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Arguments concerning the use of bitumen as adhesive for the hafting of some lithic tools from the early Bronze Age in the region of the Curvature Subcarpathians

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Abstract: **Arguments concerning the use of bitumen as adhesive for the hafting of some lithic tools from the early Bronze Age in the region of the Curvature Subcarpathians.** This study brings into question the use of bitumen for hafting lithic tools from the Romanian early Bronze Age. Bitumen samples were mechanically recovered from the surface of two retouched slabs discovered in Adânca and Gorgota. The source of raw material is local and comes in the shape of thin menilit plates belonging to menilitian and disodilic shale formations within the geological formation of the Pucioasa-Fusaru Facies, a local variety of Subcarpathian Oligocene deposits. Bitumen is present in association with salt deposits near the sites of Adânca and Gorgota.

Keywords: bitumen, plates,Early Bronze, menilit, disodil

Introduction

The lithic tools that are the subject of our study has been treated in a previous study (M. Cosac et al., 2009), but intrigued by the consistent presence of black dots, both on cortical surfaces and in areas deemed by us as covering areas of these parts (Fig. 1) on retouched slabs from Adânca and Gorgota, we have started performing a chemical analysis on them to determine the black substance origin. Initially we believed that differences in color and the presence of these black spots may be due to selective action depending on the origin and position of these parts, of chemical/mineral deposits processes, and so on, some of them being even post – depositional (Cosac et al., 2010).

1. Determination of bitumen

Analytical techniques such as the Fourier transform infrared spectroscopy (FTIR), is taken into account so as to evaluate samples taken from two lithic tools from the Bronze Age, discovered at "La Păşune" – Adânca village and at "La cazan" – Gorgota village (Răzvad town, Dâmbovița County). A crust of black organic matter, located on the surface of artifacts, was separated from the limestone surface thereof. Samples were extracted using chloroform and tetrahydrofuran or ultrasounds for 45 minutes at 45°C

1.1. Apparatus and methods

Standard IR spectra using a Fourier transform (FT-IR) were collected using a Perkin Elmer Spectrum GX, using the KBr pellet technique in the 4000-400 cm-1. In the first version, it was possible to use an accessory drift by transforming powder samples scraped from the surface of parts, thereby ensuring that the analysis be carried out with ease. Note that this method of sampling is non destructive and provides for the possibility of a future harvest and other analyses. Samples (≤ 10 mg) were extracted twice, first using 2 ml of acetone to dissolve any resinous fractions that may be present. After washing, the residue was extracted with the same volume of chloroform to dissolve

less polar substances and/or polymerized substances (e.g. wax, bitumen) (Fig. 2). After drying, the two fractions were analyzed by the KBr pellet standard with a Perkin Elmer FTIR spectrometer. Transmittance (%) was measured in the 4000-400 cm-1 with a resolution of 4 cm-1.

The presence of carboxylic acids with a three-cycle structure requires a strong shear vibration due to CH2 and CH3 groups at 2928 cm-1. O-H shear bands appear at 3431cm-H-1, are either broad or narrow due to the dimerized vibration of carboxyl group in the solid phase. Strong shear vibrations C = O in groups of carboxylic acids or acylglycerols appears at 1795m cm-1. Other bands appear at 1620 and 1399 cm-1 due to shear aromatic cycles, at 1630 cm-1the pendulum vibration appears in resin and acids and the band appearing at 1163 cm-1 is typical of alcohol and ether groups (Fig. 3, 4). All this leads to the conclusion that the analyzed black solid samples belong to bitumen.

The presence of Al or Si is indicated by the peak reaching 466 and 505 cm-1. And the peak of 792 cm-1 is attributed to the frequency of oscillation of the OH of the AH-OH group and the peak at 1035 cm-1 stems from the Si-O sheer vibration, probably coming from the surfaces where the bitumen sample was extracted (Fig. 5).

2. Description of lithic tools and contexts

The lithic tools recovered from the "La Păşune" location, the Adânca village area (Gura Ocniţei town, Dâmboviţa County), includes 11 tools of different types of flint and one piece of tuff. The piece examined (Fig. 6/1) is a thin fractured slab, (40 mm long, 29 mm wide, 7 mm thick) of gray flint with a yellowish cortex, displaying detachments of small sizes all throughout the edges, including on the opposite area to the fractured region.

