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DATA PROCESSING METHODS OF SYSTEMATIC ARTEFACT COLLECTIONS IN MULTI-PERIOD SITES. THE EXAMPLE FROM THE ÉRD-SZÁZHALOMBATTA LOESS PLATEAU

TÖBBKORSZAKÚ LELŐHELYEKEN VÉGZETT SZISZTEMATIKUS LELETGYŰJTÉSEK ADATFELDOLGOZÁSI MÓDSZEREI. AZ ÉRD-SZÁZHALOMBATTAI LÖSZPLATÓ PÉLDÁJA•

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Abstract

The research of multi-period site complexes has several challenges, particularly in topographical investigations where contextual and stratigraphical information is lacking. In such cases, distinguishing the extent of settlements or cemeteries of different periods based on surface artefacts can be challenging. When I was processing the data of the gridded artefact collections gathered from the multi-period site complex of the Érd-Százhalombatta loess plateau between 2017 and 2019, and then in 2023, I encountered several problems regarding this issue. One was related to collection units that could only be partially surveyed, resulting in an incomplete representation of their artefact counts. I have attempted to solve this issue, the problem of not fully researched collection units, with Quantum GIS tools. While this experiment produced better results, it did not solve other difficulties arising from the uncertainty of the findings dating. Since the research area was occupied from the Early Bronze Age to the Late Iron Age utilising the same raw materials for their ceramics, it was challenging to identify the exact period of the sherds. I aimed to deal with this issue by using two different approaches: one using the grid system to display the minimum and maximum number of findings from each chronological period, and the other using a point selection method for displaying differently dated artefacts simultaneously. Through the data management systems developed in this research and the various attempts to address these obstacles, I was able to extract detailed information from the raw data and consequently provide a more comprehensive interpretation of the results.

Kivonat

A többkorszakú (vagy többkorszakos) lelőhely-komplexumok vizsgálatakor számos kihívással szembesülhetünk. Különösen igaz ez a topográfiai kutatásokra, ahol a leletek, jelenségek kontextusa és stratigráfiai adatai nem ismertek, így csak a felszíni leletek alapján nehéz meghatározni a különböző korú telepek és temetők pontos kiterjedését. Amikor az Érd-százhalombattai löszplató több korszakú lelőhely-komplexumának 2017–2019 közti, illetve 2023-as négyzethálós leletgyűjtéseit dolgoztam fel, több nehézségbe ütköztem ebben a témában. Az egyik azokhoz a gyűjtési egységekhez tartozott, amelyek területét csak részlegesen lehetett kutatni és így a felszíni leletek hiányos reprezentációját eredményezték. A nem teljesen kutatott gyűjtési egységek problémájának megoldására a Quantum GIS eszközeivel tettem kísérletet. Habár ezáltal sikerült jobb eredményeket elérni, a leletek bizonytalan keltezéséből fakadó problémák nem oldódtak meg. Mivel a vizsgált területet a kora bronzkortól a késő vaskorig szinte minden korszakban lakták, valamint ugyanazokat a nyersanyagokat használták fel a kerámiáikhoz, meglehetősen nehéz volt különválasztani az egymást követő periódusok leleteit. Ezt a problémát kétféle módon próbáltam megoldani; elsőként a négyzetháló használatával jelenítettem meg az egyes korszakokhoz tartozó leletek legkisebb és legnagyobb számát, míg a második módszer esetében egy GPS pontokon alapuló rendszert használtam a különféleképp datált leletek egyidejű megjelenítésére. A kutatás során kidolgozott adatkezelési rendszerek, illetve a fent említett akadályok megszüntetésére tett kísérletek révén sikerült a nyers adatokból részletesebb információkat kinyerni, és ezáltal lehetővé tenni az eredmények átfogóbb értelmezését.

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KEYWORDS: SYSTEMATIC FIELDWALKING, GRIDDED ARTEFACT COLLECTION, DATA PROCESSING, GIS, BRONZE AGE, EARLY IRON AGE

KULCSSZAVAK: SZISZTEMATIKUS TEREPBEJÁRÁS, NÉGYZETHÁLÓS LELETGYŰJTÉS, ADATFELDOLGOZÁS, TÉRINFORMATIKA, BRONZKOR, KORA VASKOR

Introduction

In recent decades, the topographical research of archaeological sites has undergone some remarkable advancements. New methods came to the service of archaeologists, such as geophysical prospecting, satellite imagery, or LiDAR, and with the development of technology, old methods also gained some new aspects.

The appearance of handheld GPS devices and the more widespread use of GIS (e.g. see Conolly 2008; Conolly & Lake 2006; García Sánchez 2012; Wheatley & Gillings 2002) have provided new possibilities and perspectives for fieldwalking surveys (e.g. Czajlik & Holl 2011; Gyucha et al. 2015; Koller 2018; Koller 2021; Mesterházy 2013; Mesterházy & Füzesi 2024; Mesterházy & Stibrányi 2012). These tools improved the intensive surveys of large territories, yielding copious amounts of data about the sites and artefacts (Czajlik 2022, 62). Nevertheless, collecting data is only one part of the process; managing, visualising, comparing, and interpreting the results alongside other methods is equally crucial.

In the case of gridded surface collections, the most common method of data management involves linking the numbers or weights of artefacts to the specific collection units for each period. Utilising pre-established collection units, such as grid squares, is a well-established solution as it provides a clear and manageable unit for collecting artefacts and handling their data in GIS (e.g. Campana et al. 2006; Czajlik et al. 2015; Dreslerová & Demján 2019; Mesterházy 2013; Mesterházy & Füzesi 2024; Wroniecki & Barton 2018). Furthermore, a unit like a square can effectively display the artefact density of archaeological sites period by period. However, the incomplete surveying of a collection unit, due to fragmented and mosaic parcels or other obstacles, can lead to misleading density numbers or colours displayed on a map. I call this *the problem of not fully researched collection units*, for which I was seeking a solution while working on my master's thesis.

While the previously mentioned method can effectively show the artefact density of the grid on a period-by-period basis and is useful for many surveys, it can be insufficient for multi-period site complexes. Whereas, in areas where human settlements existed for several periods, the differences in the material culture may not be as apparent. Therefore, this can make it much more difficult to date the collected artefacts. The difficulty of dating can result in the artefacts not being able to be definitively assigned to a particular archaeological period. In these cases, it is not possible to simply indicate the number of artefacts per period on the grid of a map, as a considerable part of the dating data is only partially reliable. Therefore, another data management and displaying method is necessary to address this difficulty.

I faced these issues while I was writing my master's thesis about the systematic surface collection of a multi-period site complex at the loess plateau of Érd-Százhalombatta (for further details and research history see: MRT 7; Czajlik et al. 2016; Czajlik et al. 2019b; Czajlik et al. 2023; T. Németh et al. 2016; Vicze 2004; Vicze 2013). In this area, there are two larger and better-researched sites; *Százhalombatta–Százhalom* is a well-known Early Iron Age tumuli field whose territory contains burials from several periods of the Bronze Age, too; and *Százhalombatta–Földvár* which is a fortified tell settlement inhabited from the Early Bronze Age up to the Late Iron Age. In addition, there are several smaller prehistoric sites on the loess plateau, whose connection with the two large sites is still uncertain (**Fig. 1.**).

The challenges in dating were not the only difficulty I had to face while surveying this area. The loess plateau of Érd-Százhalombatta is mainly cultivated in small parcels with diverse vegetation and many enclosed gardens. As a result, conducting systematic artefact collections was difficult as we had to work within the constraints of the small parcels, and therefore many collection units could only be partially researched.

Between 2017 and 2019, an extensive topographical investigation was conducted in this area as part of the Interreg Iron-Age-Danube (DTP1-1-248-2.2) project. The research focused on exploring the settlements and cemeteries of the Early Iron Age along the Danube and brought together a team of twenty institutes from Austria, Croatia, Hungary, and Slovenia. From 2017 to 2019, several research methods (e.g. aerial and geophysical prospection, LiDAR) were applied on the loess plateau, including the systematic artefact collection discussed in this paper.

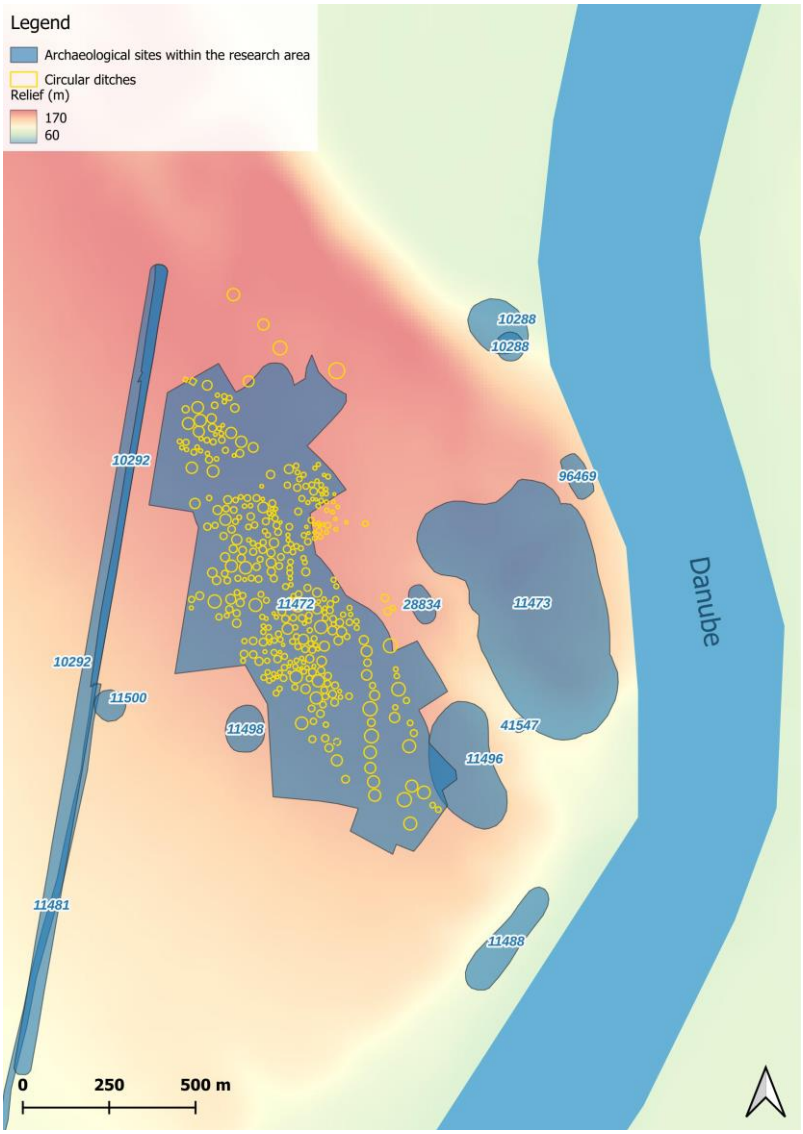

Fig. 1.:
Archaeological sites within the research area with the circular ditches of the Early Iron Age tumuli field. Sites:

1. ábra:
Régészeti lelőhelyek a kutatott területen és a kora vaskori halomsírmező körárkai. Lelőhelyek:

10288: Érd - Téglagyár;
10292: Érd - Római út;
11472: Százhalombatta - Százhalom;
11473: Százhalombatta - Földvár;
11481: Százhalombatta - Római út;
11488: Százhalombatta - Alkotmány utca;
11496: Százhalombatta - Megyunka-dűlő (Kocsányné dombja);
11498: Százhalombatta - Tóthtanya;
11500: Százhalombatta - Stichtanya;
28834: Százhalombatta - Szőlőskert;
41547: Százhalombatta - Turul utca 49-53.;
96469 Érd - Ófalu, Zátony

As a student at the Institute of Archaeological Sciences of Eötvös Loránd University, I had the privilege of joining the Hungarian team, led by Zoltán Czajlik. Related to this project, the topic of my master's thesis (Gergácz 2020) was to process the systematic surface collection data and help to analyse it in the context of further non-invasive research methods. The first conclusions of the research were published in the volume presenting the results of the project (Czajlik et al. 2019b) as well as in a conference volume (Czajlik et al. 2023).

A few years later, in 2023, the systematic artefact collections continued with the support of the Hungarian National Museum. These investigations were crucial for dating the phenomena discovered through previous aerial and geophysical prospection (Czajlik 2008; Czajlik et al. 2016; Czajlik et al. 2017) and for understanding the archaeological topography of the area.

Systematic artefact collections between 2017 and 2023

During the initial planning of the fieldwork, we realised that researching all ~75 hectares of the tumuli field within the timeframe of the Iron-Age-Danube project would be impossible; therefore, we needed to prioritize our research questions. In the first year, the southern part of the tumuli field was in focus to delineate the Early Iron Age finds to the east and west of the known border of the burial mounds. During the second year, to test the hypothesis of the archaeologists of the "Matrica" Museum, we examined the cultivation plots situated northwest of the hillfort settlement for the Early Iron Age horizontal settlement. Our plan for 2019 and 2023 was to explore the area close and in between the two previously investigated territories, but due to the vegetation cover, our efforts were only partially successful (**Fig. 2.**).

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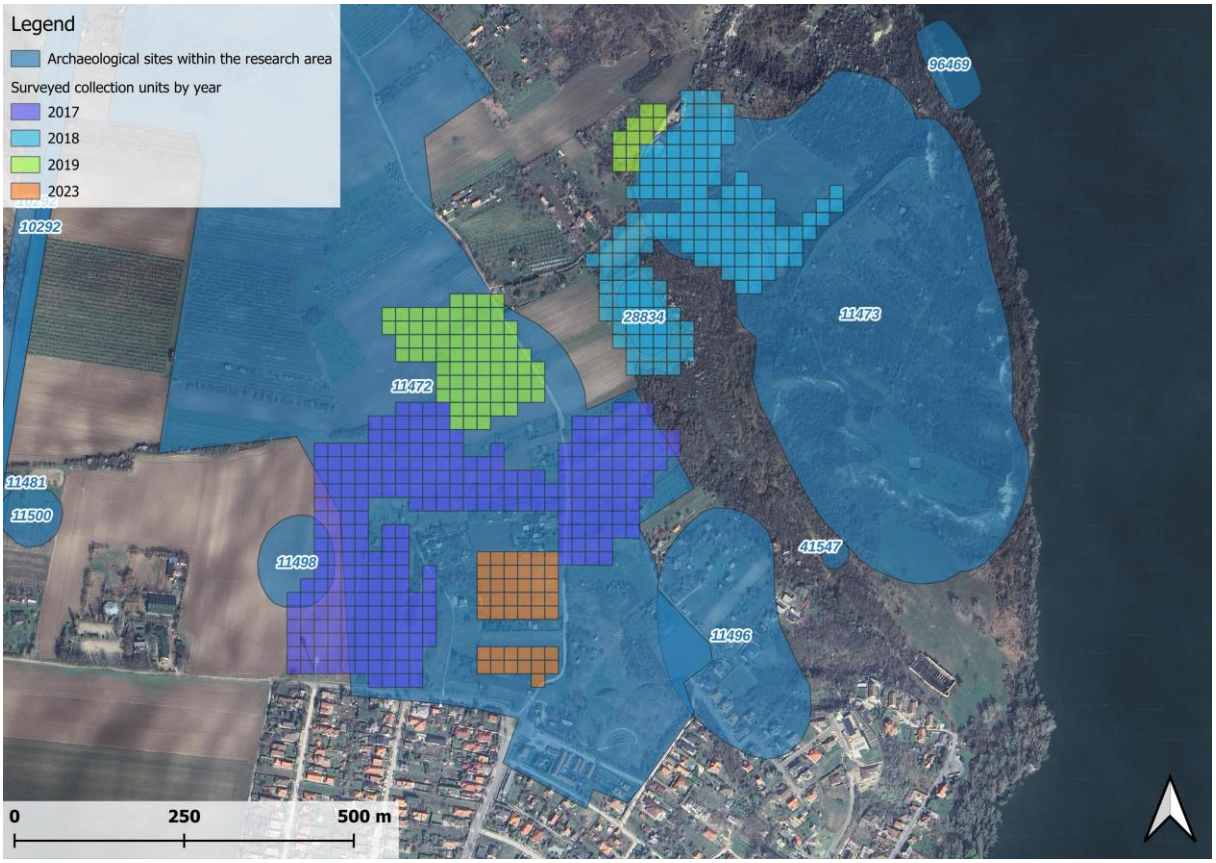

Fig. 2.: Researched collection units between 2017–2023
2. ábra: A vizsgált gyűjtési egységek 2017–2023 között

During our fieldwork, we used a 20 m x 20 m north-south oriented grid corresponding to the EOV (Unified National Projection) coordinate system, created by two colleagues of Eötvös Loránd University, András Bödőcs and László Rupnik. We decided to use the 20 m x 20 m grid system, because this size could provide detailed results, while also be time-effective regarding the fieldwork. In 2017, the fieldwalkers followed the grid on handheld GPS devices, then the edges of the collection units were marked out with wooden stakes using a Trimble GeoX 7 GPS in 2018 and 2019 and a Leica GS07 antenna with a Leica CS20 controller in 2023. A collection unit was examined by one person, usually for 10–15 minutes, the finds were marked on handheld GPS devices and collected by these units. During the four seasons of research, we managed to investigate ~22 hectares with this method in 10 working days.

During the years of the fieldwork, the workflow of washing, dating, and documenting the finds was continuous. The cleaning was done by fellow students and me, while PhD students Kata Novinszki-Groma and Eszter Fejér provided invaluable assistance with the dating. Meanwhile, I started to build the database which grew and evolved organically as I gained more knowledge and experience. The database structure described in this paper represents its latest and most evolved state.

For the data management, I created two Excel files. Both files included unit ID, GPS ID, survey status and survey date. Besides that, one contained the number of finds collected by unit in total and by era, while the other incorporated the weight data of the artefacts of different periods also by unit. By joining these Excel files with the grid's shape file in QGIS, I was able to display the number and weight of artefacts.

However, precisely determining the age of the sherds during dating proved to be a challenging task, often bordering on the impossible. The reason for this is the continuity of human activity on the landscape, spanning from the Early Bronze Age to the Late Iron Age and that the former habitants used the same raw materials for crafting their ceramics. Therefore, the above-mentioned Excel files did not contain just a simple era for most of the sherds. Instead, it featured two columns for each phase, indicating the minimum and maximum artefact number. The minimum represented surely dated artefacts of a period, and the maximum included both certain and potential artefacts.

Processing the data of the artefact collections

The problem of not fully researched collection units and a solution attempt

Although a grid is frequently used to show the number or weight of collected artefacts in each unit by period (e.g. Czajlik et al. 2015, Fig. 4.; Gruškovnjak et al. 2019, II.4.2. Fig. e-f; Kecheva 2014, Fig. 2.; Mesterházy 2013, Fig. 3.) or with a heatmap (e.g. Czukor et al. 2013, Fig. 14.; P. Fischl & Horváth 2010, Fig. 6.), this figure or colouring alone may not always represent the actual density of artefacts. This display method often fails to consider that the collection units have not been surveyed in the same spatial extent. In places, such as the study area with fragmented and mosaic parcels, *the problem of not fully researched collection units* could have a significant impact on data interpretation.

The techniques developed by Anderson & Negus-Cleary (2018), Burgers et al. (2004), and Dreslerová & Demján (2019) tried to face this type of bias during gridded artefact surveys. Since we strived to do the field surveys in fairly uniform visibility circumstances, I only considered the differences in the extent of the researched units.

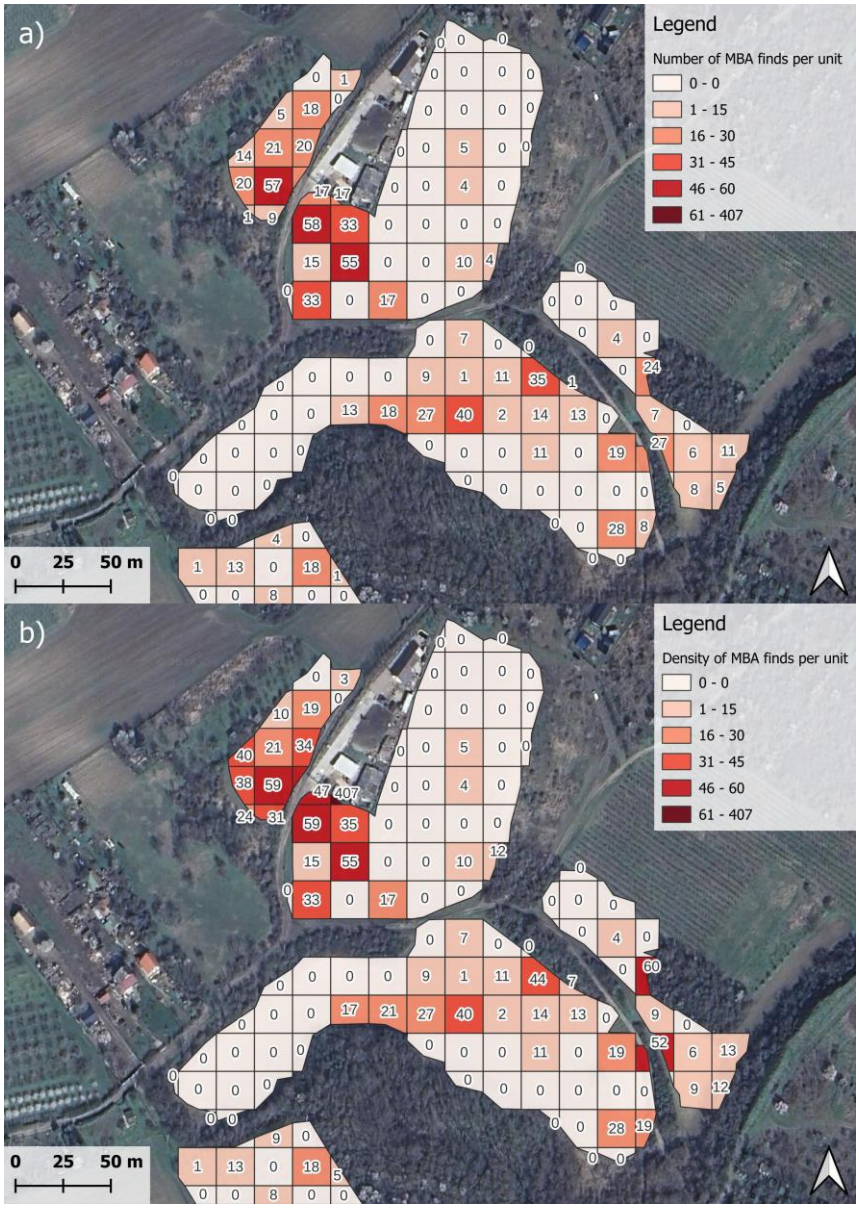

Fig. 3.: a) The minimum number of Middle Bronze Age finds by collection unit, b) The density of Middle Bronze Age finds after the area-based correction, based on their minimum number

3. ábra: a) A középső bronzkori leletek legkisebb száma gyűjtési egységenként, b) A középső bronzkori leletsűrűség a területi alapú arányosítás után, a legkisebb számokat felhasználva

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I applied an area-based density-correcting approach (**Fig. 3.**), similar to the one used by Anderson & Negus-Cleary (2018), since that seemed the most suitable for this research. My first step aimed to delineate the surveyed areas within every 20 by 20 metres unit by creating a surface shape file in QGIS to mark out the surveyed areas based on the tracks of the fieldwalkers and then to cut out the indeed studied territories of the grid. Then I joined the cut grid and the Excel files dynamically, enabling the data of the Excel files to be constantly updated in the grid's attribute table in the QGIS software.

Once I had the roughly accurate surveyed area and the number of collected artefacts in each unit, I calculated the area compensated artefact density. The 'number of findings per area' was defined by using the formula: $x = a / b * 400$, where *'x'* is the density, *'a'* is the number of collected finds, *'b'* is the researched area (m^2) of the given unit and the '400' represents the area in m^2 of a fully researched 20 m x 20 m sized collection unit. To obtain the value of *'b'* I used the *'$area'* function in the QGIS field calculator. While the density I received was hypothetical, it proved to be advantageous for determining the concentration of findings, and for later interpretation. However, there are limitations to this method, as it does not alter the values of the squares without findings and can only proportion the number of pieces from periods known from the surface collection, leaving us with no data on other, otherwise present periods. Furthermore, it must be taken into account that the units that were surveyed to a very small extent could also distort the results with too large, compensated artefact numbers.

The effect of chronological uncertainty and a solution attempt

As previously mentioned, it had been challenging to precisely date the collected artefacts. During the fieldwork, we marked a total of 5431 points on the GPS devices, out of which 4020 were sherds from archaeological periods. We were able to date 1887 artefacts to one (e.g. Early Iron Age), 1618 to two (e.g. Late Bronze Age or Early Iron Age) and 528 to three possible periods (e.g. Middle Bronze Age or Late Bronze Age or Early Iron Age). Therefore, only 46% of the archaeological artefacts had a certain dating, while the others could belong to two or even three periods.

By displaying each period on a map and comparing their minimum and maximum densities, I was able to gain more comprehensive information. Since the minimum number would probably signal too few artefacts and the maximum number too many, by examining them together, we can get a better picture of what the actual density could look like. Additionally, applying the area-based density correcting method discussed previously to both cases enables a more precise visualisation. Although this step brings us closer to the real distribution of archaeological finds of different ages, the map display still does not reveal the probability of a finding belonging to a specific period.

A different approach: using point selection for visualising several period categories at the same time

Since we can only visualise the data of one period at a time using grid-based densities, I shifted my focus to analysing GPS points during data processing. Using the latter for spatial analyses proved to be a great approach by multiple studies (e.g. Brooks et al. 2009; De Clercq et al. 2013; Koller 2021; Mesterházy & Füzesi 2024; Terrenato 2000; Trachet et al. 2017) as it can provide more accurate data about specific objects (Gruškovnjak 2019, Fig. 7.) compared to the conventional gridded surveys. Furthermore, by assigning dating data to these points, multiple periods and their dating probabilities can be visualised simultaneously.

In order to achieve this, my first step was to generate unique IDs for the GPS points using the field calculator of QGIS and to add these IDs to a newly created Excel file as well. These IDs contained the date of the fieldwalking in YYMMDD format, the GPS ID, and the point number, such as *"191129_G4_0195"*. It was calculated with a quite simple formula as *'191129_G4' + "name"* in the case of the previous example, where the *name* is the column containing the point numbers. Then I merged all the shape files into one and joined together with the new Excel file utilising the point IDs.

This enabled further analysis of the points. Before I could assign any archaeological phases to the points, it was necessary to address the collected non-archaeological artefacts. As mentioned before, a significant number of non-archaeological sherds were gathered during the fieldwork, making up one-fifth of the items collected. The reason for this was probably the limited expertise of the students participating in the fieldwork and the abundance of modern artefacts on the surface. The points of the latter made the real accumulation of archaeological finds invisible by creating a false homogeneity.

To eliminate this issue, I assigned a "modern" attribute to as many points inside a collection unit as many non-archaeological sherds had been noted during the dating process. I aimed to select points that were evenly distributed within the collection units to prevent any artificial clustering of the fragments. For the selected points I added a "modern" attribute in the Excel file's column containing the types of the finds. Then I repeated this for all find types and assigned any associated field notes to the corresponding point (**Fig. 4.**).

