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Geangoeşti-Hulă, Romania: A Gumelniţa settlement on the banks of the Dâmboviţa River. Non-invasive research results

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Abstract: *Geangoeşti-Hulă, Romania: A Gumelniţa settlement on the banks of the Dâmboviţa River. Non-invasive research results***.** The Geangoeşti-Hulă neo-eneolithic tell, Romania, is one of the numerous settlements belonging to the Gumelniţa culture: it is located at the northern extremity of the culture area, which involves, from the point of view of the habitation landscape, certain features. This study presents results of non-invasive research, archaeological survey and geo-physical prospection as a component part of a new project of systematic archaeological research of the place. The issues related to the position and micro-relief of the area were analyzed based mainly on the detailed digital terrain model (DEM) of the site allowing hypsometric, slope declivity, morphological profile tracing or visibility analyses. The magnetometric prospection completes the whole image of the site pointing out part of the structures underground, which is an important starting point in future invasive research.

Keywords: Geangoeşti-Hulă, Gumelniţa settlement, topographical and geophysical survey, non-invasive research

Introduction

The study of settlements from the perspective of the environment and landscape where they started and evolved asks for the discussion of some elements belonging to at least two different fields – archaeology and geography – that combine harmoniously producing what we call nowadays *landscape archaeology*. The importance of geography in understanding history, and particularly the importance of understanding the factors that determined the choice of certain places to settle are basic elements in the study of both current and past civilizations. The need to integrate geography in the study of history was illustrated in a very suggestive manner by the reputed Romanian geographer Ion Conea (I. Conea, 1934, p. 60) who claimed that „Without a presentation and an understanding of the geographical frame where a village was born and has lived we cannot present or understand anything that makes it up [...]. We cannot understand its location, shape, orientation, or structure – nor can we understand the material or spiritual life of its inhabitants."

This paper presents the Gumelniţa settlement at Geangoeşti-Hulă, Romania, starting from the non-invasive research of the site by the team of the West University from Timişoara, Romania, and the team of the „Curtea Domnească" National Museum Complex from Târgovişte, Romania. The research started from at least four premises that cover both old and current research topics:

- Identifying the trajectory of the defence system made up of earth walls and ditches;
- Identifying older digging made by G. Mihăiescu in the 1960s;
- Identifying the distribution of dwelling complexes within the settlement and its extension within the territory;
- Determining with accuracy the metric features of the tell;

- Determining the features that favored the settlement within this landscape.

We believe that both archaeological survey and geo-physical research have allowed us to reach these desiderata and developed the premises for a new stage in the research of the Geangoeşti-Hulă site.

Historiographical and geographical background

The archaeological site at Geangoeşti-Hulă, Romania, is a neo-eneolithic tell that belongs to the Gumelniţa culture. It was first researched in the 1960s by Romanian archaeologists R. Gioglovan and G. Mihăiescu who traced a 64 m main section. From a stratigraphic point of view, they identified five dwelling levels; the last of which being also the best documented – the remains of a burned down dwelling (G. Mihăescu, A. Ilie, 2003-2004, p. 72). According to monographic and repertoire works, the stratigraphic succession of the tell covers six dwelling levels (A. Păun, 2003-2004, p. 86; C.E. Ştefan, 2011, p. 91). As for the chronological stages specific to the culture, most researchers agree that the settlement was functional during the stages A_2 and B_1 (A. Ilie, I. Neaga, 2010, p. 80; A. Păun, 2003-2004, p. 86; A. Frânculeasa, 2008, p. 15), the latter being superimposed by a inconsistent dwelling level of the Brăteşti type (A. Frânculeasa, 2008, p. 17; A. Frânculeasa, 2011, p. 17).

Bibliographical references to the site at Geangoeşti also concern the fortification system; however, in this case also there are inconsistencies regarding the depth of the defence ditch, i.e. 1.1-1.2 m (G. Mihăescu, A. Ilie, 2003-2004, p. 73) or 1.2-1.3 m (A. Ilie, 2006-2007, p. 245).

Archaeological materials consisting in ceramic vases, metal items or stone items, found during the invasive researches in the 1960s or recuperated from the hands of "treasure seekers", were valorized in several synthesis articles and studies whose extensive mention would burden this paper.

The habitat and landscape at Geangoeşti was the core of analyses and succinct mentions in papers on landscape archaeology or on the analysis of habitat types in the Gumelniţa culture area (S. Morintz, 1962, p. 274; A. Morintz, 2007, p. 50; C. E. Ştefan, 2011, p. 62, 91;C. Bem *et al.*, 2012, p. 21).

The archaeological site is circumscribed geographically to the Romanian Plain: it is located at the limit between several relief sub-units such as the Piedmont Plain of Târgovişte, the Ciuta Plain, the major riverbed of Dâmboviţa and the Piedmont of Cândeşti (Fig.1). From the perspective of major milestones in the area, it is located 1.7 km NE from the School of Geangoeşti, 2.1 km N from the church in Mogoşeşti and 2 km south-south-west from the church in Priseaca; the geographical centre of the site has the coordinates 531521.796; 377926.662 (Stereo 70). The macro-geography of the area is made up of three major units easily discernible upon analysis of the Digital Elevation Model (DEM) in the Dragomireşti downstream area – Văcăreşti upstream area, as follows: the Târgovişte Plain, the major riverbed of Dâmboviţa and the Piedmont of Cândeşti. The Plain of Târgovişte has a fluviatile origin and is the result of the juxtaposition of discharge cones of the rivers Dâmboviţa and Ialomiţa (P. Coteţ, 1976, pp. 183-184). Its altitude is 282-298 m, which defines, morphologically, a terrace bridge between the two watercourses.

