Non-invasive research on the Neolithic settlement of Mezőkeresztes, Lapos-halom

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Abstract

The aim of this publication is to present the non-invasive research on the Neolithic hill at the Mezőkeresztes, Lapos-halom site.

The site is a late ALP period settlement hill with unknown stratigraphic relations. Based on geophysical surveys, it was a densely built-in area with an artificial boundary.

In terms of typology, the assemblages of the northern Szakálhát and formerly known as Szilmeg groups are the most similar to the finds excavated at this site, which also show a few late Neolithic characteristics.

Data suggesting the artificial land use of surrounding area around the site proves the conscious land usage of the area's former inhabitants.

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The site

Lapos-halom is located south of Mezőkeresztes (Northeast Hungary, Borsodi-Mezőség), on the bank of the Lator stream (also known as Tardi stream or Nád stream) *(Fig. 1)*. Lapos-halom is a craggy settlement hill stretching on a 120 by 130 metre area, with 2.20 metres of height. Today the area is ploughed and a triangulation station can be found on the top of the hill. The site was first reported to the Herman Ottó Museum by secondary school student Katalin Fekete in 1990 (HOM Archaeological Database: 2220-91). Despite the site being surveyed (HOM Archeological Database: 2221-91; Koós 1991) and included in the archaeological site registry (ID: 16070), no research was performed until 2019. Based on the surface finds of recent research, Lapos-halom can be categorized as a settlement from the Neolithic period.

The site was examined using non-invasive methods in May 2019. At the time the area was covered in 10 to 12 centimetres tall cornstalks, however this did not hinder the work, which involved the following phases:

- collection and analysis of historical maps
- collection and analysis of archived aerial photography
- Photo 3D model creation based on drone recordings

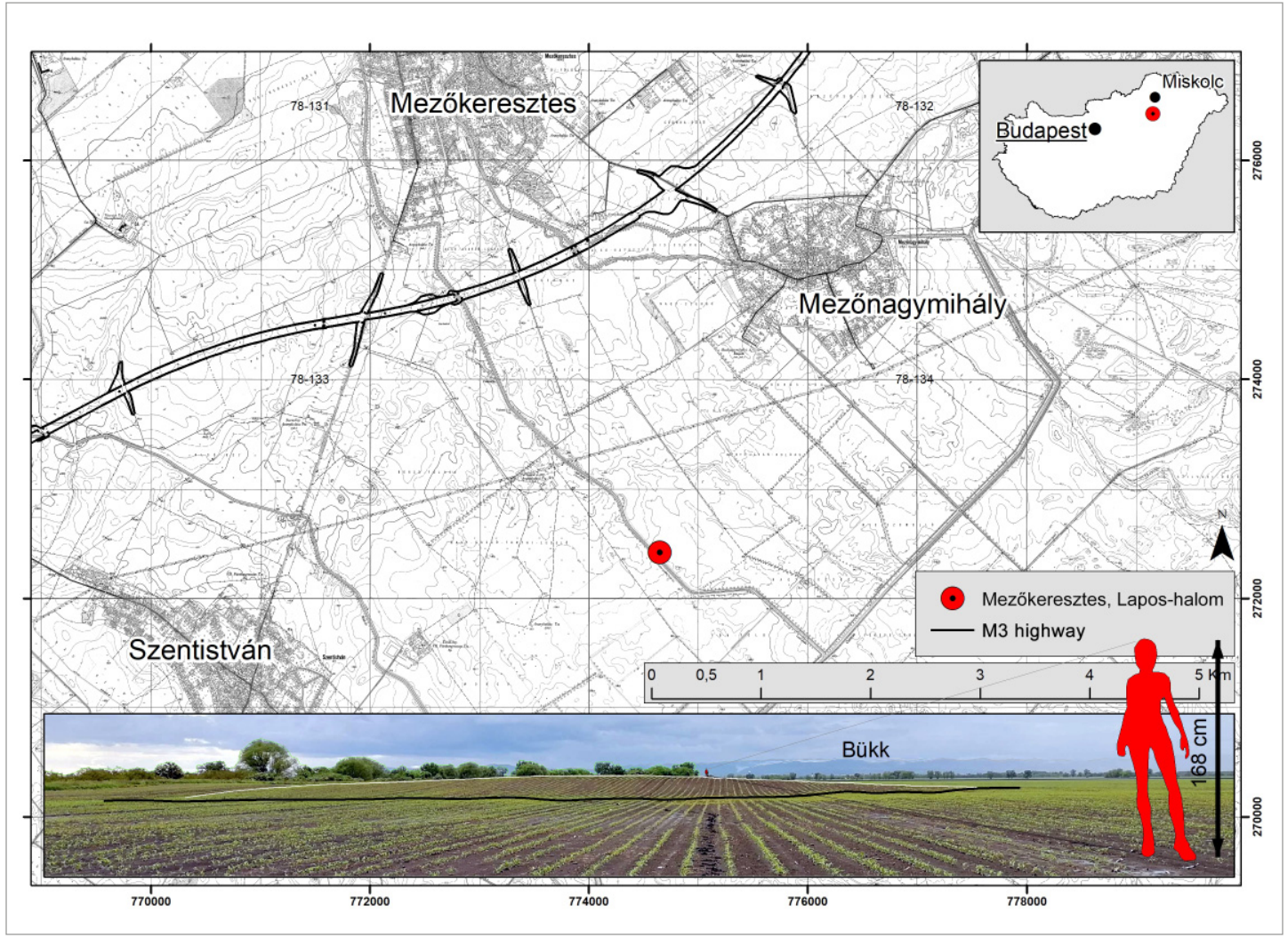


Fig. 1 *The location of the researched area.*

- orthography generation
- DEM generation
- geophysical survey of the central core area
- determining settlement boundaries based on surface finds, using extensive surface surveying methods
- determining settlement period through typological examination
- integrating the site into the former settlement network based on archaeological data

Historical map analysis

Bükkalja is a foothill area located at the southern edge of the Bükk Mountains in Northern Hungary; it is characterized by its drastically different geological composition from the main mountain range. The waterflows stemming from this area flow towards the Great Hungarian Plain and divide the gradually smoothening flatlands between the two areas, the northern part of these which is known as the Borsodi-Mezőség. The southern edge of the Borsodi-Mezőség is bordered by the River Tisza. The streams stemming from the Bükk Mountains created a vast marshland in the region, which they sustain by flowing through

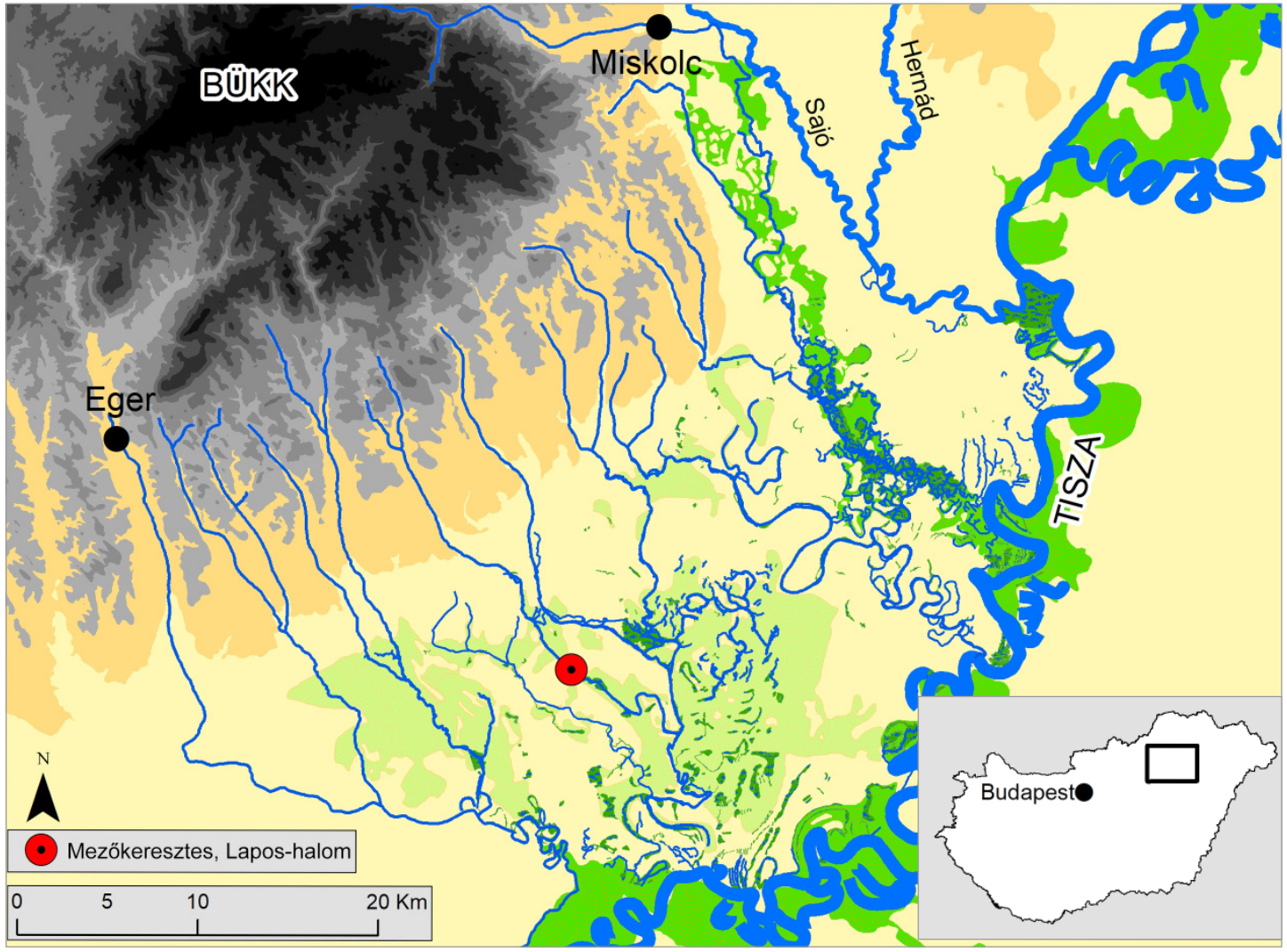


Fig. 2 *Mezőkeresztes, Lapos-halom on a map of the Borsodi-Mezőség prior to water regulation, based on historical maps.*

there before reaching its confluence with the Tisza. Most settlements were established along the lines of these streams throughout the prehistoric era *(Fig. 2)*.

The site is located on the bank of the Tardi stream and follows a similar path as the waterways described above. It stems from Felső-szoros, located east of Mélyvölgy, which is above the village of Tard. The stream in its post-water regulated state flows into the Csincse stream, south of Mezőnagymihály, becoming a part of the Eger–Laskó–Csincse water system. However, prior to water regulations the hydrographic conditions of the area around Lapos-halom were significantly different.

The waterflows in the area of the Borsodi-Mezőség where Lapos-halom is located were regulated twice, in the 19th century and after World War II. This is why the site is located on the right, western bank of the Tardi stream on historical and military survey maps *(Fig.s 3/2–4 and 4)*, even though it is situated on the left, eastern bank today. The 1852 cadastral map showing the edge of Mezőkeresztes shows the original downstream (MNL. S 78-79. téka-Mezőkeresztes 1-13), whereas the 1889 cadastral map shows the regulated line of the Nád stream (MNL. S 78-79. téka-Mezőkeresztes 14-61). The current hydrographic state, which places the settlement hill on the left bank of the stream, was created in the mid-19th century.