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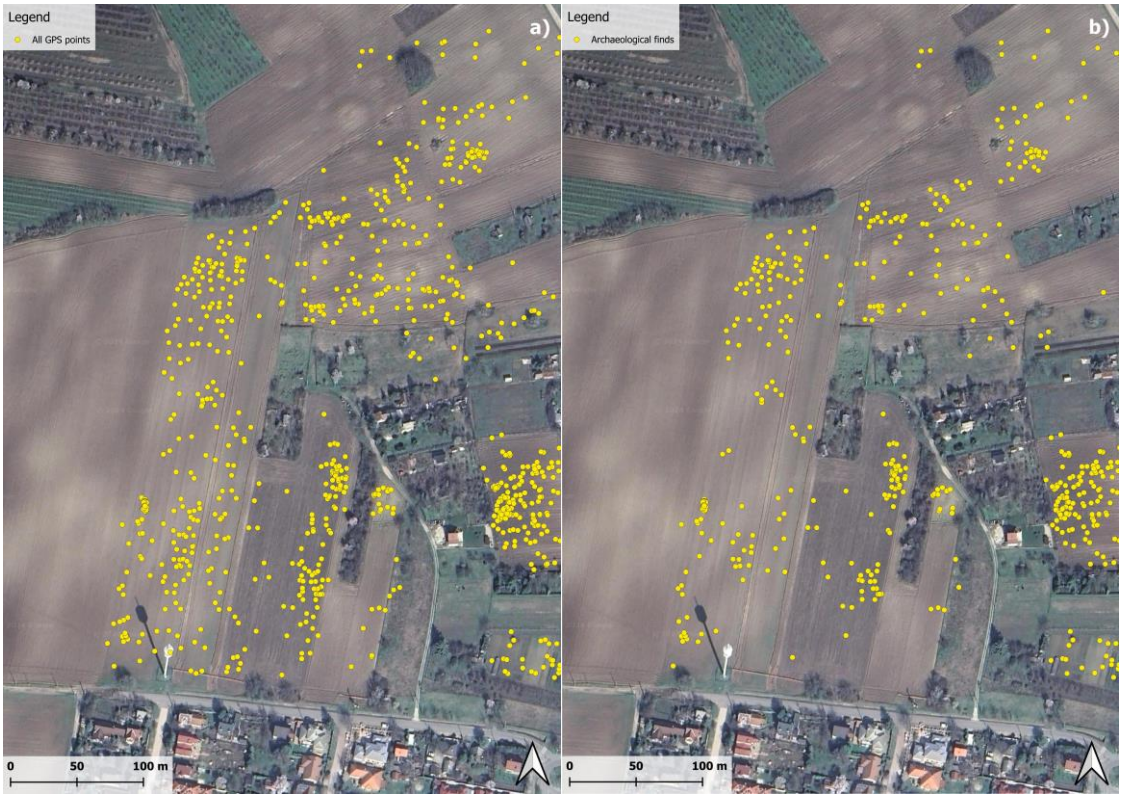

Fig. 4.: a) All GPS points marked during the fieldwork, b) The GPS point of real archaeological finds
4. ábra: a) Minden terepen felvett GPS pont, b) A régészeti korú leleteket jelölő GPS pontok

A similar approach was previously used to display various types of findings such as glass, sherds or *terra sigillata* by utilising field notes data (Bartus et al. 2016, 216, Fig. 5, 12). However, as far as I know, it has not been used to differentiate between time periods, except in surveys where sherds were marked and collected one by one, making the next step of the data processing an interesting methodological experiment. After selecting all the archaeological sherds, I used the point selection method to assign dating data to them using abbreviations, such as *"LBA/EIA"* for the period names in the related column of the Excel file. Whenever I had additional information about a specific point, I was able to link the point to the actual find and its true chronological property. Similar to the non-archaeological finds, I assigned the different eras of the finds to points located mostly evenly within the collection units.

By applying this approach, it has revealed previously hidden accumulations of archaeological artefacts at site-level and I was able to display artefact distribution maps for the different chronological periods. For example, a few Early Iron Age sherd accumulations could be linked to specific burial mounds (**Fig. 5.**) and some of the Middle Bronze Age sherd concentrations showed the ploughed-out burials found during the fieldwork (Czajlik et al. 2019b, 169) (**Fig. 6.**). By using this method not only were we able to see the probability of a finding being from a certain period but – in a few cases – we also could associate some sherd concentrations with specific archaeological objects.

However, it might be worth noting that the distribution of the finds on the surface does not usually represent the distribution of archaeological objects under the surface (Ammerman 1985) and there are lots of factors influencing the results of artefact collections and which periods or site types can be detected (e.g. see Doneus 2013; Gruškovnjak 2019; Noble et al. 2019; Shott et al. 2002). Furthermore, the linking of certain artefact concentrations to archaeological objects is hypothetical and only possible within favourable conditions supported by additional data (e.g. ploughed-out burials with human remains in the case of Middle Bronze Age concentrations).

In addition to the above-mentioned results, this visualising method pointed out how the sherds of different collection units got a diverse dating on the area of the Middle Bronze Age horizontal settlement, even though they were probably from the same period, and how misleading results we could get if using only the grid display (**Fig. 7.**).

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Fig. 5.: The GPS points of all archaeological finds which could belong to the Early Iron Age with the circular ditches of the tumuli

5. ábra: Minden lehetséges kora vaskori lelet GPS pontja az ismert körárkokkal

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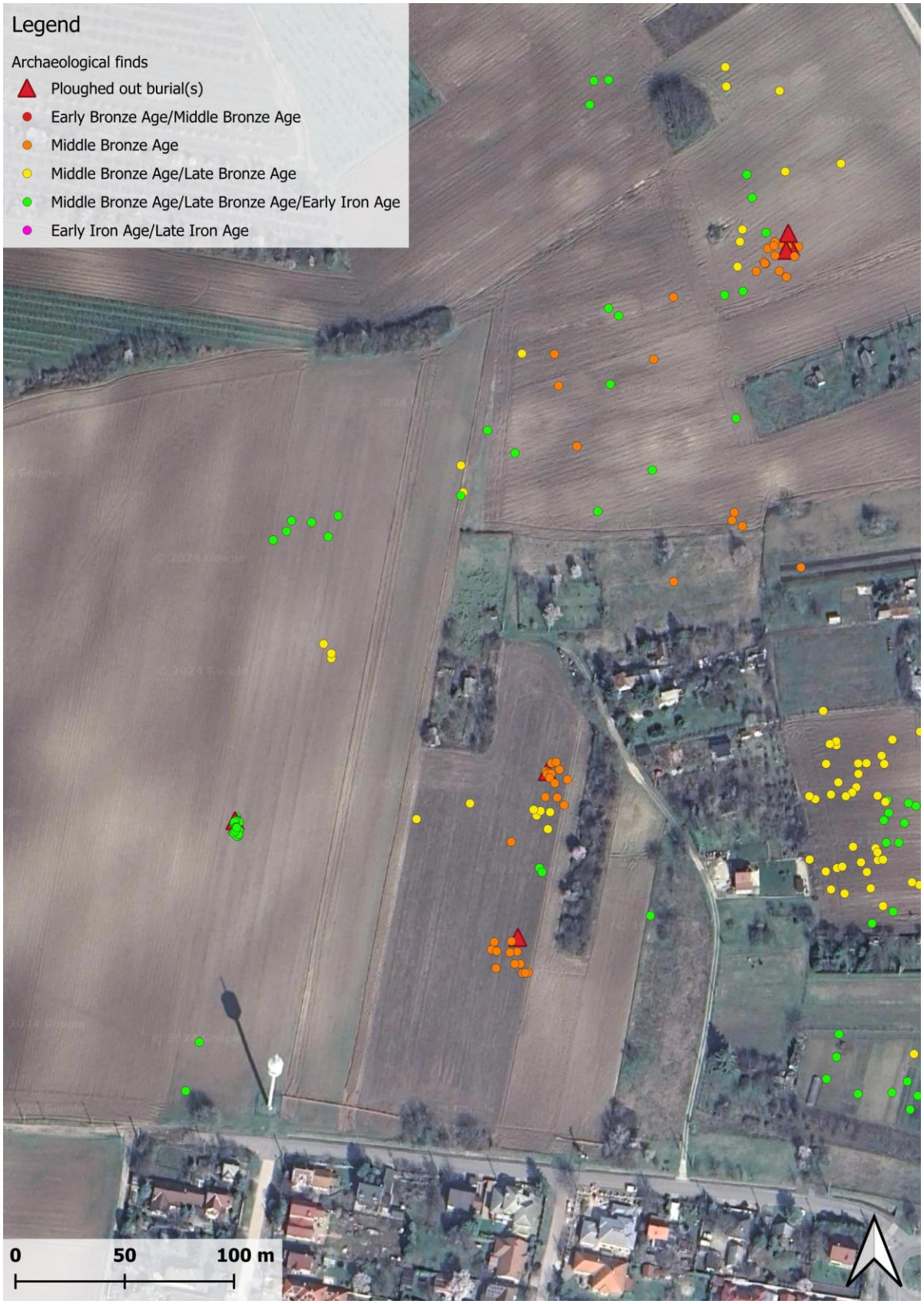

Fig. 6.: The GPS points of all archaeological finds which could belong to the Middle Bronze Age with some ploughed-out burials found on the surface

6. ábra: Minden lehetséges középső bronzkori lelet a felszínen észlelt kiszántott sírokkal

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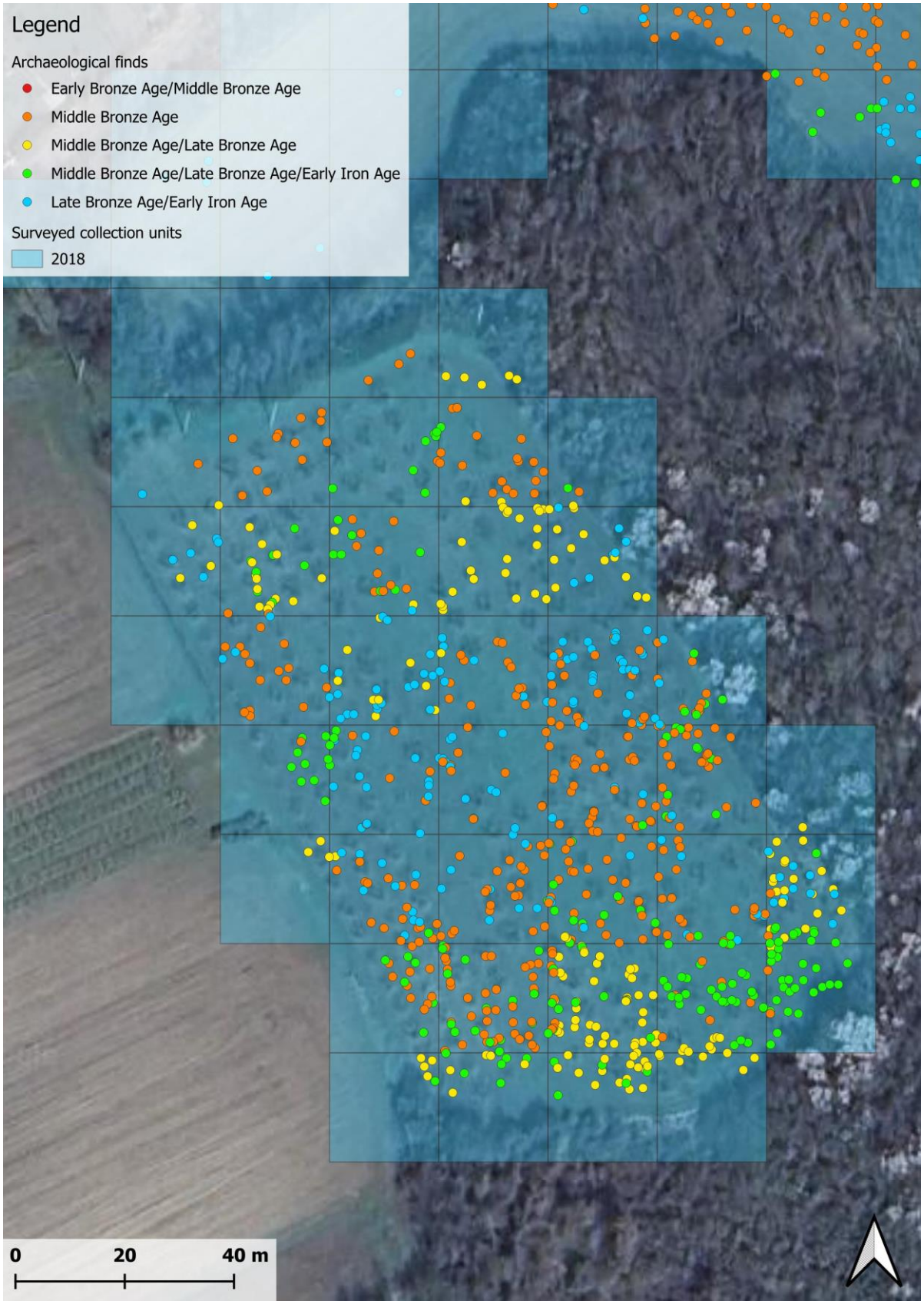

Fig. 7.: The GPS points of differently dated finds by collection units which probably all belong to the Middle Bronze Age

7. ábra: Négyzetenként különbözően datált leleteket jelölő GPS pontok, amelyek valószínűleg mind a középső bronzkorhoz tartoznak

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Conclusions

When dealing with archaeological data we likely cannot achieve complete certainty in our results. However, it is crucial to acknowledge the potential biases and strive to find solutions that minimise their impact on our data. The above-mentioned challenges should be considered when dealing with gridded surface collections or any systematic artefact collections located on multi-period sites.

Whereas gridded surface surveys can be conducted without fragmentary units in certain cases, such as when the research area is located on one large or multiple contiguous cultivation plots as in the case of Süttő-Sáncföldek (Czajlik et al. 2019a) or when only a smaller part of a site is being studied (e.g. Czajlik et al. 2015; P. Fischl & Horváth 2010), research circumstances are rarely so optimal. In the case of the loess plateau of Érd-Százhalombatta, the gridded fieldwalking could not have been carried out without investigating the fragmentary collection units, so I had to find acceptable solutions for the data processing, creating a hypothetical density.

While the developed solutions regarding the grid system (hypothetical density correction, using minimum and maximum finding numbers for periods) for the problem of not fully researched collection units and the dating uncertainty produced better results than the usual grid density visualisation, the real break-through was brought about by the applied point selection method.

It is possible that the dates of the finds using the latter method are hypothetical and some sherd accumulations from a certain time period may have become less visible. However, there are certainly no artificial accumulations due to the data processing technique. This method has its flaws and will not show us the real distribution of the artefacts of different periods unless we pack the findings individually. However, keeping these in mind, it can still make a big difference when analysing the data of systematic artefact collections.

The point selection method can be used not only in the case of gridded surface collections but any intensive systematic artefact collections on multi-period sites too, which means we can get more detailed results with less invested time and energy. In addition, in some fortunate cases, some finding accumulations can be associated with specific archaeological objects or phenomena at a site level using this data processing method together with other investigations, for instance, aerial reconnaissance or geophysics.

Contribution of the author

Gergácz Rebeka Writing – Original Draft.

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AN OUTSTANDING PRE-SCYTHIAN BURIAL FROM BÜKKÁBRÁNY-KÁLVÁRIA

EGY KÜLÖNLEGES PRESZKÍTA TEMETKEZÉS BÜKKÁBRÁNY-KÁLVÁRIA LELŐHELYRŐL •

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Abstract

The study presents a burial, and its assemblage discovered at Bükkábrány-Kálvária (Borsod-Abaúj-Zemplén County, NE-Hungary) dating to the 9th–early 8th century BC, along with additional pieces of bronze artefacts collected nearby from a systematic metal detector survey. The grave held the remains of an adult female and an infant. Scientific examinations were carried out to analyse the burial assemblage. In addition to the anthropological and archaeozoological analysis of the human and animal remains, the chemical composition of the recovered gold beads was analysed by ED-XRF spectrometry. The measurement results revealed that the beads were likely to have been made using the same or very similar base material, relatively high silver-containing (14–16 wt%) native gold. The residue adhering to the surface of the antler plate likely contains the remains of a plain weave textile. Cobalt blue, dark green, pink, and natural colour threads forming the finely woven fabric were documented by digital microscope images. CT scans were used to visualise the decoration of the plate in order to preserve the corroded textile remains. Among the stray finds of horse equipment, the cheekpiece was analysed by ED-XRF spectrometry; based on the results, the bit was made of tin bronze with around 9–10 wt% tin content in the original alloy. The archaeological evaluation of the Pre-Scythian finds from Bükkábrány revealed complex cultural interactions between East, North, and West.

Kivonat

A dolgozat egy Bükkábrány-Kálvária (Borsod-Abaúj-Zemplén vármegye) lelőhelyen feltárt, a Kr. e. 9. századra –8. század elejére keltezhető preszkíta sír leletanyagát és a lelőhely szisztematikus fémkeresős kutatásából származó leleteket mutat be. A felnőtt nő és csecsemő maradványait tartalmazó sír mellékletein természettudományos vizsgálatokat végeztünk. A sír embertani- és állatcsont-anyagának vizsgálata mellett az előkerült aranygyöngyök elemösszetételét energia diszperzív röntgen spektrometriával (ED-XRF) elemeztük. A gyöngyök feltehetően ugyanabból vagy igen hasonló alapanyagból, aránylag nagy ezüsttartalmú (14–16 tömeg%) termésaranyból készültek. Az agancslemez felületén lévő lerakódásban nagy valószínűséggel vászonkötésű szövet maradványait azonosítottuk. A finom szövetet alkotó kobaltkék, méregzöld, pink és natúr színű elemi szálakat digitális mikroszkóppal készült képekkel dokumentáltuk. A korrodálódott textilmaradványok megőrzése

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érdekében a lemez díszítését CT-felvételek segítségével jelenítettük meg. A szórvány lószerszámok közül a fém zabla az ED-XRF módszerrel végzett elemösszetétel analízis alapján ónbronzból készült, az ón aránya az eredeti ötvözetben 9–10 tömeg% körül lehetett. A Bükkábrányban előkerült, preszkíta korú leletanyag régészeti elemzése komplex, keleti, északi és nyugati irányú kulturális kapcsolatokra világított rá.

KEYWORDS: PRE-SCYTHIAN, MEZŐCSÁT CULTURE, FEMALE BURIAL, TEXTILE REMAINS, ANTLER PLATE, HORSE EQUIPMENT, ARCHAEOMETALLURGY, CT IMAGING

KULCSSZAVAK: PRESZKÍTA, MEZŐCSÁT-KULTÚRA, NŐI TEMETKEZÉS, TEXTILMARADVÁNYOK, AGANCSLEMEZ, LÓSZERSZÁMZAT, ARCHEOMETALLURGIA, CT-KÉPALKOTÁS

Introduction

The BORBAS project (Borsod Region Bronze Age Settlements) has been investigating Early and Middle Bronze Age settlement networks in the region of the Bükk-Foothill zone and South Borsod Plain since 2012 (Kienlin et al. 2018). The project set out to explore the internal structure of Bronze Age settlements – as a first step − to identify individual households, while seeking to better understand how basic units of habitation functioned in this period. The next level of our enquiry is to map out the relationship between the construction and the use of Bronze Age buildings within a given settlement. Putting all this into a broader perspective, the project aims to contextualise these building structures in the wider Bronze Age environment and to sketch out the roles of individual settlements within regional economic and social networks. A long-term aim of the project is to take the micro-regional settlement data and place it into the broader context of the Hatvan and Füzesabony habitation network and to examine it in detail against the backdrop of Middle Bronze Age social histories.

Set within this framework, the site of Bükkábrány-Kálvária was investigated between 2021 and 2024 (**Fig. 1.**). The site was not intact; above the core area of the Bronze Age habitation a modern cemetery was established.

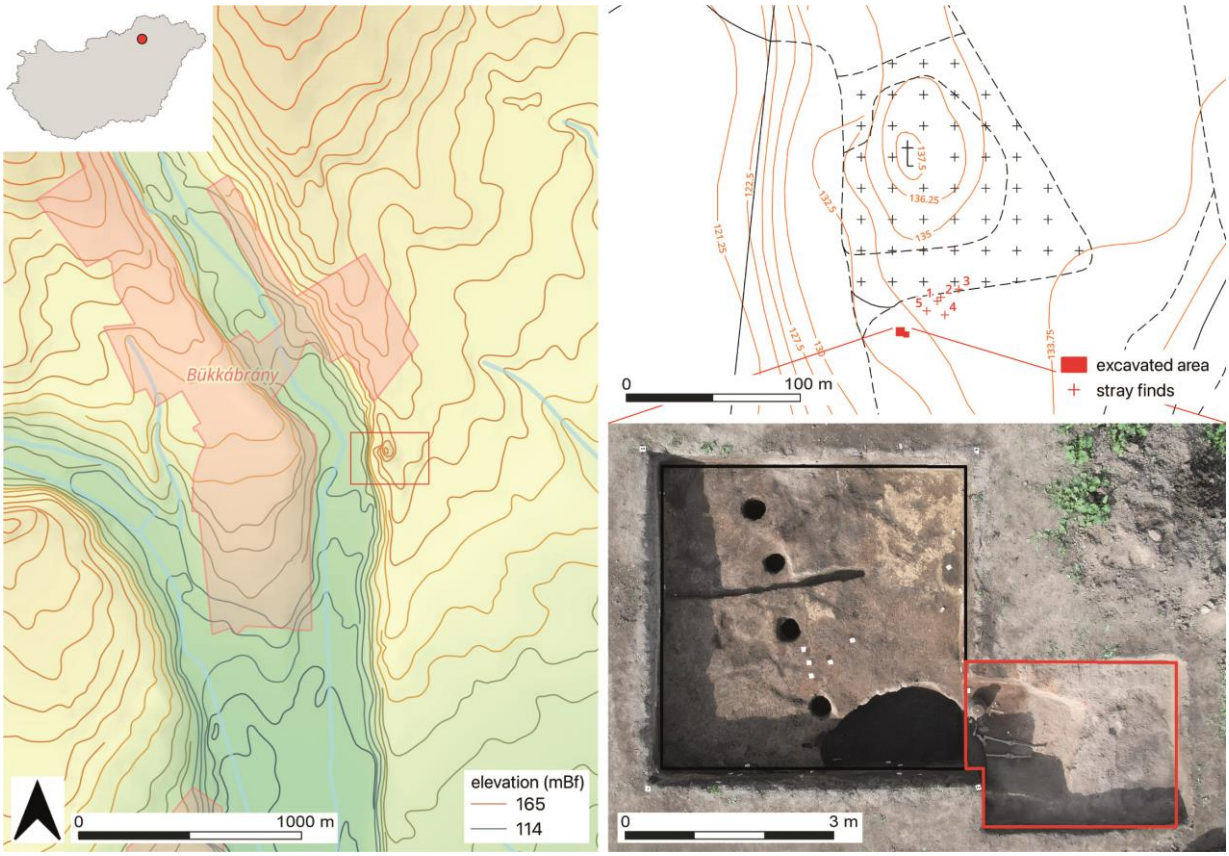

Fig. 1.: Location of the site and finds (K. P. Fischl, Z. Hrabák)

1. ábra: A lelőhely és a leletek elhelyezkedése (P. Fischl K., Hrabák Z.)

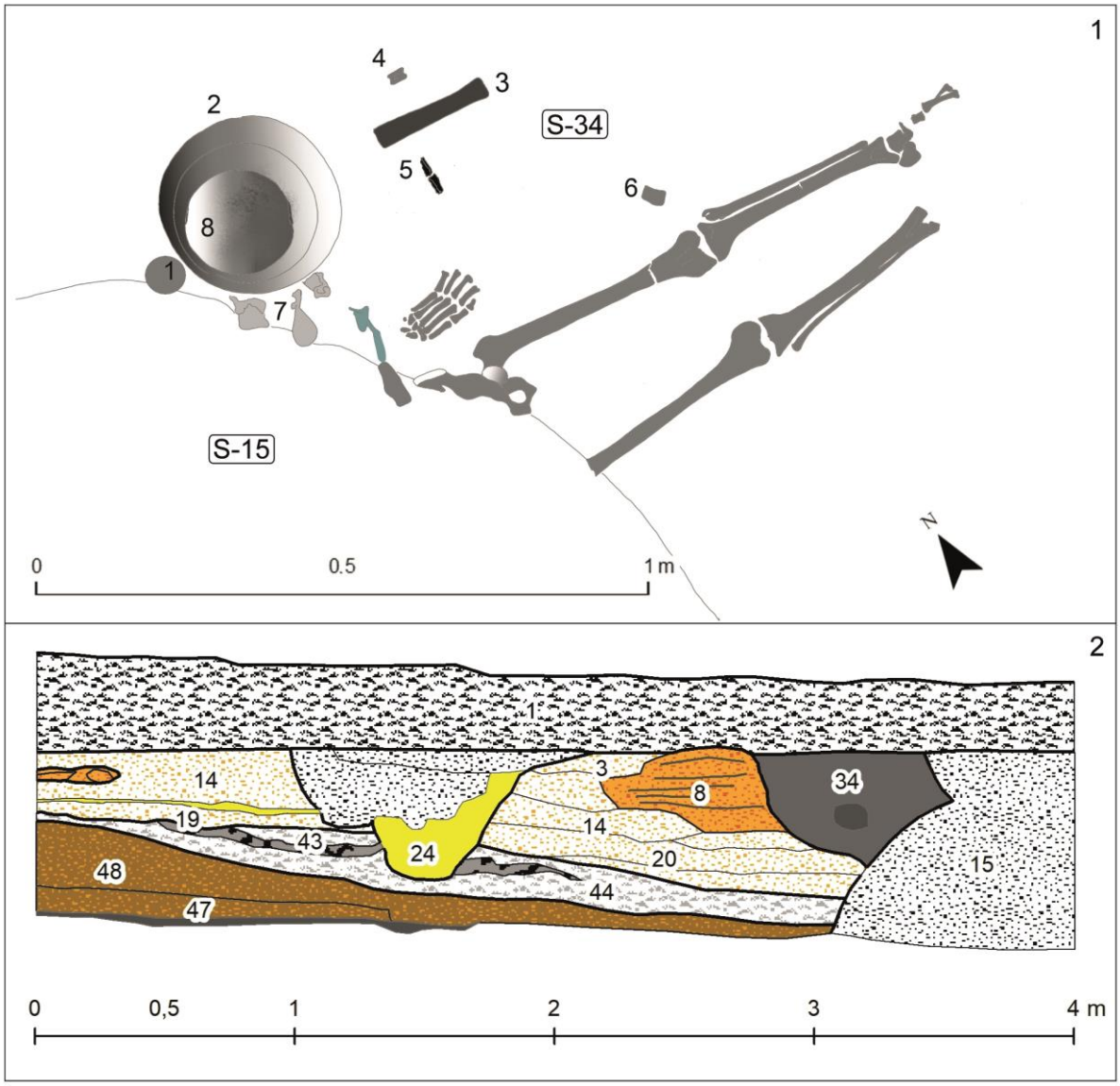

Fig. 2.: Bükkábrány–Kálvária, 2/1: plan of the Pre-Scythian burial, 2/2: section drawing of the east wall of the excavation trench, illustrating the Pre-Scythian burial (S34) and the Sarmatian pit (S15) cut into the Bronze Age layer sequence (T. Pusztai)

2. ábra: Bükkábrány–Kálvária, 2/1: preszkíta sír alaprajza, 2/2: a szelvény keleti metszetfala a bronzkori rétegsorba vágott preszkíta sír (S34) és szarmata gödör (S15) ábrázolásával (Pusztai T.)

The modern burials were dug into a Bronze Age settlement mound, which was surrounded by a ditch identified by magnetometric survey and confirmed by coring. On top of the surrounding ditch, the Stations of the Cross were installed by the local parish. South and east beyond the modern cemetery's fence, the geophysical survey identified settlement remains beyond the core habitation site; here systematic find collection was also carried out. The aim in this outer settlement area was to investigate one of the better-defined buildings shown on the magnetometry by targeted excavation. Before the excavation, the area was further investigated by coring, which provided evidence for a series of undisturbed Bronze Age occupation layers at a significant depth. The ^{14}C dating of the organic residues brought up by the cores supported the Bronze Age dating of the structure.

