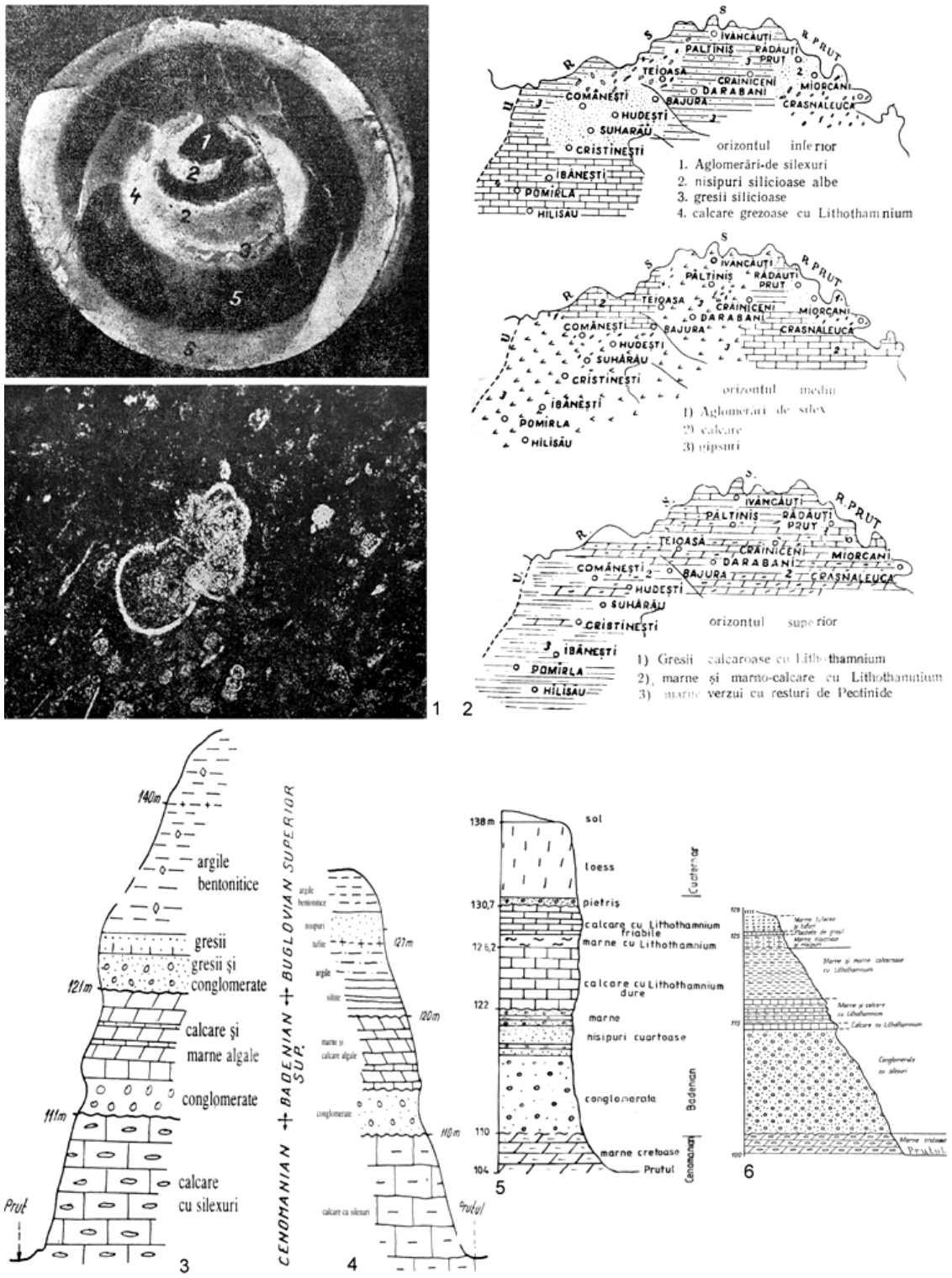

Fig. 6 - Geological profiles from region and sections from flint pieces published by: 1. N. C. Albu, C. Gheorghiu, I. Popescu, 1960, fig. 3-4; 2. Gh. Bâgu, 1965, fig. 1- 3; 3. L. Ionesi, 1984, fig. 7; 4. L. Ionesi, 1984, fig. 8; 5.Claudia Cirimpei, 1985 (Mirocani area); 6. E. Nicorici, Bica Ionesi, 1978, fig. 1.

- Flint. For the analysis the author has provided one sample of this type, yellow-brown, without specifying where they came from, in which composition he observed the foraminifera and sponge spicules, catched in chalcedony that makes up the fundamental mass of flint.

The author tries to explain the modalities of formation of the siliceous rocks under analysis, on the basis of diagenesis processes on the seafloor, "where sediments were in the form of mud, water-logged" ("unde sedimentele se aflau în stare de noroi, îmbibate de apa mării").

In the study published in 1929 by N. N. Moroşan entitled *Noi contribuţii preistorice asupra Basarabiei de Nord* (New Prehistorical contributions about Northern Bessarabia), the author refers only once to the presence in the area of geological outcrops including flint, in-between Cuconeştii Vechi and Corpaci, mentioning that the tools made of flint, black of bluish, correspond as "structure to the flint concretions present abundantly in the region", this meaning according to the author that the tools were manufactured *in situ*, and were not brought from other areas. Although in 1938, N.N. Moroşan publishes an ample volume on the Paleolithic of NE Romania, he does not approach the issue of the geological outcrops in which flint appears in this area.

The study published in 1960 by N. C. Albu, C. Gheorghiu and I. Popescu, entitled *Depozitele sedimentare de la Rădăuţi-Prut* (Sedimentary Deposits from Rădăuţi-Prut), presents new information on the issue of the appearance of flint in the region, describing a series of geological profiles from this area.

One of these profiles is also the most complete, being situated in-between Rădăuţi-Prut and Miorcani, in the sand quarry. Here the authors mention that the cretaceous deposits represented by milky white chalky limestones present numerous siliceous accidents with choncoidal fracture, evenly distributed in the mass of the rock, of a whitish-grey color that laterally turns to a yellowish-brownish color.

Over them, there is a level of tortonian sands with flint nodules, which shows large lithological facies variations, from one point to another. Flint nodules described by authors, are different in size, sizes between 2 and 18/12 cm, and morphology. The most common forms are ovoid, elliptical, rarely spheroidal, sometimes rod-shaped, very rolled or covered by a whitish crust. However, appear also irregular shape,with the intricate structural aspects, because different mineralogical structure of silica.

Flint nodules color ranges from gray - black , gray- intensive to a pale gray, almost milky. Some samples have several shades of colors, like in Fig.6/1). It shows different flint rings of white milky color and dark gray. In its mass were identified sponges spikes, and rare fragments of radiolarians, and unidentified forms of foraminifera, globigerina (Fig.6/1).

The authors state that the analysis of the sand from this level revealed that consists entirely of very rolled flint grains (due to mechanical actions), rare angular. Also, it also notes the presence of a level of marl and limestone-chalk, with flint nodules, in the Rediu drilling, and a relatively homogeneous lithology of flint conglomerates horizon and siliceous sands between Rădăuţi-Prut and Miorcani.

At the end of the study, the authors analyze the conditions that have led to the formation of the geological deposits of the region, with a focus on the manner of accumulation of conglomerates from flints and siliceous sands.

Based on data obtained from geological drilling, Gh. Bâgu published in 1965 the study entitled *Variaţii litofaciale ale formaţiunilor tortoniene din nordul Moldovei, în comparaţie cu cele din vestul U.R.S.S. şi a R.P. Polonă* (*Lithofacial variations of Tortonian formations in northern Moldova, compared to those of western USSR and P.R.Poland*), presenting in details the structure of the three horizons (inferior, middle and superior), both as petrography and as fauna. In the illustration of this study, the author presents three figures with the occurrence areas of these geological horizons, mentioning the presence of certain areas in which, also by drilling, flint has been detected (Fig.6/2).

The author mentions that in the lower horizon, they are either under the form of sands with flint or conglomerate with flint, between Miorcani and Rădăuţi-Prut, or under the form of coarse sandstones with flint, between Rădăuţi-Prut and Crăieniceni, or under the form of fragments of rolled flint, which in their upper area turn into conglomerate with flint attached in a fossil matrix,

between Teioasa and Bajura. In the sector Păltiniş, the accretions of flint in this horizon form a promontory, a hypothesis later on confirmed by finding in a geological drill in this horizon of a fragment of an *Anchiterium aurelianense* mandible, south of Rădăuţi-Prut.

In the middle horizon, the author mentions yellowish-grey limestones, in patches arenaceous, with fragments of flint pebble, without indicating the place of their occurrence. In the sector Hudeşti-Ibăneşti, massive flint accretions or rounded fragments replace the gypsum and limestones, the typical case being met in the drills of Rediu-Crăieni and Suhărău area, while the situation determined in Teioasa, Hudeşti and Comăneşti suggests the existence of a semicircular promontory on the level of this horizon, opened northwards. In this horizon, and also by drills, at Păltiniş, accretions of flint formations have been highlighted, coming from the lower horizon degradation and deposed over a gypsum layer.

The presence of flint in the upper horizon is no longer signaled by the author.