Such detachments can be considered as retouches applied in order to modify the active front of a knife-like piece. It is worth mentioning that the angle in which the bifacial retouches were applied, has different amplitude from one side to the other, as well as a different angle. This allows us to assume that the area where piece displays bifacial retouches of a lesser degree was used to be fixed on a handle. An argument is that the frequency of bitumen spots is greater on the detachments surface (Fig. 7). In fact, on the opposite side, the retouches bear obvious traces of polishing.

Fig. 1- Detailed images, the tools from Adânca (a – d) and Gorgota (a – d), under the microscope

At Gorgota (Răzvad town, Dâmboviţa County), in the area of "La Cazan", two slabs with bifacial retouche were discovered in the Bronze Age cultural context at the basis of a tumulus and near a cyst in the center of the area. At this stage of research we cannot accept that they were part of the funerary inventory.

Both slabs had black spots, but only one of them allowed for samples collection (Fig. 8). The piece has a relatively rectangular shape (58 mm long, 38 mm wide, 8 mm – maximum values) of layered menilite with gray cream and black strips, bearing isolated visible fossilized spots. Both surfaces are covered with a cortical and neocortical layer of variable thickness (1.45 to 0.70 mm) arranged unevenly having a grayish-

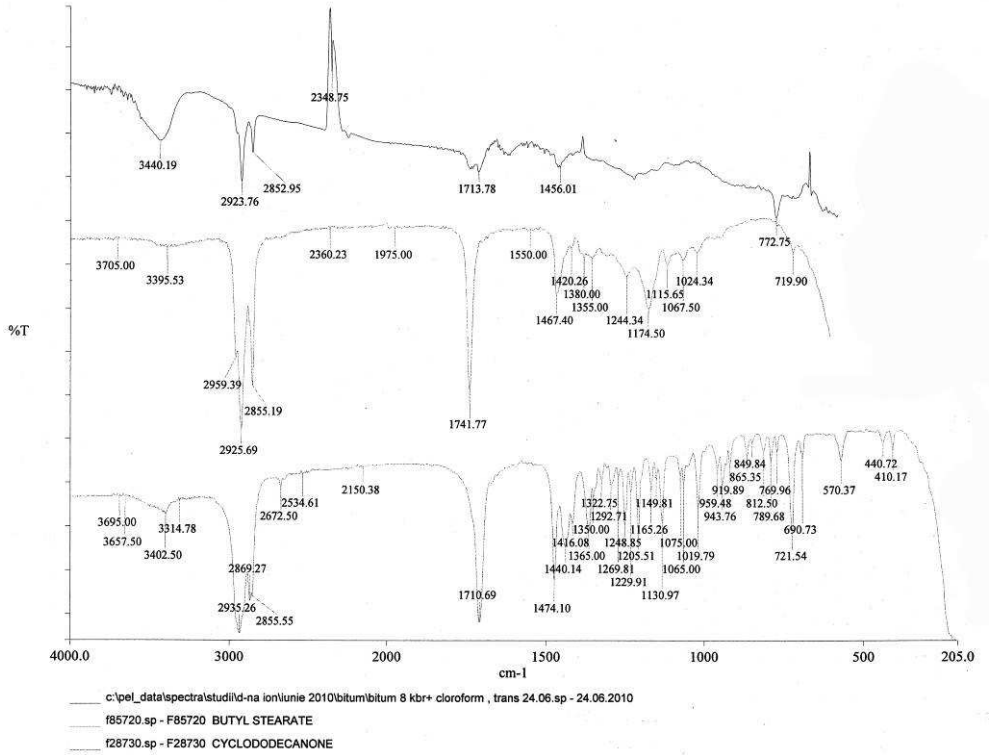

Fig. 2 - Spectrums for identification of the bitumen on the analysed pieces

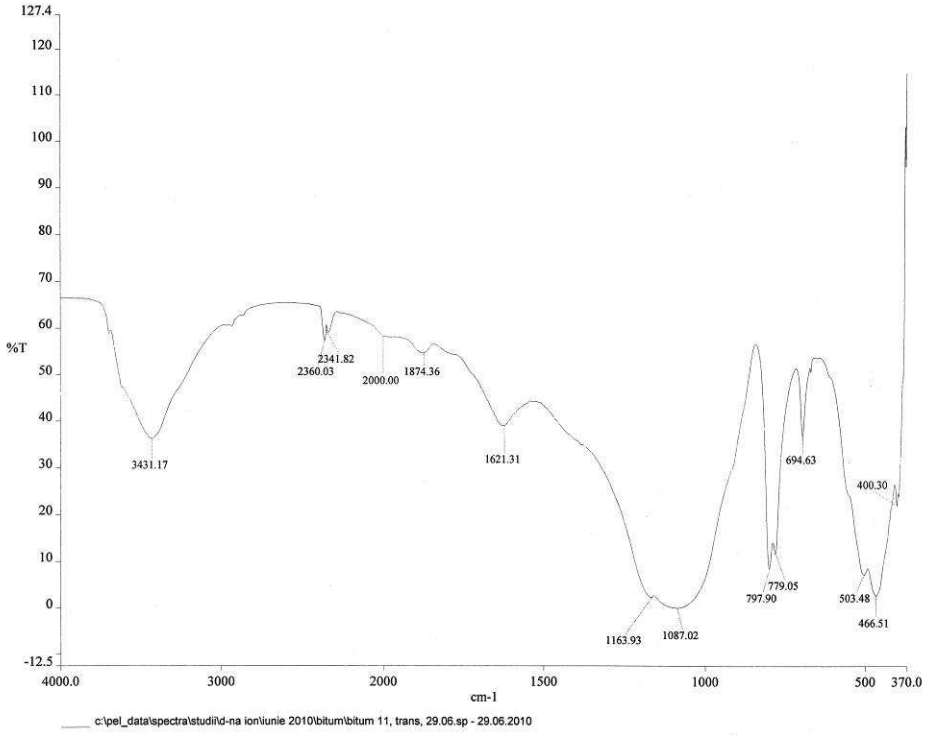

Fig. 3 - Spectrums for identification of the bitumen on the analysed pieces

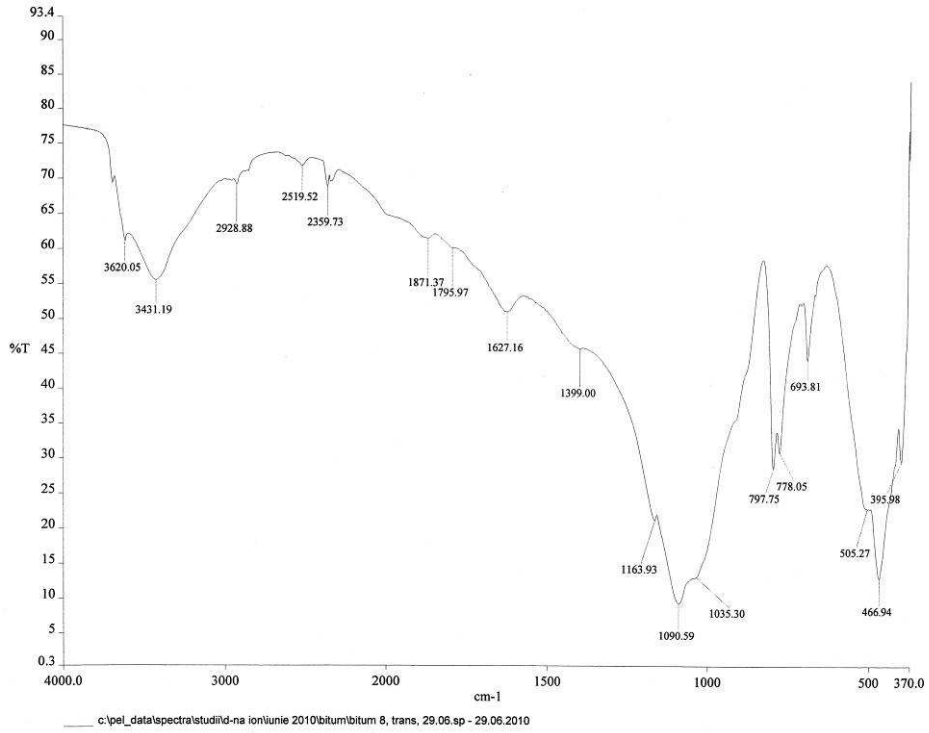

Fig. 4 - Spectrums for identification of the bitumen on the analysed pieces