The original hydrographic reconstruction of the area

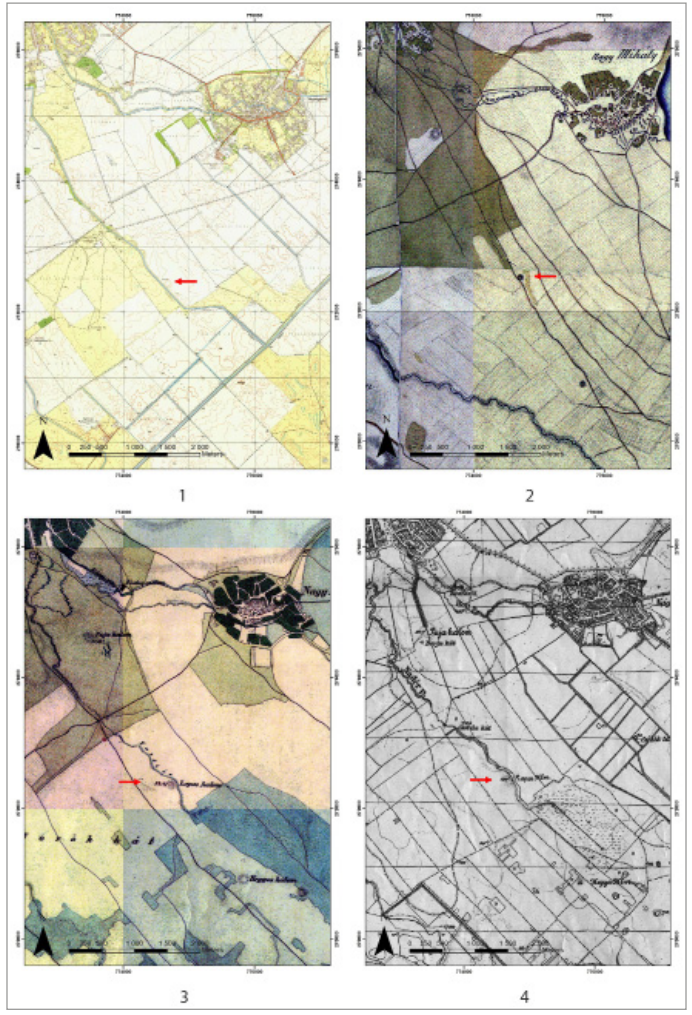


Fig. 3 *Mezőkeresztes, Lapos-halom on the EOV (Uniform National Projection system) map (1), and on the maps of the first, second and third military surveys (2–4).*

was made possible through the use of the historical maps showing the edges of the village of Mezőkeresztes from 1756 (MNL. S 11.NO.830.63), 1767 *(Fig. 4. 1)* and 1800 (OSZK TK 1203, MNL. S 11.NO. 830:66), the map of the II. military survey *(Fig. 3. 3)* from the early 19th century and the 1857 map used for the regulation of the River Tisza (MNL. S 101.NO. 896) *(Fig. 4. 2)*.

The 1756 and 1767 historical maps show a short eastern waterflow stemming from the Nád stream at

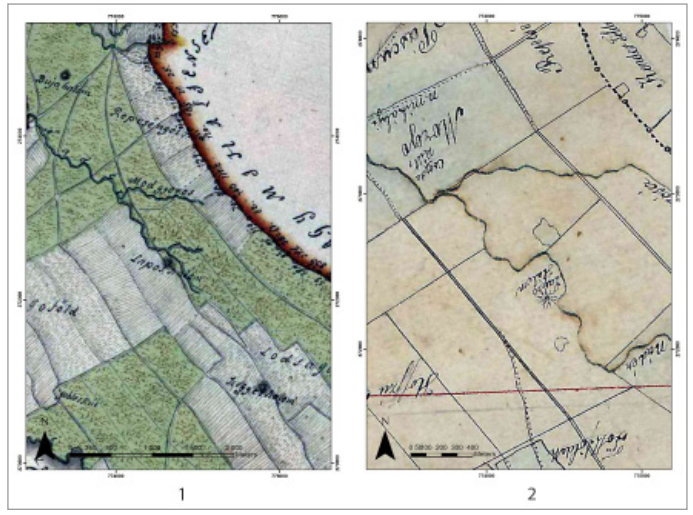


Fig. 4 *1: Cut-out of the 1767 historical map showing the village border of Mezőkeresztes. 2: Cut-out from the 1857 historical map used for the water regulation of the River Tisza.*

Lapos-halom. The Nád stream disappears after Lapos-halom, the area south of that, highlighted in green, is named Lodcsagó (=Locsogó) föld (wetlands). On the 1857 map, the Nád stream is depicted to flow into a waterlogged area named Kis-Locsogó. The II. military survey shows a continuous waterlogged surface in the area. On the 1:10000 EOV (Uniform National Projection system) map, an area named Nagy-Locsogó can be found southeast of Lapos-halom, and a parcel named Keresztesi-nagy-gyep can be found south of Hegyes-halom. This means that the Nád stream originally flowed into a watershed area of the Csincse stream, a low-lying marshland territory located in the middle of the Borsodi-Mezőség with high water levels to this day.

However, several maps depict a road west of this marshland area, near Lapos-halom and Hegyes-halom. The map of the first military survey is one of them, which highlights said road over the waterflow in the area. This road borders the central marshland part of the Borsodi-Mezőség from the west, crossing it next to the former medieval settlement of Montaj and leading until the line of the River Tisza. This means that the founding communities of the settlement of Lapos-halom chose a prominent geographic location to settle in, situated by a stream, at the edge of an impassable, waterlogged area. The elevated areas serving as the foundations of the prehistoric settlements established in the region were connected by roads throughout historical periods. It is possible that prehistoric settlements, including Lapos-halom, were established in the line of the road that connected the foothill region to the River Tisza. Based on the aforementioned maps, another deeper, waterlogged area can be located east of the line made up of Lapos-halom and Hegyes-halom, which means that both settlements were located in the only habitable and traversable strip of land stretching from north to south.

The 1857 historical map shows that while the stream flows with the usual meandering from north and south of the settlement, there are two, sharp 90-degree angle turns in it just in front of Lapos-halom, forming three sides of rectangle. The relation between the settlement and the streambed will become significant in later analyses.

The settlement of Hegyes-halom, located 1900 metres to the southeast from Lapos-halom, has not been systematically excavated yet. Nándor Kalicz and János Makkay reported assemblages belonging either to a younger phase of the Alföld Linear Pottery culture (ALP) or to the Szilmeg group (Kalicz–Makkay 1977, 142, Kat.-Nr. 237). ALP pottery sherds were collected from the surface of Hegyes-halom (ID: 80975) by National park ranger Nándor Seres in 2011.

Aerial photography analysis

By using historical maps along with the patterns found on archived (1976) *(Fig. 5. 1)* and current *(Fig. 5. 2)* aerial photography in a geoinformatics system, the pre-regulation flow of the Tardi stream became well visible.

The spring of the Lator stream is located at Bükkalja, northeast of the village Cserépváralja. Like many

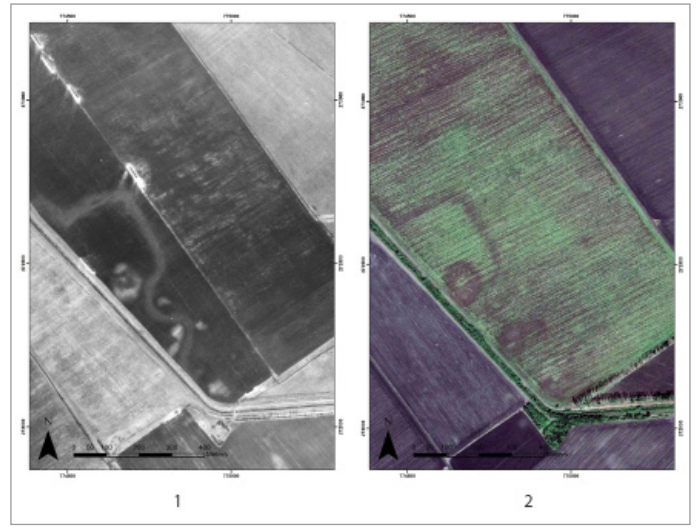


Fig. 5 *1: 1976 Aerial photography of Mezőkeresztes, Lapos-halom. 2: Google Earth recording of the site, 05 October 2009.*

other streams of the Bükk foothills, this one also springs where the carbonate rocks of the mountain range and the rhyolite and dacite layers of the foothills meet. This is due to the fact that most of the rainwater flows through the heavily karstic, carbonate mountain rocks down under the surface, accumulating and resurfacing where the different types of rocks meet in the form of springs. The stream then flows through the volcanic rocks of the Bükkalja foothills, reaching the edge of the Great Hungarian Plain where its streambed shifts to a gradually meandering type, travelling 130 metres in elevation from its source to the confluence of the Csincse stream.

Following its regulation, the Lator stream currently flows north of Tard in an artificial streambed, crossing settlements and fields of the flatland area in a man-made environment. However, its original streambed can still be traced via archived and current aerial photography, with denser than usual vegetation showing cut off sections. Traces of former meanders can be found on fields as well, since those areas contain significantly lower amounts of humus and appear lighter than their surroundings. The Lator stream was a classic meandering type of waterflow before its regulation. Its stream capacity was reduced upon entering the flatlands, causing the stream to create opposite bend pairs in a sinusoidal shape to facilitate the carriage of sediment (Tímár–Telbisz 2005). The outer curves experience constant erosion, while the inner curves experience constant build-up, which leads to a constant development of bends, creating new ones as the stream flows towards its confluence. Despite all of that, the condition of the stream is stable, its stream power and the amount of sediment carried are in balance (Tímár 2005).

A particularly good example of the former streambed can be found west of Mezőkeresztes, allowing the Lator stream to be categorized as a 3A type stream pre-regulation, characterized by low wavelength (the distance between the apexes of bends facing the same direction) and high amplitude (the difference between the apexes of opposite facing bends) (Lóczy 2011). This means that bends are very frequent and the stream flowed through a relatively wide area *(Fig. 6)*. This section also shows that some bends had been cut off prior to the regulation, shortening the flow of the stream. However, from a morphological standpoint, it is also noticeable that even on a short section like this, bends would have been cut off naturally, with several neighbouring curves joining together naturally. Such occurrences are common at sections like this, as the stream primarily strives for balance and seeks the shortest path towards the confluence.

Lapos-halom is situated next to the bed of the Lator stream. The stream originally flowed east of the elevation, and to the west after water regulation, as shown on the aforementioned maps. It was close to the confluence as the Csincse stream is located only two kilometres from here. Classic meanders, cutting

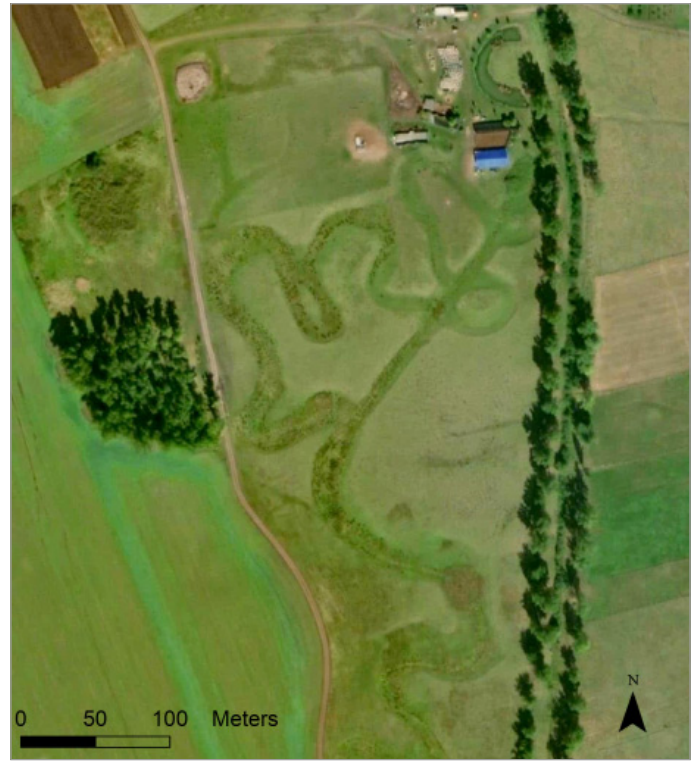


Fig. 6 *The former, meandering bed of the Lator stream, including cut off corners from a previous water regulation effort and its present day, completely straightened bed, located west of Mezőkeresztes.*

past the flow of the regulated bed, can be found north of the settlement hill, further highlighted by denser natural vegetation. No such sections can be traced towards the confluence, south of the research area. Based on archived and 2019 drone aerial photography however, a section passing around the settlement hill and heading towards the current streambed can be identified, the presence of which is confirmed by the aforementioned historical maps *(Fig. 7)*.