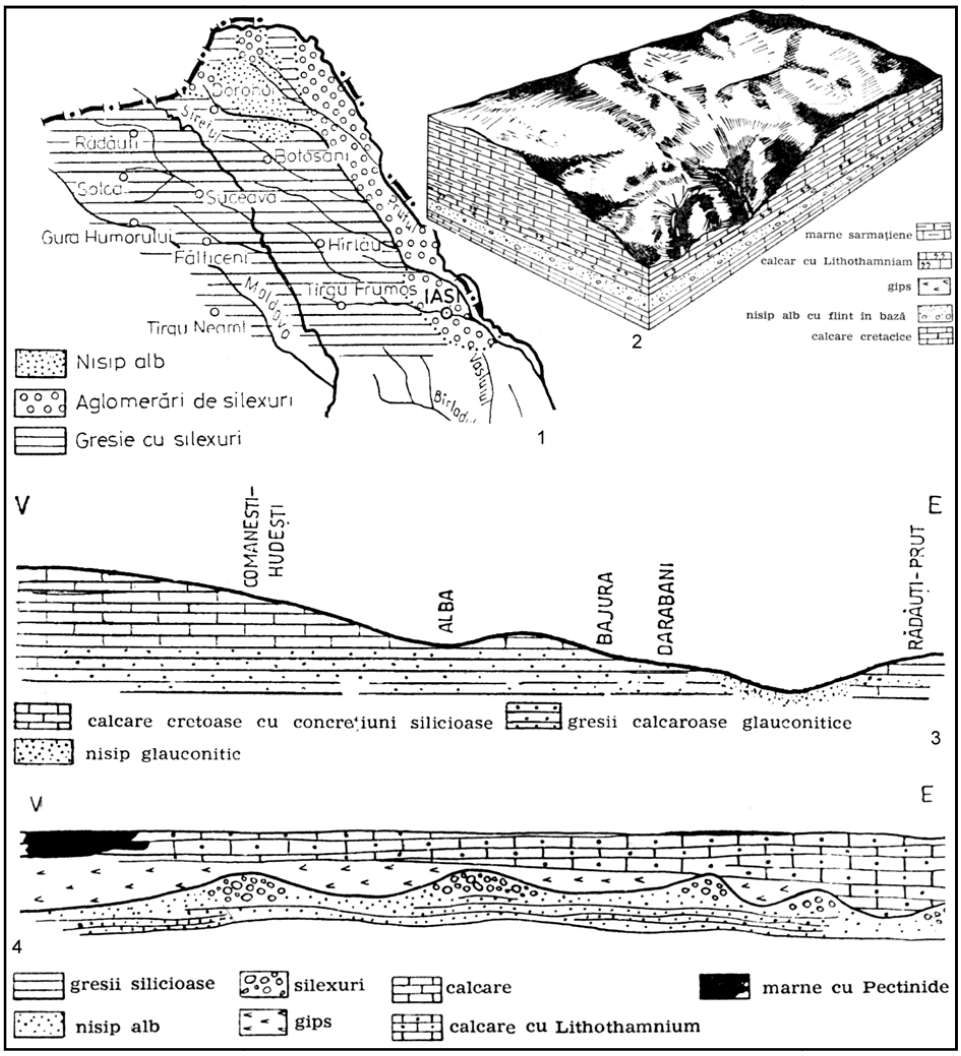

Fig. 7 - Geological profiles and sections from region after Gh. Bâgu, 1984: 1. The lower Tortonian horizon in the Moldavian Platform (fig. 9); 2. The block-diagram with deposit of white sand from Hudeşti (fig. 17); 3. The cross section in Cretaceous deposits from Radauti-Prut and Hudeşti (fig. 2); 4. Cross section in Tortonian deposits (schematically) in northern Moldova (fig. 3).

The analysis of geological similarities between the area of north Moldova and that of western USSR or P.R. Poland is relatively brief, the author mentioning that the situation in the area of Bajura-Hudeşti resembles that of the Rapuşneţ and Ocna area on Dniester or that of the Baranov-Sandomiretz area on Vistula River, while that of Mitoc, Crasnaleuca-Miorcani-Crăiceni, resembles that of Percăuţi, also on the riverside of Dniester, 20 km south, downstream from Ocna.

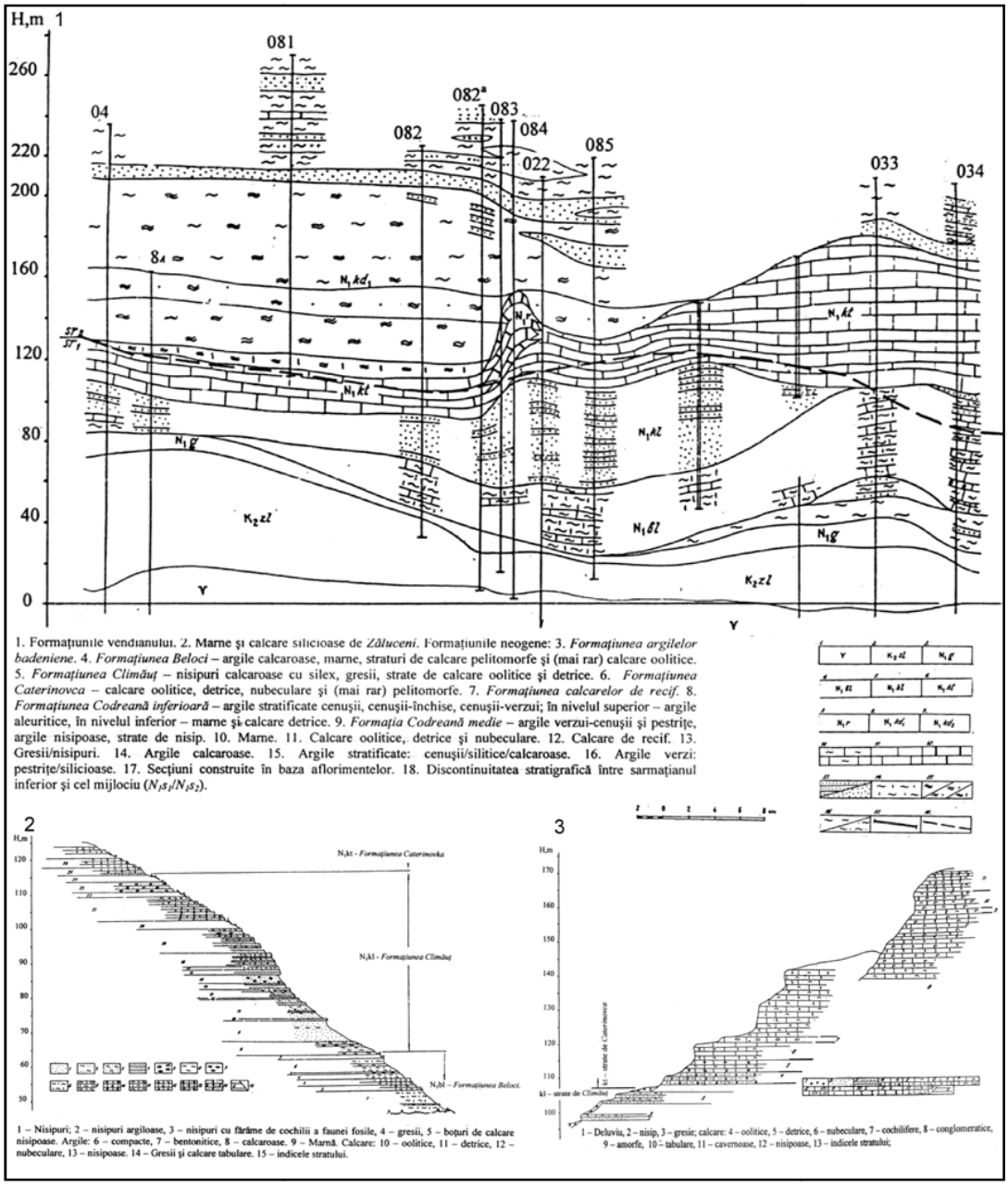

Fig. 8 - Profiles and geological sections from the Prut - Dniester area, after V. Ciubotaru, 2011: 1. Scheme of the Neogene geological formations from themcentral area of Nistru basin (fig. 9); 2. Geological situation (Climauti geological formation) at the northwest edge of the village Climauti (fig. 11); 3. Cross-section in Caterinovca geological formation at the northwest edge of the village Caterinovca (fig. 13).

In the work published in 1978 entitled *Studiul pectinidelor badeniene din nord-estul Platformei Moldoveneşti* (Study on the Badenian pectinoides north-east of the Moldavian Platform), Eugen Nicorici and Bica Ionesi mention an interesting piece of information, namely that the outcrop mentioned by I. Simionescu in the work of 1902, *Picket 51 bis*, situated north-west of the locality Crasnaleuca, and which presented *the most complete section*, rendered later on also by other researchers without any further information (as is the case of G. Macovei and I. Atanasiu in 1929) was at that time covered by vegetation, yet the erosion opened other points, as is the case of Cotul Grimeşti, south of Crasnaleuca, in the area of the former *Picket 53*, a situation illustrated in this work (Fig.6/6).

A much ampler work than those mentioned so far, and which includes a series of pieces of information of interest for the present study, is the volume published in 1984 entitled *Geologia Moldovei. Stratigrafie şi consideraţii economice* (The Geology of Moldova. Stratigraphy and Economic Considerations) of Gh. Bâgu and Alecu Mocanu, a first work offering an overview on region). In fact the authors resume the data known in the specialized literature resulted via the research carried out in this zone, summing up the information successfully, without updating the geochronological terminology, continuing to use the name of Tortonian.

Thus, further information is presented on the formation of the Cretaceous deposits with flint concretions or on the concentric siliceous areas observed in a section made into a oblong flint pebble, in the paper published in 1960 by Albu, Gheorghiu and Popescu, generated by the water chemism variation in which it appeared (p.21), realizing even a special subchapter dedicated to the sand and flint deposits, viewed through the prism of their economic use (p.67-73). At the same time, the figures add to the quality of the work, and also to the general idea on the issues related to occurrence of flint deposits in the region (Fig.7/1-4), along with the attempt to correlate geological formations in Moldova with similar formations in other regions.

Another synthesis that needs to be reminded is the one of Liviu Ionesi, published in 1994, *Geologia unităţilor de platformă and a orogenului nord-dobrogean* (Geology of the Platform Units and of the North-Dobroudjan Orogen), which, based on the specialized literature brings clarifications on the occurrence of geological formations in the region, without detailing, the levels in which flint appears, publishing however several outcrop profiles (Fig.6/3-4).

And, last but not least, we would like to mention two interesting bachelor degree theses, the first of Miss Claudia Cirimpei, of the year 1985, entitled *Studiul depozitelor calcaroase badeniene din regiunea Miorcani şi posibilităţile de valorificare* (Study on the Badenian limestone deposits of Miorcani region and possibilities of using them) and the second of Miss Aurelia Ionela Stănculete of the year 2005, entitled *Studiul geologic al depozitelor badeniene din nord-estul Platformei Moldoveneşti (zona Rădăuţi-Prut-Crasnaleuca)* (Geological Study on the Badenian Deposits in the NE Moldavian Plateau), works describing the geology of the area in a more detailed manner, the accent falling on the eroded outcrops present along the Valley of Prut and their geological analysis (Fig.6/5).