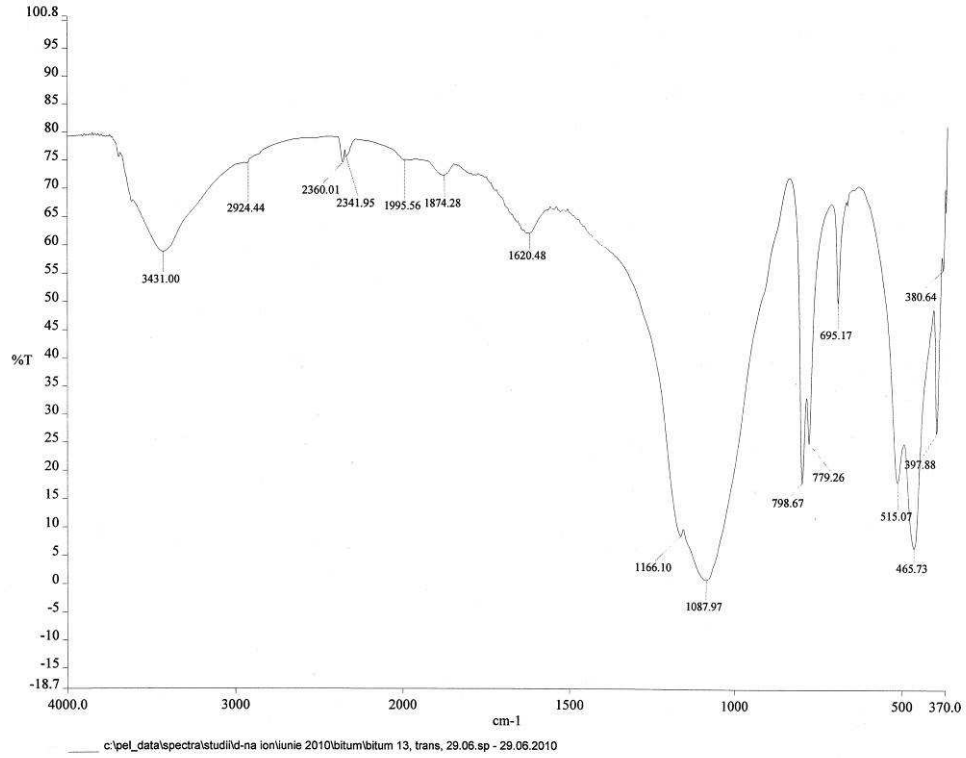

Fig. 5 - Spectrums for identification of the bitumen on the analysed pieces

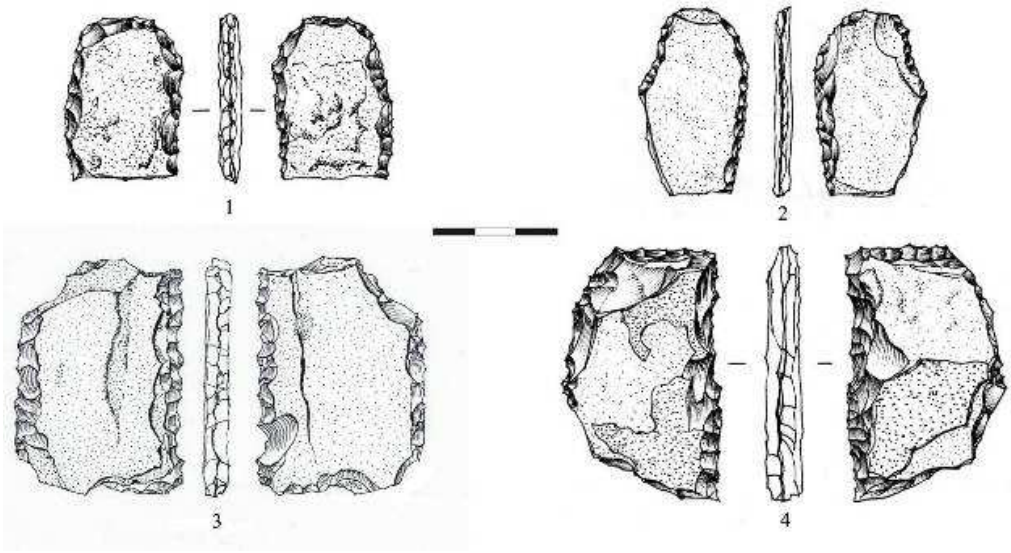

Fig. 6 - 1. Adânca; 2-4 Gorgota; 3. Băleni (drawn by F. Dumitru)

Fig. 7- Detailed images, the tools from Adânca, under the microscope

black color on one surface, and a yellowish-white color on one surface, and a yellowish-white tint, with black spots on the other surface. On two sides of the piece (a long one and a short one) there are bifacial retouches in a relatively continuous, regular pattern, affected by the accidental detachments of variable degrees.

On the other two sides of the edges, the detachments are more intense, accompanied by approximately perpendicular fractures on the blank, the surface of which bears attempts to redevelop similar retouches to those described above. From a functional perspective, one cannot say with certainty whether the almost entirely visible retouched surface plays a passive (hafting) or active role. On the one hand, due to the incomplete morphology of the two other sides and, on the other hand, to the lack of comprehensive information on how the discovery took place, defining the piece functionally and typologically remains uncertain. For both parts, the tool axis is parallel to the active area, as well as to the hafting area.

A piece similar to those described was identified in the lithic complex found in the layer corresponding to the Bronze Age in the multi-layer site at Băleni - "La Plantaţie" (Băleni town, Dâmboviţa county) (Fig. 6/3). This tool displayed black spots, but unfortunately, the author of the archaeological research has only given us the possibility of obtaining images of it and not extracting mechanical evidence for future analysis.