The passage to the major riverbed of Dâmboviţa has a level difference of about 15 m, with abrupt slopes and important relief energies. The micro-relief of the major riverbed is characterized by flatness, which has caused in time strong divagations of the main flow of Dâmboviţa, thus developing a rich network of meanders that are now fossil. Though nowadays the pre-historic settlement is at about 2 km from the River Dâmboviţa, satellite images point to the presence, at only 70 m far from the tell, of a fossil meander (probably a paleo-riverbed). The ex watercourse is well profiled in the field as shown by the satellite image print (it is about 12 m wide on the average). In addition, in the southern part of the site, agricultural works bring to the surface materials once deposited made up of rolled gravel: the soil here has a loamy-sandy texture (Fig.2). The NW area between the archaeological site and the Geangoeşti village is an ex-marching area that spread to the contact area with the slope of the high terrace.

To the west, the riverbed of Dâmboviţa is bordered by the Piedmont of Cândeşti characterized by altitudes higher than those of the other geographical sub-units ranging between 295 and 356 m. In this case, the relief is strongly

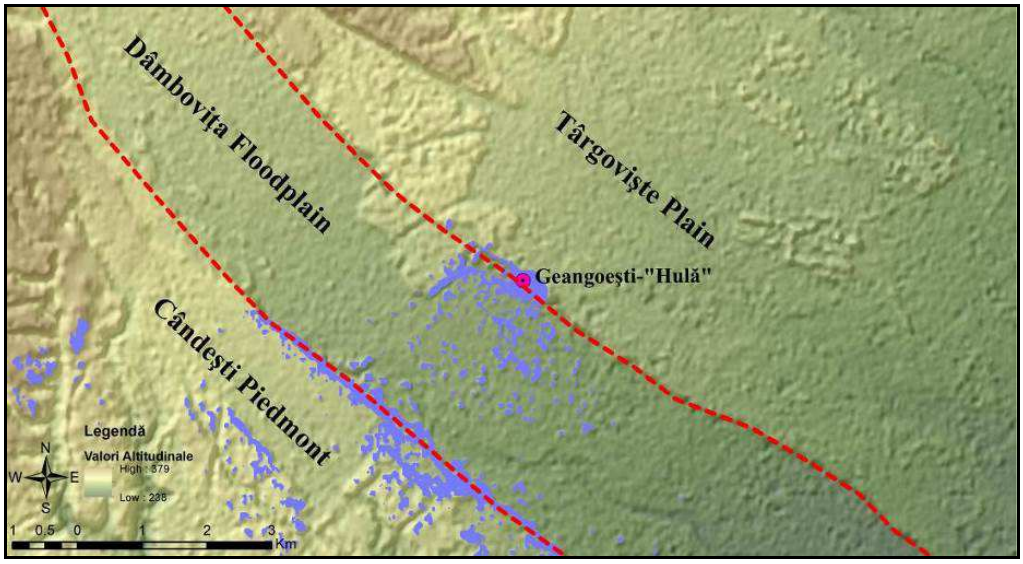

Fig. 1 Geographical framework and visibility factor analysis of Geangoeşti-"Hulă" archaeological site

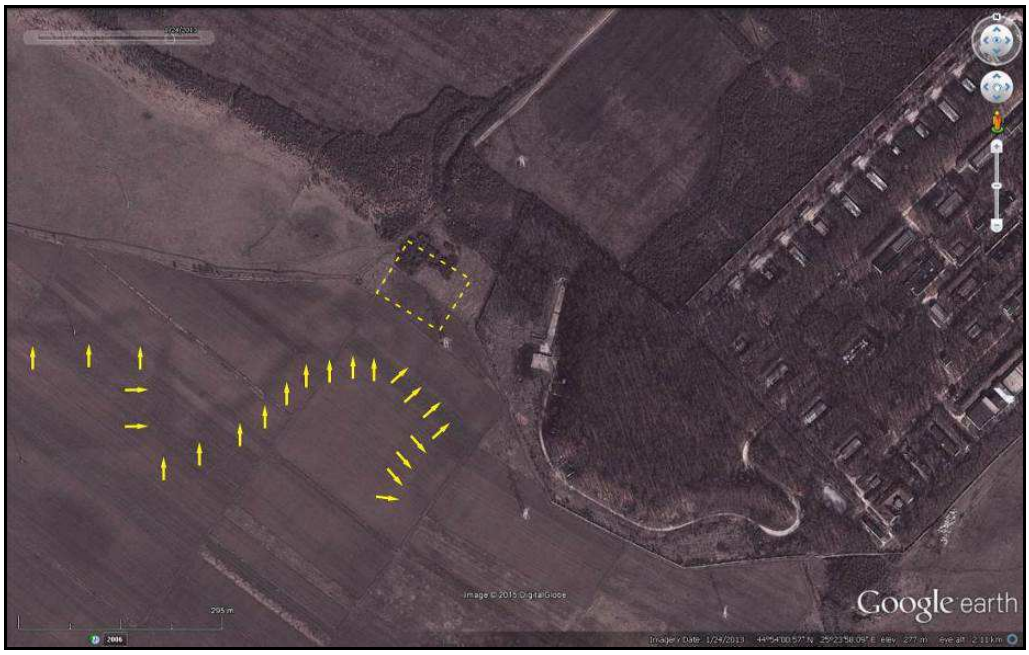

Fig. 2 Satellite image with the indication of fossil meander

fragmented into numerous valleys and small valleys; the transition to the lower area is done, as in the previous case, through a slope fall of 15 m.