5. Flint occurrence on the Prut-Dniester interfluve (Republic of Moldova & Ukraine)

On the geological structure of the territory of Bessarabia and western Ukraine, areas situated between Prut and Dniester, we have made some remarks above, related to studies published in the interwar period. Unfortunately, the state barrier that divided the area for more than two centuries (but let us admit sincerely, to which the linguistic and political barrier contributed as well) clearly led to similar developments with no systematic convergence points.

Even though unpublished yet, the doctoral thesis defended in the year 2001 at the University of Iaşi by Valerian Ciobotaru, entitled *Studiu geologic şi geochimic al formaţiunilor geologice din zona nord-estică a Republicii Moldova* (*Geological and Geochemical Study of the Geological Formations in the North-East of the Republic of Moldova*), remains a first step in this direction. Along with a detailed presentation of the geological formations in between Prut and Dniester, the work offers both a description of the main geological researches in the region of the soviet period, and also an ample bibliography, an important part of it being made up of materials

remained unpublished from the fund of the Geological Association of Moldova.

Concerning the geological layers with flint of the zone of the interfluve Prut-Dniester, it is mentioned that on the Cretaceous level, in the upper part of the Zăluceni Formation, in the white and light grey siliceous limestones, in the upper level, there appear flint nodules, sometimes situated "in a continual series, creating the impression of an untouched layer", sometimes as flint intercalations in lenticular bedding, as well (p.50). The shape of these nodules is varied, with dimensions ranging between a few cm and 20-30 cm, grey and dark-grey; one can also observe samples with spots or zonal textures, formed of light or dark colored varieties.

Another geological level in which flint appears is that of the Badenian clay formation, ranged by transgression over the Cretaceous, and overlapped by the upper level, although in relation to it the limit is sometimes hard to mention. These appear in outcrops, such as the one in the riverside of Dniester in Vertiujeni Village, or the one near Sănătăuca Village, the flint nodules being grey or dark-grey and of small dimensions, 1-3 cm in diameter, the layers varying between 0.9 and 3.2 m in thickness.

In the Climăuţ formation, attributed to the lower Sarmatian (lower Volânian), in the outcrop of the north-west margin of the locality bearing the same name, there appear at the basis sands with flint, 6.2 m thick (layer 9) and above, in profile, calcareous sandstones with flint, 3.1 m thick (level 23) (Fig.8/1-3).

6. Research area.

In the area under analysis, beginning with the years 1997-1998, we undertook a series of research works out in the field to identify flint outcrops, to locate and map archeological sites known in the area and identify new ones, also making a profitable use of a series of partial results (M. C. Văleanu, 2003, p. 196 and the subsequent). Later on, the research out in the field was intensified, acquiring a systematic character, as it happened with the research works of 3-16 July 2013or those of the years 2014-2015.

Interesting for the present study was also the scholarship completed during the period 4-17 November 2014 at the Royal Belgian Institute of Natural Sciences of Brussels, which permitted an analysis by comparison to the geological situation of Spiennes, where flint mine exploitations exist since the Neolithic (Fig.39).

Just as important was the research undertaken in July 2015 along the Dniester Valley and in the area of Naslavcea locality (Ocniţa County, Republic of Moldova) with Dr. Valerian Ciubotaru from the Geological and Seismological Institute of the Academy of Sciences of the Republic of Moldova (Fig.40-41).

To prepare the research in the field but also to elaborate the present study, useful information regarding the geology of north-east Moldova, and also of the interfluve Prut-Dniester, was obtained as well by analyzing cartographic sources, the oldest being the Geoogical Map of Romania, drafted by N.A. Constantinescu and printed in Braşov in 1929 (Fig.3).

Very useful have proven to be various soviet geological maps, such as the map sheet L-35, 36, scale 1:1.000.000, edition: 1988, presenting the geological situation in between Prut and Dniester up to the 48^0N parallel, the map sheet M-34, 35, scale 1:1.000.000, edition: 1978, of west Ukraine, presenting the geological situation up to the 27^0E meridian, and the map sheet M-36, scale1:1.000.000, illustrating the territory in between Prut and Dniester, north of the parallel 48^0N and east of the 27^0E meridian, and respectively the northern area of the Republic of Moldova and the northern sector at its boundary with Ukraine.

At the same time, we also used the Geological Map of the Popular Republic of Romania at the scale 1:1.000.000, edition 1964 (Fig.4), but also other subsequent ones, like that at scale 1:200.000, map sheet M-35-XXIII/M-35-XXXIV Darabani, edition 1966, drafted under the coordination of Emilia Saulea.

To map the points on the ground, we used the 1984 edition of the Topographic Maps of Romania, scale: 1:25.000, a very useful tool, even 30 years after its publication, and the ortophoto map of the area or aerial and satellite photographs, available online today.

7. Mapped points

The research focused on the Romanian sector of Prut Valley, actually on the right side of Prut, between the localities Rădăuţi-Prut (in the north) and Mitoc (in the south), and we researched the following points:

7.1. *Rădăuţi-Prut and Miorcani– The sand and*

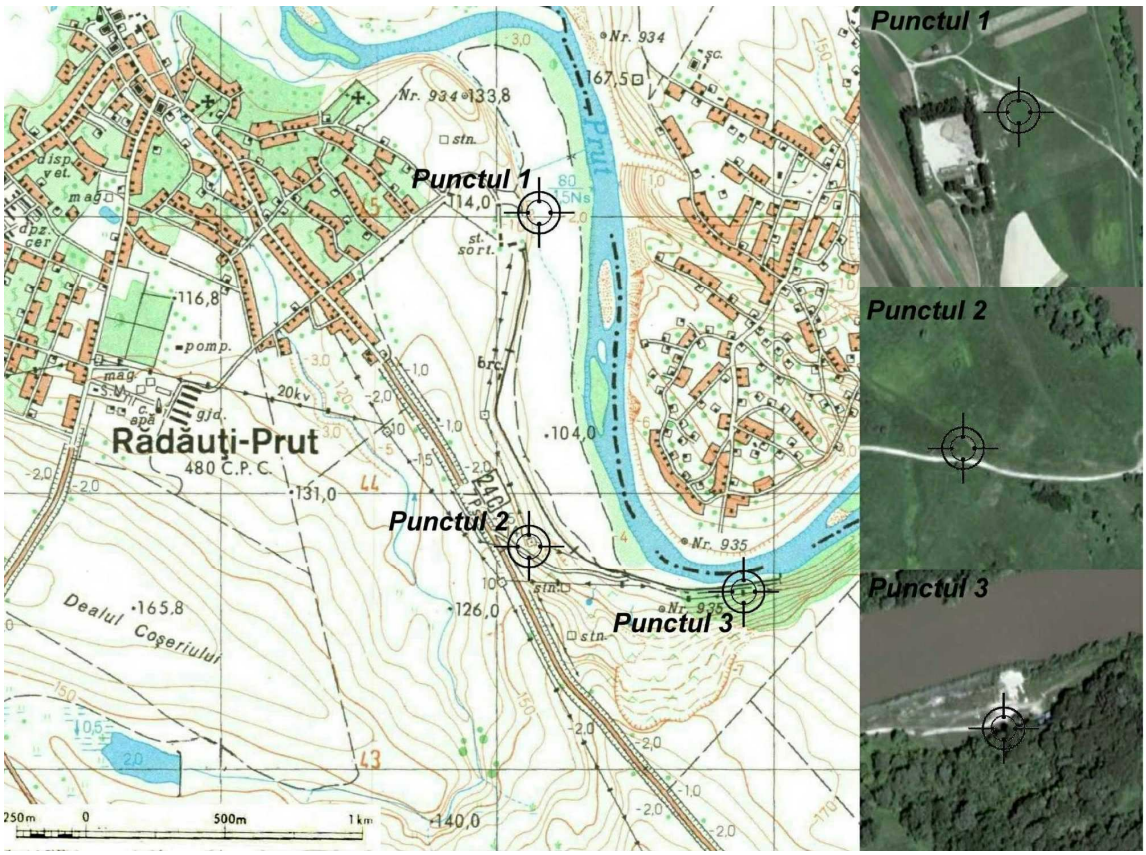

Fig. 9 - Extract from terrain map (scale of 1: 25,000) and satellite images for Rădăuți-Prut and Miorcani area – Quarry and sand mine (7.1.).

quarry mine (Fig. 9).

Point 1 (48.2375^{0}N, 26.8239^{0}E). The research in the field began east of the locality Rădăuți-Prut, in the perimeter of the former mining platform Miorcani (Fig.9, 11). Around 50-100 m east of it, due to anthropic works, the alluvium of Prut is open, and one can note pebble, generally small, of Carpathian rocks and of flint, of various shapes, dimensions and colors (Fig.10).

Point 2 (48.2263^{0}N, 26.8282^{0}E). Southwards, towards the locality Miorcani, the slope nearing Prut Valley is almost totally overgrown with grass, and one cannot even notice the area of the former sand mine, affected by landslide. We were able to identify easily the entrance in a former drift bank (48.2263^{0}N, 26.8282^{0}E), today under conservation, whose access has been blocked (Fig.9, 11).

Point 3 (48.2257^{0}N, 26.8357^{0}E). Around 600 m east of it, one can find another drift and several former buildings of the mining exploitation, seriously degraded (Fig.9, 11-12). In front of them, up to the riverside of Prut, one can observe flint nodules, of various shapes and dimensions, remained after the extraction of the underground sand, and attributed to the infra-anhydrous Badenian formation (Fig.12-13). Flint pebbles are generally rounded, their colors varying from black grey (Fig.45), to various other colors, sometimes with zonal or concentric color variations etc. (Fig.12, compare to Fig.6/1).

Note: downstream from this area and up to north of Cotu Miculinți Village, the right slope of Prut Valley was overgrown with grass or here and there wooded, with serious landslides, which has not allowed the realization of geological observations. In this area one can also find the outcrop found by Gr. Ștefănescu in 1885, presented previously, or that described by I. Simonescu in the work of the year 1902.

Fig. 10 - *Rădăuți-Prut and Miorcani – Quarry and sand mine - Point 1* (7.1.). Geological profile and details.