Despite the fact that the area has been ploughed since its regulation, the former streambed (and the settlement hill itself) is visibly distinguishable from the rest of the farmland with its paler hues, due to its different soil composition and overall lack of humus. However, it is also noticeable that the former bed surrounds the settlement in a near-rectangular shape with sharp, 90-degree bends, which suggest that this section was man-made. Unless there is a geological reason behind it, waterflows do not alternate with 90-degree breaks on flatlands naturally. *Fig. 6.* shows the kind of typical, arching, loop-shaped meanders created by the stream prior to its regulation.

Analysis of the Digital Elevation Model (DEM), created from drone aerial photography using photogrammetry *(Fig. 8. 1)*, also suggests that this streambed section is artificial. The former bed and its sharp bends are visible on the DEM as well, and there is

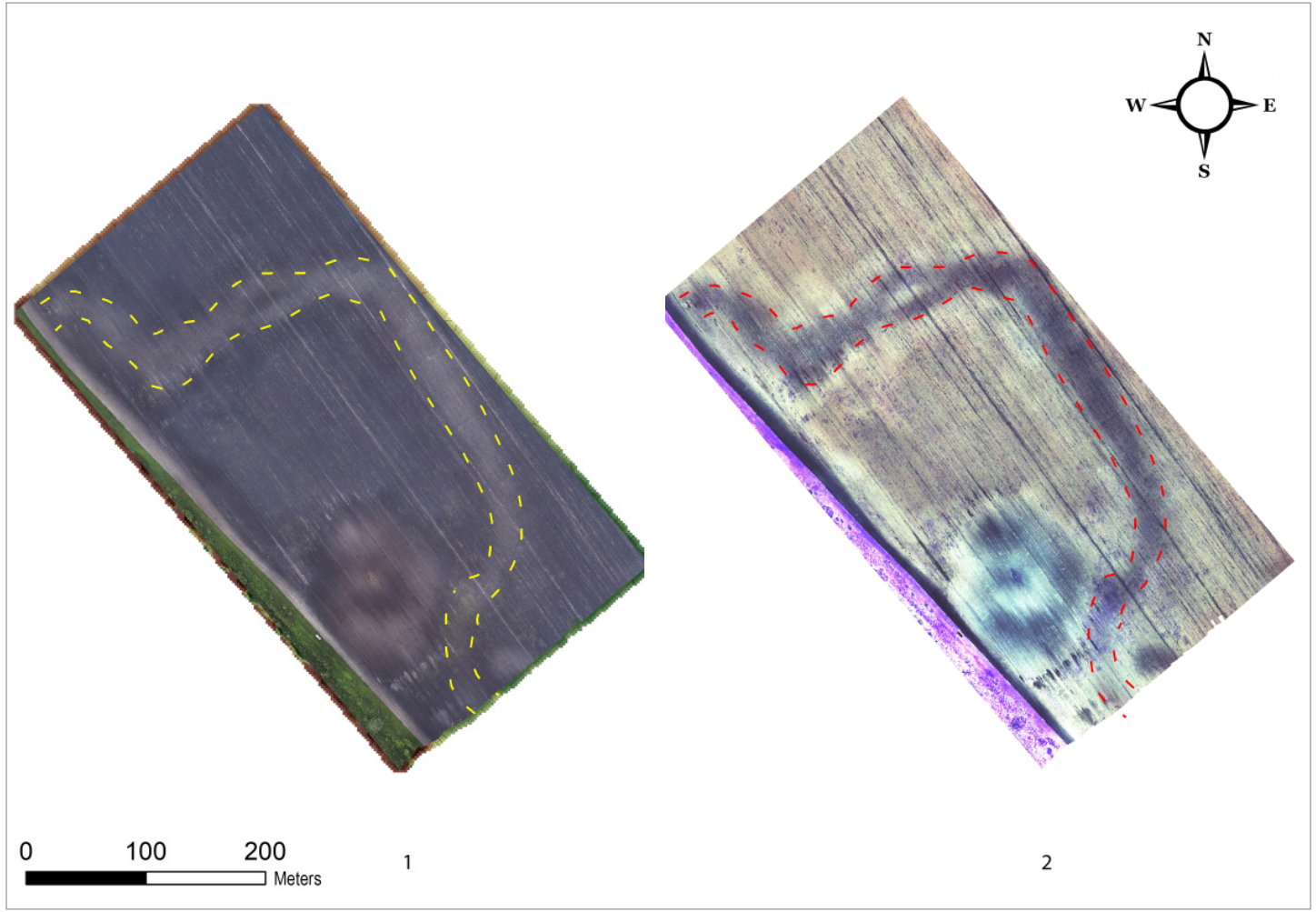


Fig. 7 *1: Orthomosaic map created with the use of drone photography, showcasing the former stream section surrounding the settlement hill. 2: False colour variation of the previous image, highlighting the streambed. The flow of the Lator stream, reconstructed based on aerial photography, is shown with a dashed line.*

a slight elevation in terrain from the settlement hill towards the former stream. Natural waterflows always flow on an optimal path and strike a balance between stream power and stream capacity. Analysing the DEM from a gradient perspective *(Fig. 8. 2)*, the artificial shaping of the bed north-northeast from the settlement hill becomes even more apparent, as the straight riverbed section with 90-degree bends is bordered by elevated embankments on both sides. By contrast, a more natural-shaped bend can be observed east of the settlement hill. This artificial structure is clearly visible on a cut-out *(Fig. 8. 2 A)* based on the gradient image *(Fig. 8. 2)*. Presumably the stream flowed in the area in a more sinuous manner before it was straightened out. Aerial photography above *(Fig. 7)* shows a small, island-like elevation north of the settlement hill, which is result of a natural bend getting cut off. The section with the apex of the former bend is still visible today, with the area between the natural and artificial riverbends appearing as an island.

The cross-section of the site *(Fig. 9)*, created with the use of the DEM, shows that no ditch surrounding the settlement hill is visible from the surface. The dimensions of settlement hill area are 120 by 130 metres. Its shape is not perfectly circular, it is more of a rectangle with rounded edges instead, with NNE–SSW orientation.

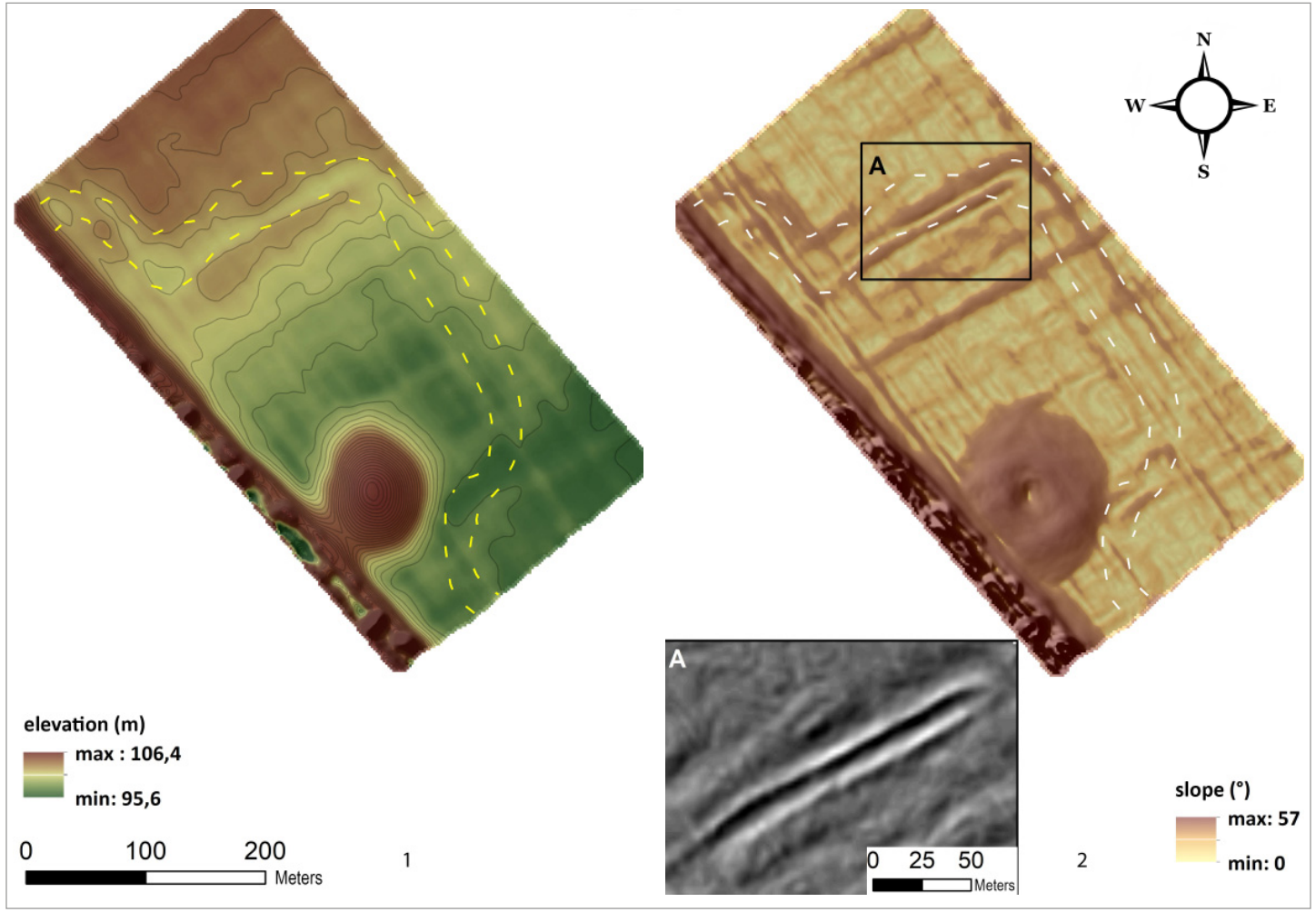


Fig. 8 *1: Contour map generated from the DEM based on aerial photography, showcasing the elevations of the research area and an interpretation of the streambed section. 2: Topographic gradient map generated from the DEM.*

Based on the DEM, the elevation of the settlement hill is 2.2 metres, with a height of 98.80 metres compared to the 96.60 metre height of the surface.

Several light soil patches were observed in the bends of the meandering stream south of the settlement and its surrounding rectangular – presumably artificial – ditch, on both archived and recent aerial photography *(Fig. 5. 1–2)*. One of the most prominent spots south of the settlement matches the small, 97.1 metres high elevation marked on the EOV map. Soil patches with similar characteristics can be found on the present day, western, right-hand side bank of the stream.

Geophysical survey

On 2nd of June 2019, geophysical survey was carried out at the site and its vicinity, in a 100 by 150 metre rectangular area *(Fig. 10)*.

The survey was carried out using a Sensys MAGNETO® DLM magnetometer. The device is equipped with five FGM-650 type fluxgate gradiometer sensors, each with a measuring range of ±10.000 nT and resolution lower than 0.2 nT. Sampling distance was set to 0.1 metre. Measured values for the surveyed area ranged between -164 and 104 nT/m; no outliers were detected.