Data acquisition and processing

Serious archaeological research nowadays should use a more consistent range of research techniques and methodologies that allow finally more complete and complex correlation and interpretation of the data.

The non-invasive research of the settlement at Geangoeşti-Hulă involved the use of two research methodologies belonging to different fields – geodesy and geophysics. To point out the micro-relief forms in the area and the outer look of the tell, we surveyed the site archaeologically: this allows a 2D and 3D reconstruction of the site as well as a set of analyses relevant in the pointing out of its morphological and morphometric features. The geophysical research

aimed at detecting the structures underground as well as their space distribution; geophysical prospection allowed us to reach all these desiderata. To complete the data, we also consulted and analyzed historical map and satellite images of the area.

The archaeological survey was analyzed with a Leica TCR1201 Total Station: we thus collected from the field a set of data under the form of a cloud of 206 points based on which we later generated the DEM of the studied area. The goal of the archaeological survey was to reconstitute the 2D and 3D configuration of the terrain while removing as much as possible elements of modernity upon reading field data (D. Micle *et al.*, 2010, pp. 86-87; D. Micle *et al.*, 2010a, pp. 140-141). The morphology of the terrain allowed the use of a single base station with random orientation of the horizontal angle of 0º towards a fixed point. Both the working procedure and the lack of points with known coordinates in the field made us use a local reference system (M-M. Ştefan *et al.*, 2012, pp. 58-59). Turning the data in the local reference system into the national one (Stereo 70) was done according to the methodology described by A. Cîntar (Cîntar, 2013), which supposes to rotate the points by applying a trigonometry formula specific to Euclidian transformations.

Magnetometry, a component of geophysical prospection, was used to measure the vertical gradient of the land magnetic field; this was done with a Bartington Grad 601-2 unit. This equipment has two sensors capable of recording data with high accuracy (D. Ştefan, 2012, p. 46). The conditions *in situ* allowed the magnetometric research of the entire site; its area was covered with 9 grids (Fig.3) measuring 30 × 30 m (900 m^2/grid). The ninth grid could not be prospected entirely because of the vegetation that prevented us from seeing about ⅓ of its area. Under these conditions, we prospected an area of 7,860 m^2, recording 31,200 individual values of the vertical gradient.

The values read in the field were processed to produce a magnetogramme that reflects as accurately as possible the structures and their space distribution underground. To remove the errors inherent to such an approach, we applied a set of filters of geometrical correction of incorrect data caused by a lack of synchronization of the pace during the crossing of the traverses (*DeStagger*) or by the removal of linear anomalies (*DeStripe*). To point out the details, the value variation of the data was limited within the interval ±44 nT by removing extreme values (*Clip*).

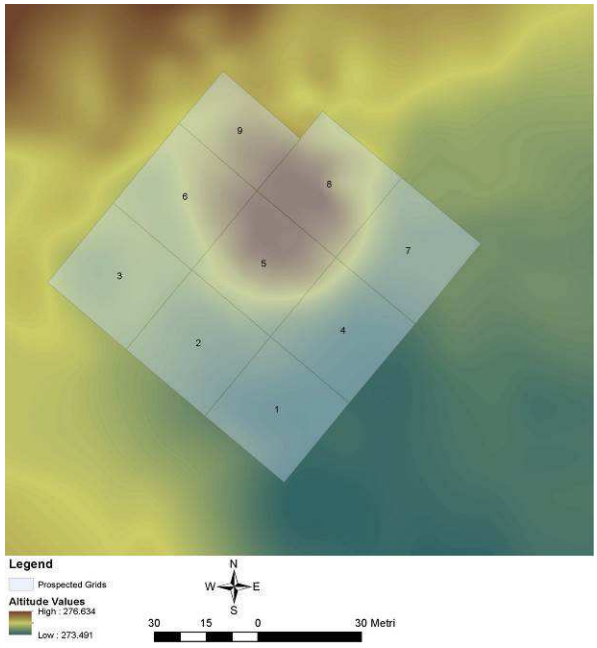

Fig. 3 - Spatial distribution of prospected grids

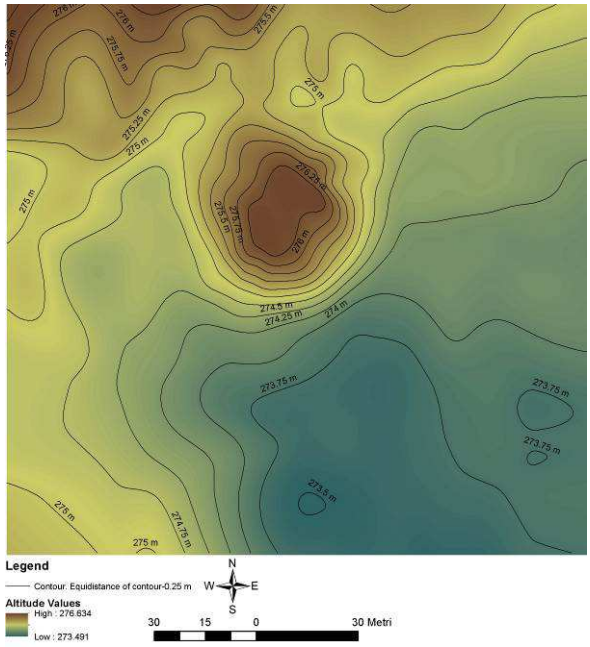

Fig. 4 - The hypsometric analysis (Equidistance of contour – 0,25 m)

Analysis of survey and geophysical data

As stated previously, the role of non-invasive research of the site at Geangoeşti-Hulă

was to clarify some older issues related to both the site morphology and its inner structure; we also aimed at developing a starting point for the new research project of the site.