In August 2022, a trench measuring 4 m × 4 m was opened targeting the NW corner of the previously identified building (**Fig. 1.**). From the west-facing section profile, an intact one-handled cup came to light. This cup was sitting in a fill of a later cut (S34) which was dug into the debris of the Bronze Age building (**Fig. 2.**). During October, another, 2.8 m × 2.2 m trench was opened aiming to investigate this later cut, which produced the Pre-Scythian burial presented in this paper.

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The description of the Pre-Scythian burial (S34)

The grave was cut into the debris layer of a Bronze Age building (S3, S8, S14, S20) containing large amounts of burnt daub. The grave's fill was observable on the surface directly below the plough zone (S1). The grave and the skeleton were oriented W–E. The western section of the grave was disturbed by a pit dating to the Sarmatian period (S15; **Fig. 2.**), destroying the skeleton significantly. Only bones of the pelvis, the left hand and the legs were found more or less intact. The position of the remains suggests that the body was placed in the grave in a supine position. The bones of the feet were disturbed by another cut. An amphora (2 on **Fig. 2/1**) stood north of the pelvis, while west of this vessel lay the above-described one-handled cup (1 on **Fig. 2/1**), which was found and removed earlier during the construction of the section wall. North of the bones of the left hand, and east of the amphora, an antler plate (3 on **Fig. 2/1**) and a sheep astragalus (4 on **Fig. 2/1**) were found. South of the antler plate, the highly corroded remains of an iron object (5 on **Fig. 2/1**) were documented. North of the left patella, a small plate carved from a split wild boar tusk (6 on **Fig. 2/1**) came to light. South of the amphora, between the vessel and the hand bones lay a few fragments of animal bones (7 on **Fig. 2/1**). Furthermore, at the same spot, the remains of an infant were identified (the bones are highlighted in greenish grey on **Fig. 2/1**). When lifting the contents of the grave, 13 pieces of gold beads came to light from the fill inside the amphora (8 on **Fig. 2/1**).

Grave goods

No. 1. A thin-walled, burnished cup fired black with an everted rim, slightly funnelled neck, and a pressed, globular body with an omphalos base, made from a fine clay paste. A wide, high-swung strap handle arches over the rim and attaches to the shoulder. The top of the handle is ornamented by three parallel, shallow channels where its curve joins the rim. The rim opposite the handle is slightly raised. There are three main groups of ornaments on the shoulder, composed of small knobs, which are surrounded by a smoothed-in, shallow, circular channelling and alternately oblique, finely smoothed line bands above them, in a tent-like fashion. Two groups of ornaments are placed at approximately 80° and one opposite to the handle with a further set of finely smoothed bundles of lines on either side of the latter. In the middle of one of the sections between the three panels, there is an additional small knob surrounded by a smoothed-in, shallow, circular channelling, making the pattern asymmetrical. The burnishing of the vessel is outstanding. There are visible signs of wear surrounding the omphalos. The left quarter section of the rim, opposite the handle, is chipped in five places. Height at the rim: 7.8 cm; height at the handle: 9.2 cm; rim diameter: 11.3 cm; largest diameter: 11.8 cm; base diameter: 3 cm; wall thickness: 0.3–0.4 cm (Herman Ottó Museum, HOM, Miskolc – Archaeological Collection inv. no. 2023.25.1., **Fig. 3/1**).

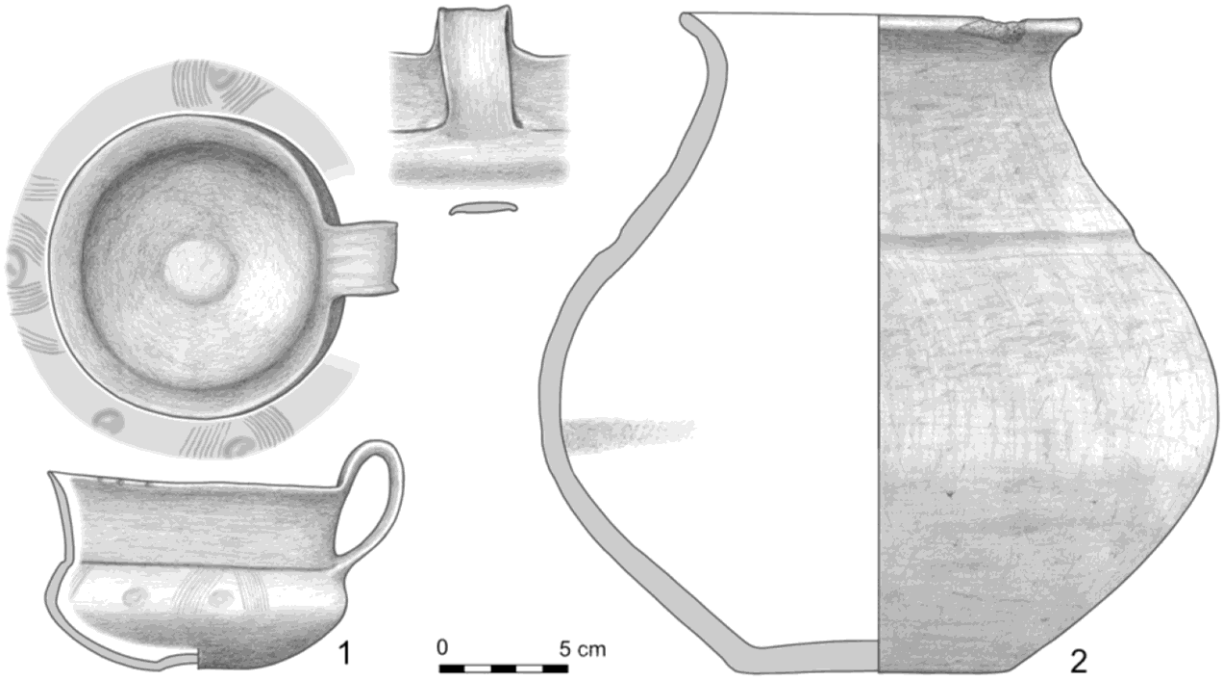

Fig. 3.: Ceramic grave goods of the Pre-Scythian burial (L. Gucsi)

3. ábra: A preszkíta sír kerámiamellékletei (Gucsi L.)

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Fig. 4.: Antler plate from the Pre-Scythian burial and details of the decoration (M. Takács)

4. ábra: A preszkíta sír agancslemeze és a díszítés részletei (Takács M.)

Fig. 5.: Animal bones from the Pre-Scythian burial (P. Hámori, N. Mészáros)

5. ábra: A preszkíta sír állatcsontmellékletei (Hámori P., Mészáros N.)

No. 2. Black, highly burnished thick-walled, therefore, quite heavy amphora without handles and ornamentation. It has an everted rim, a conical neck, and a pressed globular belly. The line where the neck meets the shoulder is accentuated by a horizontal channel. The proportion of temper is high compared to the clay matrix. The process of burnishing left scratch-es on the surface and present on the outer surface and the upper interior segment of the neck. A reddish-brown residue is visible on the interior in a 1.5−2 cm wide band below the line of the belly. A 1.3 cm segment of the rim was chipped before deposition. Height: 25.6 cm; rim diameter: 15.6 cm; largest diameter: 26.4 cm; base diameter: 10.5 cm; wall thickness: 0.6−1 cm (HOM 2023.25.2., **Fig. 3/2**).

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No. 3. Rectangular antler plate decorated with incised spiral, triangle, net, and dot-and-circle motifs. Soil adhered to the decorated surface alone. Length: 18.2 cm; width: 3.6 cm; thickness: 0.7 cm (HOM 2023.25.3., **Fig. 4/1, Fig. 8/2**).

No. 4. Sheep astragalus belonging to the left limb of the animal. Its edges are slightly worn off but otherwise well-preserved. It is yellowish, probably due to being exposed to heat. Greatest length: 2.6 cm (HOM 2023.25.4., **Fig. 5/1**).

No. 5. Long, thin, corroded iron object, likely to have been similar to an awl. It perished during lifting. Due to the very poor condition of the remains, it was not possible to subject it to scientific testing.

No. 6. Rectangular plate carved from the mandibular canine of a wild boar with its edges intact. Several cutmarks present on the dentin side of the object suggest that it was difficult to work the hard material. There was no indication of use wear on the edges under an optical microscope. Measurements: 3.8 cm × 2.3 cm (HOM 2023.25.5., **Fig. 5/2**).

No. 7. Animal bones as remains of food offering. Altogether seven bones were present belonging to at least two cattle and a sheep/goat. Four pieces out of seven were yellowish, probably due to their exposure to heat: a distal epiphysis from the left radius and three carpals of a cattle. The unfused epiphysis of the radius suggests that it belonged to a specimen younger than 3.5–4 years (HOM 2023.25.6., **Fig. 5/3-6**).

The other carpal bone (brownish) and a diaphysis of a long bone also belonged to a cattle but a slightly larger and older specimen. A further caprine bone fragment was identified as a diaphysis of a radius (HOM 2023.25.6., **Fig. 5/7-9**).

No. 8. 13 pieces of pressed spherical gold beads were discovered inside the amphora. Individual weight: 0.0286−0.0552 g, mass weight: 0.4763 g, average weight: 0.0366 g. Diameter: 0.4 cm (HOM 2023.25.7., **Fig. 6.**).

Finds from the systematic metal detector survey

Alongside the excavation of the Bronze Age building, a systematic metal detecting survey was also carried out on 18 August 2022 and 28 March 2024. A group of volunteer metal detectorists associated with the National Institute of Archaeology of the Hungarian National Museum led by András Gömöri and assisted by Gábor Bakos conducted a thorough survey covering the area of the Bronze Age settlement site. About 25 m NE of the excavated grave, in an area about 23 m in diameter, four bronze objects were found (The artefacts will be inventoried in the collection of the HOM, 1−5 on **Fig. 1.**).

Fig. 6.: Gold beads from the Pre-Scythian burial (L. Gucsi, K. P. Fischl)

6. ábra: A preszkíta sír aranygyöngyei (Gucsi L., P. Fischl K.)

No. 1. Conical bronze sheet tutulus. Height: 3.2 cm; diameter at the top: 0.3 cm; diameter at the bottom: 0.7−0.8 cm (5 on **Fig. 1.**, **Fig. 7/4**).

No. 2. Two matching fragments of a bronze cheek-piece with three integral cylindrical strap divider units. The object is rod-shaped, its shaft slightly bent at one end and ornamented with a conical knob-like finial. Glued from two pieces, straight end broken off, missing. Length: 12.8 cm; diameter of the shaft: 0.7−0.8 cm; length of the cylindrical units: 1.9 cm; diameter of the holes: 0.7−0.8 cm; diameter of the knob: 1.9 cm (1 and 4 on **Fig. 1.**, **Fig. 7/1**).

No. 3. A helmet-shaped bronze strap divider with a decorative plate consisting of a nearly semi-circular upper part and a narrow, trapezoidal lower part. The semi-circular part is decorated with two converging, curved lines starting from the corners, with spiral ends; the centre of the lower part of the plate is decorated with a slightly amorphous oval, concentrically protruding knob. On the reverse, the stumps of four pegs, originally joined by a ring base, have been preserved at varying heights. The remaining tiny stumps suggest that the ring was probably square with rounded corners. Measurements of the plate: 2.4 cm × 2.0 cm; height: 1 cm; diagonal spacing between the pegs: 1.1−1.2 cm; spacing between adjacent pegs: 0.7−0.8 cm (2 on **Fig. 1.**, **Fig. 7/2**).

No. 4. Conical cast bronze phalera, slightly concave on the sides with a loop on the back, round in cross-

section. Diameter: 4.1 cm; length of the loop: 1.3 cm (3 on **Fig. 1., Fig. 7/3**).

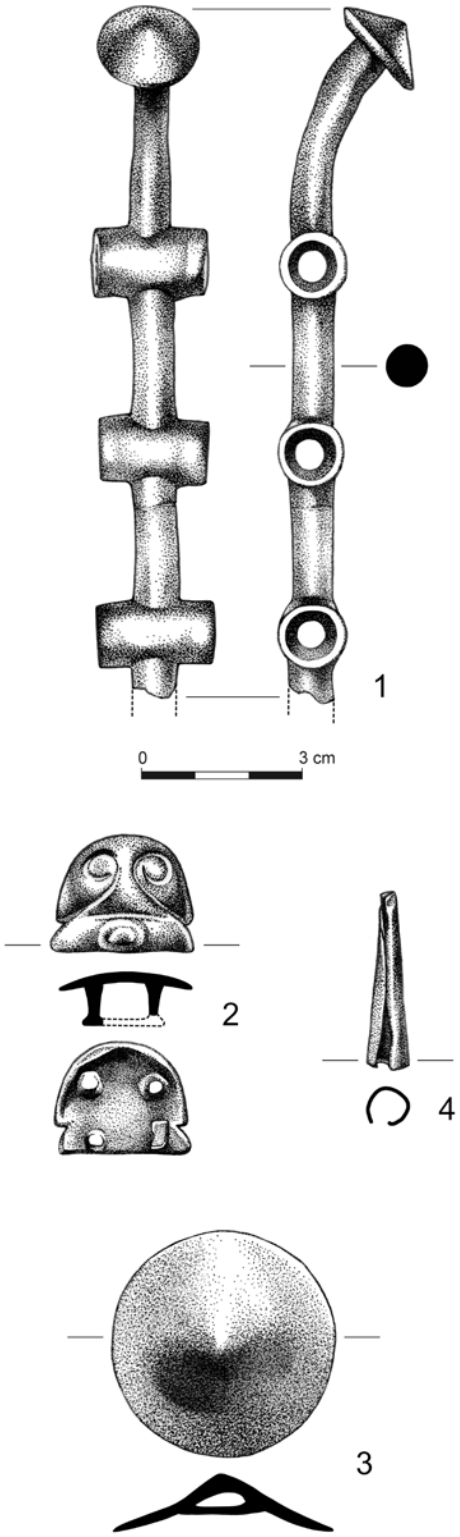

Fig. 7.: Pre-Scythian finds from the systematic metal detector survey (Z. Hrabák)

7. ábra: A szisztematikus fémkeresős kutatás preszkíta korú leletei (Hrabák Z.)

Physical anthropological examination of the skeletons

The upper elements of the female skeleton (apart from the sternum) were destroyed by the cut of a later Sarmatian pit. The skeletal remains from the hip bone down were also incomplete. From the left pelvis, only the pubic bone, ischium, and the anterior portion of the ilium were present. On the right side only the pubic bone survived. The sacrum was missing. The long bones of the lower limbs and the patellae were present, however, the proximal third of the right femur was missing. Bones belonging to the left hand and left foot were also found along with a phalanx of the right hand, a tarsal bone and two phalanges of the right foot.

The sexing of the skeleton was carried out according to the method developed by Éry, Kralovánszky & Nemeskéri (1963). Altogether four characteristics could be examined in detail. The subpubic angle, the obturator foramen, and the diameter of the femoral head all showed hyperfeminine attributes, while the linea aspera was undiagnostic. Given the morphology of the pubic symphysis (Meindl et al. 1985) the age of the skeleton could be estimated to over 30 years of age (the symphyseal surface was completely smooth, dorsal and ventral edges were developed). Further, mild degenerative changes present on other joints confirm this assessment, therefore, the biological age of the skeleton could be projected to the second half of the adultus range (perhaps the beginning of the maturus range) to between 30 and 45 years of age.

Table 1 contains the measurements of long bones, which indicate a height of 150.35 cm for the individual (Sjøvold 1990). In the knee joints, on the margins of the distal articulation surfaces of the femurs and the patellae, a slight edging began to develop, just as around the joint surfaces of the foot bones and the costal notches of the sternum, indicating the presence of mild degenerative osteoarthritis. Entheseal changes could be observed at the muscle attachment regions of the left ischium, the ventral of the pubic bones around the symphysis, the patellae and on the left calcaneus. These alterations could be linked to the advanced age and physical activities carried out by the individual.

The highly fragmentary skeleton of an infant was discovered by the left hand of the woman. Only a piece of the occipital bone, the basilar part survived as part of the skull. From the postcranial skeletons, the left scapula, fragments of vertebrae and ribs, distal half of the right radius, the left tibia and fibula and two metatarsals were present.

Table 1.: Measurements of long bones of the lower extremities (in mm)

1. táblázat: Az alsó végtagok hosszúcsontjainak méretei (mm-ben kifejezve)

Martin No.		Right	Left
Femur	1	-	392
	2	-	388
	6	22	22
	7	22	24
	8	-	28
	9	-	28
	10	-	19
	19	-	40
	21	69	70
Tibia	1	313	315
	1a	319	321
	1b	309	310
	2	295	296
	3	65	66
	6	44	45
	8	22	21
	8a	26	25
	9	17	19
	9a	19	20
	10	65	66
	10b	61	61
Fibula	1	311	313

The distal epiphyses of the tibia and fibula were damaged, therefore the length of these could only be estimated. The length of the tibia was approx. 73 mm, while the fibula measured approx. 71 mm, but their original size could not have been longer by 1−2 mm. The length of the scapula could only be estimated as well to be around 39 mm, its width is 31 mm. These measurements suggest an age between 10 lunar months and 6 months (Kósa 1989; Stloukal & Hanáková 1978).

The typological assessment of the grave finds

The ceramic vessels typically occurring in graves of the Pre-Scythian Mezőcsát culture were classified into three main categories by Tibor Kemenczei. According to this classification, the objects in the first group reflect the shapes and ornament styles preferred by local Late Bronze Age communities; here Tibor Kemenczei differentiated between Kyjatice and Gáva influences and identified so-called non-culture-specific Late Bronze Age characteristics. As a second group, he distinguished vessels that, in their form and simple decoration (typically consisting of four knobs), although reflecting Late Bronze Age traditions, cannot be specifically linked to the ceramic traditions of local cultures of Eastern Hungary. Instead, they show common characteristics shared by related cultural groups spreading between the Tisza and the western forest-steppe region at the end of the Bronze Age. In his opinion, these vessels can be considered primarily as the products of the Mezőcsát culture. The third group contains objects of foreign origin – Tibor Kemenczei has named the Basarabi–Bosut cultural complex and the forest steppe region as possible origins of some of the vessels. He also considered the continuous manufacture and use of Late Bronze Age ceramic forms during the Early Iron Age in the Carpathian Basin and farther to the east (Kemenczei 2005, 120–121).

Analogues of the shape of the Bükkábrány cup (**Fig. 3/1**) – with an outcurving rim, funnel neck and pressed globular body along with the omphalos base and the tall, arching strap handle – are well-documented in the burials of the Mezőcsát culture in Heves County (Patek 1990, Tab. 7/6, 8/18, 10/1, 14/2, 21/8) and Borsod-Abaúj-Zemplén County (Kemenczei 1988, Fig. 2/5,9, 3/9; Patek 1993, Fig. 28/10, 30/7, 31/28). However, decoration similar to that on the Bükkábrány cup does not appear on these cups. A pattern consisting of groups of alternating, incised oblique lines combined with round pits was the characteristic decorative style of the Mikušovce horizon of the Lusatian cultural complex in its Slovakian area of distribution, i.e. in central and NW part of the country, dating to the Reinecke BD and beginning of the HA1 period (Veliačik 1983, 168–171; Kujovský 2015, 180; Kujovský 2022, 91). This decoration also appears on the shoulders of cups, which feature a sharply profiled body and a handle that does not rise above the rim (e.g. Krásna Ves, Budinský-Krička & Veliačik 1986, Tab. 6/8,15; Diviaky nad Nitricou, Suhajiková-Pivarová 1961, 239 Fig. 1/2; Lehota pod Vtáčnikom, Veliačik 1983, Tab. 9/1; Liptovský Michal, Ibid. Tab. 1/34; Oravský Podzámok, Čaplovič 1987, 51 Fig. 15/5; Dolný Kubín III., Ibid. 101 Fig. 43/1). The Bükkábrány cup, with its softer profile, pressed globular body and handle raised above the rim differs from the basic form of the above-mentioned cups, and represents a later form. It bears a closer resemblance to the softer profiled cups with flared rim, distinct neck, rounded belly, straight base and raised handles of the HA1–HA2 period (Diviaky nad Nitricou horizons I–II), namely the IV-1, V-1 and IV-2 type cups described by

Veliačik (1983, Fig. 7). Among these, type IV-2 cups are distinguished by the retention of archaic decoration on the shoulders, consisting of incised stacks of oblique lines, groups of small lenticular pits and small protrusions. These cups were dated to the HA1 period by Veliačik (1983, 132). The same type of cups was dated to the HA2 period in Ilava based on the chronology of decoration and the chronological position of analogous cups from Polish and Czech Silesia. The authors note that this type was also in use in Silesia in later periods, and as large Late Lusatian cemeteries are still unprocessed in Slovakia, their persistence in this region cannot be excluded either (Benediková et al. 2016, 221, 326) (e.g. Kšinná, Veliačik 1983, Tab. 24/11; Veľké Hoste, Ibid. Tab. 25/4; Diviaky nad Nitricou, Veliačik 1991, 153 Fig. 9/14; Krásna Ves, Budinský-Krička & Veliačik 1986, Tab. 10/28; Ilava, Benediková et al. 2016, 221 Fig. 149, Tab. 11/18, 26/10). However, despite the similar shape and decorative style, the pattern of alternating groups of oblique lines combined with single round pits – characteristic on the cups of the Mikušovce horizon and also on the cup from Bükkábrány – does not appear in this form on the aforementioned type IV-2 cups of the HA1–HA2 period, and they do not feature either the omphalos base and the longitudinal channelling of the handle. We were also unable to identify a close equivalent to the Bükkábrány cup among Late Lusatian assemblages in Slovakia dated to the Final Bronze Age (HB) and Hallstatt period (a comparison was made with the published materials of Late Lusatian sites referred by Veliačik 1988, 236–245; Kujovský 2015, 181–184; Kujovský 2022, 93–99). However, it should be noted that a detailed comparison with the Late Lusatian material is complicated by the fact that mainly settlement material and far fewer cemeteries than in the earlier periods are available for comparison. Additionally, after the relatively uniform development of the previous period, the late phase shows disintegration, with the emergence of local groups with distinct characters and different cultural orientations, resulting in a more diverse material (Veliačik 1988, 241).

We identified the closest analogues to the Bükkábrány cup in the Final Bronze Age – Early Iron Age (HB–HC) assemblages of the Lusatian cultural complex in Poland. In the southern region of Greater Poland (SE territory of the Western Greater Poland group of the Lusatian cultural complex, see Gedl 1994, Fig. 1) a characteristic decoration of the profiled cups of the Bronze Age period V (corresponding to the HB period), consists of a combination of vertical or oblique (alternating or unidirectional) groups of lines and single or short rows of lenticular pits. The basic shape of the cups is characterised by an everted rim, curved neck, a pronounced, curved shoulder, a conical lower part, a straight base, and raised handle (e.g. Biernatki, Krzyżaniak 1963, Fig. 40/3,7, Fig. 108/2,7; Włostowo, Śmigielski 1963, Fig. 42/16; Przemęt, Kihl-Byczkowa 1970, Tab. 12/4; Karzec, Śmigielski 1965, Tab. 15/17). Similar decoration also appears on profiled cups with a pressed globular or rounded lower part and omphalos base, which occur in assemblages dated from the Bronze Age period V to HC (e.g. Dębiczek, Zeylandowa 1968, Tab. 4/24, 7/2; Czarne Piątkowo, Naumowiczówna 1964, Fig. 22/19; Włostowo, Śmigielski 1963, Fig. 42/15; Grabonóg, Durczewski & Śmigielski 1966, Tab. 31/41; Biernatki, Krzyżaniak 1963, Fig. 64/1, 98/3).

In Lower Silesia (on the distribution area of the Silesian Group), during the Bronze Age periods IV and V, the basic form of profiled cups is characterised by an everted rim, pronounced neck, rounded shoulder, conical or slightly pressed globular lower part, straight or omphalos bottom, and raised handle (types I/B and I/C cups by Gediga 1967), similar in shape to the Bükkábrány cup. Variants decorated with alternating, oblique stacks of lines (type I/B3 – e.g. Jordanów Śląski, Ibid. Fig. 28/d) and combinations of groups of lines and lenticular pits (types I/B7 and I/C7 – e.g. Jordanów Śląski, Ibid. Fig. 11/c, 24/i, 27/d, 42/g, 50/c; Kaszyce Milickie, Fig. 51/c; Suchowice, Fig. 46/p; Przychowa, Fig. 44/e; Wrocław-Osobowice, Fig. 35/k) are typical of the younger period, i.e. the transition between the periods IV and V of the Bronze Age (Ibid. 93–100, diagram 8). The author notes that profiled cups often have a burnished, black surface (Ibid. 92).

East of the Silesian group, similar cups are also present in the Upper Silesian – Lesser Poland group of the Lusatian cultural complex, especially in the Kraków subgroup, where a number of profiled cups with raised handles, decorated with a pattern of oblique or straight stacks of lines and lenticular pits on the shoulders, can be identified (e.g. Mydlniki, Durczewski 1948, Tab. 50/11, 74/9; Prokocim, Tab. 55/54, 76/5). Two cups from the HB–HC period cemetery at Baczyn, Kraków County, shall be highlighted. The basic form of the cups with everted rims, conical neck, sharply profiled belly, rounded bottom and omphalos base, and short handles slightly raised above the rim differs from the Bükkábrány cup; however, the longitudinal channelling of the handles and the decoration of the shoulders with a combination of short, oblique stacks of lines and smoothed-in small circles show a close affinity with the decoration of the Bükkábrány cup. The cups also feature a burnished, black surface (Prokopowicz-Kraus 1967, Tab. 5/4, 6/2).

Summarizing the above, we can conclude that the closest parallels of the Bükkábrany cup were identified among the HB–HC assemblages of the southern region of Greater Poland, in Lower Silesia and

in the Upper Silesian – Lesser Poland group of the Lusatian cultural complex. The fine material, the unusually thin wall, the almost perfect burnishing and the evenly black colour of the Bükkábrány piece make this cup outstanding in its quality; a representation of high-grade ceramic craftsmanship, which is a further argument in favour of its import character. However, its place of origin within this broad region cannot yet be narrowed down.

It is also relevant to note that a decoration almost identical to that on the Bükkábrány cup and the cups from the Baczyn cemetery appears on another exquisitely crafted vessel from burial 40 at Füzesabony-Kettőshalom, another grave of the Mezőcsát culture. The unique cup, made from a fine clay paste, evenly fired to grey, has a slightly everted rim, a conical neck, a sharply profiled belly, and a rounded lower part with shallow omphalos. The lower stem of its knee-shaped, angular handle is pierced longitudinally and functions as a suction tube. The neck is decorated with fine, smoothed-in horizontal lines along its entire length; the shoulders are decorated with smoothed-in, alternating short, oblique groups of lines separated by shallow circles. The upper part of the handle at the joint of the rim is decorated with multiple parallel lines in "V" form, opposite the handle the belly is decorated with a slightly protruding knob, smoothed into the vessel wall (Patek 1990, Tab. 11/12, Dobó István Castle Museum, Eger – inv. no. 67.3.69). The vessel, based on its pointed handle, was previously associated with the Pre-Scythian finds of the Middle Dniester region (Kemenczei 1981, 80–83; Patek 1990, 72), most probably not taking into account that the lower stem is pierced-through and thus functions as an outlet, which feature is not depicted in the published illustrations (Kemenczei 1981, 82 Fig. 2/7; Patek 1990, Tab. 11/12). In fact, this cup is very similar to the characteristic, often exquisitely crafted "feeding vessels" known from the burials of the Kyjatice culture in the southern region of Central Slovakia, dated in particular to the HB period, and associated mostly with graves of adults (Furmánek & Mitáš 2007; Furmánek et al. 2022, 174 Fig. 216/1–2, 176–178). Type "a" cups described by Furmánek & Mitáš (2007, 96, 108 Fig. 10/a) have a similar shape to the Füzesabony piece resembling an amphora, a knee-shaped angular handle with pierced-through lower stem, the horizontal grooving of the neck is also typical for the decorated pieces, and even the decoration of the shoulder with alternating groups of oblique lines appears on some of them (e.g. Kyjatice, Furmánek et al. 2022, Tab. 7/2, 22/13). However, the pattern consisting of oblique groups of lines separated by circles doesn't appear in this form on the cups known from Kyjatice context, and it has the closest parallels in the Lusatian cultural milieu (see above, in particular Baczyn, Prokopowicz-Kraus 1967, Tab. 5/4, 6/2). Based on the above we can conclude that the cup from burial 40 at Füzesabony-Kettőshalom can also be associated with the northern, Kyjatice and Lusatian ceramic traditions.