Fig. 11 - *Rădăuți-Prut and Miorcani – Quarry and sand mine* (7.1.) - *Point 2* - up and middle. *Point 3* - down.

Fig. 12 - *Rădăuți-Prut and Miorcani – Quarry and sand mine - Point 3* (7.1.). Details.

Fig. 13 - *Rădăuţi-Prut and Miorcani – Quarry and sand mine - Point 3* (7.1.). Details.

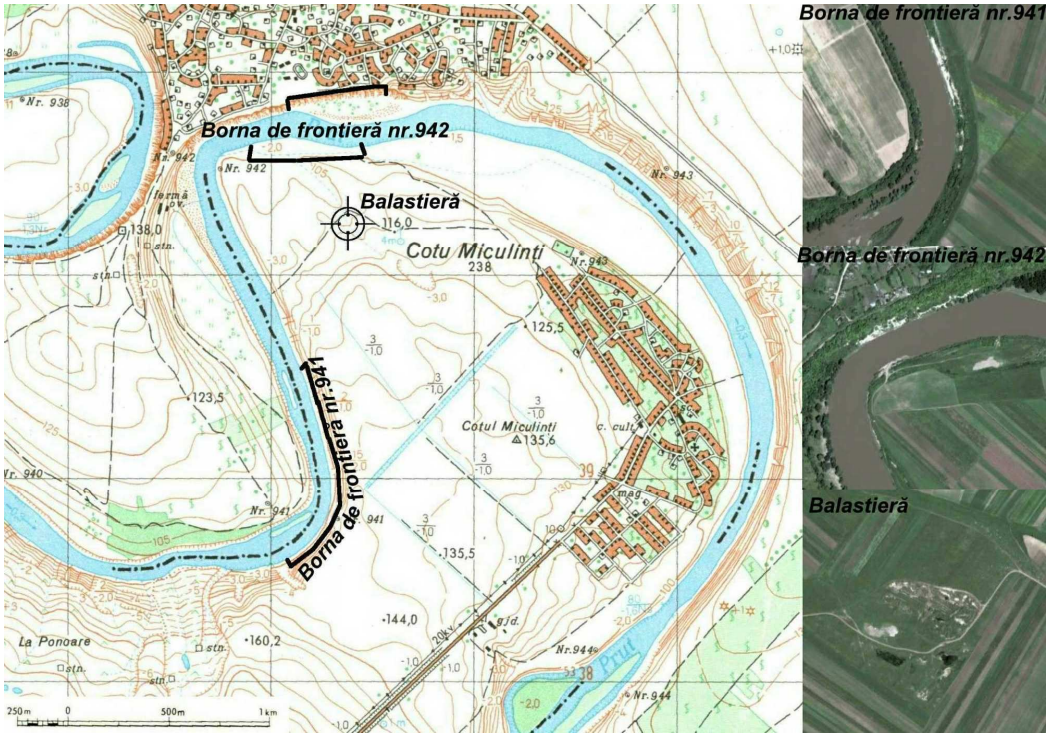

Fig. 14 - Extract from terrain map (scale of 1: 25,000) and satellite images for *Cotu Miculinţi – Border stone no.941* (7.2.), *Border stone no.942* (7.3.) and *Gravel Pit* (7.4.)

7.2. *Cotu Miculinţi - Border stone no. 941* (Fig.14)

West of this locality, upstream and downstream from border stone no. 941 (48.1821^{0}N, 26.9222^{0}E), situated over 60m above the level of Prut along 1000m (Fig.14), the geological deposits were opened by erosion. The depositional sequence starts with chalky marl with Cretaceous flint, on which there is Badenian flint conglomerate, on top of which there are *lithothamnium* limestones, the abruption reaching heights of 30-40m (Fig.15).

Fig. 15 - *Cotu Miculinţi – Border marker stone no. 941* (7.2.). Images with geological outcrop.

The flints from the limestone marl are black-grey, dark grey, irregular, with a whitish cortex, sometimes also yellowish, at the contact with the rock, of various dimensions (Fig.16-17). The depositional sequence includes not just one flint layer, but also an amorphous chalk mass, almost not differentiated as layers, where siliceous accidents appear under the form of flint (Fig.16-17).

Fig. 16 - *Cotu Miculinţi - Border marker stone no.941* (7.2.). Details with Cretaceous layer.

In point of color, this type of flint is similar, actually identical, to the dominant type of flint described previously, extracted from sands of the infra-anhydrous Badenian formation from the former mine of Miorcani, mentioned previously at **7.1.** *Rădăuţi-Prut and Miorcani - Sand quarry and mine* - Point 3 (Fig.12).

The Badenian conglomerate flints, opened 7-10 m above the water, were impossible to analyze *in situ* (Fig.18). In fact, we did not even aim to do this, because at the bottom of the outcrop, the erosion led to the appearance of debris-slide fallen off this level. The flint pebbles, relatively large, caught in limestone cement, have variable dimensions and obvious rolling traces. Macroscopically, this flint has great variations in color from grayish-white to brown-yellow, often in fracture being translucent; however, there are absolutely no black-grayish or light gray varieties like those of the lower, Cenomanian level, described previously (Fig.18).

Fig. 17 - *Cotu Miculinţi - Border marker stone no.941* (7.2.). Details with Cretaceous layer.

Fig. 18 - *Cotu Miculinţi - Border marker stone no.941* (7.2.). Images of the Badenian conglomerates.

Note: downstream from this zone and up to pt.**7.5.** *Crasnaluca - Stanişte* the right slope of Prut Valley was overgrown with grass or wooded, here and there, a fact that did not allow the realization of geological observations. In this area one can find the outcrop described by I. Simonescu in the work of the year 1902 under the name of Picket 51 bis.

7.3. *Cotu Miculinţi - Border stone no. 942* (Fig.14)

From the area of the border stone no. 942 (48.1978^0N, 26.9141^0E), yet on the left side of Prut (on the territory of the Republic of Moldova), along a 400 m distance one can notice a geological outcrop (Fig.19), similar to the one above - *Cotu Miculinţi - Border stone no.941*.

On the right side of Prut one can notice recent alluvium, including numerous flint pebbles, of various dimensions and shapes, of various colors, from grayish-white, to brown-yellowish, light grey, black-grayish etc. (Fig.20).

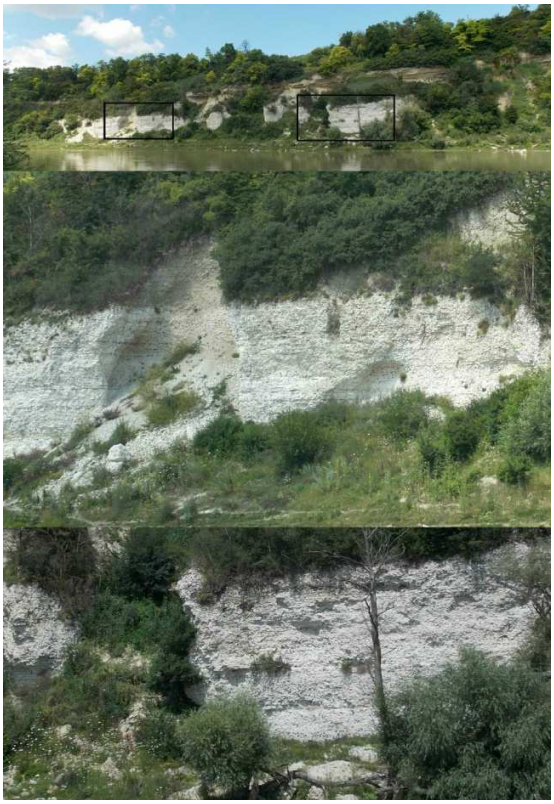

Fig. 19 - *Cotu Miculinţi - Border marker stone no.942* (7.3.) Details wit Cretaceous layer.

At the same time, eastwards from this area, up to Cotu Miculinţi Village two fluvial terrace levels are well delineated (Fig.20).

7.4. *Cotu Miculinţi - Balastieră* (Fig.14)

Also west of this locality, but around 400m from the northern end of the village (48.1925^{0}N, 26.9288^{0}E), there is a gravel and sand exploitation, situated around 25m over the level of Prut River.

Among the rock pebbles, mostly small and of Carpathian origin, flint pebbles have also been noticed (Fig.21).

7.5. *Crasnaluca - Stanişte* (Fig.22)

About 1.5 km south of Crasnaleuca Village and around 1km NW of the border stone 949, on the right side of the rivulet joining the Prut, about 100 m west of the junction point (48.1369^{0}N, 26.9520^{0}E), there are the archaeological sections realized during the period 1994 by V. Chirica and P.Haesarts (Fig.21). We shall mention that previous sections realized by M. Brudiu in the years 1974 and 1977 were impossible to identify out in the field.

Note. Between this point (**7.5.**) south of Crasnaleuca Village and up to the point that shall be mentioned next (**7.6.**), situated north of Mitoc Village, near the border stone no. 952, the high level of the water during the land research and the fact that the right bank of Prut was wooded and overgrown with grass, did not allow the identification of outcrops. **7.6.** *Mitoc - Border stone no. 952* (Fig.23)

North of Mitoc Village, from around 300 m upstream from border stone no. 952 up to around 900m downstream from it, the right bank of Prut is very abrupt, triggering sectioning and cropping of the geological layers (Fig.23-24). The stratigraphic series is as follows:

- at the upper part, loess deposits with numerous alluvium levels, of various thickness, varying from 5-10cm to over 50cm;
- under these loess deposits a level of *Lithothamnium* limestone and Badenian flint conglomerate was described, the latter being largely covered by recent alluvium brought by the Prut and deposited on the bank.
- at the basis of the profile, there is a chalky limestones/marls Cretaceous level with flint, almost completely covered by the scree from the basis of the slope and by recent alluvium, yet observable only in the southern area.

Fig. 20 - *Cotu Miculinţi - Border marker stone no.942* (7.3.). Two levels of terraces (up) and flint cobbles in beach alluvial area of the river.

Fig. 21 - *Cotu Miculinţi – Gravel Pit* (7.4.). Geological profile and details with flint pebbles.