The survey research aimed at developing a working tool meant for a landscape archaeology study for the most exact capture of geomorphological elements that favored the settlement in this specific point.

The location of the site on the northern branch of the culture also involves morphological and morphometrical features. In general, as far as the northern area of the Gumelniţa culture is concerned, they identified four general types of landscape (A. Frânculeasa, 2011, pp. 9-10). The tell at Geangoeşti, according to this classification, belongs to the third category (the Prahova-Olt interfluve) characterized, in general, by a relief dominated by high areas of piedmont with altitudes ranging between 150 and 325 m; the settlements speculated, in general, the base of the terraces, the river banks or the aits (A. Frânculeasa, 2011, p. 10).

The Gumelniţa settlement at Geangoeşti-Hulă individualises clearly through a set of natural features. The micro-relief speculated by the tell is a transition one from the High Plain of Târgovişte to the major riverbed of Dâmboviţa, with the site covering the last terrace of the higher relief unit. Though in the field the transition from a high relief form to a flooding meadow seems to be abrupt, the detailed analysis of the land survey allows some detail observations. Thus, we can see that the people of those times settled on the last terrace of the high plain, a well-defined altitudinal step within the interval 274.5-275.5 m (Fig.4). Higher forms belonging to the Plain of Târgovişte were in the northern-western area of the site; the transition to these forms was done slightly by progressively increasing the altitude along the direction SE-NW. The differences in altitude between the two areas are minor (between 0.5 and 0.7 m).

The eastern side of the settlement is also an area higher than the flooding meadow, with a difference of level between the two units of 1.5 m.

The flooding meadow was perceived exclusively in the south-east area of the tell: it is characterized by absolute altitudes between 273.5 and 274.5 m. Most probably, this area represented the permanent water source of the settlement, an area crossed by a divagation meander of the River Dâmboviţa, currently a fossil. Though it is difficult to see the morphology of the meander nowadays, the traces of its activity in the area are still visible on the soil (there are deposits of alluvial materials). The soil in the southern area of the site has a loamy-sandy structure intertwined with well-rolled river gravel of different size (Fig.2).

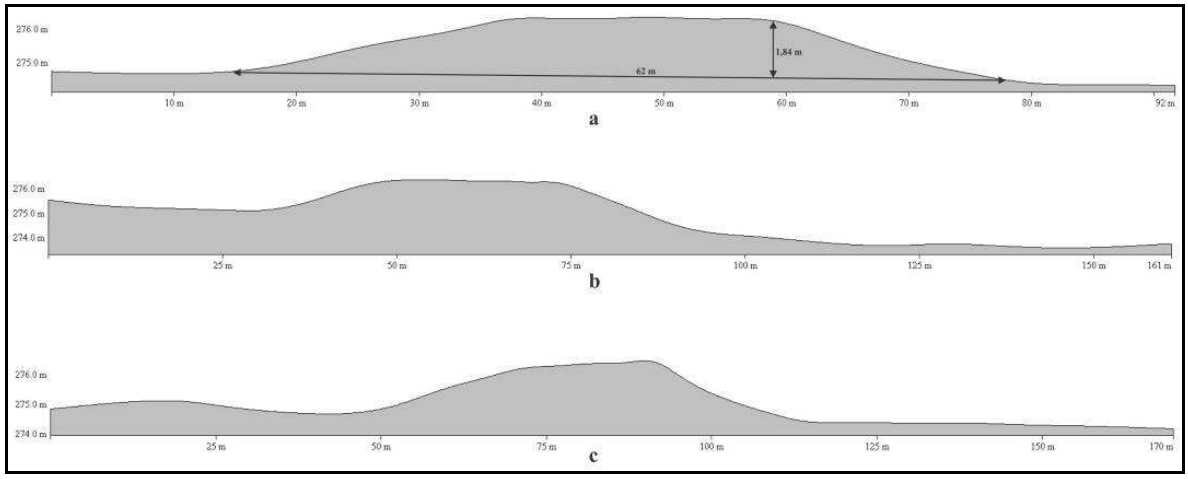

Fig. 5 - Longitudinal profiles: a – profile of the tell; b– N-S profile of the site; E-W profile of the site

As for the strict morphology of the tell, it is characterized by a circular mound 276.4 m high and 1.84 m higher than the surrounding ground. The diameter of the mound is also important from the perspective of classification: 62 m. In general, the figures supplied by the land survey contradict the information supplied by the bibliography regarding the morphometry of the site (G. Mihăiescu, A. Ilie, 2003-2004, p. 72; A. Ilie, I. Neaga, 2010, p. 80; C. Bem *et al.*, 2012, p.

21), which reflects only a stage of natural changes of the landscape and, implicitly, of the tell (Fig. 5).