The amphora (**Fig. 3/2**) – another piece of the Bükkábrány grave furniture – with its black burnished exterior also represents a link to Late Bronze Age ceramic traditions. Its S-profile and the shallow channel emphasising the line of the shoulder is typical among analogous vessels from burial context of the Mezőcsát culture, although in the majority of cases plastic knobs sit on the shoulder (e.g. Kemenczei 1988, Fig. 4/4, Kemenczei 1989, Fig. 6/1, Patek 1990, Tab. 2/5, 6/6 11/10, 23/2, 27/4, Patek 1993, Fig. 27/7, 28/2,14, 31/30). A similar, undecorated vessel came to light from burial 8 at Sirok-Akasztómály (Patek 1990, Tab. 23/8). Overall, the basic shape of the amphora, characterized by a flared rim, conical neck, and pressed globular body (Kegelhalsgefäß) was a widespread basic form of amphoras among the ceramic repertoire of the Late Bronze Age and Early Iron Age cultures of the Carpathian Basin (e.g. Gáva culture, Transdanubian Urnfield culture, Hallstatt culture). The amphora from Bükkábrány can be considered a simplified, rounded, thick-walled, stubby version based on these models. Similar tendencies in copying models, i.e. reproducing them with a softer, rounded profile and simplified decoration, generally in a smaller and stubby form with thick walls, can be observed in several other cases within the repertoire of the Mezőcsát grave pottery (e.g. Kemenczei 1989, Fig. 6/1, 7/6, 8/1, Patek 1990, Tab. 2/5, 4/5, 13/2, 14/6, 18/1, 19/1, 23/2, Patek 1993, Fig. 30/6). Thus, these vessels most likely can be interpreted as the own products of the Mezőcsát culture. Based on this consideration, the amphora from Bükkábrány belongs to Kemenczei's above-described second group.

Gold beads (**Fig. 6.**) can occur in a range of different shapes in the assemblages of Pre-Scythian burials and hoards (pressed-spherical, biconical, star-shaped, with three lobes). Tibor Kemenczei considered the pressed-spherical and biconical variants within the same cluster (Kemenczei 2005, 88). Besides the small, pressed-spherical pieces, larger versions are also known from the hoard of Besenyszög-Fokoru (Ibid. 2005, 130−131). Analogous forms made of bronze appear in Late Bronze Age assemblages in the Carpathian Basin but are also present in Early Iron Age contexts east of the Carpathians. Given the uncertainty of their dating, instead, we shall focus on how these ornaments could have been worn since their finding circumstances at Bükkábrány (discovered in the fill inside the amphora) are quite unusual. Gold beads were found in four graves related to the Mezőcsát culture. In 1903, a disturbed inhumation burial was excavated by János Reizner at Szeged-Öthalom. Amongst the grave goods were a decorated antler

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plate, two Šarengrad type gold hair-rings (found among the ribs) and further five gold and three bone beads whose position were unknown. Reizner noted that there may have been more gold beads present in the grave originally (Reizner 1904, 81 Fig. 2.; Gallus & Horváth 1939, Tab. 48/6). At Sirok-Akasztómály, female grave 8 contained two gold beads, found behind the skull and at the right clavicle, along with a Šarengrad type gold hair-ring, the grave assemblage also contained a decorated antler plate among others (Patek 1990, 67). Three biconical gold beads were documented in grave 93 accompanying a female burial at Mezőcsát-Hörcsögös. One bead was found at the left leg, another among the ribs on the left side, while yet another west of the single ceramic vessel of the grave, probably in a displaced position due to animal disturbance, as the excavator noted. An amber bead found 5 cm above the right hand, and an antler plate were also part of the grave assemblage among others (Patek 1993, 147). Close to this grave, four cylindrical gold beads were documented in grave 94: one was found by the ribs on the left, another south of the cranium, and further two scattered in the grave's fill, a fragment of an antler plate was also part of the grave goods among others (Ibid. 147). As the above description suggests, there are only a couple of direct analogues that exist of the Bükkábrány gold beads from mortuary contexts. A common feature of all four graves is the presence of antler plates, and in addition to the gold beads, all of them contained other jewellery and/or decorative costume items too, along with the more common food offerings (animal bones and ceramic vessels). Overall, these graves represent the most richly furnished female graves of the culture (Szabó 1969, 75; Metzner-Nebelsick 2002, 439). Gold beads in contrast, occur more frequently in hoards (Kemenczei 2005, 88). The shape of gold beads cannot be linked to a particular period or context; these are generally interpreted as part of a garment or as components of a more elaborate piece of jewellery. However, given their small size, it is likely that they are often not spotted during excavation. The weight of an individual bead is so small (0.0286−0.0552 g), that at Bükkábrány they were left unnoticed even by metal detectors. To interpret their presence inside the vessel, unfortunately the above-mentioned analogues known from funerary situations are not particularly helpful. Their small size indicates that – in this instance – the beads were probably sewn onto some type of textile or either strung onto a string and then placed in the amphora, or the vessel was covered by a piece of cloth with the beads attached to it.

The sheep/goat and cattle bones (**Fig. 5/3-9**) found in the Bükkábrány grave are likely remains of food offerings – except for the astragalus. These two species represented the majority of animal remains from a total of 70 graves found in eight Mezőcsát culture cemeteries (Vörös 2015), which may suggest that the meat provision of the society was (mostly) based on keeping ruminants. However, as specific selection in a funerary context is also possible, this should be considered a hypothetical assumption until the archaeozoological material of contemporary settlements associated with the culture is uncovered. Similar conclusions concerning the animal husbandry at the Iron Age sites of Ludányhalászi-Sóderbánya and Salgótarján-Ipari Park II have been drawn (Bartosiewicz & Gál 2010, 117, Fig. 9.2; Tugya 2010, 354 Table 1). Both sites are located about 100 km NW of Bükkábrány. Based on preliminary data, those were associated with the Pre-Scythian and Scythian populations, however, the Pre-Scythian horizon of the sites is not yet sufficiently supported by find assemblages.

The sheep astragalus (**Fig. 5/1**) with slightly worn edges may have been given to the infant, as examples of three children's burials associated with the Mezőcsát culture imply. Grave 31 at Mezőcsát-Hörcsögös, the burial of an 8-year-old child contained a single, drilled sheep astragalus, while six sheep astragali were placed around the feet of an 8–9 years old child buried in grave 4 at Sirok-Akasztómály (Vörös 2015, 488). Grave 6 of Adács-Mérges-patak (Fodor 1973), the burial of a 7–8-year-old child also yielded a set of nine astragali (unpublished material, Dobó István Castle Museum, Eger – inv. no. A.74.1.10.).

Astragali, either modified (e.g. drilled, carved, etc.) or in intact form, represented items commonly associated with gaming, magic and divination across cultures and geographical regions (e.g. Bartosiewicz 1999; Dandoy 2006). Knucklebones from sheep and goats especially were found in great numbers among ritual deposits dated to the Late Bronze Age and Early Iron Age in the Near East (e.g. Affani 2008). Grave 1 at the Hallstatt Period site of Halimba-Cseres yielded 26 drilled sheep astragali which had been placed to the left foot of a woman aged 25–30 years old (Patek 1993, 88, Fig. 68/1–21). From the Early Iron Age burial chamber at Süttő, 39 pieces of drilled sheep astragali came to light (V. Vadász 1983, 31). The Iron Age cremation burial 236, excavated in the courtyard of the Slovenian Academy of Sciences and Arts in Ljubljana, was lined with several intact astragali (Puš 1971, 71, Tab. 57). Knucklebones also occurred frequently in child burials in the Mediterranean region during Antiquity (Hermary & Dubois 2012). Consequently, the sheep astragalus found in Bükkábrány may have equally represented a toy given to the infant or a symbolic object aimed to bring good luck for both the woman and the child in the afterlife. Its placement among the personal belongings, such as the antler plate and the iron implement (**Fig. 2/1**), stands as evidence of their meaningful function.

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The 4 cm long tusk plate (**Fig. 5/2**) most resembles those small boar tusk plates which, either perforated at their corners or, in undrilled form, were attached to the leather base of boar's tusk helmets in the Mycenaean world, dating to the 17th–10th century BC (e.g. Castleden 2005, 120–123, Figs. 5.1–5.3). The single plate found in the grave at Bükkábrány could be reconstructed as a decorative element attached to a piece of cloth or an accessory on its own or simply as a sundry exchange item. It might have also represented an object endowed with symbolic meaning, similar to the sheep astragalus, and functioned as a trophy or a protective token, associated with the power of wild boars (Markiewicz & Diakowski 2016). Although working ends were not identified on the tusk plate, its function as a small blade used for cutting textile fibres cannot be excluded either.

The highly corroded, small, rod-shaped iron object (5 on **Fig. 2/1**) found in the grave is most likely to have been an awl based on the find circum-stances because the antler plate found near the iron object suggests the presence of a "sewing kit". First, János Győző Szabó pointed out that in the burials of the Mezőcsát culture, antler plates can be accompanied by bronze needles, iron awls, and bone piercers, which are sometimes found close to each other, and can therefore be reconstructed as a sewing kit based on this find association (Szabó 1969, 75). This idea was also accepted by Gergely Bóka; in his opinion, the antler plate could have served as the cover for a composite object that was used to store needles and piercers. He further notes that in one case, 50 small bronze beads were discovered just beneath the antler plate, supporting the sewing kit hypothesis (Sirok-Akasztómály, grave 5) (Bóka 2012, 152). This combination of antler plates and tools also led Biba Teržan to conclude that they formed parts of sewing kits and, at the same time, raised the possibility that the plates could also have been used as utility tools for weaving and embroidery, such as measuring de-vices, shuttles, or, in the case of decorated plates, they could also serve as pattern templates (Teržan 2012).

The issue of Pre-Scythian antler plates has been at the forefront of research since the discovery of the first burials associated with the Mezőcsát culture due to their culture-specific nature and dubious function. Due to Gergely Bóka and Biba Teržan's recent overviews (Bóka 2012; Teržan 2012), the history of research will not be discussed here in detail. Instead, in the following section, we compare Bóka's results to our observations regarding the antler plate from Bükkábrány. Gergely Bóka listed 29 antler plates from 28 graves (Bóka 2012, 159, Appendix); this can be complemented by a plate fragment from grave 94 at Mezőcsát-Hörcsögös (Patek 1993, Fig. 25/3, 147), and an antler plate from a female burial associated with the Mezőcsát culture recently excavated at Veľké Kostoľany, Slovakia (Žaár et al. 2024, Fig. 71/3), and the plate from Bükkábrány discussed in this article. This means that 32 plates from 31 graves associated with the Mezőcsát culture are known to date.

Anthropological examinations have shown – where sexing of the skeleton was possible – that antler plates accompanied female burials in particular. The Bükkábrány specimen was also carved from a deer's antler and not from bone as István Vörös pointed out in the case of the other plates (Vörös 2015). The plate was found split along its mid-section. Transverse or longitudinal fractures were observed in nine additional plates (Bóka 2012, 151). It has been shown that antler plates are much more common in graves where the deceased was buried in an extended, supine position than in graves with different burial rites (Ibid. 151); in 23 of the 29 cases in which the skeletal position was observed, the deceased was lying in extended, supine position. It was also observed that in the extended skeleton burials, the bone plates were typically placed around the head or next to the arm, with the only exception of grave 6 in Füzesabony-Kettőshalom, where the plate was found at the feet. It is also typical that the left side is selected when the plate is not found around the head but rather on one of the sides; the only exception being grave 65 at Mezőcsát-Hörcsögös, where it was placed on the right side of the deceased along with the other grave goods (Ibid. 151). These trends are also confirmed by the Bükkábrány grave, where the plate was placed on the left side of a woman who was lying on her back in an extended position, close to her hand.

The decoration of the plate was largely indecipherable due to the amount of soil residue adhering to the surface. During the conservation process, in the area where the decayed substance was removed, a semi-circular frame-like line incision became visible, at the opposite end of the plate, a striped motif was identified as part of the decoration (**Fig. 4/2**). Furthermore, the high-resolution images taken during the conservation process made it clear that the lines were made even more pronounced by rubbing some kind of dark pigment into the incisions (**Fig. 4/3**). As it turned out during the conservation, the soil residue contained the remains of a woven piece of textile. Where the deposits were partially removed, the recovered textile fibres were documented; however, to protect and preserve the textile remains and make them available for further examination, the rest of the attached material was left intact on the surface. For this reason, it was crucial to find another, non-destructive method to examine the decoration of the plate.

The CT imaging process of the antler plate and the reconstruction of its decoration

The CT imaging process was conducted in the 3D Laboratory at the University of Miskolc using a YXLON FF35 µCT device. The X-ray source was a Y.FXT 190.61 transmission beam tube operated in microfocus mode at 125 kV and 30 µA. The detector operating was a Varian 2530HE flat panel detector with the exposition time of 333.33 ms. The level of magnification was 6.67×, and over 5000 projections were taken to achieve the best possible results. The total measurement time was around 5.5 h. The reconstructed image was further processed by VGStudio Max 3.3 software. For the graphics reconstruction, the sample was flipped into a vertical position, after which a series of images were taken along the coronal plate of the sample. The slice thickness for the reconstruction was set to 21 µm which came from geometrical constrains regarding the FOD (Focal – Object Distance), FDD (Focal – Detector Distance), and the physical pixel size of the above-mentioned detector (139 µm).

158 very thin slices cutting the decorated surface of the artefact were suitable to produce a detailed picture of the design. The field of decoration on one end of the plate was surrounded by three incised lines in the shape of a rectangle (base and two sides) closed by a semi-circular line on the fourth, top side. The field of decoration is divided into three zones. The upper segment of the object features a motif consisting of four interlocking spirals, the ends of which are accentuated by dot-and-circle motifs. The 4 outer dot-and-circle motifs are also connected by tangential spirals, resulting in a spiral vortex motif. The same spiral motif is repeated further below, although here the decoration is less regular. Both motifs are framed by a circular line and connected by a straight tangent line. The middle zone is divided into three lengthwise bands filled with a geometric design: two of the bands are filled with rows of incised – perhaps striped – triangles, while the third band is filled with a net-pattern. A row of striped triangles arranged in a perpendicular band joined the three lengthwise bands. At the lower segment of the plate, a seamless spiral meander motif was created by using a pair of incised lines. Some of the dominant motifs were further accentuated with striped infill (**Fig. 8.**).

The decoration of the Bükkábrány plate shows the characteristics of A-B-C pattern groups established by Bóka (2012, Fig. 8): a combination of interlocking spirals, striped triangles, net-pattern and dot-and-circle motifs. The closest analogues of the pattern can be found on the plates from burials 13 and 60 at Füzesabony-Kettőshalom (Patek 1990, Tab. 5/21, 15/13, 28/5, 29/1). The decoration of these plates is also divided into zones, with the spiral being the dominant motif in some zones, while other zones are filled with geometric motifs, including striped triangles. However, the main motif, the spiral vortex composed of four segments depicted on the Bükkábrány piece, does not appear in this form on any other plate. Gergely Bóka has developed his classification based on the principal motifs of the plates, in which "group A" is distinguished by the interlocking spirals as the main motif. The Bükkábrány plate can also be cate-

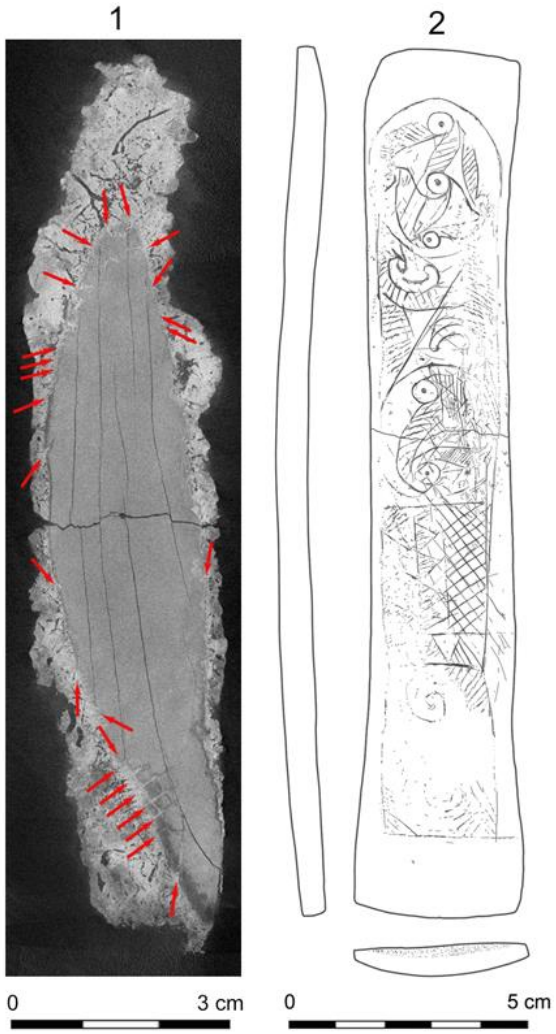

Fig. 8.: 8/1: One CT slice of the Pre-Scythian antler plate, the fragments of the incised decoration visible are marked by arrows (one slice displays only a small part of the plate surface due to its slightly curved shape) (T. Bubonyi). 8/2: The ornament of the plate reconstructed using 158 CT slices (L. Gucsi)

8. ábra: 8/1: Preszkíta agancslemez CT felvételének egy szelete, a látható mintarészleteket nyilak jelölik (a tárgy enyhén ívelt formája miatt egy szeleten a lemez felületének csak kis része jelenik meg) (Bubonyi T.). 8/2: A lemez díszítésének 158 szelet felhasználásával készült rekonstrukciós rajza (Gucsi L.)

gorised in this major group on the basis of the repeated depiction of interlocking spirals in different forms. However, because of the unique arrangement of interlocking spirals in a four-segment vortex, it might be regarded as a distinct subgroup. The design is, however, well known from round bronze phalerae and strap dividers of the Pre-Scythian period. Its closest parallel is the circular bronze phalera of the Biharugra depot, on which the four-segment vortex of interlocking spirals and dot-and-circle motifs appears as an engraved design (Gallus & Horváth 1939, Tab. 15/3; Kemenczei 2005, Tab. 14/36). The same motif appears as an openwork decoration on ring-footed, round bronze strap dividers, which we know from the depot of Fügöd (Kemenczei 1988a, Fig. 4/3–5; Kemenczei 2005, Tab. 22/A16–18) and from Pécs, the latter being an uncertain find, presumably from the area of the tumulus cemetery (Gallus & Horváth 1939, Tab. 45/2–3; Kemenczei 2005, Tab. 26/B3–5). A four-segment vortex motif of five interlocking spirals completed with additional concentric circles also appears on an ornamental bronze disc dated to the Pre-Scythian period, a stray find from the area of Osytnjažka in the Middle Dnieper region (Kirovohrad region, Ukraine, Terenožkin 1976, Fig. 39/4, 42/3). The above-mentioned finds were mapped by Carola Metzner-Nebelsick (2002, Fig. 153). As a further close parallel, a horse bit from an unknown location in Hungary can be mentioned, on which the round knob closing the hook is decorated with a three-segment spiral vortex motif consisting of tangential spirals connecting openwork circles (Gallus & Horváth 1939, Tab. 41/1, 47/5).

The so-called “Tangentenkreis” motif, composed of tangent lines connecting circles – which is also recognisable as a building element in the spiral vortex motif –, also appears as a linear pattern on contemporary goldworks, e.g. on conical ornamental discs and the diadem of the Besenyszög-Fokoru hoard (Kemenczei 2005, Tab. 11/8–11) and on a conical ornamental disc, a stray find from Zlaté Moravce, Slovakia (Ibid. Tab. 56/C).

Referring to Aleksei Ivanovič Terenožkin, Tibor Kemenczei asserts that "Tangentenkreis" motif appearing on Pre-Scythian finds of the Carpathian Basin is not of local origin; rather, it can be associated with the art of the Pre-Scythian era of the steppe and North Caucasus region (Terenožkin 1976, 178, 182; Kemenczei 1995, 345; Kemenczei 2005, 90, 109−110, 119). Christopher Pare, however, presents further examples from the Balkans and Asia Minor to illustrate the interregional use of the motif in the Early Iron Age (Pare 1998, 373, 374 Fig. 35).

Textile remains

The antler plate was found in the grave with its front panel facing the bottom of the grave, with a thick layer of soil adhering to its decorated surface. The conservation of the artefact and the scientific examination of the residue were carried out in the Conservation Laboratory of the Hungarian National Museum.

The residue was partly removed in stages, mechanically in a moist environment. During this delicate process, some details emerged that suggest-ed the presence of a textile. It is feasible that the antler plate was either wrapped in some sort of textile, or it contacted the garment or the burial shroud. Remains of a woven construction identified as a plain weave became visible under the hand-held magnifying glass and were even observable to the naked eye. Although the woven structure was difficult to determine in detail even on a high-resolution digital image, the basic warp and weft threads were successfully documented in the residue matrix.

The entire surface of the antler plate was scanned by a NIKON, Eclipse stereo microscope using 20× and 50× magnification, making it evident that the textile remains formed part of a finely woven piece of cloth. A series of fine threads could be distinguished placed at regular intervals on the whole surface of the plate: threads of cobalt blue, dark green, and in some places, pink were identified along with threads of natural colour (**Fig. 9/1-4**). The threads were documented by a KEYENCE, VHX5000 type digital microscope subject to 100×, 150× and 200× magnification. The individual threads were colour coded according to the colours observed on the textile and projected as an extra layer onto the image (**Fig. 10.**).

During the conservation process only the threads lying deeper below the surface were registered (alignment, colour, material) to avoid the documentation of potential subsequent contamination. As a result, linen fibres were identified (**Fig. 9/1-4**). For the identification of threads, the work published by Annette Rast-Eicher (2016) was employed as a key piece of literature. In addition to the textile remains, on a small area, a kind of ochre-coloured residue was also documented which could have been left by the presence of leather (**Fig. 9/5**). Furthermore, on the entire surface of the plate, a strong presence of chromium oxide green-coloured material was detected under the textile threads (**Fig. 9/6**). The present data can only be evaluated as preliminary results, as both the textile remains and the other components identified in the deposition require further, more detailed investigation. To protect and preserve the remains, the rest of the material adhered to the surface was left intact.

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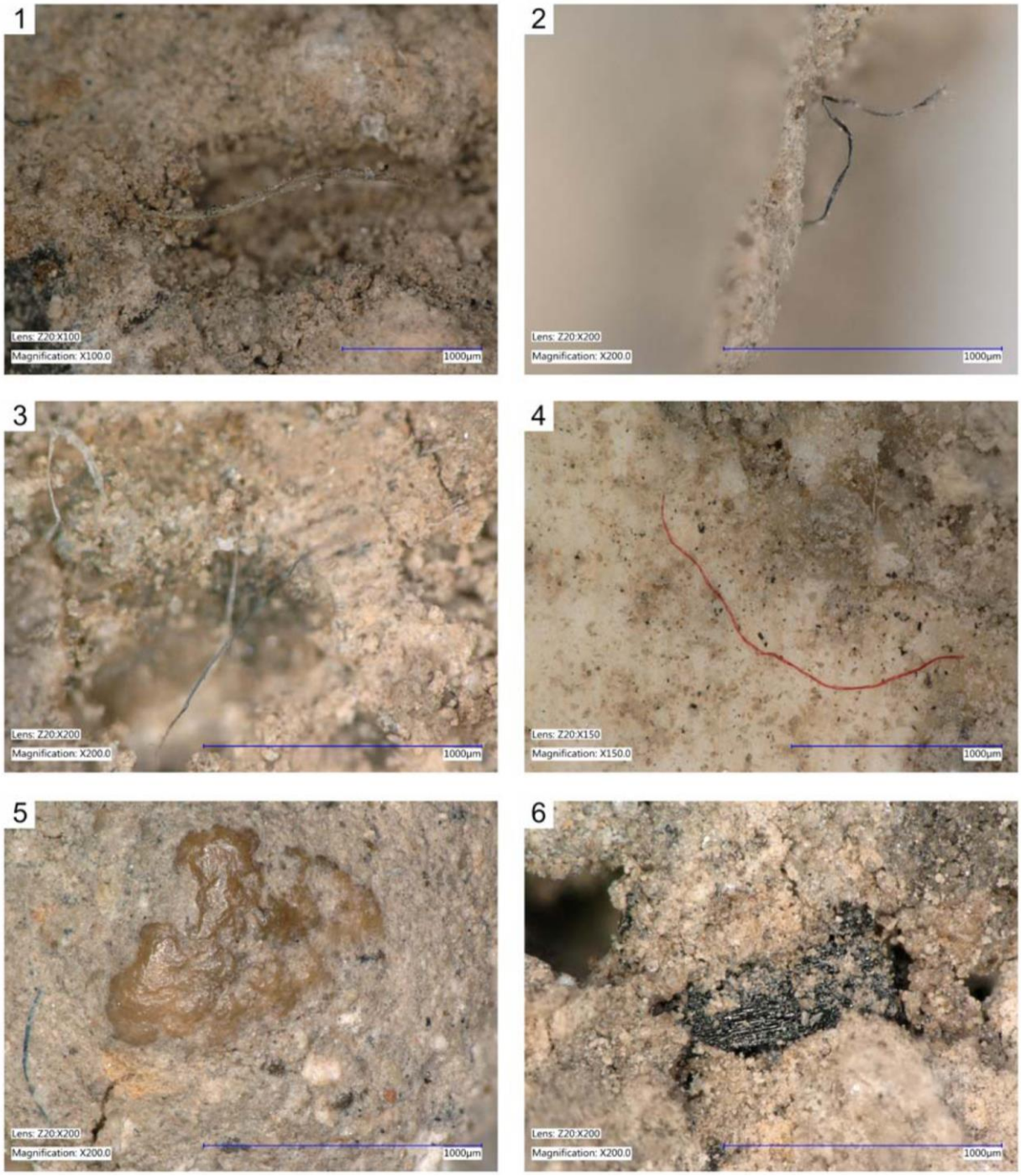

Fig. 9.: Elementary threads and layers observed in the residue on the surface of the antler plate (T. Somfai)
9. ábra: Az agancslemez felszínén lévő lerakódásban megfigyelt elemi textilszálak és rétegek (Somfai T.)