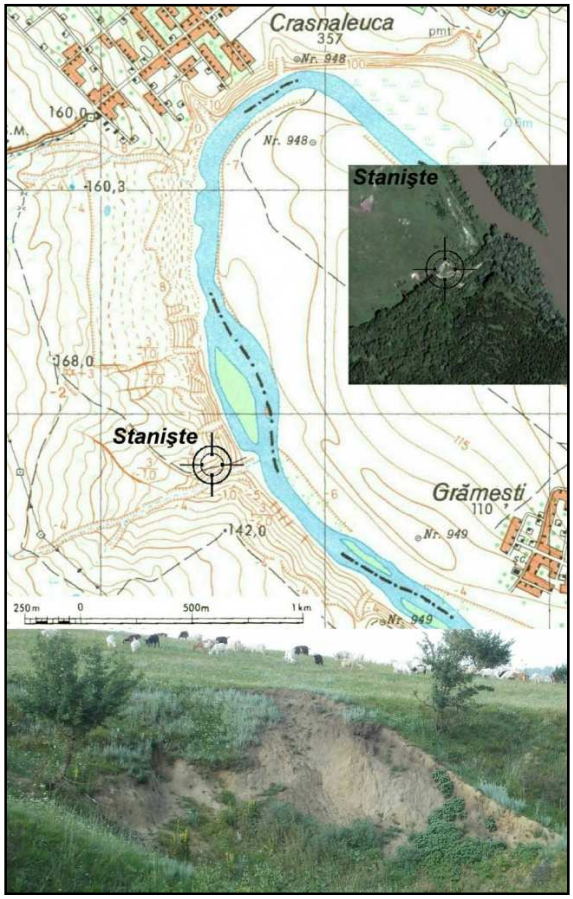

Fig. 22 - Extract from terrain map (scale of 1: 25,000) and satellite images for *Crasnaleuca - Stanişte* (7.5.), image with archaeological section.

In this area, several points were researched, from north to south, namely:

Point 1 (48.1248^{0}N, 27.0223^{0}E) (Fig.23-24). In this place one can note in the loess deposits numerous alluvium levels, from 5-10cm to over 50cm thick. In this point, between around 4.5 m and 7.5 m from the upper side of the slope, one can observe in profile most alluvium levels (sometimes even 7-8 such levels) (Fig.25). At about 10m from the northern end of the outcrop, around 1.10 m over the first layer of alluvium, black traces of coal have been noticed in profile, which apparently seemed to form a distinct level in the loess. At profile sloping, although several pieces of coal appeared in profile, their presence within a distinct stratigraphic level was no longer noticeable (Fig.25). At the basis of the slope, just a few meters downstream from this place, one could find a large flint conglomerate pebble, broken off from the Badenian layer, and recent alluvial deposits, with a lot of flint pebble, of various colors and shapes (Fig.25).

Point 2 (48.1232^{0}N, 27.0261^{0}E) (Fig.23-24). In this place, a sloping profile was realized, to better observe the loess structure and the alluvium layers (Fig.26). So, in the loess, darker layers have been noticed, actually representing palaeosoil levels (Fig.26). In the alluvium level, one could note rounded pebbles, of small dimensions, of Carpathian rocks, but also pebbles, more or less rolled, of flint of varied colors (Fig.26). A few scores of meters downstream from this point, at the slope bottom, in the recent alluvium covering the bank, a mammuth tooth was identified (Fig.26).

Point 3 (48.1246^{0}N, 27.0310^{0}E) (Fig.23-24). In this point, there is a larger outcrop, where at the upper side one can observe the *Lithothamnium* limestone level, under which there appears Badenian conglomerate with flint and, in the lower area, chalky limestones/marls. Regarding the Cretaceous layer, due to the shape of the slope, both the waters of the Prut and those from precipitations, removed the limestone matrix, freeing the flint nodules, of various dimensions, from a few centimeters to several scores of centimeters (Fig.27). In this point, the flint varies widely in color, from black-grayish to dark grey - as it has been described previously at pt. **7.2.** *Cotu Miculinţi - Border stone no.941* - and much whiter varieties, milky white, translucid, similar to the Badenian conglomerate described as well at pt. **7.2.** *Cotu Miculinţi - Border stone no.941*. On some pebbles, one can observe alternations of color from black-greyish and dark grey to light colors, milky white, and translucent (Fig.46-47). Concerning the flint dimension, in general it is up to 10-15cm long, however in this point we identified as well large flint, more than 50cm long.

7.7. *Mitoc - Cotul Mic* (Fig.23)

Point 1 (48.1265^{0}N, 27.0396^{0}E). In this place, but on the left side of Prut, on the territory of the Republic of Moldova, one can observe an outcrop around 200m long (Fig.28). At the bottom, one can find the chalky marl level, yet covered by alluvium, over which there appears a conglomerate level, apparently bedding, being covered by a tough rock - *lithothamnium limestones*, forming a veritable shelf. North of this point, one can observe erosion opening up the described deposits (Fig.28).

Point 2 (48.1297^{0}N, 27.0382^{0}E). In the same area,

yet on the right side of Prut, on the Romanian territory, upstream and downstream, a large fluvial beach appears (Fig.28 up), with alluvium, with a varied petrographic structure, partially overgrown with grass, however, here and there, including flint pebbles, of various shapes, dimensions and colors.

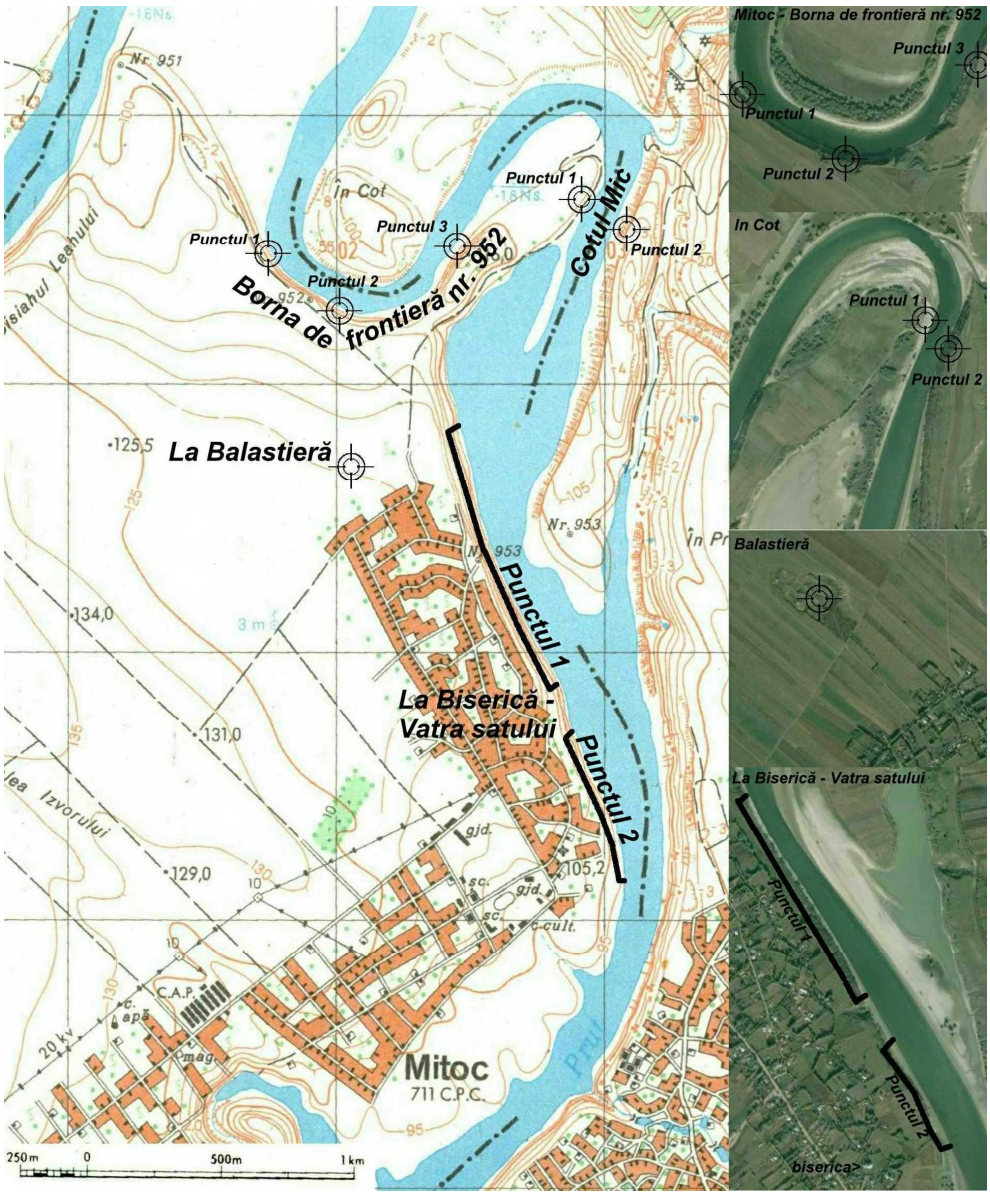

Fig. 23 - Extract from terrain map (scale of 1: 25,000) and satellite images for Mitoc area: *Mitoc - Border stone 952 (points 1-3)* (7.6.), *Cotul Mic (points 1-2)* (7.7.), *Gravel Pit* (7.9) and *At the Church – Within the Village Boundary (points 1-2)*(7.8.)

Fig. 24 - *Mitoc - Border stone 952* (7.6.). *Point 1* - up (view to north direction). *Point 2* - middle (view to south direction); *Point 3* - down (view to south direction).

In the area of Cotul Mic, I. Simionescu mentioned in 1897 "yellowish-white unstratified chalk marl", by whose destruction "rounded flints placed in parallel lines" become "free and get taken by the water", a fact narrated as well by the local people of the area, who mentioned that when the Prut is low, in its bed one can identify flint veins, which seem to have a eastern arrangement across the river.

Although we returned several times in this area, at different moments of the year, to be able to confirm the situations described above, the alluvium brought by the river and the water level did not permit these observations. The phenomenon noticed is, however, a very real one, because, as we have mentioned, in this area the outcrops are shaped by the erosion of the Cretaceous deposits (Fig.28 up), weathering the chalk marl and displacing up the small flint fragments, leaving in place the flint of larger dimensions, as we have noticed out in the field, as well, a few hundred meters upstream, in the place **7.6.** *Mitoc - Border stone no. 952 - Point 3*, where there are a lot of flint boulders, over 50cm long.