The individualisation of the Plain of Târgovişte and of the Piedmont of Cândeşti through the deepening of the major riverbed of Dâmboviţa in the studied sector determined specific slope declivity. The area is characterized mainly by slopes with low declivity (ranging between 0 and 4.3 degrees) specific to the interfluve Dâmboviţa-Ialomiţa, to the major riverbed of Dâmboviţa and to certain well-defined areas of the Piedmont of Cândeşti. Medium and high slopes (10.8-30.6 degrees) are more frequent in the Cândeşti Plateau and in the contact areas of the three relief subunits, which once more emphasises the landscape diversity in the area.

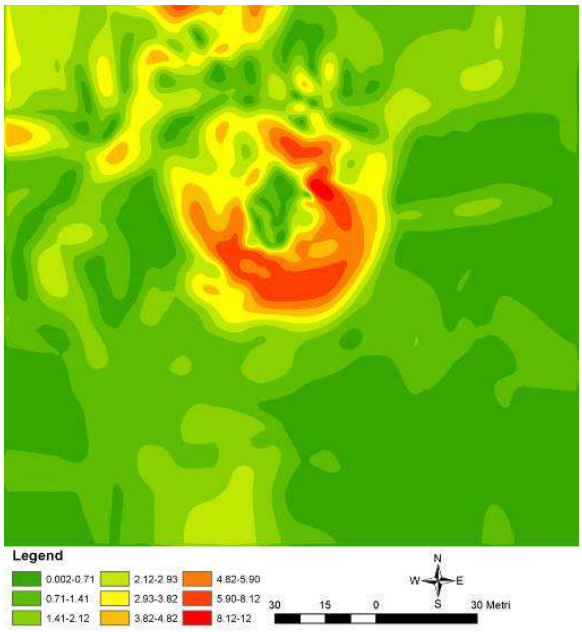

Fig. 6 - Thematic map of slope gradient (degrees)

Speculating, in general, a landscape with altitudes whose variations are not spectacular over small distances, the environment characteristic to the tell has small and medium slopes (0.02-3.3 degrees) representing 90.2% of the total slopes. Medium and high slopes individualize the mound, in general: thus, declivities ranging between 3.3 and 5.7 degrees are distributed at its base, while slopes with considerable values (ranging between 5.1 and 12 degrees) are met on the northern and north-eastern side of the tell. The slope classes with considerable vales are also in the north-eastern areas of the site along the linking segment between the low terrace and the high plateau of the interfluve Dâmboviţa-Ialomiţa (Fig.6).

The relationship between the geography of the place and the location of the settlement is also obvious in the analysis of the exposition of the slopes whose relevance is concrete exclusively when applying it at a general level. According to land survey and historical maps, the entire left slope of the major riverbed of Dâmboviţa has a southern and south-western exposition, which, corroborated with the flatness of the low terrace of the settlement, ensure a good exposition to sunlight during the entire day.

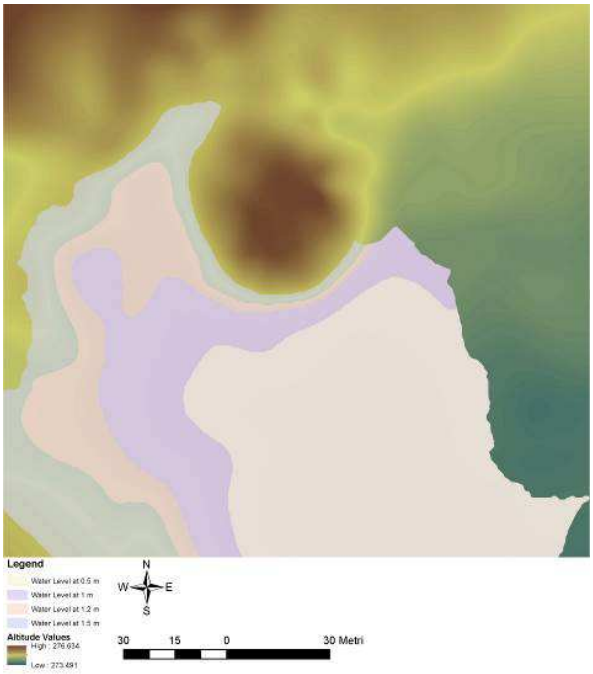

Fig. 7 - Water levels according to minimum elevation read on DEM
(levels between 0.5 and 1.5 m)

The capture of the relief detail features was done by tracing longitudinal profiles in the relevant points of the DEM. In general, they pointed out level differences, the general features of the mound and the ratios between the morphological units identified within the landscape (Fig.5). In most cases, through such analyses, it is possible to point out the defensive structures of a settlement; but most probably, the features of the ditch surrounding the settlement at Geangoeşti – 4.2 m opening and 1.1-1.3 m depth (A. Ilie, 2006-2007, p. 245; C.E. Ştefan, 2010, p. 62) – corroborated with the effects of modern

agriculture, have removed from the landscape the land survey anomalies characteristic to such a structure.

Based on the detailed DEM of the terrain, we could simulate the possible flooding levels of the area (Fig.7) and their effects on the tell. Starting from the minimum altitude recorded (273.5 m), we simulated four levels of water level increase within the range 0.5-1.5 m. The increase of the water level with 0.5 m would have flooded the flooding meadow area close to the tell, and the minimum distance between it and the marsh area would have been 8 m. compared to the results described previously, when water level increased 1 m, the western areas of the settlement would have also been flooded and the distance to the water bank would have been only 2.5 m. The last two simulation levels (1.2 and 1.5 m) would have affected the tell directly, with the entire southern and even the eastern-northern areas being flooded. Obviously, our model is a fictitious one, but we believe that it clarifies once more the configuration of the relief, the intuitive intelligence and the „professionalism" of the people of the Gumelniţa culture in choosing dwelling areas.