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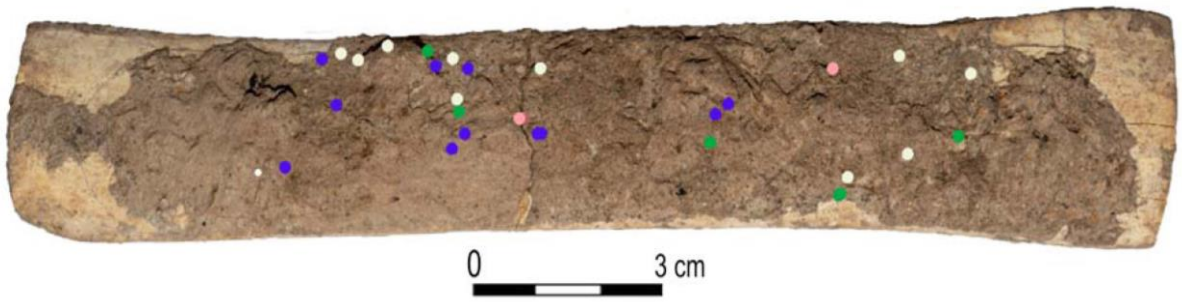

Fig. 10.: Colour distribution of the elementary threads observed in the residue on the surface of the antler plate (K. Dúzs)

10. ábra: Az agancslemez felszínén lévő lerakódásban megfigyelt elemi szálak színbeli eloszlása (Dúzs K.)

The typological assessment of the stray finds

Small conical bronze tutuli, bent from thin bronze sheet (**Fig. 7/4**) are relatively common grave goods in the burials of the Mezőcsát culture and can be interpreted primarily as a costume element (Metzner-Nebelsick 2002, 458–459; Kemenczei 2005, 85). To date, we know their occurrence from 11 graves at six sites. In Füzesabony-Kettőshalom, they appear as a characteristic element of women's costume (graves 13, 22, 23, 29, 62, 63 – Patek 1990). In some cases, they were clustered around the right hand (graves 13, 29, 62), leading János Győző Szabó to suggest that they may have been decorating gloves (Szabó 1969, 75). Carola Metzner-Nebelsick also considers it possible that they were applied to gloves or directly to nails (Metzner-Nebelsick 2002, 459). In other burials they were found in a different position, i.e. in front of the pubic bone (grave 63) or in a pile between the femurs (grave 22), allowing them to be reconstructed as decorations on the hem of a garment or belt. In further five cemeteries of the culture, bronze tutuli were found in children's burials (Füzesabony-Öregdomb, grave 2; Dormánd-Hanyi puszta, grave 3; Mezőcsát-Hörcsögös, grave 95; Szeged-Algyő, 258. kútkörzet, grave 82; and the 100 cm skeletal length indicates that the burial at Csongrád-Vendelhalom is also a child's grave). Their position in the grave was observed in three cases, which suggests that in the case of children, tutuli may have been hung on a necklace or sewn onto the neck of a dress (see also D. Matuz 2000, 144). It is noteworthy that in grave 82 of Algyő, the bronze tutulus was found together with a red deer tooth pendant and a pendant of a tubular bone, interpreted as an amulet, possibly strung on a chain with other items (D. Matuz 2000, Fig. 4, 7/8). A further bronze sheet tutulus was found in the grave of a Maturus II male buried in a crouched position in Želiezovce, Slovakia. The authors noted that the conical tutulus, with a 9 mm × 9.5 mm diameter at the bottom, bent from a 1.3 mm thick sheet, differs in size and thickness from the smaller, thinner pieces common in burials of the Mezőcsát culture (Ožďáni & Nevizánsky 1996, 261, Fig. 8/2, Fig. 11). In conclusion, bronze tutuli are primarily associated with women and children in Mezőcsát cemeteries, and the way they were worn varied according to age, gender and community customs. It is particularly striking that while in the cemetery of Füzesabony-Kettőshalom, about 40% of the female graves contained bronze tutuli; whereas in the cemetery of Mezőcsát-Hörcsögös with nearly 50 graves, only one child's grave had 2 pieces. The presence of bronze tutuli as costume elements in the late Tumulus culture – early Urnfield period in the Carpathian Basin suggests that their use in the Mezőcsát culture might be traced back to these former, local traditions (D. Matuz 2000, 144; Metzner-Nebelsick 2002, 459; Kemenczei 2005, 85). However, in the Early Iron Age they also appear as decorative elements on belts and clothing in a wider area, such as the Dniester, Dnieper, North Caucasus and Volga-Kama regions (Kemenczei 2005, 85). Their also higher occurrence in the cemeteries of the South-Eastern Pannonian group, particularly in Dalj/Dálya, Croatia, has been attributed to a close relationship with the Mezőcsát culture by Carola Metzner-Nebelsick (2002, 458–459).

The bronze cheekpiece from Bükkábrány (**Fig. 7/1**) belongs to the type with straight shaft and curved end, perforated with three parallel cylindrical strap divider units (uniplanar arrangement), which corresponds to type I in Carola Metzner-Nebelsick's typological system (2002, Fig. 97), and described as Füzesabony type by Tibor Kemenczei (2005, 100–101). This is the most prevalent type of psalia in the Late Urnfield – Early Hallstatt period west of the Carpathians, with a distribution centering in the Carpathian Basin (Metzner-Nebelsick 2002, Fig. 98–99), suggesting that its form may have been developed in workshops in the Carpathian Basin based on eastern models (Kemenczei 2005, 100). Over time several variants were developed, possi-

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bly as a result of multiple workshops producing them (five variants: Ia–e, were distinguished by Metzner-Nebelsick 2002, 217). The closest parallel to the Bükkábrány piece is a cheekpiece from grave 3 at Füzesabony-Öregdomb, burial of the Mezőcsát culture, which, apart from the basic form, also show similarities in that the curved end is closed by a larger, hat-shaped finial, and the cylindrical perforations are plain, not featuring a thickened rim or knob ornament (Gallus & Horváth 1939, Tab. 2/1–2; Kemenczei 1989, Fig. 4/2,6). This type was classified in subtype Ib by Metzner-Nebelsick (2002, 508), the uniqueness of which is shown by the fact that only one other piece was included in this group, a stray find from Füzesabony-Öregdomb (Gallus & Horváth 1939, Tab. 5/1–2; Kemenczei 1989, Fig. 6/3,5). This one has a similar basic design but with additional knob decoration on its tubular perforations. In our opinion, the group can be completed by another stray find from an unknown location in Hungary (Gallus & Horváth 1939, Tab. 51/3; Kemenczei 2005, Tab. 50/1). The rest of type I/Füzesabony type cheekpieces differ more significantly in shape compared to the Bükkábrány piece; cheekpieces with plain tubular units are typically complemented with a smaller, knob-like finial (e.g. Dalj/Dálya, Kemenczei 2005, Tab. 8/A3; Batina/Kiskőszeg, Tab. 36/2–3, Tab. 52/A2; Vetiș/Vetés, Tab. 39/B1–4; Szanda, Tab. 32/4–5; Hrtkovci, Tab. 54/D2), whereas pieces with a larger finial, typically feature some additional elements such as a thickened rim, small knobs on the tubular units, or a decorated finial (e.g. Dalj/Dálya, Ibid. Tab. 8/A4–5; Batina/Kiskőszeg, Tab. 36/1; Dinnyés, Tab. 18/2–3; Sarkad, Tab. 44/B1). Tibor Kemenczei dated the Füzesabony type cheekpieces to the Late Urnfield – Early Hallstatt transition period (Kemenczei 2005, 100), Carola Metzner-Nebelsick dated the type I cheekpieces to the 9th–8th century BC (Metzner-Nebelsick 2002, Fig. 135). She dated the psalia from grave 3 at Füzesabony-Öregdomb – the closest formal parallel of the Bükkábrány piece – to the late Urnfield period, the 9th–early 8th century BC (Ibid. 283).

The helmet-shaped strap divider (**Fig. 7/2**) is a characteristic element of horse harness of Ponto-Caucasian origin of the Pre-Scythian period (Metzner-Nebelsick 2002, 337–341, 531; Kemenczei 2005, 110). Within the group of strap ornaments, they represent a non-local type in Central Europe, whose parallels can be traced to the Caucasus region, where the bone and antler predecessors of the bronze pieces have been identified. About 40 known specimens of this type have been discovered in the region between the Caucasus and Lower Bavaria. They occur most numerously in the Ciscaucasus and the Kuban region, more sporadically in the steppe and forest steppe between the Dnieper and the Don, and again in higher numbers in the Carpathian–Danube region (Metzner-Nebelsick 2002, Fig. 157, 531; Reinhold 2007, 75, Liste 267; Skoryj et al. 2016).

Western pieces are distinguished from the Eastern finds by a key structural element: while the vast majority of Eastern pieces feature one or two simple parallel loops on the back, the majority of Central European pieces have four pegs on the back joined by a circular or rectangular ring, enabling them to fasten transverse straps, i.e. use them as strap dividers. This method of fastening can be traced back to local traditions in Central and South-Eastern Europe, suggesting that helmet-shaped strap ornaments were adopted in the Pre-Scythian period, and they were also made locally, based on eastern models, modified to local needs (Metzner-Nebelsick 2002, 337, Fig. 157).

In the Trans-Tisza region (east of Tisza), helmet-shaped strap dividers have been discovered exclusively in hoards so far (Biharugra, Gallus & Horváth 1939, Tab. 15/4, 16/4; Kemenczei 2005, Tab. 14/45; Vetiș/Vetés, Ibid. Tab. 39/B7). However, the closest formal parallels of the Bükkábrány piece can be found west of the Danube, among the grave goods of those Late Urnfield – Early Hallstatt burials, which are distinguished by the presence of horse harness elements of Ponto-Caucasian origin: in the Batina/Kiskőszeg assemblage (Gallus & Horváth 1939, Tab. 54/5, with a possible interpretation as grave finds: Metzner-Nebelsick 2002, 392, 640, Tab. 37/1), among the grave goods of tumulus burial 15 at Pécs-Jakabhegy (Maráz 1978, Fig. 5), in the Stillfried “hoard”, Lower Austria (Gallus & Horváth 1939, Tab. 72/6-7, reassessed as grave finds: Kaus 1989), among the grave goods of Künzing “grave A”, Lower Bavaria (Metzner-Nebelsick 2005, Fig. 1/7; Deicke 2011, Tab. 1/4), and the tumulus grave of Záboří nad Labem, Central Bohemia (Richlý 1894, Tab. 51/27). In a different geographical and cultural context, a helmet-shaped strap divider, also a close analogue of the Bükkábrány piece was discovered among the finds of a bronze hoard associated with the Černoles culture near Leliaki, Kyiv Oblast, Ukraine by the Dnieper (Skoryj et al. 2016, Fig. 19/3, 20/3). Since the hoard’s two sets of Füzesabony type cheekpieces and a round, ring-footed strap divider are likewise related to the finds of the Carpathian Basin, the authors consider it possible that the bridle components of the hoard originated from the Carpathian Basin or were made locally, based on western models (Ibid. 118–122). Considering the aforementioned, it is plausible that the Bükkábrány piece was produced in the Carpathian Basin, both because of its mounting structure and the spatial distribution of the closest formal parallels of its decorative plate, which are concentrated within and surrounding the Carpathian Basin.

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In terms of chronology, the Central European pieces of helmet-shaped strap dividers are present in find assemblages of the 9th–8th centuries BC, and were no longer in use in the 7th century BC (Metzner-Nebelsick 2002, 337–339; Metzner-Nebelsick 2005, 130). The closest formal parallels of the Bükkábrány strap divider are represented by the pieces from Batina/Kiskőszeg, Künzing and Stillfried, they are almost identical in detail. Of these, the find from Künzing was dated to the late Urnfield, HB3 period, the 9th century BC (Deicke 2011, 140), meanwhile the Stillfried "depot" represents a later assemblage dated to the early Hallstatt period, the 8th century BC (Metzner-Nebelsick 2002, 339). The Batina/Kiskőszeg assemblage cannot be dated more precisely because of its uncertain find circumstances (Ibid. 349).

The conical cast bronze phalera from Bükkábrány is 4.1 cm in diameter with a simple loop on its back (**Fig. 7/3**). This type of phalera has not yet been found in the funerary context of the Mezőcsát culture. As grave goods, similar-sized round bronze and iron buttons, between 2 and 4.5 cm in diameter, were found, but these are typologically different, having spherical or flattened spherical form and a small, eye-like loop at the back with a narrow, round hole. They are associated with graves of women and children. In those cases where their original position has been observed, they are usually found around the ankle (Füzesabony-Kettőshalom, grave 10, 23, 29, 43, Patek 1990; Füzesabony-Öregdomb, grave 9, Kemenczei 1989, Fig. 5/7–9; Sirok-Akasztómály, grave 8, Patek 1990, Tab. 23/6–7; Mezőcsát-Hörcsögös, grave 94, Patek 1993, Fig. 32/22–24), in one case they were found at the left pelvic bone (Füzesabony-Kettőshalom, grave 63, Patek 1990, Tab. 12/8–9), so they can be interpreted as sewn-on ornament, a costume item. Conical phalerae with longer loops, similar in form to the Bükkábrány piece (type AI phalerae by Metzner-Nebelsick 2002, Fig. 161; Kemenczei 2005, 115), are primarily found in hoards (e.g. Biharugra, Kemenczei 2005, Tab. 15/70–71; Dinnyés, Tab. 19/A12; Prügy, Tab. 27/6–7; Szanda, Tab. 32/8). They are, however, slightly larger, typically 6–8 cm in diameter but sometimes exceeding 14 cm. Although these types of phalerae may be multifunctional, the solid, moulded pieces with longer loops could have been used as ornaments for horse harnesses (Metzner-Nebelsick 2002, 348), this is particularly likely to be the case when they are found together with other elements of horse equipment (Kemenczei 2005, 115). Based on the above, the Bükkábrány piece most likely served as a bridle ornament. A stray find from Füzesabony-Öregdomb, a spherical bronze phalera 8.3 cm in diameter, also suggests that phalerae may have been associated with the burials of the Mezőcsát culture (Kemenczei 1989, Fig. 6/8). Regarding the origins of the spherical and conical, undecorated round bronze buttons, Tibor Kemenczei noted that such buttons were produced throughout the Late Bronze Age in the Carpathian Basin; therefore, the Early Iron Age pieces may have been made primarily based on local models, although bronze buttons decorating the bridle were also characteristic elements of horse equipment in the North Pontic region (Kemenczei 2005, 115).

The archaeometallurgical analyses of metal objects

To establish the chemical compositions of the artefacts a non-destructive examination was carried out by Energy Dispersive X-ray Fluorescence (ED-XRF) spectrometry with an Oxford Instruments X-MET8000 Expert portable spectrometer at the University of Miskolc. The instrument measures the chemical composition on a few mm diameter of the surface of the sample, which can be significantly reduced using a collimator. The X-ray beam can penetrate to a depth of up to 100–150 μm, but the penetration depth is quite material-dependent. The precision of the measurement is usually of the order of 0.1% and the accuracy is between 0.2 and 1 rel.%, but this also depends on the atomic number, the light elements generally being more difficult to measure.

All 13 gold beads were measured using a "Fundamental Parameter" method (Precious_FP) to analyse the elements found in alloys and in particular precious metals. The concentration range for each element is from 0 wt% to 100 wt%. Fundamental parameter methods use a complex mathematical analysis of X-ray fluorescence to calculate the concentrations of elements in the sample. It is less accurate than a similar empirical method, but it is accurate over a much wider range of element concentrations. In some cases, the Alloy_FP method was also used for comparative measurement information. The concentration range for each element is from 0 wt% to 100 wt%, too. All measurements were taken within 30 seconds. In the first column of **Table 2**, the compositions are listed by the number of each bead. The letters after the numbers indicate different measurement locations or methods. All the values are indicated in percentage by weight.

The measurement results revealed that the beads were likely to have been made using the same or very similar base materials. The values scatter in a narrow range. The base material was gold containing 14−16 wt% silver, 1 wt% copper, and iron below 0.5 wt%. Although in some cases the iron content was relatively high, however, this could have been due to surface contamination as well.

The material of the beads can be relatively high silver-containing native gold, which is often contaminated and mixed with native silver which is

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Table 2.: Compositions of gold beads (wt%)

2. táblázat: Az aranygyöngyök elemösszetétele (tömeg%)

No.	Method	Fe	Cu	Ag	Au
1A	Precious_FP	0.28	0.96	13.97	84.78
2A	Precious_FP	0.28	0.89	16.38	82.45
3A	Precious_FP	0.49	0.98	14.61	83.92
4A	Precious_FP	0.54	1.10	18.13	81.23
4B	Precious_FP	0.36	0.96	14.55	84.14
4C	Precious_FP	0.61	0.94	16.81	81.63
5A	Precious_FP	1.32	0.70	16.42	81.55
5B	Alloy_FP	0.68	0.99	14.86	83.46
5C	Alloy_FP	0.48	0.98	15.08	83.47
6A	Precious_FP	0.32	1.04	14.11	84.53
6B	Alloy_FP	0.23	1.05	14.88	83.83
7A	Precious_FP	0.33	1.03	16.23	82.41
8A	Precious_FP	0.62	1.02	14.58	83.79
9A	Precious_FP	0.25	1.04	15.09	83.62
9B	Alloy_FP	0.27	1.08	15.74	82.92
10A	Precious_FP	0.26	0.97	14.06	84.70
11A	Precious_FP	0.26	0.96	14.59	83.98
12A	Precious_FP	0.96	1.09	14.57	83.38
13A	Precious_FP	0.44	1.01	14.86	83.69
13B	Alloy_FP	0.97	1.03	15.76	82.19
13C	Alloy_FP	0.66	0.97	15.58	82.79

very similar in properties and nature. However, the silver content of this native alloy is less than 20 wt%, above which it would be called electrum.

On the surface of the cheekpiece, 28 XRF measurements were carried out (**Table 3**). Several measurements were made on all parts of the object, using the Alloy_FP method and 30 seconds measuring time in all cases. Due to the geometry of the object, a collimator was used for most of the measurements (except for No. 11, 12, 18, and 23).

The results show that the cheekpiece was made of tin bronze. Among the contaminants remaining in the metal from the copper ore, the arsenic and antimony content is noteworthy. It should be noted that the iron content may be due to inherent contamination of the crystal structure of the metal alloy, but also to surface contamination, even of modern age, which can be detected with a high value, especially on the surface of the fracture.

Based on the chemical components, the only possible alloying element is tin. Its measured values, which are very high, but with a high standard deviation, reveal two main characteristics.

Firstly, tin is an alloying element and not a coating since it is also measurable in significant amounts on the surface of the fracture. On the other hand, the results indicate that a significant surface tin segregation has occurred. Due to corrosion processes, the surface of bronze objects can usually be expected to be segregated into certain constituents, mainly tin and lead (Orfanou & Rehren 2015, 392; Szabó et al. 2018, 99). The degree of segregation can depend on several parameters, which are influenced by the time elapsed, the composition of the environment, the humidity, and other characteristics, as well as the composition of the alloy, shape, and design of the object. In this case, the surface is relatively large and segmented compared to its volume, but it is not a thin cross-sectional sheet-like object.

A comparative analysis of the chemical composition of the different parts of the cheekpiece fragment shows varying compositions. The analysis of a bronze buckle ring from the Regöly tumulus dated to no earlier than the last third of the 7th century BC also showed a similar phenomenon. The authors explain the discrepancy in the measured data by methodological issues, surface alloy enrichment, retention of particles due to imperfect melting, and environmental effects (Szabó et al. 2018). Our measurements further reveals that the corroded surface of the object is most worn on the knob at the end, where the tin content is the lowest. The compositional data from here suggest that the original bronze alloy contains no more than 9–10 wt% tin, which is presumably what would be measured in the inner part of the cross-section of the object if it were cut in half. Such a high tin content suggests a typical composition, as in many regions of Europe (e.g. the British Isles), after the bronze alloys with often higher tin content of the Middle Bronze Age, a ratio of 1/10 tin/copper or 8–10 wt% tin content gradually but increasingly clearly became common over the centuries, as a kind of ideal compositional standard (Tylecote 1992, 18, 30), which varied little, if at all, up to a ratio of 1/8, except in special cases (e.g. bell bronze) until the Roman Age and even the Middle Ages. However, it is also worth noting that bronze containing 9–10 wt% tin is similar in colour to gold (Charalambous & Kassianidou 2012, 302).

Discussion and conclusions

The burial excavated at Bükkábrány-Kálvária held the remains of a female individual between 30–45 years of age placed in the W–E orientated grave in a supine position and an infant between 10 lunar months and 6 months. The grave was cut into the burnt debris of a house established and used during the Middle Bronze Age and significantly disturbed by later cuts. The burial goods that survived in the

Table 3.: Compositions of the cheekpiece (wt%)

3. táblázat: A zablaoldaltag elemösszetétele (tömeg%)

No.	Measurement location	Fe	Co	Ni	Cu	As	Ag	Sn	Sb	Pb	Bi
1	Concave segment below the knob-like finial	0.13	0.08	0.26	85.12	0.46	0.22	**12.54**	0.78	0.41	0.00
2	Concave segment below the knob-like finial	0.15	0.12	0.40	81.76	0.83	0.27	**15.00**	0.88	0.55	0.03
3	Concave segment below the knob-like finial	0.18	0.17	0.57	77.76	1.20	0.29	**17.88**	1.15	0.63	0.03
4	Concave segment below the knob-like finial	0.08	0.06	0.20	87.18	0.39	0.16	**10.89**	0.61	0.42	0.00
5	Convex segment below the knob-like finial	0.25	0.26	0.89	67.14	1.49	0.44	**26.95**	1.64	0.71	0.06
6	Convex segment below the knob-like finial	0.17	0.20	0.81	68.02	1.43	0.45	**26.53**	1.61	0.61	0.05
7	Convex segment below the knob-like finial	0.22	0.21	0.80	66.88	1.46	0.42	**27.51**	1.66	0.63	0.04
8	Convex segment below the knob-like finial	0.31	0.23	0.81	64.03	1.39	0.46	**30.12**	1.74	0.65	0.06
9	Knob-like finial	0.47	0.07	0.21	86.91	0.68	0.16	**10.77**	0.72	0.00	0.00
10	Cylindrical aperture in middle, concave side	0.40	0.32	0.85	73.25	1.31	0.37	**21.53**	1.32	0.56	0.04
11	Cylindrical aperture in middle, concave side	0.32	0.27	0.79	73.99	1.24	0.34	**21.12**	1.28	0.56	0.03
12	Long curved shaft segment, concave side	0.29	0.16	0.58	80.12	1.07	0.27	**15.84**	0.95	0.47	0.00
13	Long curved shaft segment, concave side	0.26	0.17	0.71	73.68	1.08	0.36	**21.91**	1.28	0.52	0.03
14	Long curved shaft segment, concave side	0.19	0.25	0.98	70.82	1.46	0.37	**23.75**	1.42	0.69	0.05
15	Cylindrical aperture by fracture, concave side	0.14	0.07	0.20	86.26	0.34	0.22	**11.76**	0.73	0.28	0.00
16	Cylindrical aperture by fracture, concave side	0.19	0.14	0.42	79.31	0.82	0.31	**17.22**	1.05	0.52	0.03
17	Fracture surface	2.64	0.17	0.59	78.49	0.42	0.29	**15.97**	0.96	0.00	0.00
18	Cylindrical aperture by fracture, convex side	0.43	0.26	0.88	66.66	1.48	0.43	**27.34**	1.59	0.69	0.04
19	Cylindrical aperture by fracture, convex side	0.51	0.21	0.81	67.27	1.44	0.41	**26.95**	1.58	0.61	0.04
20	Long curved shaft segment, convex side	0.27	0.19	0.73	72.59	1.26	0.36	**22.57**	1.34	0.64	0.04
21	Long curved shaft segment, convex side	0.23	0.22	0.77	69.71	1.31	0.38	**25.30**	1.42	0.63	0.04
22	Cylindrical aperture in middle, convex side	0.48	0.19	0.59	69.98	1.37	0.43	**24.57**	1.45	0.72	0.06
23	Cylindrical aperture in middle, convex side	0.40	0.13	0.45	78.58	0.98	0.29	**17.36**	1.07	0.53	0.00
24	Knob-like finial	0.35	0.06	0.18	89.24	0.55	0.15	**8.96**	0.52	0.00	0.00
25	Knob-like finial	0.17	0.14	0.45	79.45	0.86	0.32	**17.04**	1.05	0.50	0.00
26	Knob-like finial	1.04	0.08	0.33	79.91	0.63	0.25	**16.18**	1.00	0.39	0.00
27	Straight shaft segment, side	0.43	0.28	1.10	72.44	1.77	0.38	**21.38**	1.28	0.00	0.05
28	Fracture surface	3.67	0.15	0.57	74.54	0.44	0.41	**18.49**	1.14	0.00	0.00

eastern sector of the grave indicate that the finds can be associated with the Pre-Scythian Mezőcsát culture.

The ceramic grave goods of the burial consisted of a likely locally made amphora, a simplified version of a widespread form of the Late Bronze Age – Early Iron Age cultures of the Carpathian Basin, and a decorated cup of outstanding quality, associ-

ated with the Lusatian cultural complex, probably originating from the territory of Poland.

The grave assemblage contained an antler plate, with a soil residue covering its front panel. Its incised ornament, deciphered and made visible by non-destructive CT imagery, has shown a complex ornamentation style. Its main motif, the spiral vortex, represents a so far unique ornamental element incised on an antler plate; however, it does occur on bronze and gold objects of contemporaneous hoards − especially on round elements of horse harness − further evidencing the connection between these artefacts. Attached to the antler plate, in the soil deposition, the remains of a piece of plain weave textile constructed of linen threads dyed to blue, green, pink, and natural colour were detected and documented during conservation. However, further research is required to investigate the textile remains and additional components discovered in the deposit. A corroded iron object, perished during lifting, was most likely an awl and thus probably part of a sewing kit along with the antler plate.

The majority of the animal bones can be interpreted as remains of food offering, belonging to at least two cattle and one sheep/goat. Two pieces: the sheep astragalus and the plate carved from a wild boar tusk warrant more attention. The astragalus can also be interpreted as a child's toy or as an object related to beliefs. The boar tusk plate represents so far, a unique object in the context of the Mezőcsát culture.

The 13 pieces of gold beads were all crafted of natural gold with high silver content concluded by the ED-XRF examinations. The position of the beads within the grave in Bükkábrány was quite unusual: they came from the fill inside of an amphora which suggests that the beads were either threaded onto a string or attached to some kind of textile either covering the orifice of the vessel or placed inside of the amphora.

To place the grave in the wider context of the burials of the Mezőcsát culture, we can conclude that altogether five graves are known where gold beads were found, in all cases along with "sewing kits" (antler plates and needles, awls). This, and the generally higher number of jewellery and decorative costume items of women buried with sewing kits, imply the elevated social status of the deceased, as already pointed out by János Győző Szabó (1969, 75). As certain design patterns appearing on antler plates could be associated with burial groups and therefore interpreted as expressions of identity by local communities (Teržan 2012; Bóka 2012, 150–151), Biba Teržan goes further in terms of interpretation and speculates that those buried with their sewing kit might have been embroiders or weavers, a skill that made them renowned and respected members of their community and guardians of family identity (Teržan 2012).