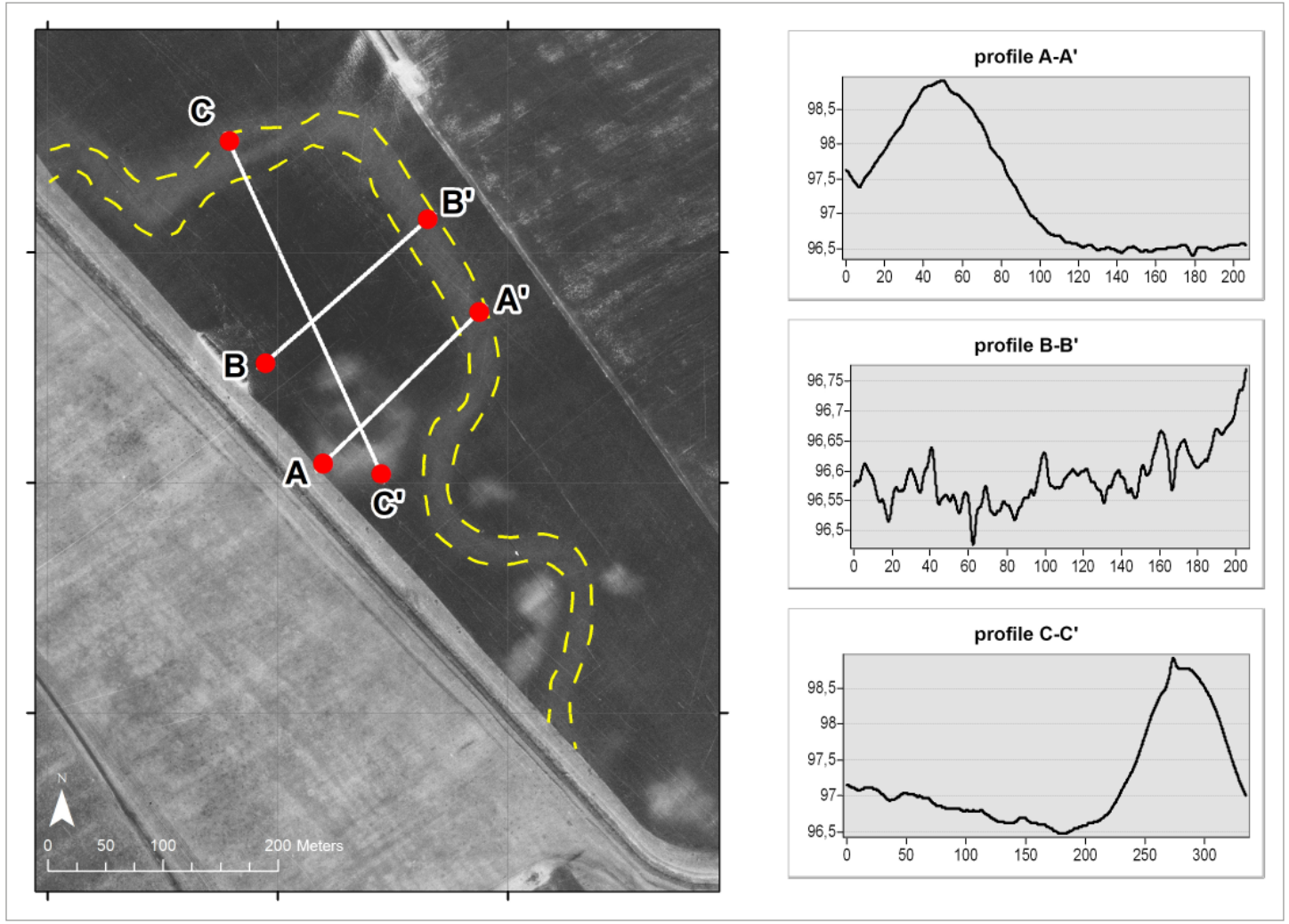


Fig. 9 *The situation of sections showcasing the characteristic elevations (generated from the DEM) on the 1976 aerial photography. The former flow of the Lator stream is shown with a dashed line.*

Based on geophysical survey results, the following conclusions can be made of the structure of the Neolithic settlement: geophysical survey shows an approximately 4 metres wide linear anomaly surrounding the settlement in a rectangular shape with rounded off corners. This anomaly is well-visible on the western, southern and eastern sides of the settlement, less so on the north. Not all sections of the potential northern outline of the settlement were involved in the geophysical survey. It is likely that a large quantity of barren soil was deposed on the southern part of the settlement during the regulation of the Tardi stream in the 20th century.

The largest area surrounded by this feature is 90 by 120 metres. Presumably this feature, either a ditch or palisade, if extended further, would have fully surrounded the settlement in a rectangular area, enclosing a 0.97-hectare area in total.

Several bipolar anomalies can be observed lengthwise, inside of the ditch/palisade, potentially hinting at the presence of a burnt structure *(Fig. 11. profile 1)*. It is hypothesized that such soil marks are the result of burnt wood-earth constructed boundaries. However, it is worth noting that this feature was only observed at a few locations, not throughout the entirety of the ditch/palisade.

Another faint, inner anomaly can be found at approximately 6 metres running parallel from the boundary; it is particularly noticeable at the north-estern rounded corner of the settlement and can be interpreted as another boundary line *(Fig. 11. profile 2)*. Its chronological relation to the outer, more pronounced anomaly line cannot be determined.

No entryway locations could be identified along the surveyed ditch/palisade lines.

Geophysical survey did not find any archaeological phenomena outside of the rounded rectangular area bordered by the anomaly line, apart from bipolar anomalies of metal scraps which are related to the present-day agricultural activity in the area.

No anomalies were found in an empty, 8 to 13 metres wide area running parallel to the inner side of

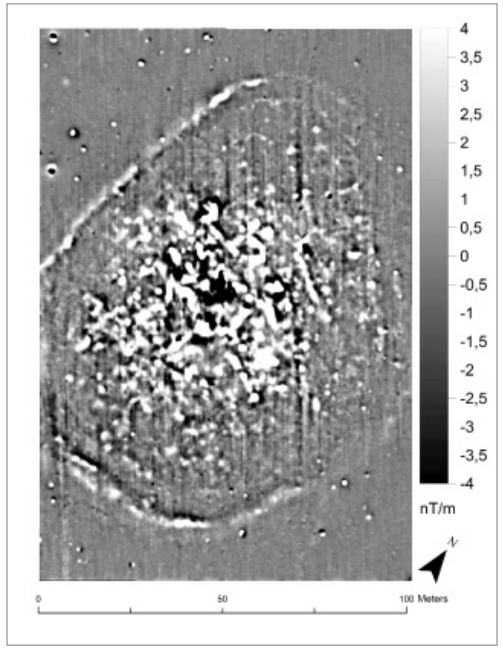


Fig. 10 *Geomagnetic survey of the central research area.*

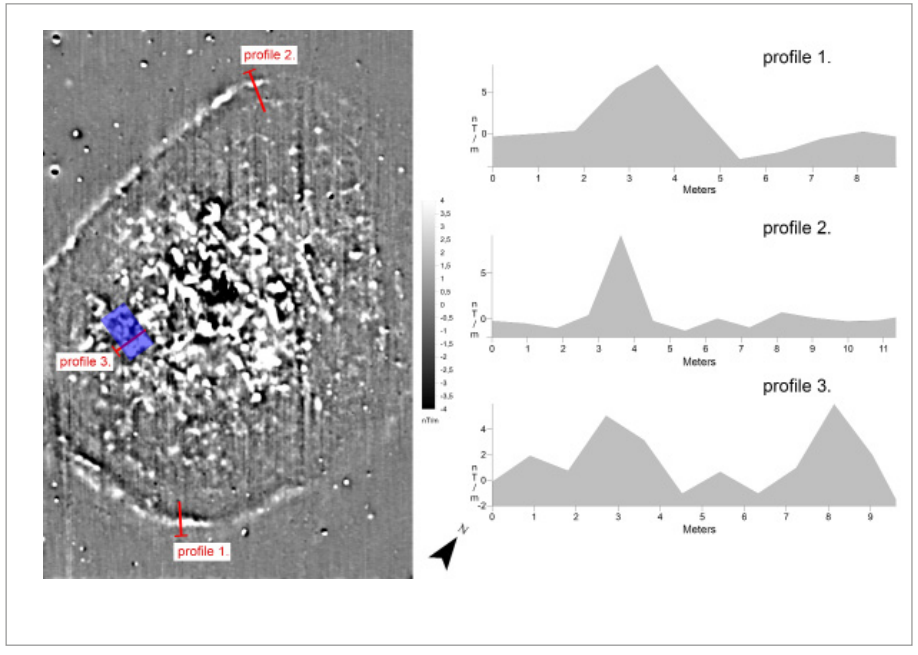


Fig. 11 *Profiles of each characteristic part of the research area, based on geophysical survey data. Geomagnetic survey profiles are highlighted with red lines, with a blue rectangle representing a potential building.*

the anomaly line bordering the rounder rectangular settlement area. Moving inwards, magnetometer survey found a 90 by 70 metres large, NNE–SSW orientated, anomaly-rich area in the middle of the hill. Inside this area, another spot (60 metres in diameter) showing an increased intensity of anomalies was located.

This central anomaly-rich area is also divided. The spot showing the highest of intensity (60 metres in diameter) is not located in the very middle of the area surrounded by the ditch/palisade, rather it is shifted to the western side. The 90 by 70 metres large, anomaly-rich area also has several spots with lower intensity, such as in its north-western corner.

The bipolar areas and the vast quantity of heavily burned pieces of daub that can be both observed and collected on the surface suggest an intensive burned horizon in the uppermost layers.

An anomaly group can be observed in a rectangular, 12 by 6.5 metres large area, situated WNW–SSW, at the southwestern edge of the central, anomaly-intense area. Since no bipolar signs were identified there, these can be hypothesized as archaeological evidence for a building with a foundation trench *(Fig. 11. profile 3)*. Additionally, several pronounced linear anomalies, situated NW–SE, each approximately 15 metres in length, can be identified in the area, however these were observed individually. Due to their length, these could be interpreted as the sidewalls of houses, if there were any similar anomalies running parallel with them. The surface of the central area showing heavy burn is approximately 23 by 11 metres. This however cannot be interpreted until further research is conducted. Based on the anomalies of the central intensive surface, it can be hypothesized that it shows signs of several buildings from different time periods.

Results of core drilling

Core drilling at Lapos-halom was carried out in September 2019 by a team of the BORBAS project working on Bronze Age sites in the surroundings of Mezőkeresztes. The aim of this work was to establish the layer thickness of Lapos-halom, to clarify the site's status as a tell or tell-like multi-layer settlement mound, and to obtain sample material for radiocarbon dating. To this end, a transect of eleven drill holes was laid out at intervals of ten meters inside the demarcation as seen in magnetometry (see above), and extending in broadly north-west to south-east direction across both the sections of the site devoid of frequent magnetic anomalies and the somewhat smaller mound itself visible on the surface and notable in magnetometry by the evidence of heavy burning *(Fig. 12)*.