7.8. *Mitoc - La Biserică* (*At the Church*) - *Vatra satului* (*Village Precincts*) (Fig.24)

In the area of Mitoc Village, north of the village church, on the right side of Prut, which is abrupt, and on a total length of over 1.1 km, we were able to make a series of observations, namely:

Point 1 (Fig.24). Starting with the north, in the point with the coordinates (48.1097^{0}N,

27.00329^{0}E) and up to the point with the coordinates (48.1097^{0}N, 27.0372^{0}E) situated downstream, on a length of 700m, are opened by erosion the Badenian conglomerate levels with flint, overlapped by *Lithothamnium* limestone, however less easy to notice, because of scree (Fig.29), the situation being similar to that described previously at **7.7.** *Mitoc - Cotul Mic*, **Point 1**. At the basis of the stratigraphic profile, the Cretaceous level should be noticeable under the Badenian one, yet we have not been able to make observations at the basis of the slope because of the scree.

Fig. 25 - *Mitoc - Border marker stone 952 - Point 1* (7.6.). Top and middle: Details of alluvial levels - river deposits in terrace. Down: traces of coal in profile (bottom left), a boulder from Badenian conglomerate and pebble flint details.

The flints from the Badenian conglomerate are consolidated with a limestone bond, are varied in shape (slightly rounded, sometimes angular) and have various dimensions. Their color varies from whitish, grayish-white, dark grey, bluish-black and yellowish-brown (we exclude here the color varieties generated by secondary oxidations) etc., with a translucent general aspect (Fig.29). The flint cortex is generally thin, because of the erosion. In the calcareous bond of the conglomerate, no fossils have been determined, yet hard, arenaceous pebbles have been noticed.

Fig. 26 - *Mitoc - Border marker stone 952 - Point 2* (7.6.). Details with paleosols and sediments levels. Detail with mammoth tooth in situ.

Point 2 (Fig. 24, 30). Downstream of the previous Point, from which it is delimited by a small escarpment, around 300m long (between the points with the coordinates 48.1092^{0}N, 27.0374^{0}E and 48.1067^{0}N, 27.0392^{0}E), in the right bank of Prut one can observe outcrops with loess levels, over 4-5m thick (Fig.30). In these outcrops, small flint pieces have been noticed, here and there, and

levels of paleosoils, which makes us state that this area might yield results in the case of future research works, in the sense of the identification of Paleolithic settlements.

7.9. *Mitoc - La Balastieră* (Fig.24)

North of Mitoc Village, around 3-400m away from it, there is a poor-quality ballast quarry (48.1200^{0}N, 27.0288^{0}E), for the needs of the locality (Fig.31). In profile, we noticed small Carpathian hard-rock pebbles. Rarely, there appears flint pebble.

Fig. 27 - *Mitoc - Border stone 952 - Point 3* (7.6.). Details with Cretaceous layer.

7.10. *Mitoc - Pârâul Ghireni* (Fig.32)

On the left side of Ghireni rivulet (48.0960^{0}N, 27.0193^{0}E), around 3-400 m SSW of the archeological site Mitoc-Malu Galben, there is a small outcrop, 10-20 m long, where one can notice Badenian conglomerate with flint.

The flint of the conglomerates is connected with a limestone bond, varies in shape (sometimes slightly rounded, sometimes angular) and dimensions (Fig.33). Its color ranges from white, grayish-white, dark grey, to yellowish-brown etc., generally with a translucid aspect (Fig.48). Because of the erosion, the pebble flint preserved only small areas of calcareous mass, being generally thin (Fig.33, 48).

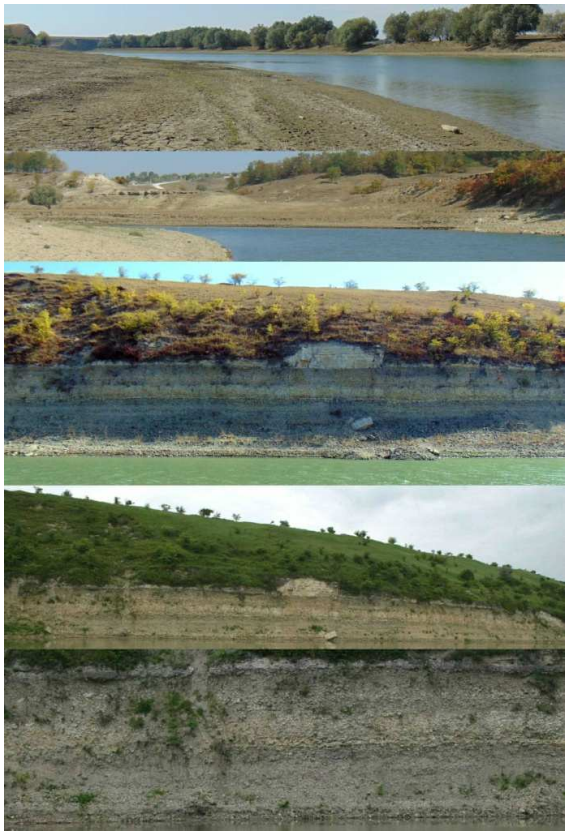

Fig. 28 - *Mitoc - Cotul Mic - Point 1* (7.7.). Details with Cretaceous and Badenian layers.

7.11. *Mitoc - Border stone no. 954* (Fig.34)

The outcrop is around 1km south of the archeological site Mitoc-Malu Galben, almost under the border stone no.954, where the erosion opened on the slope bottom the geological layers, starting from the Point with the coordinates(48.0890^{0}N, 27.0248^{0}E) up to the Point with the coordinates (48.0850^{0}N, 27.0348^{0}E), on a total length of 6-700m (Fig.35).

In the basis one can observe the Badenian conglomerate with flint, with flint pebble of various dimensions, shapes and culors, identical to that mentioned previously at **7.2.** *Cotu Miculinţi - Border stone no.941*; **7.6.** *Mitoc - Border stone no. 952*, **7.8.** *Mitoc - La Biserică - Vatra satului* (pt.1); **7.10.** *Mitoc - Pârâul Ghireni*. In this conglomerate

are caught as well lots of pebble coming from tougher, arenaceous rocks (Fig.36).

Fig. 29 - *Mitoc – At the Church – Within the Village Boundary - Point 1* (7.8.). Details with Badenian conglomerate.

At the upper side of the conglomerate there is a limestone layer where fossils of pectinids (*Chlamys sp.*) have been identified, caught in the calcareous mass, and also *lithothamnium* guide formations. This level, given its greater toughness, through erosion, has acquired in the natural outcrops on both sides of the Prut the shape of a shelf (Fig.35), constituting a landmark for the whole area in between Rădăuţi-Prut and Mitoc.

7.12. *Mitoc – Confluence between Pârâul lui Istrati* and *Prut River* (Fig. 34)

Upstream from the confluence between Pârâul lui Istrati and Prut, on the right side of Prut (48.0845^{0}N, 27.0327^{0}E), on a length of around 100m, one can observe loessoid deposits, with vertical outcrops, more than 5m high (Fig.37). The same type of deposits can be noticed downstream from the above-mentioned confluence (Fig.37).

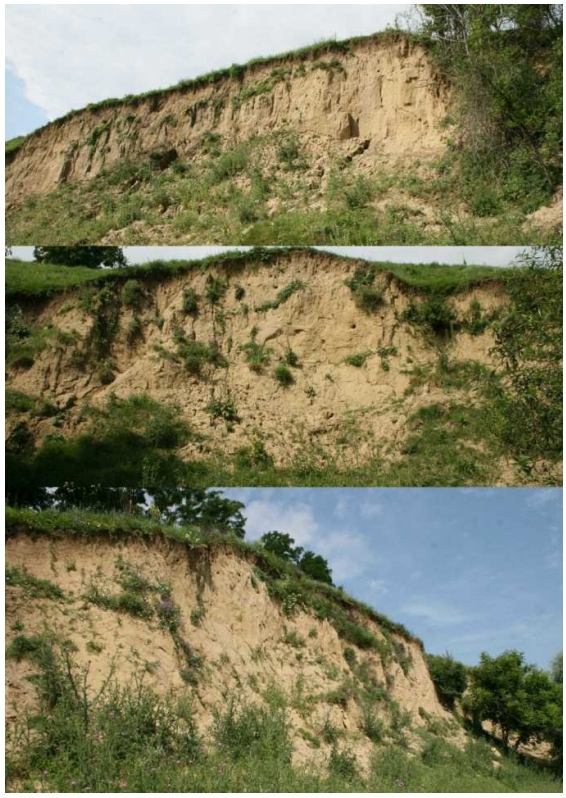

Fig. 30 - *Mitoc – At the Church – Within the Village Boundary - Point 2* (7.8.). Outcrops of loess.

7.13. *Mitoc – Ballast quarry on the Valea Pârâului lui Istrati* (Fig. 34)

About 500m west of the confluence between Pârâul lui Istrati and Prut, in the riverbend, on its right side, one can note a former local ballast quarry - today become a dump for the local population -, also partially overgrown with grass (Fig.38). For this reason, the alluvium deposits exploited once are no longer visible.

Note: On the right side of Pârâul lui Istrati one can identify in the land, but also on the ortophoto maps and aerial photographs of the area, the old archeological sections made by V. Chirica - *Valea lui Istrati*, situated around 150 m off the right bank of the Prut (Fig.34, 38) (coordinates of the excavation center: 48.0840^{0}N, 27.0307^{0}E= 651408E, 733645N Stero-70). Around 200m west of this point, on the same side of the valley, one can observe another outcrop, in whose profile there appear, here and there, flint fragments (Fig.38).

Fig. 31 - *Mitoc – At the Gravel pit* (7.9.). Details.