Among the cemeteries of the Mezőcsát culture, the Bükkábrány burial appears to be more closely related to some particular cemeteries in Heves County. On the one hand, this manifests itself in the interrelationship of the grave goods. The elaborately made ceramic cup can be associated with the Lusatian cultural complex, and as it was pointed out earlier, ceramics related to the ceramic traditions of the northern mountain regions are markedly present in the cemeteries of Heves County (Patek 1990, 71; Metzner-Nebelsick 1998, 367−373; Metzner-Nebelsick 2023, Fig. 10.2). However, this is the first time that an import from so far north has been assumed. In addition, the closest parallels to the decoration of the antler plate – despite its uniqueness – are known from Füzesabony-Kettőshalom. On the other hand, it is also reflected in the burial rite, since we know graves in Heves County in which the burial rite, the composition of grave goods and their positioning in the grave are almost identical to those in Bükkábrány. In this respect, the closest parallels to the Bükkábrány burial are the graves 23, 29, 60 at Füzesabony-Kettőshalom, graves 2 and 5 at Sirok-Akasztómály, and grave 97 at Maklár-Koszpérium which likewise feature a female deceased buried in a W/NW–E/SE orientation, lying in a supine, extended position, with their grave goods placed on their left sides, so that the food offerings (ceramic vessels, meat) were placed next to the head and upper body, and the sewing kit was placed next to the forearm or hand. In all these burials, a flat stone was placed next to the foot. It cannot be excluded either that a stone was also originally part of the set of the grave at Bükkábrány, due to the incomplete nature of the burial. Thirdly, lying at the foothills of the Bükk, the Bükkábrány cemetery is also geographically more closely related to the Heves County cemeteries (along with the sites Bükkábrány-Bánya VIII. and Mezőkeresztes-Cet-halom), separated from the rest of Borsod County cemeteries, which were established closer to the Tisza (Mezőcsát-Hörcsögös, Ároktő-Dongóhalom, Ároktő-Pélypuszta, Tiszakeszi-Szódadomb).

About 25 meters NE of the burial, in a relatively restricted area about 23 m in diameter, four metal objects were found by metal detecting. One bronze tutulus can be interpreted as a decorative costume item or part of personal jewellery; they are relatively common finds in women's and children's graves of the Mezőcsát culture. While three other objects – a cheekpiece, a helmet-shape strap divider, and a round phalera – can be interpreted as part of horse bridle. Pre-Scythian bridle parts are typical elements of contemporary hoards, but no such finds have been discovered so far in the northern area of the Northern Great Hungarian

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Plain bordering the mountain region, where the majority of the cemeteries of the Mezőcsát culture – among them the Bükkábrány site – are located (for comparison, see Kemenczei 2005, 129–138). In the burial context of the Mezőcsát culture, however, pieces of horse equipment do occur, even if relatively rarely, with six such burials attributed to the culture so far (Senica, grave 1/42, Romsauer 1999, Fig. 5; Dvorníky-Posádka, Dušek 1961, Fig. 4/12–13; Füzesabony-Öregdomb, grave 1 and 3, Kemenczei 1989, Fig. 3/4–8, Fig. 4/2,4–6,8–10; Mezőcsát-Hörcsögös, grave 52, Patek 1993, Fig. 29/8, Mezőcsát-Hörcsögös, grave excavated in 2010, P. Fischl & Pusztai 2014, Fig. 1/1–2,4–5). Based on these considerations, the metal surface finds can most probably be interpreted as grave goods, suggesting the presence of additional Pre-Scythian graves on the site and placing the single lone burial into a broader context of funerary depositions.

Considering the interrelation of the horse equipment, it can be concluded that the centre of distribution of the Füzesabony type cheekpieces is in the Carpathian Basin and can be considered as a type developed in the Carpathian Basin, based on eastern models. The closest parallel to the Bükkábrány piece was found in grave 3 of Füzesabony-Öregdomb, also associated with the Mezőcsát culture. The helmet-shaped bronze strap divider can probably also be considered a product of a Carpathian Basin work-shop, based on its fastening structure and the distribution area of its closest formal parallels. This type of object has not been found so far in the funerary context of the Mezőcsát culture. Its closest parallels are known from Late Urnfield – Early Hallstatt burials west of the Danube, providing further evidence of the relations between these populations. A similar picture can be drawn when analysing the main motif of the antler plate, the spiral vortex, the basic element of which, the "Tangentenkreis", was used more widespread, but this particular arrangement in a four-segment spiral vortex appears primarily on finds from the Carpathian Basin.

In conclusion, the Bükkábrány-Kálvária site has yielded a unique burial and stray metal finds, which significantly add to our knowledge of the Mezőcsát culture. The range of grave goods indicates the elevated social status of the deceased, placing both the woman and the child among higher social echelons of the Mezőcsát culture. Stray finds of horse equipment may also indicate the presence of high-ranking male burial(s) in the cemetery. Based on the analogues, the Bükkábrány assemblage – both the grave and the stray metal finds – can be dated to the 9th–8th century BC, which can most probably be narrowed down to the late Urnfield, HB2–B3 period, to the 9th–early 8th century BC. The grave discussed here is a good example of multidisciplinary collaboration: if meaningful dialogue takes place between experts of different fields (in this case archaeozoology, physical anthropology, archaeometallurgy and computer imagery) even an incomplete grave and its assemblage can yield relevant pieces of information.

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MEDVÉK, BIKÁK, OROSZLÁNOK... AZ ÁLLATHAJSZÁK HŐSEI

BEARS, BULLS, LIONS... THE HEROES OF ANIMAL CHASES •

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Abstract

*The main attraction of Roman amphitheatres was the gladiatorial games. The parade of wild animals was also very important. Battles between different species of wild animals, or the battle between man and beast (*venatio*), were greeted with great interest by the public. These killing fights required huge numbers of animals, which had to be acquired, transported and the carcasses disposed of. The individual beasts were captured from remote provinces of the empire and transported by ship or wagon to the site of the fights. All sorts of exotic species were also present at the fights in the capital. In peripheral areas, such as the province of Pannonia, the selection was usually made from the wild animals found locally in the area. Remains of brown bears, among others, are known from the amphitheatre near the military amphitheatre in Aquincum, but no bones of exotic species have been found in the Budapest fighting arenas. In North Africa, a hotbed of animal fighting, the spread of agriculture and pest control has left a huge ecological footprint, leading to the extinction of some species such as the lion and the elephant.*

Kivonat

*A római korban épült amfiteátrumok fő látványosságai a gladiátor játékok voltak. Mellettük igen jelentős szerep jutott a vadállatok felvonultatásának. Az egyes vadállat fajok egymás közti csatáját vagy az ember és az állatok küzdelmét (*venatio*) nagy érdeklődéssel fogadta a közönség. Hatalmas állatállományra volt szükség ezekhez a gyilkos viadalokhoz, amelyek beszerzése, szállítása, majd az elhullott tetemek felszámolása komoly tervezést igényelt. Az egyes vadállatokat a birodalom távoli provinciáiról fogták be, és szállították hajókon, szekereken a viadalok színhelyére. A fővárosban rendezett viadalokon mindenféle egzotikus faj is előfordult. A peremterületeken, mint például Pannonia provinciában, általában az adott térség helyben fellelhető vadállataiból válogattak. Az aquincumi katonavárosi amfiteátrum közeléből többek között a barnamedve maradványai ismertek, egzotikus fajok csontjai azonban egyelőre nem kerültek elő a budapesti küzdőterek térségéből. Észak-Afrikában, az állatküzdelmek fellegvárában, a mezőgazdaság térhódítása és a dúvadként aposztrofált vadak irtása hatalmas ökológiai lábnyomot hagyott maga után: egyes állatfajok, mint az oroszlán és az elefánt kipusztulásához vezetett.*

KEYWORDS: AMPHITHEATRE, WILD ANIMALS, BROWN BEAR, *VENATIO*, AQUINCUM

KULCSSZAVAK: AMFITEÁTRUM, VADÁLLATOK, BARNAMEDVE, *VENATIO*, AQUINCUM

Bevezetés

A római kori arénákban nem csupán emberek, hanem állatok ádáz küzdelmeit nézhette a brutális látványra szomjazó római nép. Hogy mi viszi rá az emberi fajt már évszázadok óta arra, hogy „színpadias" keretek közt nemcsak, hogy önmagát, de más fajokat is kitegyen az értelmetlen harcnak és öldöklésnek? A rómaiak esetében a fő cél a néptömegek megnyerése, és figyelmük fontosabb dolgoktól való elterelése volt amellett, hogy az uralkodó ily' módon újra és újra kifejezésre juttathatta az élet és halál feletti mindenhatóságát, és megerősíthette hatalmát.

Jelen tanulmányban a *venatio* alatt elsősorban az amfiteátrumok arénáiban folyt állat-állat és állat-ember küzdelmek értendők, és nem a tágabb értelemben vett, és a cirkuszi játékoktól független vadászatot jelenti. Ugyanakkor fontos megemlíteni, hogy a római korban több jelentéssel is bírt a *venatio* kifejezés: jelentett vadászatot, magát a vadászzsákmányt, valamint állathajszát és állatviadalt is.

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Honnan a vad?

A császárkor óta évente több alkalommal megrendezett amfiteátrumi játékok (*ludus*ok) során kitettek magukért a szervezők. Főként a Római Birodalom határmenti területeiről gyűjtötték be a különböző vadakat az amfiteátrumi játékokhoz. Csupán az Amphitheatrum Flaviumban (közismert nevén a Colosseumban) 450 éves fennállása alatt több százezer állat veszítette életét a látványosságok során. Az állatokat olykor képzett vadászok *(venatores, bestiarii)* gyilkolták le, máskor a vadak gladiátorokkal vagy más állatokkal folytattak élet-halál harcot. A birodalom terjeszkedésével a leigázott területek vadjaiból is küldtek Rómába. Főként Afrikából érkeztek különleges fajok: oroszlánok, párducok, vízilovak, orrszarvúk, krokodilok. Keletről és Afrikából pedig elefántok, amelyek már a Kr. e. 3. században felvonultak diadalmeneteken a nézők nagy ámulatára (Meijer 2009, 87). De a dél-olaszországi Apulia (ma Puglia) és Lucania tartományból is befogtak szarvasokat, őzeket, vaddisznókat, bikákat és bölényeket. Egyes kutatások szerint a tigriseket nem Indiából, hanem Örményország területéről hozták be (Carroll 2002).

Az első állatviadalt a Kr. e. 2. század első felében rendezték, amikor állítólag számos afrikai állat, medvék, elefántok, szarvasok, vadkanok, bikák küzdelmét nézhette végig a közönség. A köztársaságkor végétől váltak a vadászatok nagyszabású eseményekké, sok esetben önálló, önmagukért látogatott látványossággá, amelyek már a délutáni órákban, tehát „főműsoridőben" is megrendezésre kerültek (Auguet 1978, 107). Kr. e. 104-ben, a numidiai Iugurta király (Kr. e. 116–104) elleni sikeres háborút követően Licinius Crassus és Mucius Scaevola 100 oroszlán bevonásával szerveztek állathajszát a Circus Maximusban. Kr. e. 99-ben a Claudius Pulcher által szervezett viadalokon először harcolt egymás ellen két elefánt. Pompeius színházának felavatásakor (Kr. e. 55) 20 elefánt, 600 oroszlán, 410 leopárd és jó pár majom is életét vesztette, de kuriózumként hiúzt és orrszarvút is bemutattak. Caesar Kr. e. 46-ban 400 oroszlánt, bikákat, zsiráfokat és elefántokat vonultatott fel az arénában (Meijer 2009, 87–88). Augustus (Kr. e. 27 – Kr. u. 14) Kr. e. 26-ban száz napon át tartó állatviadalokat tartott, amelyek során állítólag 35000 állat, többek között jó néhány oroszlán, leopárd, medve és krokodil vesztette életét. Caligula (Kr. u. 37–41) 400 medve és 300 afrikai vadállat életével játszott, míg Nero (Kr. u. 54–68) egy nap alatt 400 medvét és 300 oroszlánt öletett le. A Colosseum felavatásakor Kr. u. 80-ban 9000 állatot mészároltak le. Antoninus Pius 149-ben elefántok, hiénák, oroszlánok, tigrisek, orrszarvúak, krokodilok és vízilovak részvételével rendezett játékokat (Meijer 2009, 87–88), olykor bölények, óriáskígyók vagy fókák is a porondon találták magukat (Auguet 1978, 113–114).

A tömeges állatsereglet befogásával és szállításával birodalom szerte rengeteg ember és több vadásztársaság foglalkozott, azonban a császárkor első két évszázadából nincs, és a későbbi időszakokból is kevés az információ, hogy ez pontosan milyen költségekkel járt (Meijer 2009, 90). Az állatviadalok előtt a szervező vagy ügyintéző feladata volt kalkulációt készíteni a szükséges állatmennyiségről és ennek költségeiről. Ezt követően léptek kapcsolatba a provinciák kormányzóival, akik felmérették, hogy a körzetükben elegendő állatállomány áll-e majd rendelkezésre a rendelés teljesítéséhez. Ezután helyi vadászokból, később leginkább a vadállatok befogására kiképzett katonai alakulatokból álló felderítőket küldtek a területre. A medvevadász katonákat *ursarii*-nak nevezték. A mai Köln és Bonn környékén állomásozó, medvevadászokból álló csapat része volt a *legio I Minervia*nak (Auguet 1978, 152), amely az írott források szerint hat hónap alatt ötven medvét fogott be (Carroll 2002). Germania mellett Pannonia is híres volt medvéiről (Vörös 2018, 255).

A vadakat gyakran veremcsapda vagy hálós befogás módszerével kapták el. Dámvadak hálós befogását ábrázoló jelenet látszik például az egyik Kr. u. 4. századra keltezett Seuso-tál középső medalionábrázolásán (Vörös 2018, 256). Az elefántok olykor nem adták könnyen magukat, mert bár felfegyverzett fáklyás lovasok völgyekbe szorítva próbálták kifárasztani, majd megkötözni és elhurcolni őket, időnként fajtársaik kimenekítették bajba esett társaikat. Az állatmutatványokra, megszelídítésre szánt példányokat még kölyök korukban ragadták el anyjuktól (Auguet 1978, 148). A ketrecbe zárt állatokat – ahogy a Seuso-tál peremén is ábrázolták (Vörös 2018, 252–253) – ökrös szekerekkel szállították a vidéki városok gyűjtőhelyeire vagy akár egészen a célállomásig. Néhány katona feladata volt, hogy a *vivariumok*ban, azaz istállókat magába foglaló elkerített területen gondozzák a vadakat, míg a megrendelőhöz kerültek. A kikötőkbe jutva a hajókra terelésük nem mindig volt gördülékeny (**1. ábra**). A mély víztől viszolygó elefántokat talán a legnehezebb a fedélzetre terelni (Auguet 1978, 151). A Földközi-tengeri szállításukat speciális, erre a célra kialakított gályaszerű teherhajóval oldották meg, ahol a befogott vadállatok mellett azok eleségének is helyet kellett biztosítani (Meijer 2009, 92–93). Az egyes fajokat nem csak maga a *venatio* tizedelte meg. Már maga a hosszadalmas, akár több hétig tartó szállítás, a korábbi élőhelyükről kiszakítás, a kedvezőtlen körülmények és a méltatlan bánásmód is vesztüket okozhatta (Meijer 2009, 94).

A legtöbb Rómába tartó hajó Ostiában kötött ki, ahonnan nagy kordékkal vagy speciális hajókkal *(codiciariae)* vitték tovább az állatokat Rómába. Az elefántok valószínűleg gyalog tették meg ezt a hosszú utat. Rómába érkezve az állatokat ketrecek-

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1. ábra: Vadállatok szállítása hajóval (Kr. u. 4. század; lelőhely: Villa Romana del Casale, Piazza Armerina, Olaszország – Szicília). Forrás: Wikimedia (https://commons.wikimedia.org/wiki/File:Transport_d%27animaux_exotiques,_villa_de_Casale,_Piazza_Armerina,_Sicile,_Italie.jpg)

Fig. 1.: Transport of wild animals by ship (4th century AD; Villa Romana del Casale, Piazza Armerina, Italy – Sicily). Source: Wikimedia (https://commons.wikimedia.org/wiki/File:Transport_d%27animaux_exotiques,_villa_de_Casale,_Piazza_Armerina,_Sicile,_Italie.jpg):

be *(vivaria)* helyezték a Mars-mezőn, vagy a császári paloták kertjeiben, esetleg a városon kívül létesített ún. állatseregletekben, vadasparkokban (Auguet 1978, 154). Innen szállították őket a viadalok előtt az éjszaka leple alatt a Colosseum sötét ketreceibe (Meijer 2009, 95), vagy igény esetén a Birodalom többi provinciájába, ahol hasonló viadalok alkalmával léptek porondra. A *venatio* Afrikában örvendett talán a legnagyobb népszerűségnek, ahol bizonyos mozaikokon az egyes állatok nevei is fennmaradtak. Innen ismerni például a Leander, Crudelis ('kegyetlen') vagy Omicida ('emberölő') nevű medvéket (Auguet 1978, 155–156), vagy a Kr. u. 3. században készített, Tunéziából előkerült Magerius-mozaikról Victor ('győző'), Crispinus, Luxurius ('dévaj'), Romanus ('római') és Rapidus ('gyors') nevű leopárdokat (Line 2022, 25; **2. ábra**).

A vadállatok egy igen szörnyű gyakorlat részeseivé is váltak. Mivel az élelmezésük drága volt, ezért halálra ítélt embereket is eléjük vetettek. A *damnatio ad bestias* a játékok déli műsorszámává vált. Ilyenkor gladiátornak öltöztetve vagy oszlophoz kötözve marcangolták szét az embereket a vadak (Szilágyi 1956, 19; Meijer 2009, 129; **3. ábra**). Mielőtt az arénába küldték a vadakat, feldíszítették őket aranyozott lemezekkel *(bracteae)*, amelyek a kiéheztetés és a rossz bánásmód mellett még inkább felkorbácsolhatták viselőjük idegeit. A Kr. u. 1. századtól kezdve ez a sors várt a nyakasabb keresztényekre is (Meijer 2009, 106–107). Ez súlyosságát tekintve megegyezett az élve elégetéssel *(vivi crematio)* és a keresztre feszítéssel *(damnatio in crucem)*. Mind az *ad bestias*, mind a keresztre feszítés a karthágói katonai gyakorlatból került át a rómaiakhoz az 1. pun háború (Kr. e. 264–241) idején.

Az arisztokrácia valódi vadászatok alkalmával is előszeretettel gyilkolta a vadállatokat, főként a nagybirtokokon, bár ez az úri huncutság viszonylag későn vált népszerűvé (Auguet 1978, 147). A vadakat nem csak viadalok számára gyűjtötték be, hanem a császári vadaskertekbe *(saepta venationum/vivarium)* és ketrecekbe is. A vadaskerteket a *villa*gazdaságokban a rezidenciák közelében állították fel, ahol a helyi és távoli vidékek vadjainak vadászata zárt helyen történhetett (Vörös 2018, 253; **4. ábra**). Az állatviadalok mellett pedig lassanként elterjedt az állatok megszelídítése és betanítása, amely kegyesebb módja az emberek szórakoztatásának. Olykor arisztokrata gyerekek is szerepeltek az amfiteátrumokban közönség előtti gyakorlásképpen, amikor is nyulakra, ludakra vadásztak, amint az a szicíliai Villa del Casale (Piazza Armarina) egyik mozaikján is látható (Auguet 1978, 161; **5. ábra**).

Pannoniában, így az aquincumi amfiteátrumokban is a mérsékelt égövi fauna állatai vettek részt a küzdelmekben. A környező erdőkben honos volt ekkor az őstulok, bölény, muflon, különböző szarvasfélék (jávorszarvas, gímszarvas, dámvad, őz), medve, farkas, róka, hiúz, borz, hód, nyúl, kisragadozók, vadmadarak (sasok, keselyűfélék, túzok, baglyok, darvak, kócsagok, pelikánok), amelyek szinte mindegyikére találni archeozoológiai bizonyítékot is a régészeti lelőhelyek leletanyagában.

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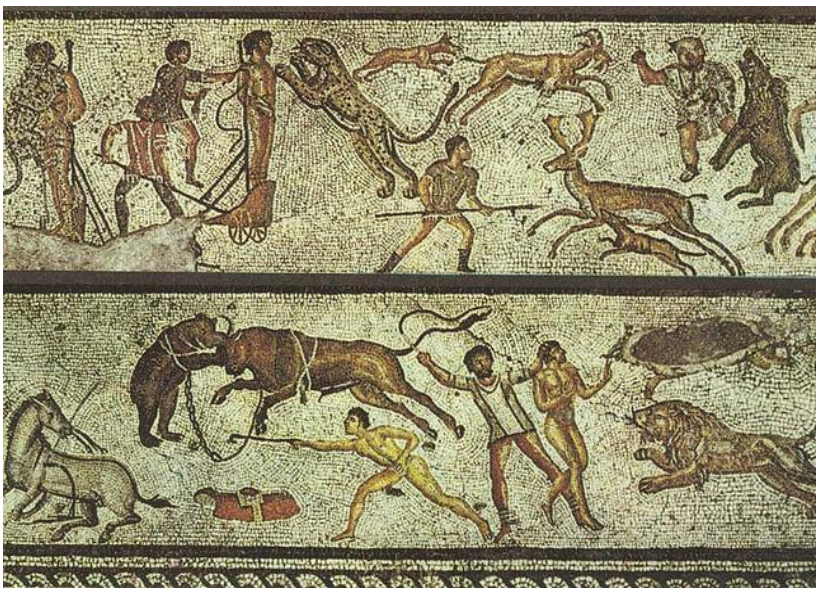
2. ábra: A *venatio* Afrikában volt talán a legnépszerűbb, ahol pompás mozaikpadlók őrizték meg az egyes harci állatok nevét. El Jemből (Tunézia; Kr. u. 3. század), a Magerius-padlómozaikról ismertek a Leander, Crudelis, Omicida nevű medvék, és a Victor, Crispinus, Luxurius, Romanus nevű leopárd. Forrás: Wikimedia (https://commons.wikimedia.org/wiki/File:La_Kasbah_Museum,_Sousse_-_50513136536.jpg)

Fig. 2.: The venatio was perhaps most popular in Africa, where magnificent mosaic floors preserved the names of individual fighting animals. El Jem (Tunisia; 3rd century AD), the bears named Leander, Crudelis, Omicida and the leopard named Victor, Crispinus, Luxurius, Romanus are known from the Magerius floor mosaics. Source: Wikimedia (https://commons.wikimedia.org/wiki/File:La_Kasbah_Museum,_Sousse_-_50513136536.jpg)



3. ábra: Egy halálra ítélt leopárd általi kivégzés, valamint medve és bika küzdelmének ábrázolása (Kr. u. 1–3. század; lelőhely: Zletin, Líbia). Forrás: Wikimedia (https://commons.wikimedia.org/wiki/File:Besti%C3%A1rios.jpg)

Fig. 3.: Execution of a condemned by a leopard, and representation of a bear and a bull fight (1st–3rd century AD; Zletin, Libya). Source: Wikimedia (https://commons.wikimedia.org/wiki/File:Besti%C3%A1rios.jpg)

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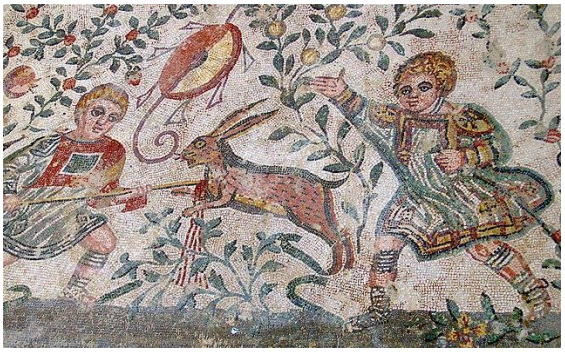
4. ábra: Falfestmény részlete tigris és leopárd ábrázolásával az aquincumi katonavárosból (Kr. u. 3. század első fele; lelőhely: Budapest, III. kerület – Pacsirtamező utca 65.) – Fotó: Biller Anna Zsófia

Fig. 4.: Detail of a wall painting depicting a tiger and a leopard from the military town of Aquincum (first half of the 3rd century AD; District III, Budapest, Hungary – Pacsirtamező str. 65) – Photo: Anna Zsófia Biller



5. ábra: Nyúlra vadászó gyerekek mozaik ábrázolása (Kr. u. 4. század; lelőhely: Piazza Armerina, Villa del casale, Szicília) – Forrás: Wikimedia (https://commons.wikimedia.org/wiki/File:Villa_del_casale_13.jpg)

Fig. 5.: Mosaic representation of children hunting a rabbit (4th century AD; Piazza Armerina, Villa del casale, Sicily) – Source: Wikimedia (https://commons.wikimedia.org/wiki/File:Villa_del_casale_13.jpg)

A Kárpát-medencei vadak egy részét nemcsak a hazai amfiteátrumokba, hanem Itáliába is szállították, erősen igénybe véve a helyi ökoszisztémát (Auguet 1978, 271). A farkasokat vallási okokból eredő tiszteletük miatt nem szerepeltették állatküzdelmekben (Rissanen 2014, 125–147). Leginkább bölény- és bikaviadalokat rendezhettek, valamint őzek, szarvasok, vadkanok, medvék eshettek áldozatul az események küzdelmei során (Torma 1881, 84). Több Pannoniában, illetve Aquincumban

6. ábra: Egy családi sírsztélén bika-medve és ló-nagymacska (vadmacska vagy párduc) küzdelmét jelenítették meg (lelőhely: Budapest, Aquincum – katonaváros) – Fotó: Biller Anna Zsófia

Fig. 6.: A bull-bear and horse-big cat (wild cat or panther) fight was depicted on a family grave stele (Aquincum – military town, Budapest, Hungary) – Photo: Anna Zsófia Biller

is fellelhető domborművön megjelenik az oroszlán és párduc alakja, míg elefánt, orrszarvú vagy krokodil soha (Auguet 1978, 280). Az aquincumi katonai amfiteátrumnál előkerült egy állatviadalt ábrázoló családi sírsztélé, amelyen bika-medve és ló-nagymacska (vadmacska vagy párduc) küzdelmét jelenítették meg (**6. ábra**). Többek között Nemeskéről is ismert oroszlán vadászatot ábrázoló római kori (Kr. u. 4. század utolsó harmadára datálható, vagy akár az 5. század eleje is tehető)

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díszített veret (Gábor & Vaday 2022, 56–68). Ugyanakkor régészeti állattani bizonyíték ezidáig nem támasztotta alá a nagymacskák (vagy egyéb egzotikus fajok) jelenlétét az aquincumi *venatió*kon.

A fauna alakulása és az állatküzdelmek leáldozása

A vadbefogások következtében nagyon megcsappant a fajok egyedszáma. A birodalom Kr. u. 3. századi krízise ellenére a *venatió*k száma nem csökkent, ám a költségesebb és túlvadászott, az élletterükről a gabonaföldek, olíva- és szőlőültetvények miatt kiszorított ragadozófajok helyett egyre inkább növényevőket kezdtek szerepeltetni. I. Gordianus (Kr. u. 238) egyik általa rendezett játék alkalmával például 200 szarvast, 30 vadlovat, 100 vadjuhot, 10 jávorszarvast, 100 bikát, 300 struccot, 30 vadszamarat, 150 medvét és 200 zergét küldött az arénába (Meijer 2009, 88). A korábbi egzotikus ragadozók helyett azok számának csökkenését követően a medvéket is előszeretettel fogták be a viadalok számára (Bomgardner 1992, 164). Az amfiteátrumokban zajló küzdelmek leáldozásának egyik oka a keresztény eszmék elterjedése volt, és ennek első megnyilvánulása Kr. u. 325-ben Constantinus császár rendeletében volt tetten érhető, amelyben betiltotta a gladiátorok további kiképzését, és inkább bányákba küldte vezekelni a korábban gladiátor-sorsra ítélt rabokat. Ez a rendelet nem volt elegendő a véres viadalok teljes felszámolásához, de elindította azok visszaszorulását. Rómában például a Kr. u. 4. század második felétől kezdett alábbhagyni a lelkesedés a gladiátor küzdelmek iránt a keresztény szellemiség által megérintett emberek körében (Meijer 2009, 138–139). A vadállatok gyilkolása, a színházi előadások és a kocsihajtás azonban még tovább fennmaradhatott. Az utolsó állatviadalok egyikére Kr. u. 519-ben Nagy Theoderik gót király (Kr. u. 493–526) uralkodása idején került sor (Meijer 2009, 140). Miután Konstantinápoly vette át Róma szerepét, a vadállathajszák még műsoron maradtak, és csak lassan koptak ki a szórakoztatás módozatai közül. Az ember és állat közti küzdelmeket a Kr. u. 6. század elején tiltották be, de hajszákat továbbra is rendeztek a lassú leáldozásig (Meijer 2009, 141). Az arénákban folyó küzdelmeket valószínűleg sohasem tiltották be teljesen, hanem idővel maguktól szűntek meg. Addig azonban az állatküzdelmek szereplőinek befogása és halálra ítélése katasztrofális következménnyel járt az állatpopulációkra nézve. A több évszázadon át tartó állatmészárlás miatt bizonyos területeken több faj is teljesen kihalt. Észak-Afrikában a Kr. u. 4. századra teljesen kipusztultak az elefántok (Auguet 1978, 147), az oroszlánok pedig eltűntek Líbia területéről (Meijer 2009, 89). Az, hogy az adott térségekben ilyen mértékűvé válhatott az őshonos vadfajok befogása és arénába küldése, összefüggésbe hozható az adott területek mezőgazdasági művelés alá vonásával (Észak-Afrika például a birodalom fő gabonatermő vidéke volt a korszakban), és így a dúvadnak számító vadak ilyen módon történő visszaszorításával (Bomgardner 1992, 164).