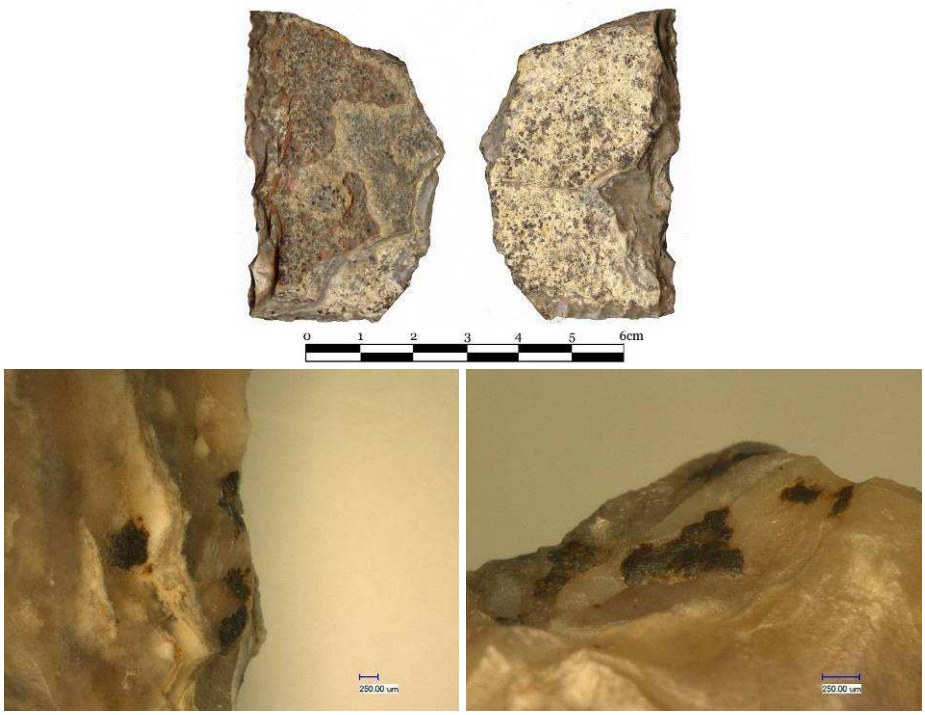

Fig. 8- Detailed images, the tool from Gorgota, under the microscope

3. Defining the blank

We are not trying to bring into question an identity in the functioning of these tools on siliceous slabs, especially since we did not have access except to the already mentioned objects. We think that we can talk about only an identity of the type of blank used and of a type of raw material. The only description of this lithic raw material comes from Alexandru Paunescu, who talks about tools made of „plates or larger plates out of glassy shiny flint and a fragile white patina... on the plates or on the flint shards (A. Păunescu, 1970, 70, 204) in the cultural environment of Glina, in the Early Bronze Age. From our point of view, we are talking about consecutive silica deposits in gray, cream and black layers having isolated fossilized spots sepparated by thinner or thicker limestone intrusions. From the observation made on the tools that are the topic of this paper we can note the fact that they were chosen to bear the plates that had consistent deposits of silica and minimal deposits of limestones between the silica layers, which did not influence the retouches and

therefore the functionality of that particular tool/ (Fig. 9). In the case of Adânca we may claim that the repositioning of the blank tool place in the area of the settlement, since we recovered numerous fragile limestone deposits flattened out, some of them interspersed with silica layers ranging in size from several mm to several cm.

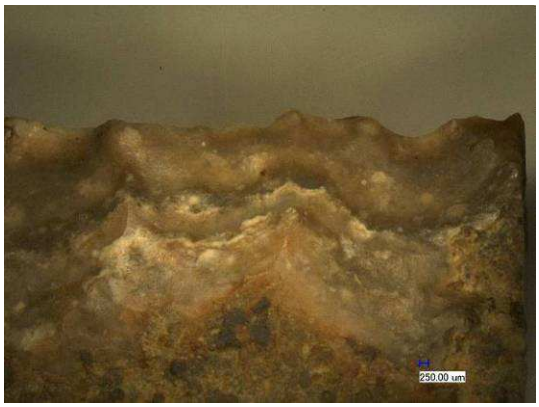

Fig. 9- Photo of the tool from Adânca under the microscope

4. THE ORIGIN OF RAW MATERIAL

The raw material that the artefacts at Adânca, Gorgota and Băleni are made up of is a combination of a series of concentrates of micro-stratified silica made up of brown, reddish-brown opal, pigmented by bitumen or containing liniar layers of bitumen known as *menilites* (N. Atanasiu, 1981). In the opal mass there are also calcite inclusions, quartz and clay minerals granulas, glauconite and sometimes pyrite.

Fragments of silica organisms can also be found (sponges, radiolarians).

Dark coloured menilites, (brown to black) can be found associated with other shale rocks – disodils. These are pelite sedimentary rocks having a clayish structure, rich in organic substances; in the layers one can always find traces of fish bone structures, sufur and plaster. Disodil is seen as the „mother-rock" of oil. In Romania, we can find it in flysch assortments from the oligocene in the Oriental Carpathians (N. Athanasiu et. al., 2007).

These rocks were formed in clay and marl with significant concentrations of organic mattter. In Romania, these rocks belong mostly to the Oligocene deposits some 37-24 million years ago (Lattorfian - Chattian) at the end of the Paleogene era. From a stratigraphic point of view, these deposits belong, at least for this region, to the external flysch of the Oriental Carpathians, as it developed outside the Carpathian Arch from the border between Romania and Ukraine to the Dâmboviţa Valley (Fig. 10).