Fig. 32 - Extract from terrain map (scale of 1: 25,000) and satellite images for *Mitoc –Ghireni Brook* (7.10.). Note: In image we can notice

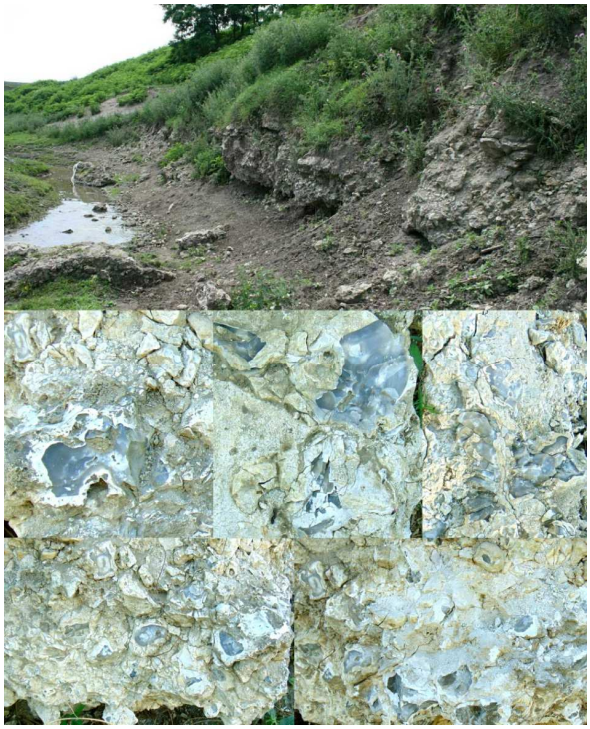

Fig. 33 - *Mitoc –Ghireni Brook* (7.10.). Details with Badenian conglomerate.

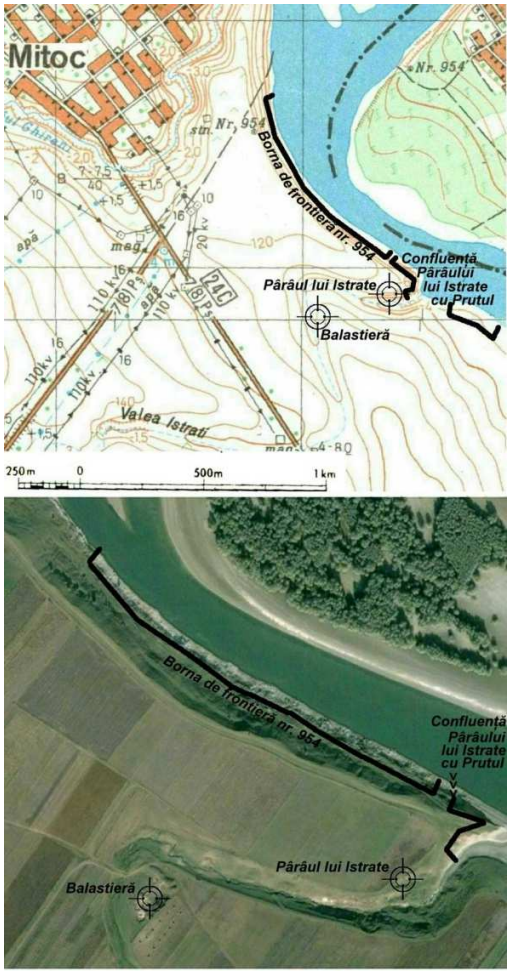

Fig. 34 - Extract from terrain map (scale of 1: 25,000) and satellite images for *Mitoc –Border stone 954* (7.11.), *Confluence of Pârâul lui Istrati with the Prut* (7.12.), *The Gravel Pit on Valea Pârâului lui Istrati* (7.13.), and archaeological site *Pârâul lui Istrati*.

Fig. 35 - *Mitoc –Border marker stone 954* (7.11.) Details with Badenian conglomerate

Fig. 36 - *Mitoc –Border stone 954* (7.11.) Details with Badenian conglomerate.

Fig. 37 - *Mitoc – Confluence of Pârâul lui Istrati with the Prut* (7.12.)

Fig. 38 - *Mitoc – Valea Pârâului lui Istrati*. Up - archaeological layer in *Valea lui Istrati*. Middle - outcrops with small fragments of flint. Down – *The Gravel pit on Valea Pârâului lui Istrati* (7.13.).

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Considerations on the Prut Valley flint occurence

Throughout history, as previously mentioned, the notion of deposit underwent major transformations. Thus, certain outcrops, which were vital sources of raw material for prehistoric communities, no longer pose a significant importance to modern geology, in which talks focus on large reserves and economic efficiency. Because of this, at best, these outcrops were either merely signaled either only briefly analyzed.

In this context, we have previously dedicated ampler space in geological literature to the matter of flint occurrence in the north-eastern region of Moldova and in the Nistru-Prut interfluve area in order to underline, as shown below, the fact that, even if proper attention was paid to the geological description of the region, to establishing the stratigraphy and its evolution stages, the conveyed specialty geological information could not provide a complete base in order to define those aspects which are important to archaeological research, especially where flint is concerned, a raw material of special importance to the prehistorical age.

For the north-eastern area of Moldova, as for flint, the information from geological literature can be grouped as follows:

- ***Informations and observations on flint occurence***:

1. The layers in which flint deposits have initially formed are those dating from the Cretaceous-Cenomanian age;

2. As result of the badenian marine transgression, the initial flint deposits were weathered and redeposed in new layers and, within

this chronostratigraphic unit, flint appears in three distinct formations:

- flint from sand and sand with flint nodules;
- in conglomerates with flint;
- at the bottom of *lithothamnium* limestones or in this limestone formation (rarely);

3. The Pliocene-Quaternary alluvium from the bottom of teraces contain flint pebble resulted from the erosion of Cretaceous and Badenian deposits.

4. Recent alluvium on fluviatile beaches or from the lower floodable part of the slope valley, contain flint pebble resulted from the erosion of the Cretaceous, Badenian and Pleistocene-Quaternary deposits, located upstream in the Prut's river hydrographic basin.

Fig. 39 - Spiennes, Belgium - A Neolithic mine with a geological level with silex.

- ***Information about the characteristics of flint*** (microscopic and macroscopic). Geological literature has very few information about this aspect. A couple of brief information pieces on the mineral composition of flint and the identification of some fossils. There are not data and informations regarding the color and color varieties of flint.

- ***Informations about the genesis of flint deposits*** which includes some details regarding the general conditions and aspects related to the forming of the initial cretaceous outcrops, and regarding the restoring of sedimentary conditions to explain the lithofacies variations of Badenian formations.

During the field research performed on the Prut river Valley, between Rădăuţi-Prut and Mitoc, our attention was drawn by the high flint morphological variations, both in the Cretaceous and especially in the Badenian deposits, an aspect which was never mentioned in the geological literature we have read. The morphological differences are obvious and macroscopically easy to observe. Thus:

- in the Badenian sands with flint nodules which appear in the sector between Rădăuţi-Prut and Miorcani we encounter flint of a relatively uniform morphological structure and colour, generally grey-black to light grey, as well as some variations, similar to the one in the cretaceous deposits opened by erosion in the Prut river's bank, at the sector between Rădăuţi-Prut and Mitoc, such as the one we identified and described at **7.2.** *Cotu Miculinţi – Border stone no.941* şi la **7.6.** *Mitoc - Border stone no. 952* , *Punctul 3.*

- in conglomerates with flint, this has a different morphological aspect, being characterized by a wide range of colours (variations from white to grey), with translucent varieties, sometimes opaque, such as the one we identified and described at **7.2.** *Cotu Miculinţi – Border stone no. 941*; **7.6.** *Mitoc - Border stone no. 952*, **7.8.** *Mitoc - La Biserică - Vatra satului* (pct.1); **7.10.** *Mitoc - Pârâul Ghireni*, **7.11.** *Mitoc - Border stone no. 954.*

The explanation behind the existence of these different morphological aspects of flint, as it also results from the previous presentation of the published geological studies, is related to the initial existing environment and to its variations, which are: pH, temperature, pressure etc.

Paradoxically, yet, the hypothesis according to which flint from Badenian layers, especially from sand and conglomerates, comes from

cretaceous deposits erosion is supported by logical and rational arguments, related to physical traits of flint, which is sometimes slightly rounded and of large sizes, which shows that it came from the proximity of the sediment.

Fig. 40 - Naslavcea area with flint occurrences. Up: the geological level with cretaceous limestone.

But this logical and rational argument can support neither the initial stratigraphy, nor the age of deposits in which the flint was found, therefore its geological age. On the contrary it raises this question, of the initial stratigraphy of deposits from which the flint deposition of Badenian layers comes, because, as shown in the previous presentation, the geological literature has no studies that analyze, date and indicate, at least with paleontological arguments, the age of the geological deposits from which this type of flint comes.

The morphology of flint from badenian conglomerate, sometimes of large size and slightly rounded (see the previous description at **7.2.** *Cotu Miculinţi – Border stone no.941*, **7.6.** *Mitoc - Border stone no. 952*, **7.8.** *Mitoc - La Biserică - Vatra satului*, **7.10**. *Mitoc - Pârâul Ghireni*, **7.11.** *Mitoc - Border stone no. 954*), as opposed to the shape and much smaller size of flint nodules from Badenian sands (as underlined at **7.1** *Rădăuţi-Prut şi Miorcani*), which show intensive rolling, including of the sand derived from the initial flint decay, suggest a different geological reality.

Fig. 41 - Naslavcea area with flint occurrences.

Can it be that in the initial geological deposits there were several flint layers, maybe also of different geological ages, with different features (colour, translucence, opaqueness etc.) generated by variations in the deposit environment? And that these deposits are completely different from what it is known today in the Cenomanian layer, such as the one described at **7.2.** *Cotu Miculinţi - Border stone no. 941*?

But, at the same time, we cannot exclude the existence of a flint layer, the one we see today in outcrops and is attributed to Cenomanian, but which has large morphological variations,

generated by diverse conditions in the initial formation environment. And arguments supporting this hypothesis would be those described at **7.6.** *Mitoc – Border stone no. 952- Point 3*, as well as the situation encountered in the area of Naslavcea village (Fig.40-41).

But regardless of which scenario was the real one, or maybe the actual facts were much more complex, by combining the scenarios previously stated, by taking into account the size of the studied area, we can clearly see the need for detailed geological research.

In addition to this initial geological situation, events that took place in Badenian, by erosion and depostion of cretaceous deposits, occurred a splintering and mixture of flint morphological varieties, on smaller or larger areas. And the Pleistocene-Quaternary and recent erosion have only to accentuate mixture of flint morfological varieties in the region.