In sum, with a thickness of cultural layers of up to c. 1.7 m in Core S0, which is in good accordance with the estimate derived from the DEM of the site above, and presumably with several phases of superimposed occupation layers Lapos-halom may

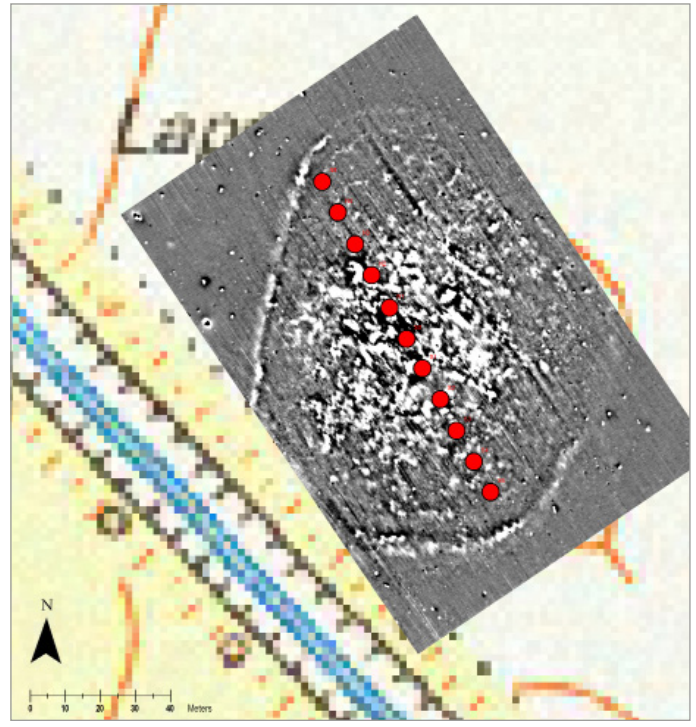


Fig. 12 *The transect of drill holes extending in broadly north-west to south-east direction across the central part of the settlement as seen in magnetometry.*

be said to fall in the category of tell or at least tell-like settlement mounds as defined by F. Gogâltan (2003). However, the actual size of this multi-layer part of the site is rather small. It extends for about 50 meters only from broadly speaking core Core N2 in the north-west to Core S3 in the south-east, while beyond this there is little or no preservation of in situ settlement layers and occupation *(Fig. 13)*. This finding is in good accordance with the magnetometer data presented above. The central multi-layer part of the site as derived from core drilling corresponds well with the area featuring strong anomalies seen in magnetometry, presumably due to heavy burning and the postulated impact of fire on surface-near settlement remains. In fact, this is precisely what we also see in our cores, for wherever in situ layers are well preserved the uppermost ones consist of greyish, ashy settlement debris indicative of heavy burning, and the same burned material can also be seen to erode and be washed downwards on the margin of the mound. Further outside, towards the demarcation, both in the north-west and the south-east there is a zone devoid of any in situ settlement layers (see Cores N5 and S5 in particular). Here, it is magnetometry that indicates that this finding indeed reflects some ancient reality, and not erosion or some other post-depositional damage, for in this zone there is also a general lack of settlement pits, that would have survived the loss of any superimposed settlement layers if such had been present at some stage. So most likely in the outer section of the site, in a zone c. 15–20 m wide in between the multi-layer core and the outer demarcation, we see in fact evidence of an open area, not built on, but dedicated to some other kinds of activities.

In detail, starting in the north-east, in Core N5 we see the modern topsoil, potentially overlying an older surface of unknown age, with some evidence

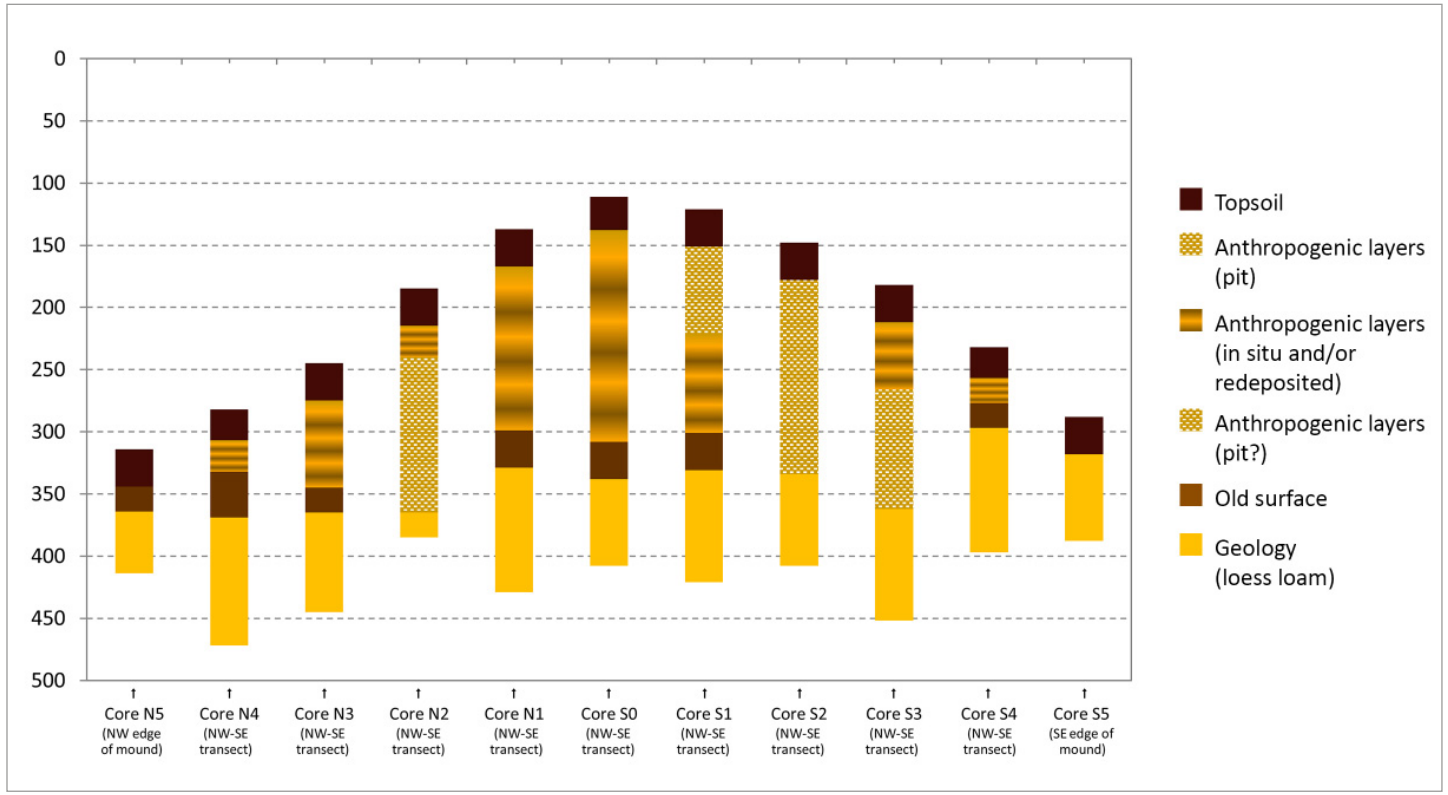


Fig. 13 *Schematic representation of the core drilling profile.*

of trampling, and humic material washing down into the underlying geology (i.e. slow natural soil formation processes). The adjacent Core N4 shows much the same sequence, but in addition features some loess loam from the underlying geology redeposited on top of the old surface also seen in Core N5. It is impossible to decide if this is a small lens only and a localised event, or evidence of some more systematic activity. In any case, this is evidence of human impact, presumably related to the Neolithic settlement evident here only. With Core N3 we are getting closer to the foot of the mound. We see here a relatively massive package c. 70 cm thick of the greyish, ashy debris from some final phase of the settlement, eroded downwards and redeposited along the margin of the original mound, superimposing there the remains of the ancient surface underneath it and the underlying geology. With Core N2 we are moving on to the artificial settlement mound itself, and we encounter some remains of in situ layers, including the final(?) destruction horizon, superimposing, most likely, a pit c. 1.25 m deep that was dug from one of the upper (younger) settlement layers and cuts through the original surface that is missing here right into the underlying geology. With Cores N1, S0 and S1 we are clearly on the central part of the mound, and in Cores N1 and S0, in particular, we have good evidence of previous settlement phases and debris underneath the final (or in any case: late in the sequence) destruction horizon already mentioned *(Fig. 14)*. Core S1 differs in that it features a small pit c. 70 cm deep that starts right underneath the modern topsoil and cuts into previous settlement layers, some of which still seem to remain underneath the bottom of the pit. Similarly, in neighbouring Core S2 we have evidence of a fairly massive pit c. 1.5 m deep, that extends from the top of the sequence (i.e. some final phase of the site) down right into the underlying geology where its bottom is clearly discernible and nicely bounded. A pit is also present in Core S3. It is more clearly discernibly overlain by the debris of the final(?) destruction horizon than was the case with previous Core S2. Finally, with Cores S4 and S5 we already find us outside again of the central tell or tell-like part of the site, and moving on into its south-eastern open section as outlined above. Here, in Core S4 we still have evidence of eroded and redeposited settlement debris from the adjacent mound on top of the old surface, while in Core S5 the stratigraphy comprises the modern topsoil and the underlying geology only.

Finally, four radiocarbon dates obtained so far from our cores nicely match the late Middle Neolithic or Szakálhát date suggested for Lapos-halom on grounds of the surface finds (see below), falling

Fig. 14 *The stratigraphic sequence in Core N1 (left, nos. 1–3) and Core S0 (right, nos. 4–7) on the central tell or tell-like part of the site.*

as they do into the late 6th millennium or the very beginning of the 5th millennium cal BC *(Fig. 15)*:

- *Sample no. MZS 19/1 at c. 5209–5005 cal BC (95.4%; Beta-565231 [charred material]: 6150 BP +/-30; Core N1, meter 2, 35–62 cm),*
- *no. MZS 19/3 at c. 5210–4997 cal BC (95.4%; Beta-565233 [charred material]: 6140 BP +/-30; Core S0, meter 2, 55–66 cm),*
- *no. MZS 19/4 at c. 5216–5016 cal BC (95.4%; Beta-565234 [charred material]: 6180 BP +/-30; Core S1, meter 2, 74–76 cm)*
- *and no. MZS 19/5 at c. 5208–4907 cal BC (95.4%; Beta-565235 [bone]: 6100 BP +/-30; Core S3, meter 2, 70–90 cm).*

As usual with such samples obtained by core drilling the amount and the choice of sample material for dating are restricted, and stratigraphic control is poor, so that there are obvious limits to the interpretation of the few dates so far available. It is noteworthy, however, that the three samples with the rather consistent and somewhat older dates – MZS 19/1, MZS 19/3 and MZS 19/4 – all come from the lower part of the sequence in their respective Cores N1, S0 and S1. They may therefore point to a slightly earlier phase of occupation than the potentially somewhat younger date given by MZS 19/5 that comes from the pit mentioned above in Core S3, overlain by the debris of the final(?) destruction horizon only, and potentially belonging to a somewhat younger horizon of occupation at Lapos-halom.

Thus, even though the overall duration of late Middle Neolithic settlement at Lapos-halom clearly was limited, the radiocarbon dates as well point to a certain time depth. They tend to confirm the above conclusion based on the existence of several phases of superimposed occupation layers that Lapos-halom may be said to fall in the category of tell or at least tell-like settlement mounds.