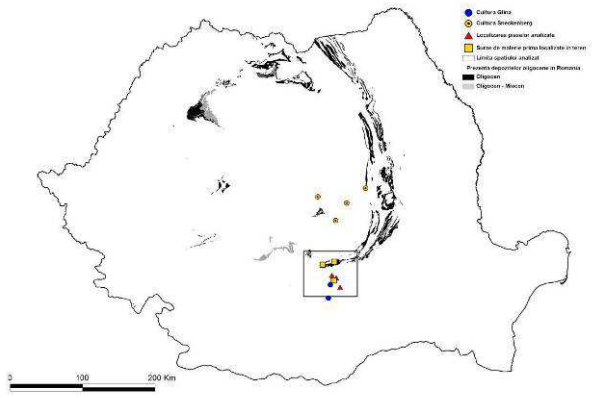

Fig. 10- Placing the analyzed area and comparing it to the Oligocenului deposits in România

In the case of external flysch, the Oligocene displays three main lithic parts: the Fusaru, the Kliwa and the Molodoviţa kinds (V. Mutihac, 1990). They show striking lithological differences from one region to another (D. Patrulius et. al., 1968), both on a large-scale of the external flysch and within each geographical unit. Thus, in the Curvature Sub-Carpathians we can distinguish between three main facies of the Oligocene (D. Patrulius et. al, 1968, p. 31):

-partly disodiliform shale and marl facies

-facies with disodilic shale, Kliwa sandstone and layers of Podu Morii

-facies with Pucioasa strata, Fusaru sandstone and olistromes.

Pucioasa - Fusaru Facies – has a typical development in the Ialomiţa basin, a thickness of 1500 - 1700 m and is actually a variety of the Krosno facies, characterized by a thick sequence of massive packets of sandstones, shale deposits with clay and marl characteristics with pelosiderite insertions (Pucioasa layers). Oligocene deposits in this facies succession entails the following terms (D. Patrulius et. al.,

1968, p. 31):

-Disodils and lower menilits (± 200 m);

-Pucioasa layers of sandstone interspersed with Fusaru sandstone (1000 - 1200 m);

-Vineţişu layers, represented by flysch with marl and sandstone characteristics with curbicortical sandstone, intercalations of bentonites and associated olistromes, containing blocks and rocks from the Senonian and Eocene (± 250 m);

- Menilits and upper disodils.

Out on the field, such raw material sources were identified up until now in three locations in the Ialomita Subcarpathians and in the Târgovişte Plain (Fig. 11).

Urseiu Point is located in the superior basin of the Cricovul Dulce River, on the trail between its tributaries called Costişata (Coclanda) and

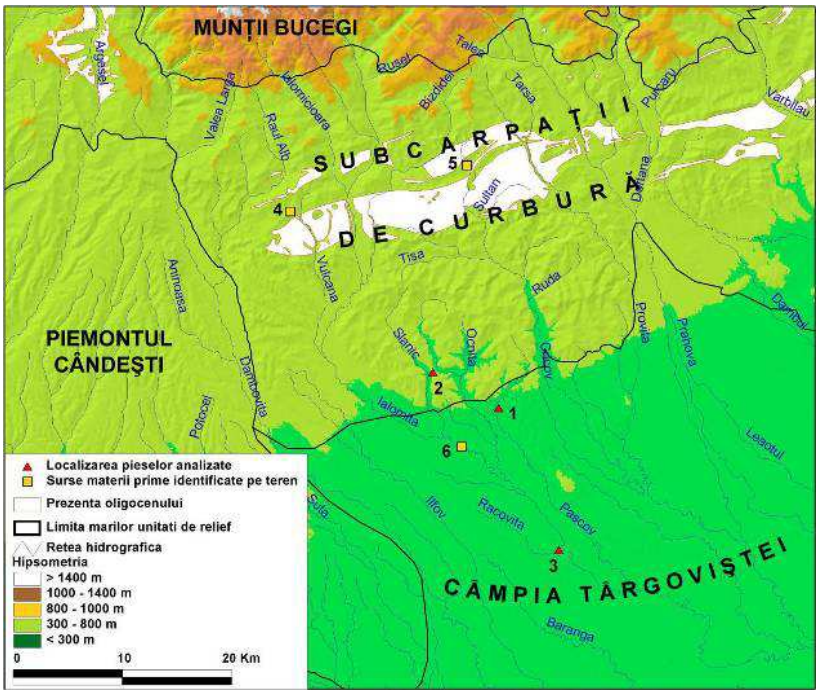

Fig. 11- The main sources of raw materials identified and the place of the analysed pieces: 1. Adânca, 2. Gorgota, 3. Băleni, 4. Vulcana de Sus, 5. Ursei, 6. Nisipuri

Urseiul, at an average altitude of 550 m, in the administrative territory of Ursei village, Vişineşti town.