Budapest két amfiteátruma

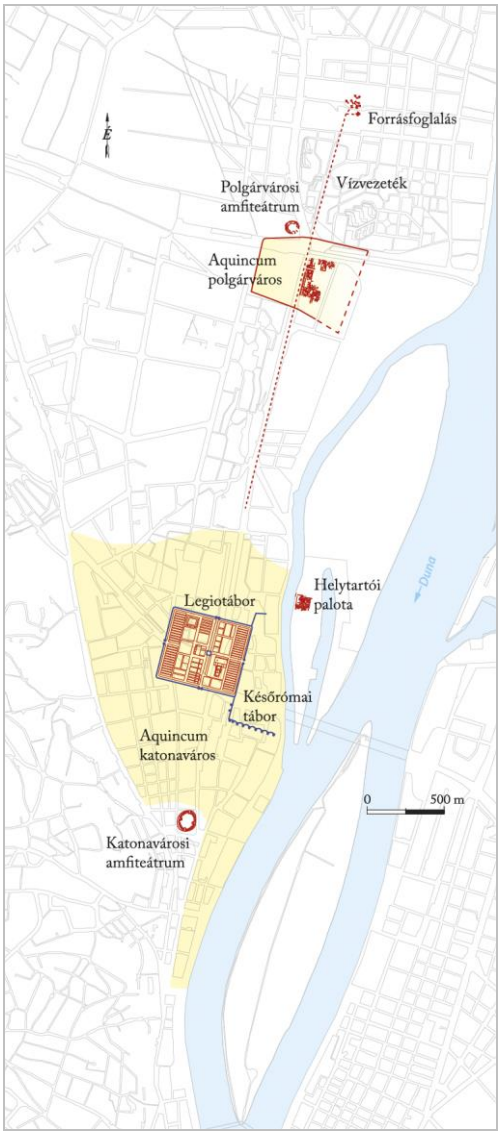
„*…A mi már magát a Régi Római Amphitheatrumot illeti, minekelőtte én ide Ó-Budára jöttem vólna, senkinek még tsak eszeágában sem vólt, hogy itt valaha Amphiteathrum állott légyen s magam is tsak történetből jöttem reá…*” (Németh Sándor kamarális *praefectus* leírása a katonavárosi amfiteátrumhoz kapcsolódóan – Tudományos Gyűjtemény 1823; Póczy 1994, 27)

Budapest III. kerületében, Óbudán, a hajdani Aquincum területén (**7. ábra**) két, tojásdad alakú, ún. földamfiteátrum (Hajnóczi 1971, 186) romjaival is találkozhatunk.

Az ülősorok terhét a kőfalas boltozatokon és támfalakon túl döngölt agyag is viselte (Szilágyi 1956, 10). E két amfiteátrum azok közé az építmények közé tartozik, amelyek a római császárok iránti tiszteletből és a gladiátorjátékok népszerűsége miatt épültek, s amelyek száma a Kr. u. 3. században meghaladta a kétszázat. A birodalom nyugati felén található az amfiteátrumok többsége, keleten jóval kevesebb létesült és ezek általában földbe mélyítettek és kisebb méretűek voltak (Meijer 2009, 83–85).

A Kr. u. 2. század középső harmadában épült a polgárvárosi amfiteátrum (**8/A ábra**), amely a városfaltól északra helyezkedett el (Auguet 1978, 275; Zsidi 2006, 23–25). Nézőtere 3320 m^2, és 6–7000 ember befogadására lehetett képes. A külső falát 46 sugárirányú, rendszertelenül elhelyezett támfal és pillér erősítette meg. Az ülősorok itt is a két övező fal közé feltöltött földlejtőn nyugodtak. A gladiátorok a nyugati kapun vonulhattak be. A főkapuk oldalfalait több szobor díszítette, amelyről négy, falba vágott fülke tanúskodik. A „Halál istennőjének kapuja” (*porta Libitinae*) az aréna északi oldalának közepén lett kialakítva, Nemezis szentélye pedig a nyugati főkapunál. A porond döngölt agyagpadlóját kavicsos homok fedte, ahogy a katonavárosi amfiteátrumét is (Szilágyi 1956, 22–25). A tetőfedő téglák maradványai alapján arra lehet következtetni, hogy a tűző nap ellen tetővel védhették a nézőteret. A katonavárosi amfiteátrumban ezt valószínűleg napvitorlával oldották meg (Szilágyi 1956, 27).

Az amfiteátrum Torma Károly által 1879–1882-ben vezetett feltárásakor (Szilágyi 1956, 7) gyűjtött archeozoológiai leleteket annak idején Szukáts József vizsgálta (**1. táblázat**). Közöttük őzek, farkasok és vadkanok csontjai fordultak elő a háziállatok maradványai mellett. Utóbbiak egyrészt a venatiók során szereplő ragadozók táplálékául



7. ábra: A római kori Aquincum térképe a polgárvárosi és a katonavárosi amfiteátrum feltüntetésével – Grafika: Kolozsvári Krisztián

Fig. 7.: Map of Aquincum in Roman times with the amphitheatre in the civil town and the military town – Graphics: Krisztián Kolozsvári

szolgálhattak, másrészt a felső régészeti rétegekben kimutatható fiatalabb korok lenyomatai. A legtöbb állatcsont az amfiteátrum falain kívül, illetve az aréna területéről került elő. A szarvasmarhaként meghatározott csontok között lehet, hogy akadt bölényhez tartozó is, de ezeket a 19. században a korabeli összehasonlító gyűjtemény hiányosságai miatt pontosabban nem tudták meghatározni (Torma 1881, 100–102). A leletanyagban nyolc megmunkált kemény állati nyersanyagból készült tárgy is előkerült: dobókocka, hajtűk, varrótűk számító-bárca, eszköznyél szarvasmarha lábközép-csontból illetve agancsból (Torma 1881, 92).

Az aquincumi katonaváros *(canabae)* déli peremén épült, ma a Nagyszombat utca térségében lévő, a polgárvárosinál kétszer nagyobb méretű katonavárosi amfiteátrum területén a Kr. u. 1. századtól a 375 körüli évekig folytak küzdelmek (Szilágyi 1956, 20; **8/B ábra**). A kőből épült amfiteátrumot az itt állomásozó *legio II Adiutrix* építette 145–161 között (Auguet 1978, 273). Arénájának méretei még a római Colosseumét is felülmúlta (Szilágyi 1956, 16.). Érdemes megemlíteni, hogy az Alpoktól északra a birodalom legnagyobb amfiteátruma volt, amely 6530 m^2-nyi területen 13000 főnek nyújthatott szórakozást (Szilágyi 1956, 15–16). A 17. században még jóval a feltárások megindulása előtt gróf Luigi Ferdinando Marsigli hadmérnök a két amfiteátrumot elfedő dombot katonai erődítménynek vélte. 1730 körül Richard Pococke angol utazó már amfiteátrumnak gondolta a katonavárosit. A 19. században a német ókortörténész, Theodor Mommsen színházat vizionált a romokban. Az 1800-as években az amfiteátrum sugárirányú falmaradványainak felhasználásával épített házak 20. század eleji pusztulása és lebontása után 1925-ben lett nyilvánvaló Kuzsinszky Bálint és Nagy Lajos számára, hogy mit is rejt a domb (Szilágyi 1956, 8–9). Az amfiteátrumot Nagy Lajos, Szilágyi János (1935-39), majd Nagy Tibor (1940) tárták fel (Szilágyi 1956, 9; Póczy 1994, 30).

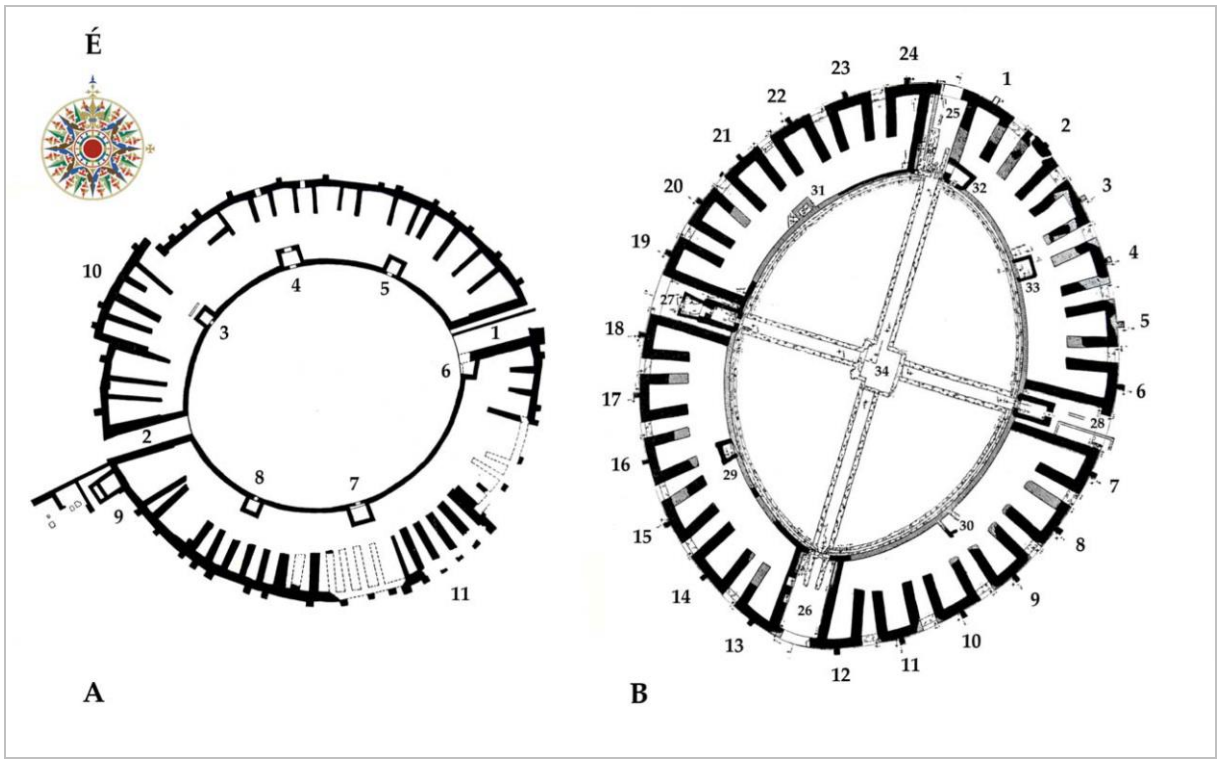
A Kr. u. 1. század végén formálódni kezdő bodegaváros első viadalait még a főtéren rendezhették, majd később fából építettek amfiteátrumot (valószínűleg a Kr. u. 117–138. közötti években; Auguet 1978, 273), amelyet mielőbb kőépítményre cseréltek (Szilágyi 1956, 10). A belső övező fal *(podium)* eredetileg 3–4 méter magas lehetett, hogy megvédje a nézőket a vadállatoktól, míg a külső – 24 ponton támpillérekkel megerősített – záró körfal a becslések szerint 12–13 méter lehetett (Szilágyi 1956, 10–12). A Kr. u. 4. század végén az amfiteátrum bejáratait befalazták, jól védhető erődítménnyé alakították. A Római Birodalom bukását követően a népvándorláskor népei ugyancsak erődként használták, Óbuda 17–18. századi lakossága pedig börtönként és vesztőhelyként hasznosította. A 19. században a romokra épített lakásokkal használták ki a hely adottságait (Auguet 1978, 273–274).

Csontleletek hiányában csak az építmény szerkezete alapján lehet információt nyerni az állatküzdelmekről. Megmaradt a két – az amfiteátrum egymással szemben lévő ívén elhelyezkedő – állatketrec kőfala, illetve kapunyílása, így az állatokat vélhetően a mai Szőlő utca, illetve Pacsirtamező utca felőli nyugati és keleti kapukon hajtották be, míg a többi szereplő az északi illetve déli kapun érkezett, mely főkapukat erős kapuszárnyakkal zárhattak le a vadak elől. Az amfiteátrum belső fala mentén öt cella *(spoliarium)* volt. Az északi kapu tövében lévő – amelybe a „Halál istennőjének kapuja” *(porta Libitinae)* vezetett – szolgálhatott arra, hogy az emberi és állati tetemeket ideiglenesen elhelyezzék, majd a viadalokat követően az északi főka-

1. táblázat: A polgárvárosi amfiteátrum római korra tehető rétegeiből előkerült állatmaradványok Szukáts József meghatározása alapján (Torma 1881, 102)

Table 1.: Animal remains found in the Roman Age layers of the civil town's amphitheatre in Aquincum. Determined by József Szukáts (Torma 1881, 102)

Állatfaj / Vázrész	Maxilla	Vertebra	Costa	Scapula	Humerus	Radius	Ulna	Metcarpus	Phalanx	Pelvis	Tibia	Fibula	Metatarsus	Összesen	
Szarvasmarha / Bos taurus	32	3	9	5	2	2	1			1	1		7	63	145
Házisertés / Sus domesticus	13				2						3			18	
Háziló / Equus caballus	2	1	11			1		5	2	1	4		8	35	
Öszvér / Equus mulus													2	2	
Házikutya / Canis familiaris					2	3	1				3	1		10	
Európai őz / Capreolus capreolus							1							1	
Vaddisznó / Sus scrofa	1													1	
Farkas / Canis lupus					2	3	1				3	1		10	
Házityúk / Gallus domesticus					3								1	4	
Madár / Aves indet. ('Pulyka / Meleagris gallopavo' szerepelt Torma Károly leírásában, de ha pulyka, akkor csak későbbi régészeti korokhoz köthető)					1									1	



8. ábra: A – Aquincum polgárvárosi amfiteátrum alaprajza: 1-2: Kapuk; 3-8: Cellák az aréna körül; 4: a „Temetés" kapuja; 9: Nemezis szentélye; 10-11: Külső lépcsőépítmények. B – Aquincum katonavárosi amfiteátrum alaprajza: 1-24: Nézőteret tartó U-falazatok; 25-26: Főkapuk; 27-28: Állatketrecek; 29-31: Cellák az aréna felől; 32: a „Temetés" kapuja; 33: Nemezis szentélye; 34: Párologtató medence. (Szilágyi 1956 nyomán)

Fig. 8.: A – Floor plan of the civil town's amphitheatre in Aquincum: 1-2: Gates; 3-8: Cells around the arena; 4: The "Funeral" gate; 9: Sanctuary of Nemesis; 10-11: External stair constructions. B – Floor plan of the military town's amphitheatre in Aquincum: 1-24: U-walls supporting the viewing area; 25-26: Main gates; 27-28: Animal cages; 29-31: Cells from the arena; 32: The "Funeral" gate; 33: Sanctuary of Nemesis; 34: Evaporation pond. (after Szilágyi 1956)

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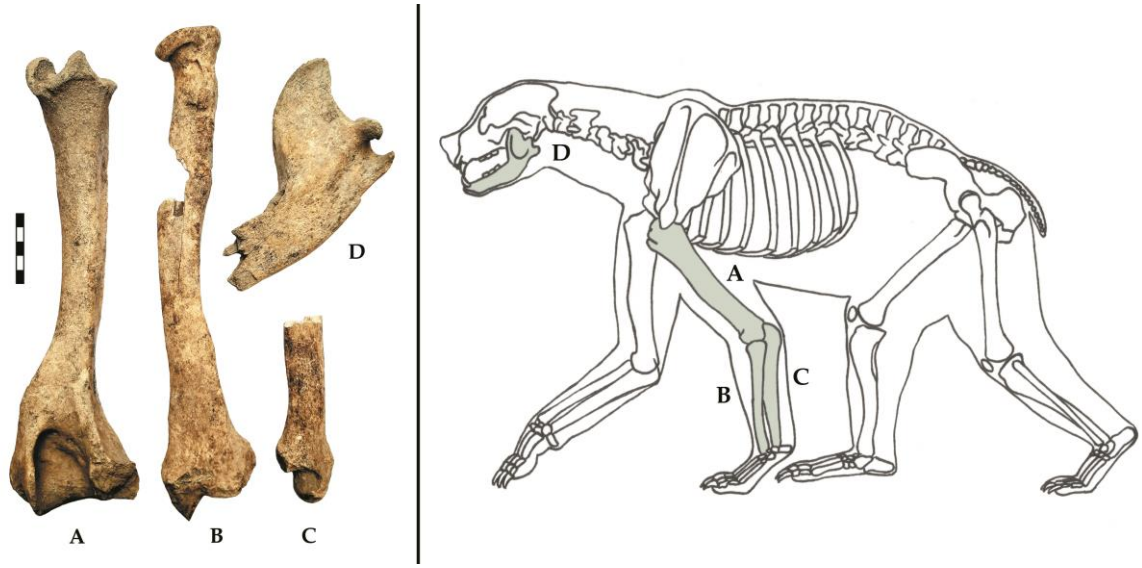
2. táblázat: A cikkben szereplő budapesti római kori barnamedve maradványok méretei (mm-ben)
Table 2.: The measurements (mm) of the Roman Age brown bear bones from Budapest mentioned in the article

Lelőhely	Vázrész	BP	DP	SB	SD	BD	DD	GL	Egyéb méretek
Bp. III. kerület - Lajos utca – Nagyszombat utca	Humerus (sin. juvenilis)			25	32	87	52		
	Radius (dext. adultus)	48	36	30	18	63	41	327	
	Ulna (dext. adultus)			25	22	41	25		
	Mandibula (dext. adultus)								izületi felszín szélessége: 42, corpus szélessége: 17, ramus mandibulae magassága: 93
Bp. III. kerület - Bogdáni út – Folyamőr utca – Sorompó utca (BUSZESZ)	Humerus (dext. adultus)			24	29				



9. ábra: Barnamedve csontleletek az aquincumi katonavárosi amfiteátrum közeléből: A – karcsont, B – orsócsont, C – singcsont, D – alsó állkapocs (lelőhely: Budapest, III. kerület – Lajos utca – Nagyszombat utca) – Fotó és grafika: Biller Anna Zsófia

Fig. 9.: Brown bear bone finds from the vicinity of the military town's amphitheatre in Aquincum: A – humerus, B – radius, C – ulna, D – mandible (District III, Budapest, Hungary – Lajos str. – Nagyszombat str.) – Photo and graphics: Anna Zsófia Biller

pun át elszállítsák őket. A másik négy cella közül az egyik Nemesis szentélyéül, a többi pedig a rendezőség, a szolgák és egyéb emberek várakozó helyiségeként, valamint raktárként szolgált (Szilágyi 1956, 2; 10–15).

A katonavárosi amfiteátrum romjai közül a 20. század első felében zajlott feltárások során előkerült állatmaradványokról nem áll rendelkezésre információ. Ezeket vagy a kor szelleméhez igazodva nem gyűjtötték össze, vagy elvesztek. A 2000. év környékén a katonai amfiteátrumtól délre, a Lajos utca - Nagyszombat utca térségében, a római katonaváros kevéssé beépített külvárosi részének Kr. u. 2. század második harmadára tehető telepjelenségei között, Hable Tibor vezetésével folytak feltárások (Hable 2000, 37). Az innen származó régészeti állattani leletanyagból Lyublyanovics Kyra archeozoológus medve csontokat (**9. ábra; 2. táblázat;** baloldali karcsont proximalis epiphysis nélküli töredéke – **10. ábra**, majdnem ép jobboldali orsócsont – **11. ábra**, jobboldali singcsont distalis töredéke – **12. ábra**, és jobb alsó állkapocs töredéke – **13. ábra**) is meghatározott a háziállatok, valamint további nagyvadak (őstulok, gímszarvas, őz) maradványai mellett. 'Jelentés a Budaújlak, III. ker., Lajos u. – Nagyszombat u. lelőhely állatmaradványainak vizsgálatáról' című kiértékelésében szerepelnek részletesebb adatok a csontanyagról, a leletek rövid ismertetéséhez Lyublyanovics Kyra hozzájárulását ezúton is köszönöm.

A csontanyag szeméttelep-jellegű volt, emiatt kerülhettek bele medvemaradványok is. A karcsont egy fiatal egyedé volt (a *proximalis epiphysis* még

nem csontosodott a *diaphysis*hez), a többi maradvány legalább két további, kifejlett medvéhez tartozott. Egy jobboldali karcsont vágásnyomos *diaphysis* és *distalis epiphysis* töredéke ismert még a közeli Bogdáni út - Folyamőr utca - Sorompó utca által közre zárt régi Szeszgyár (BUSZESZ) területén zajló 2017. évi feltárásból, a katonaváros északkeleti negyedéből (Budai Balogh & Biller 2020, 180–181, 26. kép; **14. ábra**). E maradvány is valószínűsíthetően a római korból származott, és gazdája is kapcsolatban állhatott a katonavárosi amfiteátrumban folyó állatviadalokkal. Lehetséges, hogy a mély vágásnyomok küzdelem során keletkeztek, de a sekélyebb vágásnyomok alapján az is elképzelhető, hogy az amfiteátrumi játékok lezárását követő húsosztás során, a daraboláskor sérült a karcsont felszíne. Noha a szeszgyári medvelelet csak feltételesen köthető a *venatiók*hoz, az amfiteátrum déli szomszédságából származó medve- vagy más nagyvadmaradványok minden bizonnyal az amfiteátrumban folyt küzdelmek lenyomatai. Már csak amiatt is, mert a bikák és a medvék küzdelme birodalomszerte igen gyakori és kedvelt volt. Gyakran említik is őket a különféle források (Meijer 2009, 100; **15. ábra**). E két fajhoz hazánk területén is viszonylag könnyen hozzájutottak. Az állatmaradványok között nagyméretű szarvcsapú, fiatal kecskék maradványai is előkerültek, amelyek az esetleges műhelytevékenységen túl felvetik annak lehetőségét is, hogy ezeket a robosztus testalkatú állatokat akár a *venatiok* alkalmával is felhasználhatták.

10. ábra: Barnamedve baloldali karcsont proximalis epiphysis nélküli töredéke (lelőhely: Budapest, III. kerület – Lajos utca – Nagyszombat utca) – Fotó: Biller Anna Zsófia

Fig. 10.: Fragment of a left humerus of a brown bear without the proximal epiphysis (District III, Budapest, Hungary – Lajos str. – Nagyszombat str.) – Photo: Anna Zsófia Biller

11. ábra: Barnamedve majdnem ép jobboldali orsócsontja (lelőhely: Budapest, III. kerület – Lajos utca – Nagyszombat utca) – Fotó: Biller Anna Zsófia

Fig. 11.: Fragment of a right brown bear radius (District III, Budapest, Hungary – Lajos str. – Nagyszombat str.) – Photo: Anna Zsófia Biller

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12. ábra: Barnamedve jobboldali singcsont distalis töredéke (lelőhely: Budapest, III. kerület – Lajos utca – Nagyszombat utca) – Fotó: Biller Anna Zsófia

Fig. 12.: Distal fragment of a right ulna of a brown bear (District III, Budapest, Hungary – Lajos str. – Nagyszombat str.) – Photo: Anna Zsófia Biller

13. ábra: Barnamedve jobb alsó állkapocs töredéke (lelőhely: Budapest, III. kerület – Lajos utca – Nagyszombat utca) – Fotó: Biller Anna Zsófia

Fig. 13.: Fragment of a right mandible of a brown bear (District III, Budapest, Hungary – Lajos str. – Nagyszombat str.) – Photo: Anna Zsófia Biller

14. ábra: Barnamedve jobboldali karcsont töredéke vágásnyomokkal (lelőhely: Bogdáni út – Folyamőr utca – Sorompó utca – BUSZESZ) – Fotó: Biller Anna Zsófia

Fig. 14.: Fragment of a right humerus of a brown bear with cut marks (District III, Budapest, Hungary – Bogdáni road – Folyamőr str. – Sorompó str.) – Photo: Anna Zsófia Biller

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15. ábra: Római kori villa mozaikja medvével folytatott küzdelem ábrázolásával (Kr.u. 1. század; Nennig, Németország). Forrás: Wikimedia (https://commons.wikimedia.org/wiki/File:Nennig_Roman_Villa_and_Mosaics_-_51133501972.jpg)
Fig. 15.: Mosaic of a Roman villa depicting a fight with a bear (1st century AD; Nennig, Germany). Source: Wikimedia (https://commons.wikimedia.org/wiki/File:Nennig_Roman_Villa_and_Mosaics_-_51133501972.jpg)

A viadalok menete

Magukról az állatokról, azok begyűjtéséről vagy az amfiteátrumokban zajló játékokról sok írott forrás számol be (pl. Plinius, Aristoteles, Aelianus, Plutarkhos). Martialis volt az, aki a *Látványosságok könyvé*ben *(Liber spectaculorum)* részletesebben írt az ember és állat közti küzdelmekről. Cicero, Seneca, Symmachus és Statius magánlevelezéseiben is említésre kerülnek a küzdelmek (Line 2022, 8). A római korban ugyan kevés nyílt kritika érte az arénákban folyó eseményeket, mivel ilyen formán ez a császári hatalommal is szembemenő véleménynyilvánításnak számított volna, de Cicero, Seneca és Tacitus – ha nem is teljes mellszélességgel – magánlevelezésében érezhetően ellenezte az ilyesfajta értelmetlen és agresszív viadalokat (Meijer 2009, 133–135).

A képi ábrázolások (falfestmények, mozaikok, domborművek) gazdagabb forrásanyagul szolgálnak, ám olykor a realisztikus ábrázolásokon túl mintakönyvet követő, a valóságtól elrugaszkodott alkotások is születtek (Auguet 1978, 163), ezeket érdemes kritikával kezelni.

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Rómában a gladiátor főnökök helyett a *procurator munerum* tárgyalt személyesen a császárral a játékok szervezése kapcsán (Meijer 2009, 60; 98). Az északabbi provinciákban, így Pannoniában is a költségesebb gladiátor játékok helyett a lovasjátékok és a *venatiók* lehettek porondon, amelyeket évente több alkalommal is rendezhettek (Zsidi 2002, 81). Az aquincumi katonavárosi amfiteátrum csatorna-rendszerének felépítése kapcsán felmerült az az elképzelés, hogy vízi csatákat *(naumachiae)* is rendeztek a porondon (Szilágyi 1956, 14), bár az ilyesfajta látványosságokra igen ritkán kerülhetett sor, általában hatalmas tengeri győzelmek megünnepléseként. A játékok rendezői általában városi vagy tartományi előkelőségek közül kerültek ki (Auguet 1978, 281). Az óbudai budapesti katonai amfiteátrum esetében a *legio* altisztjei töltötték be ezt a posztot. A gladiátorok pedig birodalom szerte általában a frissen ejtett hadifoglyokból váltak (Szilágyi 1956, 20).