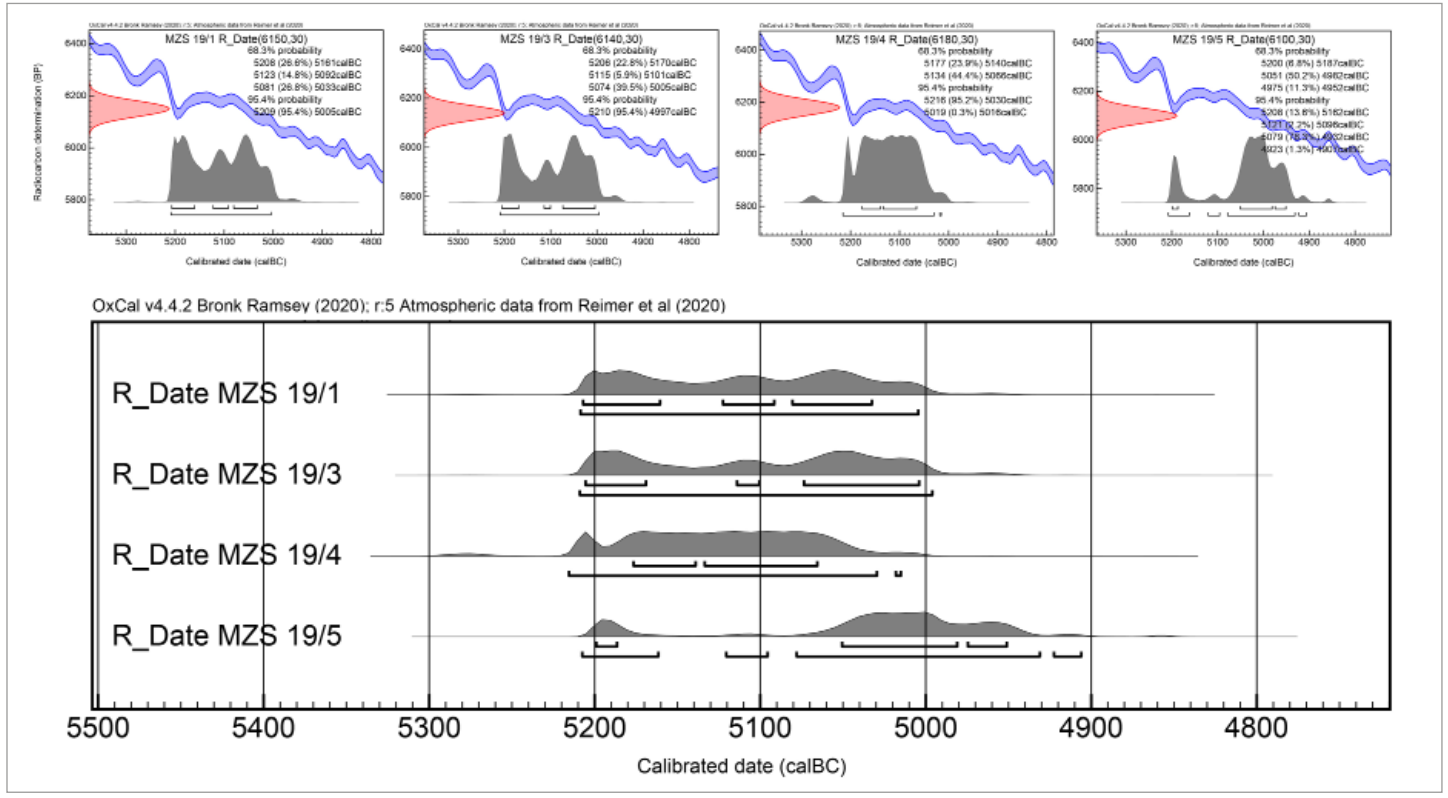


Fig. 15 *Four radiocarbon dates from drill holes across the mound.*

Non-invasive research data comparison

Geophysical survey and DEM comparison

When comparing the line of the ditch/palisade located on the geophysical survey with the topographic survey based on the DEM, it becomes noticeable that the anomaly line is not located at the foot of the settlement hill. Instead, it is situated on the hillside, 10 metres inwards from where the incline begins. However, it is only located 20 centimetres higher in terms of elevation, which can be attributed to the displacement of the cultural layer due to the erosion of the steep hillside.

Geophysical survey and aerial photography pattern comparison

The patterns found of archived and recent aerial photography can be compared with the patterns of the magnetometer survey analysis.

The magnetic anomaly line (ditch/palisade) surrounding the rounded rectangular area is visible on the geophysical survey but there are no distinct signs of it on either archived or recent aerial photo-

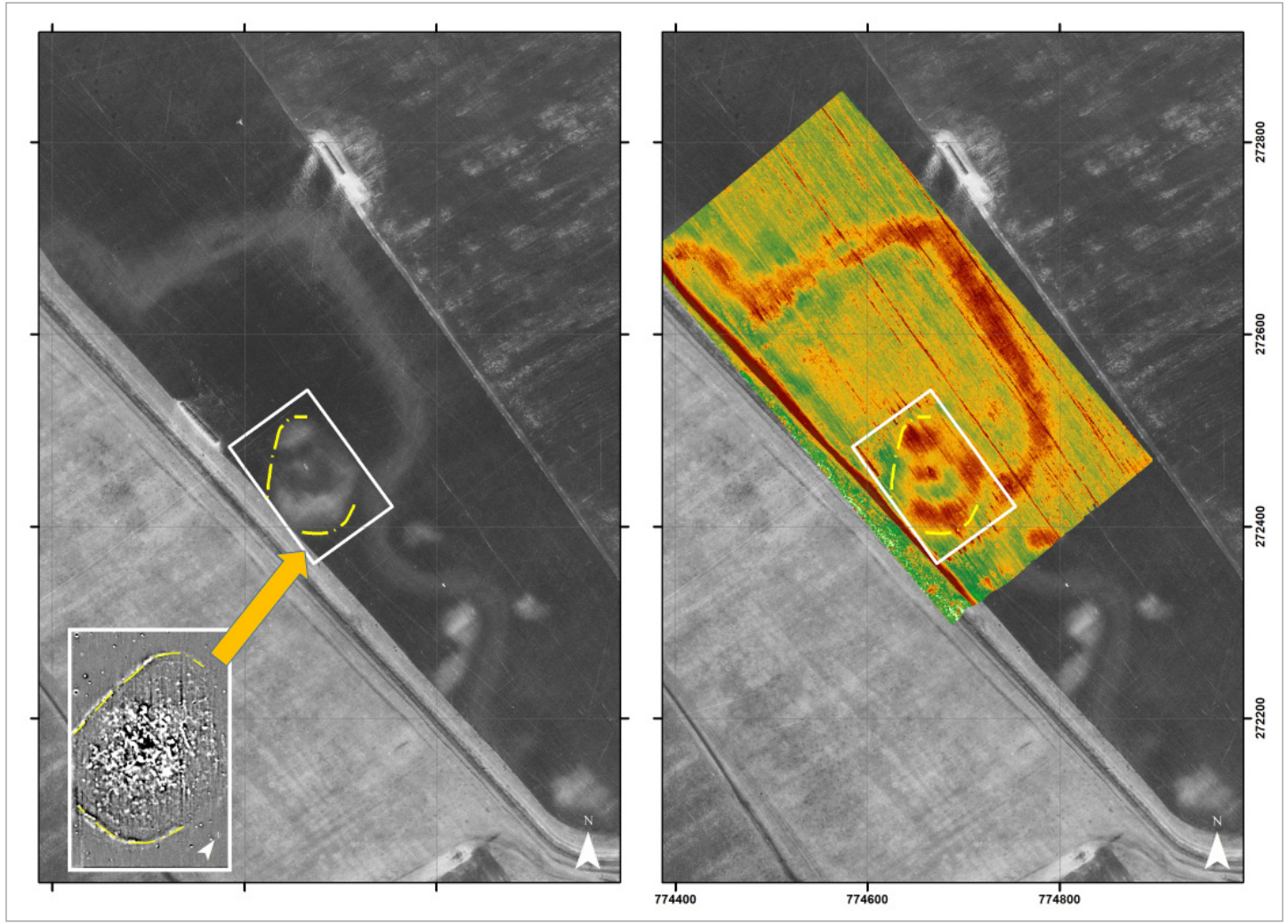


Fig. 16 *The line of the palisade(?) surrounding the settlement core, based on geophysical survey data, overlaid on the 1976 archived and the 2019 drone aerial photography of the site.*

graphy. However, there is an area on the 1976 aerial photography, corresponding with the 90 by 120 metre area of the magnetometer survey, which shows a significant change on the overall dark surface with very light and very dark soil patterns/marks. The northern, anomaly-free corner of the ditch/palisade surrounded area of the magnetometer survey can also be distinguished on both the archived aerial photography and 2019 drone photography *(Fig. 16)*.

A dark grey area spreading from the centre of the settlement, an area shown by the magnetometer survey to be covered with an intensive number of anomalies, can be observed on aerial photography. The 90 by 70 metres large, NNE–SSW situated, anomaly-rich inner area revealed by magnetometer survey can also be seen on the aerial photography, represented by 20 to 30 metres wide lighter stripes on the outside *(Fig. 16)*.

Based on aerial photography and the magnetometer survey, the central, intensively used area of the settlement can be split into two distinct areas. The purpose of the anomaly-free area located in the northern corner of the centre, shown as a separate, lighter area on both the 1976 and 2019 aerial photography, is unknown. It was either separated from the rest of the settlement core by a later digging-in, or perhaps the division was always a part of the Neolithic settlement core.

Fig. 17 *Surveyed surfaces on and around the site.*

The strip surrounding the rectangular area north of Lapos-halom is well-measurable on the drone photography as 20 metres wide *(Fig. 7)*.

Extensive survey results

The core area of the settlement was surveyed in strips seven metres apart from each other. Only the areas with a medium or large intensity of surface finds were recorded, as well as the areas where surface finds disappear. The surface finds on the hill of the settlement were spread in an area that roughly matched the 90 by 120 metres large area on the geophysical survey *(Fig. 17)*.

In spring 2020, surface find collection was carried out to confirm the presence (or lack) of archaeological finds in the area that used to be bordered by the former streambed from the north, east and south, and from the west, where the area is bordered by the present-day location of the stream. The field located between the western bank of the stream and a dirt road was also examined. No finds came to light in these areas.

Intensive survey of the areas with lighter soil marks on the aerial photography has not been carried out yet.

Only Árpád Age surface finds came to light at the hill located 450 metres south from the settlement, at the sharp eastern bend of the present-day stream. This area was originally located on the opposite, western bank of the stream.

Additionally, a collection of finds with a typological goal was carried out in the core settlement area. The collected finds were deliberately selected with the greatest typological variety in mind, so that the age of the settlement could be dated as accurately as possible given the circumstances.

Typological analysis of the assemblage

The assemblage collected during the extensive field survey, which was carried out along with non-invasive research, shows late middle Neolithic characteristics.

Large quantities of burnt daub, ceramics, animal bones can be found on the surface, as well as finds mostly consisting of grindstones, polished stone chisels and axes. This preliminary publication only contains finds that have typological significance in terms of determining the age of the settlement.

- *Several cylindrical neck sherds of various ceramic quality (including sherds tempered with stone and crushed sherds) came to light, with row of long vertical grooved decoration under their rims (Fig. 18. 1–2). A horizontal incised line can be found on the sherds to close off the vertical lines. Grooved rib ornamentation under the rim is characteristic of the face vessels of the (early) Szakálhát culture (Sebők–Kovács 2009, 84).*
- *Several spherical and hemispherical pots with grooved rims came to light in various sizes which were tempered differently (with quartz, sand, or ceramic sherds) and had various surface treatments (polished, smoothened, untreated). Thin walled sherds with highly polished surfaces were typical among the finds. This rim decoration was popular at Szakálhát culture settlements in the area (Mezőkövesd, Nagyfertő, Csengeri 2010, 17), and also during the late Neolithic (L. Hajdú 2015, 87, Fig. 5–7).*
- *A large number of sherds with densely stabbed lines were collected (Fig. 19. 1–5), which were thinned different and also have varying wall thickness. These stabs appear either in regular rows patterns, consisting of regular dots or diagonally notched sticks, or in irregular rows patterns with 90-degree bends. There is one instance where the decoration runs under the rim of a polished, spherical vessel with a straight cut rim (Fig. 19. 1). The rim is decorated with small grooves on both sides. The same stabbed decoration can be found on a large vessel sherd tempered with rock, which has a coarse surface. This decoration is the main motif of the so-called Szilmeg group (Kalicz–Makkay 1977, 50–51), but it is also characteristic of Szakálhát culture settlements of the area (along with finger and nail pressed patterns, such as at Mezőkövesd, Nagy-*

Fertő, Csengeri 2010, 17 and Fig. 7. 3–7). It can be also found in the mixed assemblage of the site Kompolt, Kistér (Bánffy 1999, 150 and 98. t. 6, 9–12), however it is missing from the core Szakálhát area.