The results of magnetometric researches are presented as magnetic maps or magnetogrammes superimposed over the terrain digital model in an attempt to corroborate the two types of data – geophysical and land survey (Fig.8-10).

As expected, most magnetic anomalies focus on the mound surface allowing distinguishing two concentration areas separated by a relatively linear anomaly. *Extra situ* we could identify mainly linear anomalies and point anomalies with variable contrasts depending on the nature of the objectives detected. An important observation refers to the fact that the data collected were relatively "clean" magnetically, while anomalies generated by modern pollution were localised punctually, with an increased share within the grids 8 and 9 of an earth road (Fig.8).

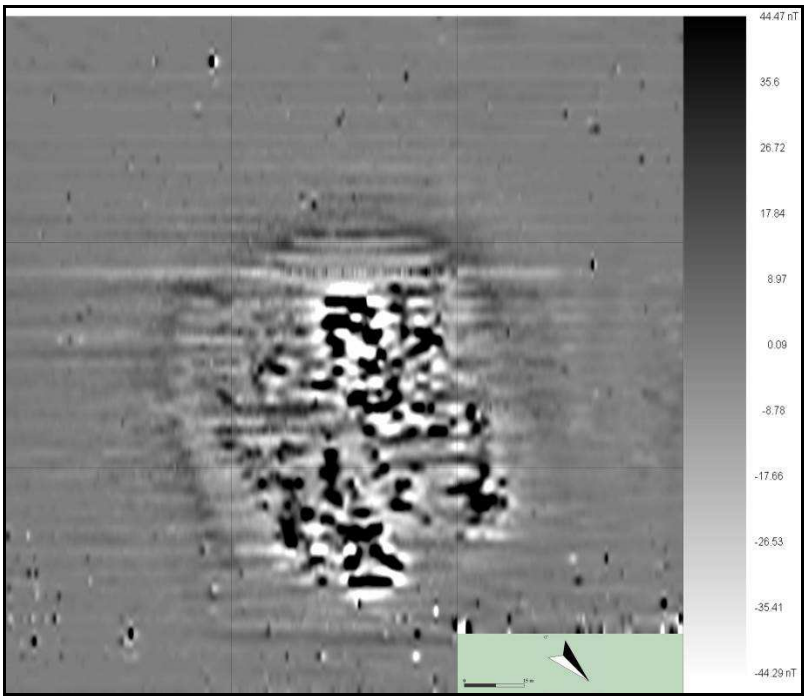

Fig. 8 The magnetogramme of Geangoeşti – "Hulă" tell settlement

To interpret the magnetic map, we identified a set of areas for practical reasons, which we designated from A to D (Fig.9).

The structures delimitated by a red contour (A) represent rectangular positive magnetic anomalies with rounded corners whose medium size is, in general, 6 m x 2.5 m. The anomalies show increased values of the magnetic gradient ranging between 50 nT and 100 nT; the representation of each of them is done by a abrupt passage from dark grey or black shades to white shades. The structural and value features of the anomalies point to a remnant magnetisation caused by temperatures that, during a fire, were above Curie point, i.e. 585ºC (D. Ştefan, 2012, pp.38-39). The anomalies discussed describe

archaeologically dwelling structures identified due to their strongly burnt adobe platforms belonging to the fifth dwelling level of the tell. The relatively small depth of these structures (0.5-0.6 m) as well as the thickness of the layer made up of massive pieces of adobe (0.6-1.0 m) (G. Mihăiescu, A. Ilie, 2003-2004, p. 74) are the main factors having generated the strong signal and the bipolar aspect of the anomaly.

We could also mark some well-delimitated anomalies (yellow contour/B) of black colour whose structure differ from those previously described due to the lack of bipolar aspect. From an archaeological point of view, they describe the same type of construction as discussed above, only most probably their make-up is less compact or not as thick.

Both types of anomaly also have circular structures whose diameter is up to 1 m and whose gradient values range between 10 nT and 40 nT. This type of anomaly can be interpreted as pits whose function can be established exclusively through invasive research.