The raw material in the Vulcana de Sus location was identified on the shores of Vulcăniţa river, a right-hand side tributary of the Vulcana river, located at an approximate altitude of 420 m, in the area pertaining to the Vulcana de Sus village, a subdivision of the Vulcana–Băi town. The presence of raw material in the Vulcăniţei riverbed can be explained by the fact that upriver there are oligocene deposits as mentioned above.

The third locations is situated in the Ialomita River riverbed where it flows away from the Subcarpathians, towards the Târgovişte Plain (în the are of Nisipuri village – Ulmi town) and can be also explained by the existance upriver of oligocene deposits. Also, in the case of the Adanca complex we believe that some of the raw material in use are local, coming from the riverbeds. One clue as to this aspect is the presence on certain tools of surfaces indicating a roling motion.

5. Analogies

As stated (M. Cosac et al., 2009), a common element between the lithic complex at Adânca and the archaeological materials recovered from occupational levels assigned to a cultural tradition still undefined from te Early Bronze Age from Gorgota and Băleni, is the use of disodilic slabs as a blank for knife-like tools. On the other hand, we can't overlook the fact that one of the characteristics of the Glina culture is the work with flint slabs. For example, they are present at the Odaia Turcului settlement (Dâmboviţa County), in the lower level (E. Tudor, 1983, p. 108), at Văcăreşti, at the „La Suhat" location, „five fragments of curved flint knives covered in limestone", „a curved knive and other fragments of curved knives", at the „pădurea Brăteasca" location (E. Tudor, I. Chicideanu, 1977, p. 144), they appear in combination with Glina clay (E. Tudor, 1972, p. 106).

It is interesting that such slabs were found in another cultural context. A flint slab was recovered from a house assigned to the Brăteşti "cultural issues" at the "Coasta Bisericii location " in Brăteşti (Văcăreşti, Dâmboviţa County) by Ersilia Tudor and Ion Chicideanu (1977).

According to Al. Păunescu, similar tools come from the Schneckemberg area as well, in Brasov, the eponymous site, but also from the Sprengi and Steinbruchhügel locations and from the Cuciulata - Pleşiţa Pietroasă settlement (Hoghiz town). The archaeologist specifies the identity of the flint "plates", having a fragile white patina, with those in the Glina cultural environment (A. Păunescu, 1970). Also, Zs. Szézely noted regarding the lithic complexes recovered from the Schneckemberg cultural environment in the settlements at Sânzieni and Sfântul Gheorghe, the presence of 'curved knives' (Z. Szézely, 1997).

Unfortunately the description he provides is quite limited, but the illustration shows (pl. XXXVI and XLV) that the blank used is of the type flint slabs. Thus one can accept the fact the working with flint plates is not necessarily a characteristic of the Glina communities, and given the state of the information we have, we may affirm that using them may be viewed as a particularity of pre-historic communities in the Ialomiţa and Dâmboviţa riverbeds, while the lithic material at Adânca could belong to a prehistoric culture too difficult to pinpoint at the moment.

6. Possible implications

Regarding the use of bitumen as hafting material, it is known that in Romania the oldest discoveries belong to the Paleolithic. In this respect, in Gura Cheii-Râşnov Cave (Braşov County) were found two tools hafted with bitumen, belonging to the Upper and Middle Palaeolithic (M. Cârciumaru et al., 2012).

The presence of bitumen on two lithic tools with different geographical origins, such as Adânca and Gorgota, but having related cultural contexts and stemming from the early Bronze Age is a unique situation in Romanian prehistoric archeology. This is the first circumstance of this kind, and the implications are not even close to being clarified in this study. Was it been used to fix the pieces on handle? We consider that the hypothesis is acceptable at this point in the study, and the argument is the high level of bitumen in areas used for covering these tools.

Bitumen as raw material accessible to pre-historic communities appears this time as well in association with salt in the area designated by the towns of Gura Ocniţei, Ocniţa and Moreni city, in close proximity to Adânca and Gorgota sites.

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