- *Also characteristic of the Szilmeg group is the so-called ball-knob ornamentation, described by early literature as one of their main motifs (Kalicz–Makkay 1977, 51); however, these are also present in the ceramic material of the Szakálhát culture (Füzesi et al. 2017, 23; Hegedűs 1985, 38; Szénászky 1979, 76; 1988, 12). Several examples of this ornamentation were collected from the site, which were found mostly on large vessels with a neck and coarse surface (Fig. 20. 3–4).*
- *The other main characteristic of the assemblage is the repeating or high angle bent ribbed ornamentation on the side of the vessels with finger pressed sections. Several instances of this pattern were observed on vessels, ranging from large storage vessels to medium-sized thin walled vessels with polished surfaces (Fig. 19. 6–7).*
- *Several handle sherds characteristic of the Szakálhát and Bükk cultures can be found among the surface finds. These elbow-shaped handles are found at the curve of the cylindrical neck vessels, sitting at a 90-degree angle (Fig. 20. 1–2).*
- *Another characteristic decoration can be found on the walls of sherds of various wall thickness and ceramic quality, in the form of round, flat knobs, often with a concave centre (Fig. 19. 8–10). This kind of decoration is characteristic of Szakálhát culture pottery (Kalicz–Makkay 1977, 90) and it can be also found in late Neolithic assemblages (Kisköre, Gát: Kovács 2013, 46. Tables 1, 7, 48. Tables 3, 7, 50. Tables 6, 11, Tiszatardos, Csobaji út mentén: L. Hajdú 2015, Fig. 9.).*
- *Several pottery sherds were collected with a row of holes under the rim, which is characteristic of ALP and its subgroups.*
- *A large number of sherds with finger pressed or grooved, lengthy knobs and ribs came to light (Fig. 20. 6, 8).*
- *There is a special conical neck sherd with rib decoration under its rim and finger pressed decoration on the rim and the rib itself (Fig. 20. 7).*
- *A few sherds of the Bükk culture were also collected. The heavily incised linear decoration is characteristic of the classic Bükk phase (Fig. 18. 5–6).*
- *Two painted sherds were also part of the assemblage. One sherd is a dark, polished piece with a curved profile and no incision, painted red (Fig. 18. 9). This type of decoration is unknown at the Szakálhát core area (painted black stripe decoration is present there instead, see Battonya, Gödrösök, Goldman 1984, 31–32; Battonya, Parázs-tanya, Szénászky 1988, 12), however it is rather common in the assemblages of the nearby Szakálhát settlements (such as Mezőkövesd, Nagy-fertő, Csengeri 2010, 17). The other sherd is a part of a neck where the handle stemmed from, painted black (Fig. 18. 8), which has parallel finds from sites such as Bükkaranyos-Földvár (Kalicz–Makkay 1977, Taf. 110, 13). The use of black painting is commonly observed on late Neolithic finds, which was used to highlight handles and knobs. Similar examples can be found in the ceramic material of the sites Kisköre, Gát (Kovács 2013, 53. Table 1, 7–8; 54. Table 3.), Tiszakeszi-Szódadomb (Kovács 2013, 86. Table 4,) and Tiszatardos, Csobaji út mentén (L. Hajdú 2015, 2. Fig. 6.)*
- *Based on their profiles and materials, two additional sherds, a cup with an S-profile (Fig. 18. 7) and a small jar with handle (Fig. 20. 5) also show late Neolithic characteristics.*
- *A very small quantity of sherds with incised decorations were also found on the surface. These sherds did not show Tisza culture characteristics.*

The surface was covered in hydro- and limno-silicide, as well as Carpathian 1 and 2 obsidian tools, flint debris, large quantities of upper and lower grindstone fragments and several polished stone tools.

In addition to the large daub pieces with wattle impressions, the entire surface of the area was covered in a layer of burned daub crumbs.

Based on these characteristics, the assemblage collected at Lapos-halom shows the most similarity with a group of sites previously categorised as part of the Szilmeg group (particularly with the assemblages of the sites Bükkaranyos, Földvár, Eger, Kis-Eged and the eponymous Polgár, Folyás-Szilmeg) and the Szakálhát culture. Several aspects about the individuality of the Szilmeg group have been questioned by research. During the stylistic analysis of the ALP, Michael Strobel stated first that the name is more suitable to categorize a certain type of goods instead of an archaeological group (Strobel 1997, 82). Finds

Fig. 19 *A selection of surface finds from the 2019 assemblage.*

Fig. 18 *A selection of surface finds from the 2019 assemblage.*

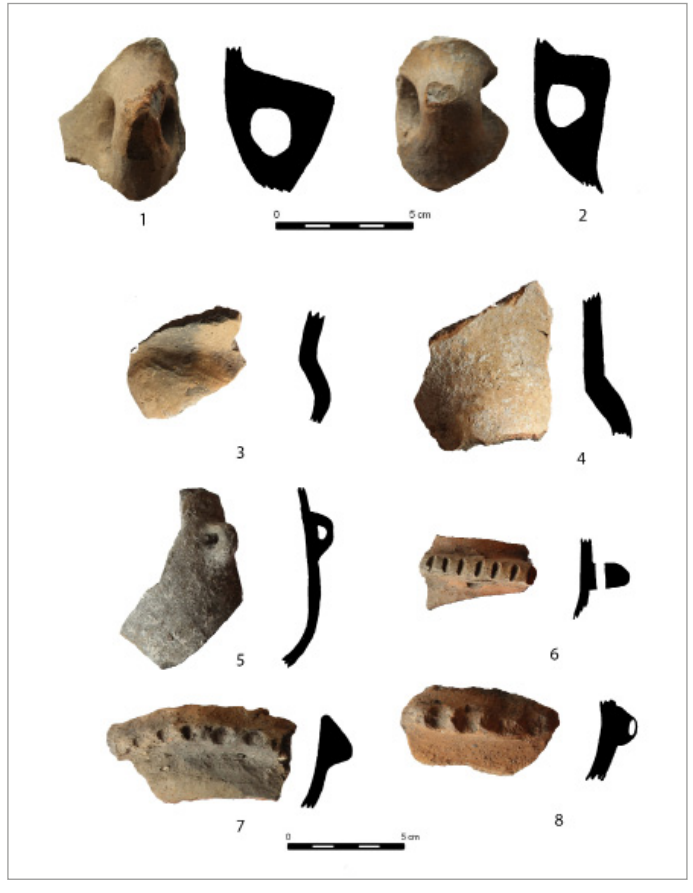


Fig. 20 *A selection of surface finds from the 2019 assemblage.*

previously categorized as Szilmeg came from contact zone the Szakálhát and Bükk culture territories and can be interpreted as an assemblage characteristic of such areas (Csengeri 2010, 25–27; 2013, 233–238; 2014, 504). However, the most characteristic traits of the Szilmeg group (stabbed rows, finger pressed ribs) are also present in late ALP assemblages, therefore these are more era- than area or group-specific traits (Raczky–Anders 2009, 41, 43).

The few well-identifiable Bükk culture sherds are normal in the Northern Great Plain region as it is the contact zone of the Bükk and Szakálhát cultures. Based on the above, the assemblage can be defined as phase IV. of ALP and, based on recent research, part of the Szakálhát culture. It is worth noting however that the most characteristic decoration of the Szakálhát culture, the incised spiral pattern, was not present in the assemblage. Of course, its absence can also be attributed to the fact that only two extensive surface find collections were performed at the site so far.

The place of Mezőkeresztes, Lapos-halom in the former settlement network

The ALP sites of the Borsodi-Mezőség and the Bükk foothill region were last summarized by Piroska Csengeri, who collected all Szakálhát and "Szilmeg" culture sites in Borsod-Abaúj-Zemplén County (Csengeri 2013, site-database; Csengeri 2014, 504) and published assemblages related to the Szakálhát culture from sites Mezőkövesd, Meleg-oldal (site M3-75.) and Mezőkövesd, Nagy-fertő (site M3-76.) (Csengeri 2010). In this collection, she categorized Mezőkeresztes, Hegyes-halom, located 1.9 kilometres from Lapos-halom and described as a Szilmeg site by Nándor Kalicz and János Makkay (Kalicz–Makkay 1977, 142, Kat.-Nr. 237), as an uncertain/unidentified site. Based on this definition, the assemblage from that site is similar to the assemblage found at Lapos-halom. In the archaeological collection of Herman Ottó Museum, there are two items from this site (HOM Inv. No.: 53.179.1–2). One is a flint tool and the other is an "elbow handle", which is characteristic of late middle Neolithic groups. However, these two finds alone are not enough to classify the site.

In March 2011, national park ranger Nándor Seres collected finds at the area of Hegyes-halom. His collection shows early ALP characteristics. The hill of the site was subject of extensive field and geophysical surveys in 2019. Small quantities of mostly undecorated, straw-tempered, early ALP ceramic sherds came to light. The only characteristic find was a pedestal vessel fragment. Magnetometer survey found no ditch around the settlement hill. Similar to the assemblage, the anomalies found on the