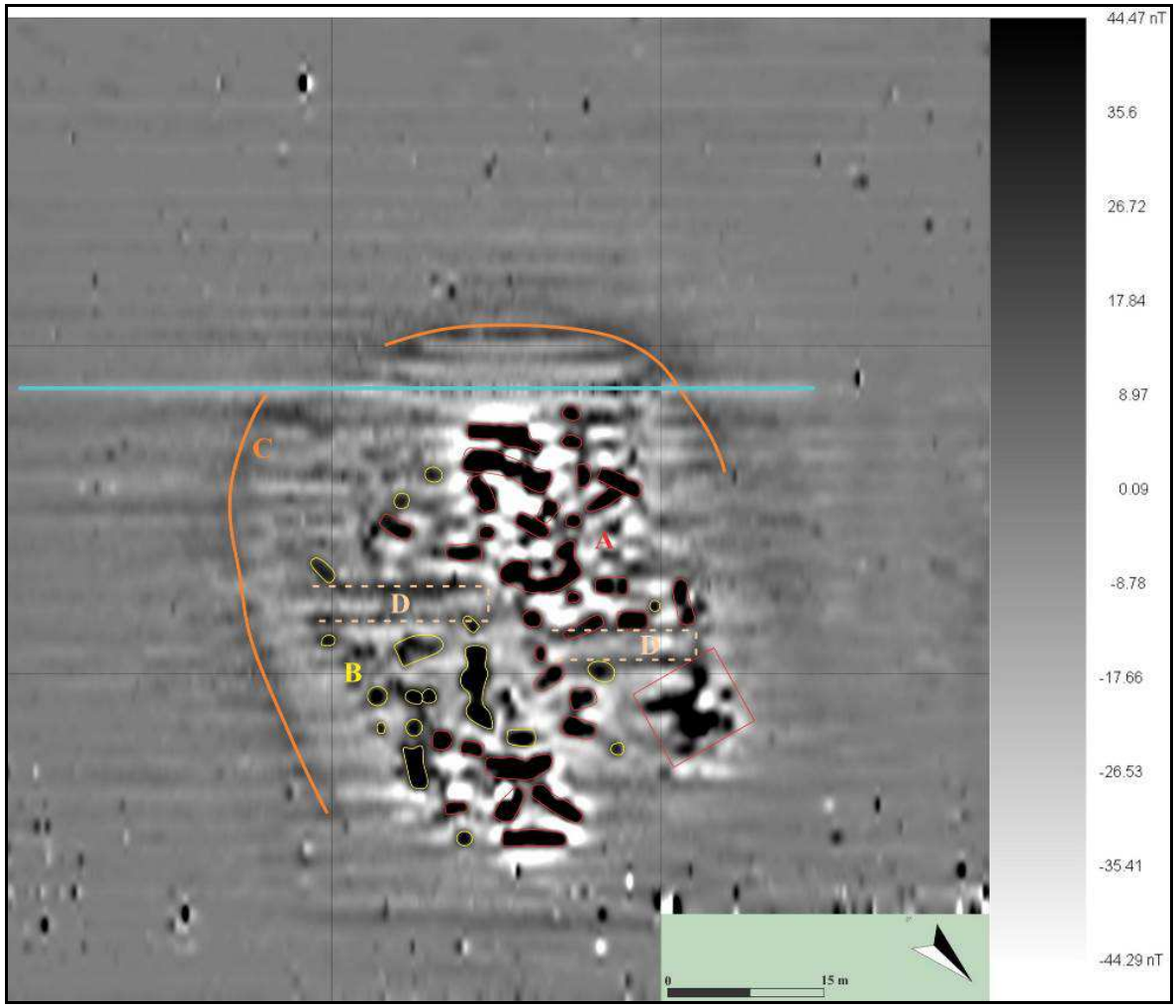

Fig. 9 - The interpretation of the magnetometrical prospection of the Geangoeşti – „Hulă" site

Two of the layers belonging to the type A anomalies have irregular shapes (a and 2) and can be interpreted as two or more archaeological complexes overlapping partially.

In the eastern and south-western areas there is a linear anomaly (C) that follows the shape of the tell, with an interruption of 9 m in the southern point of the mound the rest of which totals 80 m in length. The contrast of this anomaly is a weak one (its values range between 5 and 10 nT) and it is represented in the magnetogramme by inconspicuous shades of grey. By corroborating our results with the data from the findings, we can assume that this

anomaly represents the defence ditch of the settlement. The weak contrast of the complex on the magnetic map was most probably determined by the physical features of the ditch: an opening of 2.4 m and a depth of only 1.1-1.2 m (G. Mihăiescu, A. Ilie, 2003-2004, p. 73; A. Ilie, 2006-2007, p. 245 and Fig. 1). The prospection did not capture the ditch o the northern and north-western sides: their absence is confirmed by the archaeological research that found here, below a superficial layer of soil, natural deposits of gravel. Likewise, the possible defence wall that doubled the ditch was not identified by magnetic research: its situation is not clear archaeologically either. Stratigraphically, the defensive structure is linked to the second dwelling level (G. Mihăiescu, A. Ilie, 2003-2004, p. 73).

A negative linear anomaly 60 m long represented by shades of white can be noticed on the southern side of the tell (marked in blue). The mean values of the magnetic gradient in the area can be ranged between 6 and 12 nT. Terrain observations in this case were important because this anomaly is rooted in our modern times: they represent a delimitation of agricultural plots by a furrow that created a level difference of about 0.3-0.4 m between the mound and the area south from the mound.

Back to the central area of the tell, there are two areas represented by rectangular anomalies (D) 2 m wide and a gradient whose value ranges between 10 nT and -20 nT. The position of the anomaly corroborated with available data make us believe that the two sectors are parts of the main line section practiced by G. Mihăescu back in 1960.