We must specify that the flint pebble of Prut river recent alluvium not only come from wheathered deposits, where are the geological outcrops investigated by us, but are brought from all its drainage area, that extends far upstream, north and east in Ukraine. And the direct effect of these natural factors is that in the Holocene alluvium of Prut River there are many morphological varieties of flint, different in terms of physical and mechanical properties and color.

In fact, these extremely important issues for archaeological research are not mentioned in geological literature about the flint in our area of interest- north-eastern Romania, Prut Valley.

The geology of the area, previously presented and detailed, along with the geological situation of the Ukrainian Prut river basin, comes only to emphasize that the assumptions and theories circulated in archaeological literature on the Prut valley flint occurrence remain mostly without a real scientific support.

Fig. 42 - Flint from neolithic mine of Spiennes-Belgia.

Fig. 43 - Flint from Naslavcea area – Râpa lui Carpov

To this, we add the fact that in order to produce the necessary tools, prehistoric communities were selected from raw material only those rocks that had certain characteristics and physico-mechanical properties that allow the process to obtain adequate tools for use.

These are in fact the reasons why we have not proposed in this study the presentation of Prut Valley flint occurrence in the archaeological literature, even in a short or long *literature review*, although there are some good scientific studies , addressing in a corect manner the flint sources (M. Cârciumaru *et al.*, 2007).

Regarding the existence of flint morphological varieties on Prut valley, we have presented some data in a previous paper, but without detailing the causes that led to this (M. C. Văleanu, 2003). Now, the research that we carried out led to a description and clarification of the geological context of which the flint is found, especially in outcrops on the right side of the Prut valley, between Rădăuţi-Prut and Mitoc.

Another important aspect described in detail, and it must be stressed, is that on Prut Valley we are dealing with flint occurrences both in primary (cenomanian (cretaceous) layer) and secondary geological deposits (badenian, pleistocen-cuaternr and recent layers). In the latter geological formations, the flint varies greatly in term of color and other features, aspects that were easily observed by macroscopic observations. But these observations should be supplemented by detailed analysis to define and quantify the physical and mechanical characteristics and properties of flint varieties that appear in this area.

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Therefore at the end, it useful to make some summary regarding the flint occurrence on Prut valley, as follows:

1. The cretaceous (cenomanian) layers represent the primary geological deposits in which the flint was formed, and in geological literature structure and stratigraphy of these deposits are not fully clarified. As I observed on the field and I described at **7.2.** *Cotu Miculinţi – Bordes stone no. 941*, siliceous accidents occur in the amorphous chalk mass (almost undifferentiated stratigraphic), which generally have a dark color, but which varies from gray - black to a pale gray, similar to the samples illustrated in Fig.49. Also in this level, at **7.6.** *Mitoc - Bordes stone no. 952- Point 3*, the flint presents a wide variation of colors , from gray - black and dark gray, to the much lighter variety, milky white, translucent, sometimes opaque, and on some pebbles it can be observed alterations in color between gray and black and dark gray and light colors milky white, etc. (Fig.46-47).

2. Following marine transgression, the cretaceous primary accretions were eroded and redeposited in badenian layers, and here flint occurs in three separate formations:

2.1. Sand from flint and sand with flint nodules, observed on the field and described at **7.1.** *Rădăuţi-Prut şi Miorcani – Quarry and sand mine - Point 3*, where mostly occurs a flint similar to the one described in cretaceous layers at point **7.2.** *Cotu Miculinţi - Bordes stone no. 941*. The flint nodules shape denotes an intense rolling, phenomenon that transformed into sand the entire mass of siliceous accident, remaining the hard area, rich in silica. In fracture, the flint nodules have, most often, a color ranging from gray - black and light gray, and other varieties of color, sometimes with various colored concentric areas, etc. (Fig.45).

2.2. In the form of conglomerates, observed on the field and described at **7.2.** *Cotu Miculinţi - Bordes stone no. 941*; **7.6.** *Mitoc - Bordes stone no. 952*, **7.8.** *Mitoc - La Biserică - Vatra satului* (pct.1); **7.10.** *Mitoc - Pârâul Ghireni*, **7.11.** *Mitoc - Bordes stone no. 954*, which are characterized by a wide variety in terms of color (from gray to white), but sometimes translucent and opaque varieties (Fig.48).

2.3. Geological literature mentions the presence of flint at the bottom of *lithothamnium* limestones or, in rare cases, in this limestone formation (however, this situation has not been seen in field research of the area).

3. Pleistocene-Quaternary alluvium of the terrace bottom contain flint pebble due to erosion of cretaceous and badenian deposits

4. recent alluvium on the fluviatile beaches or on the lower, floodable, splopes, contain flint pebble due to erosion of cretaceous, badenian ant Pleistocene-Quaternary deposits, but they were brought from whole upstream basin. In these deposits, there are various forms of flint, both in terms of color and physical characteristics, etc.

Fig. 44 - Flint from Naslavcea area – La 3 Vaduri.

Fig. 45 - Flint from *Rădăuţi-Prut and Miorcani – Quarry and sand mine - Point 3*(7.1.).

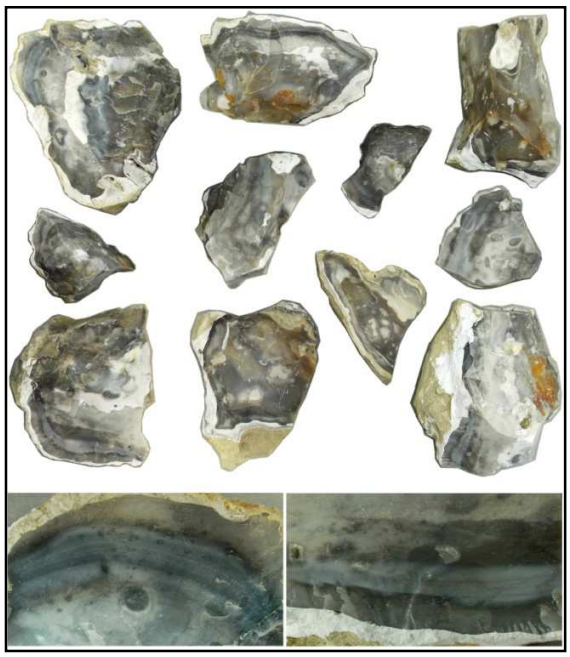

Fig. 46 - Flint from *Mitoc – Border marker stone 952 - Point 3* (7.6.).

Fig. 47 - Flint from *Mitoc – Border stone 952 - Point 3* (7.6.).

Fig. 48 - Flint from *Mitoc - Ghireni Brook* (7.10.).

Fig. 49 - Flint varieties of black colour from alluvial deposits from Prut Valley.

Fig. 50 - Flint varieties identified in the researched area. Up: Flint of dark colour, ranging from black grayish to light grayish, identified *in situ* in outcrops with Cretaceous levels open by the erosion in the Prut Valley at *Cotu Miculinţi-Border Stone 941*(7.2) and in the sand layer with flint nodules at *Rădăuţi-Prut and Mirocani – Quarry and sand mine - Point 3* (7.1.); Down: Flint of white colour, which ranging from white to light grey, translucent, identified *in situ* in Badenian conglomerate open by the erosion in the Prut Valley at *Cotu Miculinţi – Border Stone no.941* (7.2.), *Mitoc – Border Stone no. 952* (7.6.), *Mitoc – At the Church – Within the Village Boundary - Point 1* (7.8.); *Mitoc -Ghireni Brook* (7.10.) and *Mitoc – Border Stone no. 954* (7.11).

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We are aware that prehistoric man had much more patience than us in examining in particular the alluvium, for procuring quality raw material to produce tools, identifying here other morphological flint varieties, which archaeologists have seemed foreign, and this materials have been brought from other regions or geographical areas.

This first step had to be mandatorily continued through the inventory of other flint deposits occurrences in the region, especially in The Republic of Moldavia, but also in the territory of Ukraine, through the identification, analysis and detailed description of the geological and stratigraphical context, and of the flint morphological varieties which appear, in order to be able to have arguments and solid scientifically correct endorsements which regard the method of use and exploitation of this important resource by the prehistorical human communities which occupied this geographical spreading area.

Notes

[1] Communication presented at the *International Scientific Conference: Probleme actuale ale arheologiei, etnologiei şi studiului artelor* (Topical Issues in Archeology, Ethnology and the Study of Arts), 7th edition, Chişinău, Republic of Moldova, May 26-28, 2015, an abstract of it being published in the tome of this event ISBN 978-9975-3085-8-4, p.47. The variant in Romanian can be found in *Cercetari istorice* (Historical Researches), 2015, vol. XXXIV, p. 37-106.

[2] In some quotation are used many archaic words and expressions, some of them being untranslatable, therefore the translation was focused only on the phrase or sentence meaning. Original fragments are given in brackets.

[3] To locate these outcrops - see *infra*, the note at pt. **7.1.** *Rădăuţi-Prut and Miorcani – The Quarry and the sand mine*.

[4]An observation similar to that related to us by the local people of the area - see *infra* pct. **7.7.** *Mitoc - Cotul Mic*, pct.2.

[5] The location of the outcrop is south of Rădăuţi-Prut: see *infra* the note at pt. **7.1.** *Rădăuţi-Prut and Miorcani – The Quarry and the sand mine*.

[6] Concerning the location of these outcrops - see the previous note.

[7] Concerning the location of these outcrops - see note 5. On the outcrop of Pichetul 51 bis - see *infra* the mentions of E. Nicorici and Bica Ionesi in their 1978 study or those in the note on pt. **7.2.** *Cotu Miculinţi – Border stone no. 941*.

[8] Some of the research works in the field carried out in 2013 were attended by V. Chirica, but also by other members of the group that undertook the archeological excavations that year at the site Mitoc-Malu Galben. Due to the diverging opinions on this topic, later on the scientific collaboration was interrupted, each publishing independantly his own observations. And this manner of publishing is the most correct, in our opinion, because only in this way can one make a comparative analysis of what has been published. See V. Chirica *et al.*, 2014.

[9] We would like to thank here the leadership of the National Museum Complex of Moldova Iaşi and of the Royal Belgian Institute of Natural Sciences of Brussels for their support, and also our colleagues Dr. Ivan Jadin, Dr. Paul Haesaerts and Dr. Senica Ţurcanu.

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