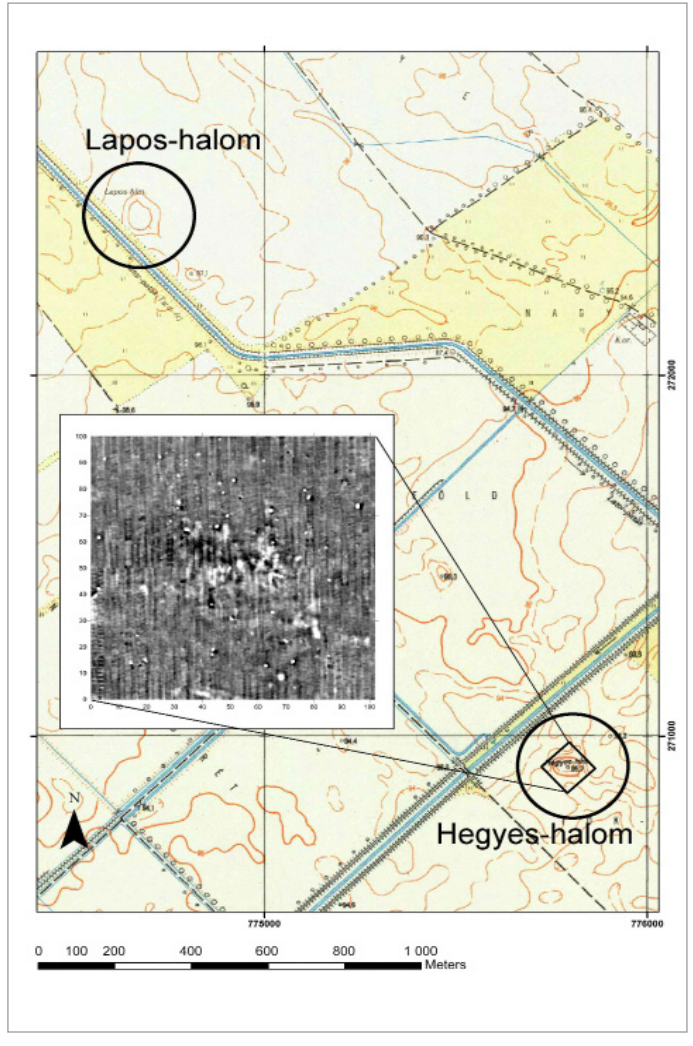
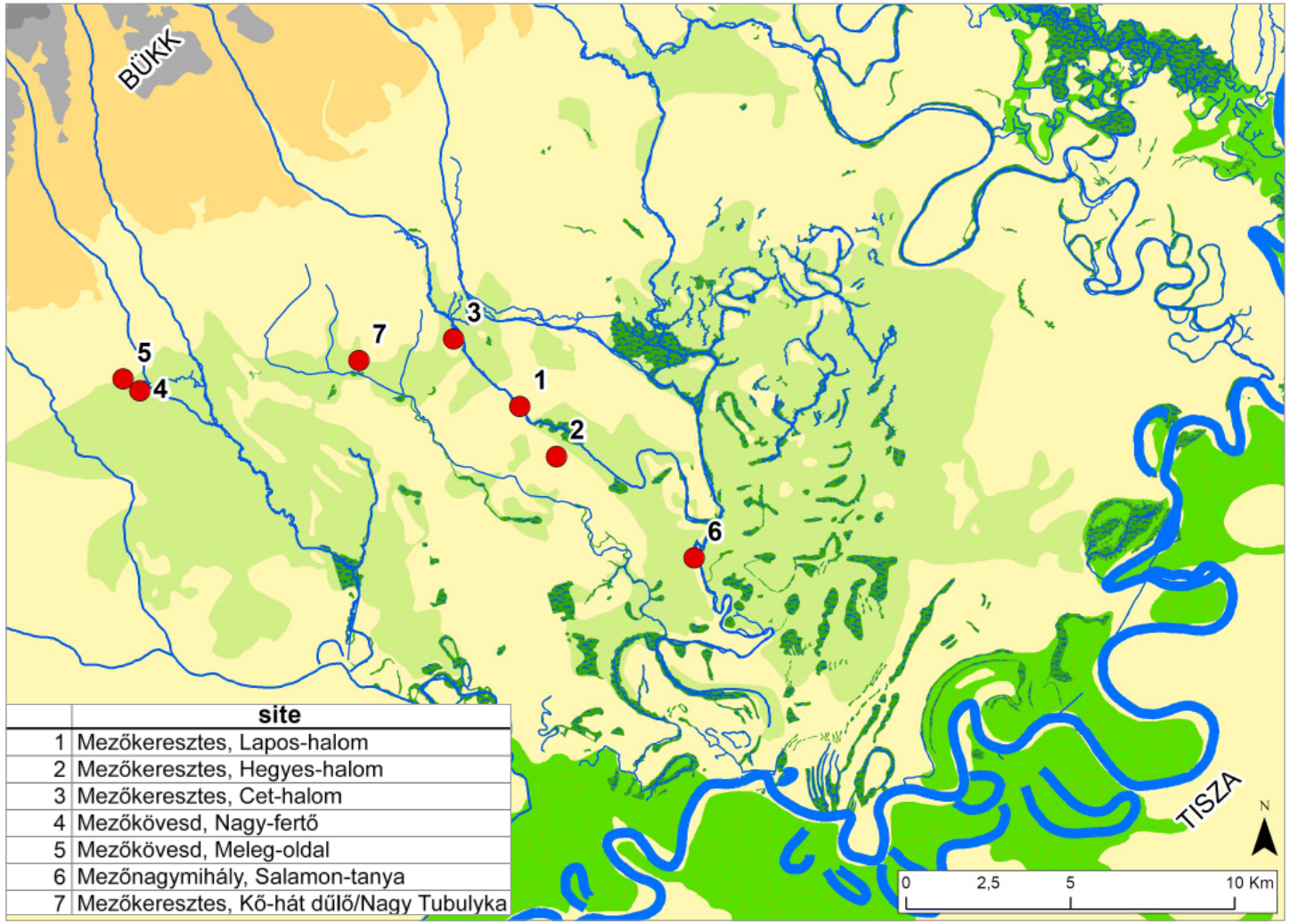


Fig. 21 *Location and magnetometry of Mezőkeresztes, Hegyes-halom.*

examined area suggest an archaeological site with very faint intensity *(Fig. 21)*. The anomalies do not form any kind of pattern. Based on this the area of Hegyes-halom is presumed to be a farmstead settlement situated on a small natural hill in an otherwise marshland area. The Hegyes- and Lapos-halom sites of Mezőkeresztes are likely from different periods and are definitely of different intensity. The sites had distinctly different roles in the settlement network.

Based on Csengeri's collection, nearby sites with similar Szakálhát finds include the site Mezőnagymihály, Salamon-tanya (excavated by Mária Wolf in 2008, Szörényi et al. 2009; defined by Csengeri) located to the south, Mezőkeresztes, Kő-hát dűlő/Nagy Tubulyka (site M3-69, excavated by Magdolna Hellebrandt and Judit Koós in 2000, Koós 2003; defined by Csengeri as features 23 and 25) located 5 kilometres to the west and Mezőkeresztes, Cet-halom (site M3-10, excavated by Maria Wolf in 1993-1994, Wolf–Simonyi 1995; defined by Csengeri as feature 257) located to the north, merely 3 kilometres away *(Fig. 22)*.

Although the aforementioned Neolithic settlements with Szakálhát assemblages can be found in the same microregion as Mezőkeresztes, Lapos-halom, they are not necessarily all from the same period. The fine pottery found at Mezőnagymihály, Salamon-tanya is categorized as ALP III., Tiszadob and Szakálhát



	site
1	Mezőkeresztes, Lapos-halom
2	Mezőkeresztes, Hegyes-halom
3	Mezőkeresztes, Cet-halom
4	Mezőkövesd, Nagy-fertő
5	Mezőkövesd, Meleg-oldal
6	Mezőnagymihály, Salamon-tanya
7	Mezőkeresztes, Kő-hát dűlő/Nagy Tubulyka

Fig. 22 *The location of Neolithic sites in the vicinity of Mezőkeresztes, Lapos-halom mentioned in the text, shown on a restoration map of the Borsodi-Mezőség prior to water regulation efforts, based on historical maps.*

style. Feature 25 of the site Mezőkeresztes, Kő-hát/Nagy Tubulyka includes Bükk style ceramic sherds in its Szakálhát assemblage, while feature 257 of the Mezőkeresztes, Cet-halom site contained Szakálhát-Bükk (classic-late Bükk) style ceramic sherds. The latter site also included an earlier horizon, characterized by Tiszadob and early Bükk style ceramics, with potential early(?) Szakálhát sherds. These factors necessitate radiocarbon measurements in order to narrow down which sites could be from the same period as the Neolithic settlement of Mezőkeresztes, Lapos-halom.

The nearest confirmed late Neolithic site is Mezőnagymihály, Liba-tanya Nyugat (excavated by Antónia Horváth in 2012, Horváth–Miskolczi 2019, 67, defined by Hajdú), which is located south of Lapos-halom and north of Mezőnagymihály, Salamon-tanya. The shapes and decorations (spherical and biconical vessels, striped black painting, rows of lentil-shaped knobs, knob and rib decorations) of the assemblage of a large pit complex (s2, s3, s4, s6) excavated at the site date the site to the early classic period of the Tisza culture (Tisza I/II, Hajdú 2013, Table XLV. 5–8, unpublished), when late Neolithic communities first appeared in the region.

There is no comparable data available on the settlement type, size and internal structure of the aforementioned sites. In addition to different reasons behind each site's excavation (optical cable routing, motorway excavation etc.) and vegetation coverage, most of the aforementioned sites contained finds of multiple periods and Szakálhát period material were only found in individual pits.

What type of settlement was Mezőkeresztes, Lapos-halom?

The 2.20 metres tall hill of Lapos-halom begs the question whether the site should be considered as a tell type settlement.

The establishment of tell settlements in the Carpathian Basin during the late Neolithic was common in the Southern Great Plain, on the area of the Tisza culture (Kalicz–Raczky 1987; Gogâltan 2003). Tell settlements were also present in Berettyó region, on the area of the Herpály culture, however those differ from the Southern Great Plain tells (Kalicz 1995).

Only a few tell or tell-like settlements are known north of the Middle-Tisza region. One of those settlements is Polgár, Csősz-halom, the unique nature of which was proven by several decades of research (Raczky 2019; Raczky–Anders 2010; Raczky–Sebők 2014; Raczky et al. 2014; 2015). The settlement of Polgár, Bosnyák-domb (Raczky–Anders 2009), with two settlement layers and Neolithic land use, can be dated to the interim period between the late Neolithic and early Copper Age, and the settlement of Hajdúböszörmény, Pródi-domb also belong to the same category (Raczky et al. 2010). In her PhD dissertation, Katalin Kovács categorized the sites Sárazsadány, Templom-domb and Sárospatak, Vár from the Bodrogköz region as an underdeveloped tell, but this claim requires further research (Kovács 2013, 76). Overall, tell settlements are not characteristic of the Northern Great Plain region, which makes the currently examined site special because of its geographical situation as well.

However, the assemblage found at Lapos-halom shows similarities not with late Neolithic finds, but with the middle Neolithic ALP cultural circle, specifically its later phase known as the Szakálhát culture. When examining the development of Tisza culture tell settlements, assemblages from the Szakálhát group of ALP can be found at the bottommost layer. This means that settlement concentration process which ultimately results in the creation of tell settlements began at the end of the ALP period (Kalicz−Raczky 1987; Makkay 1982, 124–125). A thick row of Szakálhát layers can be found under a thin Tisza culture layer at the tell settlement of Battonya, Parázs-tanya in the Southern Great Plain region, with early Szakálhát settlement features found at the very bottom (Szénászky 1988, 5). This multi-layer Szakálhát data provides the best possible explanation when it comes to the interpretation of the Lapos-halom settlement.

Based on typological characteristics, the assemblage found at Lapos-halom, showcasing late ALP features can be dated to this interim period, leading up to the development of tell settlements. However, currently there are no known tell settlements in the Northern Great Plain region with multiple thick settlement layers.

It is worth noting that in terms of land use, no Neolithic surface finds were located beyond the hill and its vicinity, outside of the settlement boundaries. The relation between the settlement hill and the artificial ditch surrounding the rectangular area next to it however suggest land use that is characteristic of late Neolithic Great Plain and Transdanubian communities. However, the presence of ditch/palisade systems was not uncommon throughout the middle Neolithic period either (Raczky–Anders 2012). These features are partially contradicted by the late middle Neolithic assemblage found at site.

The site of Polgár, Ferenci-hát (Raczky–Anders 2009; 2012, 280) was attributed a similar role in the late Neolithic settlement concentration process. The currently available published assemblage of that site shows several similar characteristics, including those of the Szakálhát and Bükk cultures.

Summary

Based on previous research, the core area of the settlement at Mezőkeresztes, Lapos-halom was defined, and a better understanding was gained of the inner structure of the settlement. Another, man-made area was defined north of the settlement; its shape is rectangular, and it is bordered by a 20 metres wide ditch. No finds came to light from its surface. The Tardi stream crossed this rectangular area at its northern side and flowed into the presumably artificial ditch as well. Further examination requires stratigraphic drillings to be performed.

The assemblage that came to light can be categorized as ALP phase IV and shows similarities with the Szakálhát and Bükk cultures. Nonetheless, the geographic location, shape and land use of the settlement all make the site unique.

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Mezőkeresztes, Lapos-halom újkőkori településének roncsolásmentes kutatása

Absztrakt

A dolgozat a Mezőkeresztes, Lapos-halom neolitikus dombján végzett roncsolásmentes kutatások bemutatására vállalkozik.

A lelőhely az AVK késői időszakához kapcsolható települési domb, rétegtani viszonyai még nem tisztázottak.

A geofizikai felmérések alapján sűrűn beépített, mesterséges határolóvonallal körbevett terület.

Tipológiailag az északi Szakálhát és a korábbi Szilmeg név alatt elkülönített csoportok leletanyaga áll legközelebb az itt bemutatotthoz, néhány jellemvonás pedig már a késői neolitikum irányába mutat.

A lelőhely körüli táj mesterséges kialakítására utaló adatok a tudatos térhasználatot bizonyítják.

A tanulmány korábban megjelent magyar nyelvű változata ezen a linken keresztül érhető el: https://hermuz.hu/wp-content/uploads/2021/01/book_home_LVIII-LIX_WEB_03_csengeri.pdf

KULCSSZAVAK: NEOLITIKUM, SZAKÁLHÁT, BORSODI-MEZŐSÉG