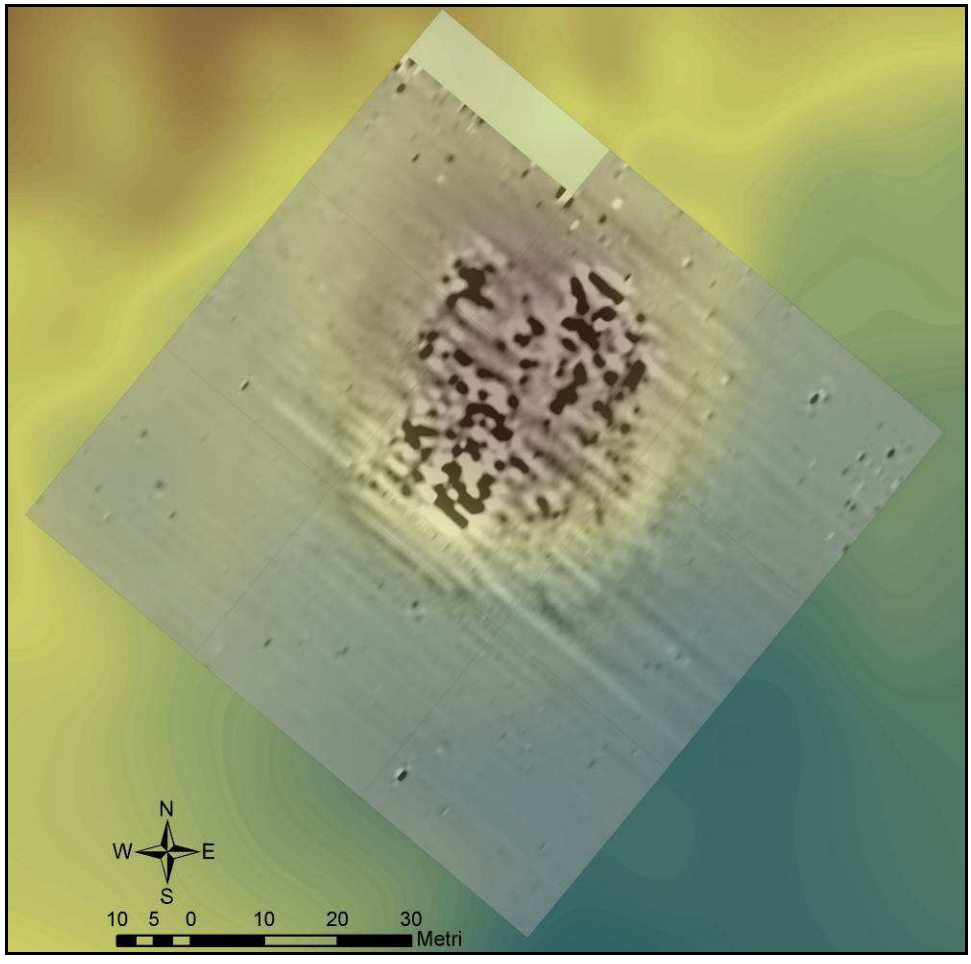

Fig. 10 The magnetogramme overlaied on the topographical survey

Other objectives of archaeological interest can also be identified outside the perimeter of the earth mound, mainly in grid 8, but with a lower intensity.

Conclusions

Non-invasive research carried out at Geangoeşti-Hulă represents the debut of a new stage in the systematic research of the Gumelniţa tell. The land survey of the entire area pointed out certain morphological features of the landscape occupied by the mound that are difficult to notice in the field. We could determine the exact size of the mound: the height of 1.84 m and the diameter of 62 m place the settlement in the range of medium settlements from the point of view of its size (see the classifications in C. Bem *et al.*, 2012, pp. 23-25). We could also determine the absolute altitude of the site – 276.4 m – that differs from known altitudes in historiography (48.6 m more).

A first classification of the types of landscapes speculated by the Gumelniţa communities based on thorough field observations from geographically different micro-areas was advanced by S. Morintz (1962) who distinguished three main types of settlements: settlements located on hill ends or on terrace head lands (a), settlements located on heights and bordered by difficult slopes (b) and settlements located in flooding meadows (c) (S. Morintz, 1962, p. 274). Though the number of Gumelniţa settlements increased due to the researches carried out in the last 50 years, the classification advanced by S. Morintz is still valid and is embraced by most researchers.

Judging the settlement at Geangoești after the morphological and morphometric features presented above, we see they range from the perspective of landscape in the third category because it speculated the terrace between the flooding meadow of the River Dâmboviţa and the terrace of the Piedmont of Târgoviște. Altimetric classes are clearly delimited: the three areas pointed out (the link area with the upper terrace, the median terrace and the flooding meadow) are organically linked topographically. To classify it in the third category of the classification advanced by S. Morintz we can also rely on slope declivities in the DEM: they range between small and medium (0.02-3.3 degrees), which points once more to a landscape that does not supply direct natural defensive opportunities specific to the categories „a" and „b".

Based on the general DEM of the area, we also analysed the visibility of the site centre (Fig.1): the visual field is limited toward the north because of the terrace, its extension being exclusively in the south-east areas. The community had good visibility in the area close to the settlement over 0.5-1.0 km and over the area on the slope on the right bank of Dâmboviţa, at the contact point with the Piedmont of Cândeşti. Over the area of major riverbed, visibility is distributed exclusively over certain areas, similar to the heights characteristic to the plateau area. It is possible that, by eliminating certain factors in the flooding meadow area (the vegetation within the DEM), visibility increase along it. The control of the high terrace and its use in case of danger is just a supposition (A. Morintz, 2007, p. 50): future systematic field research could clarify these aspects.

Magnetometric research of the site supplied a first image of the structural elements underground. We could point out clearly within the magnetogramme, the burnt dwellings of the fifth level of dwelling: the limits of the method did not allow the detection of other possible dwelling structures beneath it. Another desideratum of the geophysical investigation was the identification of the trajectory of the defence ditch surrounding the settlement dating from the second dwelling level period. The trajectory of the ditch was identified strictly along the southern half of the tell: the linear anomaly is missing for the northern area. The space distribution of the archaeological objectives of points to the fact that the settlement concentrated strictly on the tell protected by a ditch dug on the southern side. Archaeological digging will clarify if it closed the tell completely or if the communities purely and simply speculated the higher area in the north as a direct form of protection.

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