A *panem et circenses* (’kenyeret és cirkuszt’) elve alapján a *plebs*nek gyakran osztogattak ingyenjegyeket azok az előkelők, akik ilyen formán akarták megvásárolni a nép kegyét és szavazatát. Az amfiteátrumok alsó soraiban az előkelőknek, tisztségviselőknek fenntartott helyek voltak, a középső lelátórészt a jegyet vásárló vagy az ingyen jegyes polgárok számára jelölték ki. A legfelső sorokba a belépés szabad lehetett (Szilágyi 1956, 25).

A Colosseumbéli játékokról falragaszokon tájékoztatták a nagyérdeműt. A reggeli órákban voltak az állatküzdelmek („dzsungelharcok”), melyek főszereplőinek fellépési sorrendje és összepárosítása általában meglepetés volt. A nézők jobban értékelték az olyan állatküzdelmeket, amikor különböző fajba tartozó állatok csaptak össze (Auguet 1978, 112).

Több esetben az amfiteátrumok pincerészén *(hypogeum)* voltak elhelyezve a ketrecekben tartott vadállatok, és innen húzták fel a homokkal beszórt küzdőtérre őket a viadal előtt (Liberati-Bourbon 2005, 70). A Colosseum esetében a *hypogeum* külső falában voltak a ketrecek, amelyeket néhány órával az előadás előtt nyitottak ki, és egyesével egy körülbelül 55 cm széles folyosón terelték az állatokat az őket váró liftketrecek felé. Az állatketreceket ellensúly segítségével húzták fel a viadalok egy adott pillanatában, majd kikergették őket egy rézsűn vagy lépcsőn keresztül az arénába (Meijer 2009, 74). Gyakori ellenfelek voltak a medvék és bikák, az elefántok és bikák, az oroszlánok és leopárdok/tigrisek/bikák/vadkanok (Auguet 1978, 112), a bikák és orrszarvúk, valamint az orrszarvúk és bölények. A színpadot gyakran az állatok természetes élőhelyéhez hasonlóan rendezték be, olykor látványos erdei tájat *(silva)* is létrehoztak (Auguet 1978, 136–137). A harcból győztesen kikerült állatokkal a legtöbbször a show részeként végül vadászok végeztek. Az állatos etap záróakkordja a vadászat *(venatio)* volt: ember és állat küzdelme, amely során a – legtöbbször vashegyű gerelyekkel (*venabulum*), máskor lándzsával, íjjal vagy karddal felfegyverzett (Auguet 1978, 118) – vadászok *(venatores)* és vadállatokkal szembeszálló harcosok *(bestiarii)* küzdöttek meg. Először növényevőket (például struccokat, antilopokat, gazellákat, szarvasokat, szamarakat, akár elefántokat is), majd ragadozókat (medvéket, nagymacskákat) küldtek a vadászok elé. Két fő harcmodorral szállhattak szembe az állatokkal: egyesek vértezet nélkül, ám gerellyel és lándzsával igyekeztek távol tartani maguktól a vadakat, míg mások testüket borító védőfegyverzettel és karddal, közelharcban küzdöttek életükért. De akadtak akár puszta kézzel, saját testi erejükre hagyatkozó vagy egyéb, nem szokványos eszközöket bevető harcosok is (Auguet 1978, 122–124). A *venator*ok és *bestiarius*ok egyénileg is felléphettek, a bikaviadalokhoz hasonló mutatvánnyal, vagy nagyragadozókkal folytatott küzdelmeikkel. Ez utóbbi esetén már nem mindig volt biztos, hogy az állat húzta a rövidebbet… A Kr. e. 2–1. században még nehezen lehetett megkülönböztetni felszerelésük alapján a gladiátoroktól őket, majd a császárkortól tunika szerű ruhában, lábszárvédőben, vadászdárdát használva vetették bele magukat a viadalba. A Kr. u. 2. században pedig mellvértben, pajzzsal és karddal harcoltak (Meijer 2009, 101–102; 104).

A Kr. u. 2–3. században készült, tunéziai el djemi előkelő házának padlójáról ismert mozaikon ragadozók marcangolnak szét elítélteket, amely hűen örökítette meg az akkoriban delente szokásban lévő állatok általi kivégzéseket (Carucci 2019, 212). Hasonlóan hátborzongató alkotás a líbiai Zlitenből ismert, a Kr. u. 1–3. század közé keltezett *villa* mozaikpadlója is (**3. ábra**; Carucci 2019, 218). A kivégzések azonban egy idő után már unalmasnak és öncélúnak tűntek a közönség számára, így a szervezők egy részüket valamilyen mitológiai kontextusba (például Orpheus vagy Pasiphae és a bika története, Daidalos és Ikaros mondája) helyezték, amely során a halálraítélt egy színjáték szereplője lett, amely újra felkeltette a nézők kíváncsiságát a kivégzések iránt (Meijer 2009, 108–109). Martialis is megörökítette epigrammáiban egy Daedalus nevű halálraítélt medve elé dobatását:

„Daedalus

A lúcánusi medve hogy így tép, Daedalus, úgy-e
Visszakívánod most egykori szárnyaidat?”

(Martialis: Látványosságok könyve 8.; Csengery János fordítása 1942, 40. 8)

Esetenként a kivégzések helyett atlétikai versenyeket, komikus darabokat, vagy cirkuszi mutatványokat rendeztek, mint amilyen az elefántok táncoltatása vagy kötélen egyensúlyozása (Auguet 1978, 125; Line 2022, 13). Előfordult, hogy szelídített állatokkal játszottak el állatviadal-

paródiákat, nyúlvadászatokat törpék, akrobaták, bűvészek közreműködésével (Liberati-Bourbon 2005, 74), vagy háziállatokkal mutattak be különféle mutatványokat. A Colosseum csatornáinak kutatása során előkerült állatmaradványok tanúsága szerint például kisebb, tacskóhoz hasonló testfelépítésű, nagyjából 30 cm-es marmagasságú kutyák is ölre mehettek nagyobb testű ragadozókkal, akár medvékkel is, vagy őket is betaníthatták különféle trükkökre, ezzel szórakoztatva a közönséget (Squires 2022). Délután a nagyobb nézettségnek örvendő fő látványosság, a gladiátor játékok voltak soron (Meijer 2009, 98; 100). Játékokat nem csak nappal, hanem éjszaka, fáklyák fényében is rendeztek (Liberati-Bourbon 2005, 70).

Az amfiteátrumbéli viadalok alkalmával azonban nem csupán a küzdőtéren lévők sérülhettek meg, hanem a nézők is az első sorokban, ha épp egy elkeseredett gladiátor vagy egy felbőszült vad rájuk támadt. Ennek elkerülése érdekében óvintézkedéseket tettek. Sulla koráig láncra verve vezették be az állatokat a küzdőtérre (**3. ábra**), ennek a gyakorlatnak az elhagyásával azonban gondoskodni kellett a nézők biztonságáról (Auguet 1978, 107–108). A Colosseum esetében első védvonalként görgőket helyeztek az aréna kerítő falára, hogy a vadállatok ne tudjanak rajta fel- ill. megkapaszkodni. Ha ezen átjutottak volna, egy második, tetején vaskampókkal és elefántagyarakkal tűzdelt fából épített fal állta útjukat (Meijer 2009, 78).

Néhány esetben előfordult, hogy az állatokkal folytatott küzdelmek – a közönség nemtetszését kivívva – a várakozásokkal ellenkezően alakultak. Ilyenkor a vadak vagy nem bújtak elő ketrecükből, csak a *magister*ek noszogatására, vagy nem támadtak neki ellenfelüknek, mert nem volt kedvük, vagy épp másra támadtak, például a *bestiarius*ra, s nem a kiszemelt áldozatra (Meijer 2009, 110–111). A *magister*ek feladata volt az életben maradt vadak viadal utáni befogása is (Auguet 1978, 108–109).

„A hős Carpophorus

Míglen az orrszarvút ingerli remegve az őrhad
És a nagy állatban késik a feldühödés,
Már félnek, hogy az ígért küzdelem elmarad ekképp':
Végül jól ismert, zord dühe újra kitör
És a sulyos medvét kettős szarvára kerítve
Csillagokig löki, mint szalmababát a bika:
S 'íme, milyen bizton veti Nóricum érckelevézét
Bátor kézzel a még kiskoru Carpophorus!
Vitte is a bikapárt, könnyen vállára emelve,
Meghátrált ez előtt a bivaly és a bölény.
Futva előle a dárdájába szaladt az oroszlán.
Most panaszold, óh nép, a henye késlekedést!"

(Martialis: Látványosságok könyve 22–23.; Csengery János fordítása 1942, 45–46., 22–23.)

Tertullianus leírása alapján az állatokkal folytatott küzdelmek, majd a kivégzések lezárásaként bizonyos helyeken egy Charónt, a Styx folyón a halottakat átvivő révészt és egy Mercuriust, a lelkek kísérőjét megformáló alak jelent meg az arénában. Ők ellenőrizték, hogy mindenki kellőképpen halott-e ahhoz, hogy holttestét utána hatalmas kampókra akasztva kihúzzák vagy hordágyra fektetve kivigyék a *porta Libitinae*n keresztül az aréna küzdőteréről (Meijer 2009, 111; Auguet 1978, 69–70). Ha nem is mindenhol ilyen teátrálisan történt a halottak színpadról lehozatala, annyi biztos, hogy fontos és gyorsan elvégzendő feladat volt a tetemek elvitele. Az emberi testeket általában az életükben betöltött státuszuknak megfelelően temették el vagy semmisítették meg, némely esetben vadállatok vagy kutyák elé vetve a földi maradványokat (Meijer 2009, 128–129).

Az állatmaradványok sorsa

Az amfiteátrumokhoz kapcsolódó állatmaradványokkal kapcsolatban kevés információ áll rendelkezésre, számuk csekély. A küzdelmek során vélhetően egyik állat akár fel is falhatta az ellenfelét, vagy az elesett vadak darabjait a többi, még ringbe szálló ragadozó elé vethették eleségül, így a csontjaik elenyésztek.

Azt sem mindig könnyű meghatározni, hogy az egyes, amfiteátrumokhoz kapcsolódó állatmaradványok esetében valóban az ott folyt küzdelmek során elhullott vadak maradványairól van-e szó, illetve a későbbi korszakok állatmaradványai is színesíthetik a képet. A Viminaciumban 2011-ben előkerült, a Kr. u. 4. század második felére keltezhető részleges, hibrid tevecsontváz például bár az amfiteátrumból került elő, ebben az időben már nem használták az arénát a játékok színteréül. Így ez a teve a kereskedelemhez és a hadsereghez volt köthető, nem az állatviadalokhoz (Vuković & Bogdanović 2013, 263–264). Ugyanígy az aquincumi polgárvárosi amfiteátrum állatmaradványainak egy része is a későbbi korokhoz köthető.

Hogy pontosan hol végezték az állatok földi maradványai, régészetileg kevés bizonyíték áll rendelkezésre. Valószínűleg valahol az amfiteátrumokon kívül keresendők azok a tetemdepók, ahová az elesett állatok kerülhettek. A trieri amfiteátrum mellett zajló feltárások eredményei azt sugallják, hogy a viadalokhoz köthetők állatmaradványokat az emberek holtesteivel együtt időnként gödrökbe dobták (Carroll 2002). A Lajos utca - Nagyszombat utcai feltárásról származó leletek is a katonavárosi amfiteátrumban elhullott állatok tetemdepójaként is értelmezhetők.

Az állatok sorsát illetően főként az írott forrásokra lehet támaszkodni. A kisebb állati tetemeket kocsikra dobálhatták és úgy vitték el, a nagyobbak viszont, mint például egy oroszlán vagy víziló, komoly gondot okoztak. A tetemek mennyisége

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olykor irdatlan nagy volt, elszállításuk pedig hosszadalmas, a fertőzés veszélyét is magában rejtetve. A tetemek valószínűleg elhagyott helyeken: erre a célra kiásott gödrökben vagy ahol a földrajzi adottságok megengedték, mély szakadékokban végezték. Olykor a más játékok alkalmával bevethető állatok gyomrában kötöttek ki élelmezésük költséghatékony megoldásaként. Az elhullott állatok – főként a kisebb testű vadak – tetemét gyakran szétosztották a szegényebb néprétegek között. Ez a *plebs* számára ingyen húsforrást, míg a császár számára a hatalmának stabilitását jelentette (Meijer 2009, 129–131).

Összefoglalás

Az amfiteátrumokban zajló állatküzdelmekről a képi ábrázolások, írott források és a feltárások során előkerült épületszerkezetek, illetve az állatmaradványok nyújtanak információt. A gladiátor játékokat megelőző *venatiók* izgalmas és várt eseménnyé nőtték ki magukat. A játékok szervezői vagy az egzotikummal, vagy az állatok mennyiségével, vagy a különleges ellenfél összepárosításokkal, vagy ezek mindegyikével együttvéve igyekeztek lenyűgözni a mindenféle társadalmi rétegből érkező nézőközönséget. A hatalmas mennyiségű állatállományt a Római Birodalom peremvidékeiről szervezett módon szerezték be a játékok számára, amelyben a hadseregnek is nagy szerepe volt. Kezdetben a mérsékelt övi faunához mérten egzotikumnak számító fajok (nagymacskák, zsiráfok, orrszarvúk, vízilovak, krokodilok, stb.) nagyobb száma volt megfigyelhető. A képi ábrázolásokon ezen fajok még az északabbi provinciákban is megjelentek, noha ezeken a területeken a mérsékelt övi fauna tagjaiból válogattak a viadalokhoz. A birodalom Kr. u. 3. századi gazdasági hanyatlása következtében, illetve az észak-afrikai mezőgazdasági tevékenység védelme érdekében olykor a kipusztulásig irtott fajok eltűnése miatt egyre inkább áttértek a mérsékelt övi állatok (barnamedvék, vadkanok, szarvasfélék, vadjuhok, bikák) befogására, és őket küldték az arénába. Ennek bizonyítékai lehetnek az aquincumi katonavárosi amfiteátrum közeléből előkerült medveleletek is. Pannoniában gyakori ellenfelek lehettek a medvék és a párosujjú patások közül a bikák és a bölények.

Az amfiteátrumokból vagy azok környezetéből előkerülő kevés állatcsont maradvány arra enged következtetni, hogy az elhullott állatok egy részét a még életben maradtak elé vetették eledelül, vagy feldarabolva szétosztották a nép között (amiről a régi óbudai szeszgyár területéről előkerült vágott medve alkarcsont is tanúskodhat), illetve valahol az amfiteátrumokon kívüli területeken, gödrökben földelhették el őket (amint az valószínű a Nagyszombat utca - Lajos utcai medveleletek esetében is).

Szerző tudományos közreműködése

Biller Anna Zsófia Eredeti kézirat

Köszönetnyilvánítás

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NEW INSIGHTS ON MATERIAL USE FOR ROMAN AND LATE ANTIQUE SARCOPHAGI IN THE BASILICA OF SAN APOLLINARE IN CLASSE (RAVENNA, ITALY)

ÚJ ISMERETEK A RÓMAI ÉS KÉSŐ ANTIK SZARKOFÁGOK ANYAGHASZNÁLATÁRÓL A SAN APOLLINARE IN CLASSE BAZILIKÁBAN (RAVENNA, OLASZORSZÁG)•

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Abstract

This paper presents the provenance of white marble used in late antique sarcophagi from the Basilica of San Apollinare in Classe (Ravenna), challenging the long-held assumption that most marble came from the quarries of Proconnesos (Marmara Island, Turkey) in the Eastern Mediterranean. While previous studies have relied primarily on stylistic, typological analysis and historical presumptions, the research of this project uses a combination of non-destructive and minimally invasive methods, including macroscopic and microscopic examination, Raman spectroscopy, X-ray fluorescence spectroscopy, $\delta^{18}O$ and $\delta^{13}C$ stable isotope analysis. The analysis of sarcophagi from the Basilica of San Apollinare in Classe reveals the use of different types of marble, showing a combination of marbles from different quarries. The results of the analyses indicate that in addition to Proconnesos marble, material from quarries on Thassos and Paros was also used in the Ravenna region. The results emphasise the diversity of marble sources beyond Proconnesos, including quarries in Asia Minor, Thassos and Paros. This study contributes to a broader understanding of Mediterranean trade networks and artistic production in Late Antiquity, and also highlights the need for further research into the marble trade in the northern Adriatic.

Kivonat

Ez a tanulmány a Ravenna közelében lévő San Apollinare in Classe bazilikából származó késő antik szarkofágokban használt fehér márvány eredetét vizsgálja, megkérdőjelezve azt a régóta fennálló feltételezést, hogy a legtöbb márvány a Kelet-Mediterrán térség keleti részén található Proconnesos (Marmara-sziget, Törökország) kőbányáiból származik. Míg a korábbi tanulmányok elsősorban stilisztikai, tipológiai elemzésekre és történelmi feltételezésekre támaszkodtak, addig a jelen projekt keretében végzett kutatás roncsolásmentes és minimálisan invazív módszerek kombinációját alkalmazza, beleértve a makroszkópos és mikroszkópos vizsgálatot, a Raman-spektroszkópiát, a $\delta^{18}O$ és $\delta^{13}C$ stabil izotópelemzést. A San Apollinare in Classe bazilikából származó szarkofágok elemzése különböző márványtípusok használatát tárja fel, néhány szarkofágon különböző kőbányákból származó márványok kombinációja látható. Az elemzések eredményei azt mutatják, hogy a prokonnészoszi márványon kívül a Thassos és Paros kőbányáiból származó anyagot is felhasználtak a prokonnészoszi bányákon kívül. Ez a tanulmány hozzájárul a mediterrán kereskedelmi hálózatok és a késő ókori művészeti termelés szélesebb körű megértéséhez, és rávilágít az Adria északi részén folyó márványkereskedelem további kutatásának szükségességére.

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KULCSSZAVAK: MÁRVÁNY SZARKOFÁGOK; SZÁRMAZÁSI HELY MEGHATÁROZÁS; RONCSOLÁSMENTES ELEMZÉS; KÉSŐ ÓKOR; RAVENNA; SAN APOLLINARE IN CLASSE

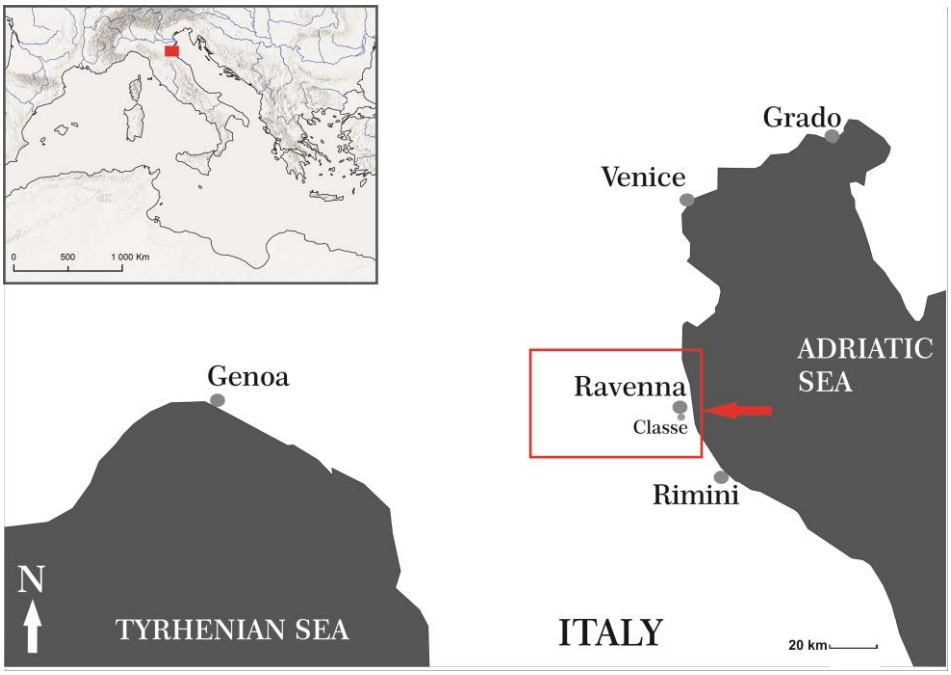

Fig. 1.:

Ravenna with the port district of *Civitas Classis*. (Unless otherwise stated, the image attachments are the work of the authors.)

1. ábra:

Ravenna a Civitas Classis kikötői negyeddel. (Eltérő hivatkozás hiánya esetén a képmellékletek a szerzők munkái.)

Introduction

It is widely believed that Ravenna (**Fig. 1.**) sourced marble from Proconnesos and the Eastern Mediterranean between the 5th and 8th centuries. The theory that Proconnesos is one of the main sources of marble is supported by its competitive cost in Antiquity and its wide distribution in the Late Antique Mediterranean (Guidobaldi 2002; Pensabene 1986; Pensabene & Barsanti 2008; Sodini 2002). It is generally considered unlikely that the marble came from Italian quarries, such as Carrara. Thus, the provenance of white marble artefacts preserved in late ancient basilicas was historically attributed mainly to the imperial quarries of Proconnesos on the Marmara Island or, more generally, to some of the Greek or Eastern quarries, or it was left unspecified. However, there was no mention of the methodology of provenance determination, which was based only on macroscopic inspection, historical presumptions and references in the ancient sources (Farioli 1969, 1977, 1983; Angiolini-Martinelli 1968; Valenti-Zucchini & Bucci 1968; Andreas Agnellus XVII,26; XXI,50; XXVI,76; XXXVIII,149). Only the first attempts have been made to study the white and white-grey marble samples found in the basilica and monastery of San Severo in Classe (Tůmová 2013, Tůmová et al. 2016, 2021). The issue of marble provenance is closely linked to the question of commercial exchange and long-distance trade in the whole of Mediterranean (Kingsley 2009; Laiou & Morrisson 2007; Mazzocchin 2003; McCormick 2001; Morrisson & Sodini 2002; Panella 1989, 1993; Rizzardi 2016; Walker 1988). The current research carried out on the eleven sarcophagi in the basilica of San Apollinare in Classe was based on macroscopical and microscopical observations, determination of the mineralogical composition using mobile Raman spectroscopy, determination of the chemical composition using X-ray fluorescence spectroscopy, taking small samples with a micro drill and measurement of stable oxygen ($\delta^{18}O$) and carbon ($\delta^{13}C$) isotope ratios.

From about the second half of the 19th century, the scientific community became interested in the sarcophagi in the basilicas in Ravenna (Garrucci 1881). Interest in the Ravenna sarcophagi continued throughout the first half of the 20th century (Wilpert 1929, 1932, 1936), and then especially in the second half of the last century, when they were studied more systematically (Angiolini-Martinelli 1968; Bovini 1954; De Francovich 1959; Deichmann 1969a, 1974, 1982; Dresken-Weiland, Bovini & Brandenburg 1998; Farioli 1966a, 1966b, 1968, 1972, 1975, 1983, 1989; Koch 1998, 2000; Kollwitz & Herdejürgen 1979; Lawrence 1970; Rizzardi 1994; Russo 1968, 1974; Schoolman 2013; Valenti-Zucchini & Bucci 1968).

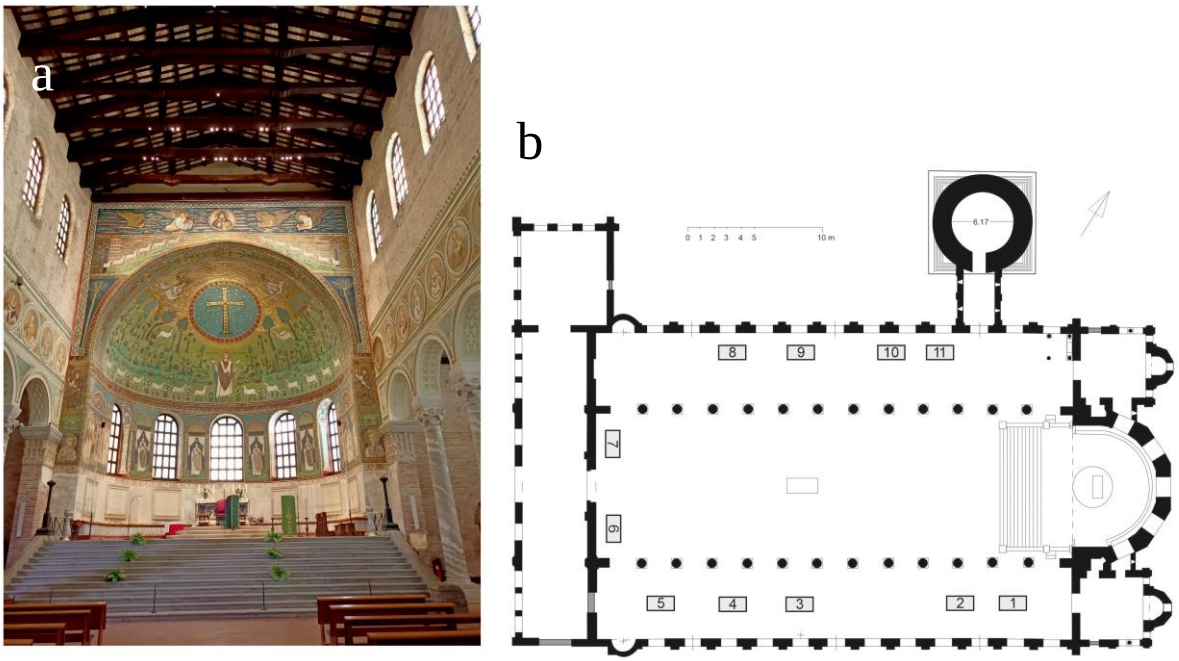

Fig. 2a.: The basilica of San Apollinare in Classe; **Fig. 2b.:** The layout of the basilica of San Apollinare in Classe with evidence of 11 sarcophagi (sph): 1. sph of the Twelve Apostles; 2. sph of archbishop Theodorus; 3. sph of the archbishop Gratiosus; 4. sph "a sei nicchie"; 5. Roman sph of Licinia Valeria; 6. sph "a tre e quattro nicchie"; 7. sph with the *adoratio crucis* and lambs; 8. sph of the archbishop Felix; 9. sph with the *adoratio crucis* and antithetic lambs; 10. sph with the lambs carrying crosses ("agnelli cruciferi"); 11. sph of IOHANNIS (modified after Deliyannis 2010, 262, Fig. 90).

2a. ábra: San Apollinare in Classe bazilikája; **2b. ábra:** A San Apollinare in Classe bazilika alaprajza 11 szarkofág leletével: 1. a tizenkét apostol szarkofágja; 2. Teodor érsek szarkofágja; 3. Gratiosus érsek szarkofágja; 4. „a sei nicchie" szarkofág; 5. Licinia Valeria római szarkofágja; 6. „a tre e quattro nicchie" szarkofág; 7. „a tre e quattro nicchie" szarkofág. szarkofág az „*adoratio crucis*"-szal és bárányokkal; 8. Félix érsek szarkofágja; 9. szarkofág az „*adoratio crucis*"-szal és bárányokkal; 10. szarkofág a keresztet tartó bárányokkal („agnelli cruciferi"); 11. IOHANNIS szarkofágja (Deliyannis 2010, 262, 90. ábra után módosítva).

For a stylistic and iconographic analysis of the development of Western and Ravennate sculptural art, sarcophagi and Eastern (Byzantine) influences cf. Deichmann 1969a, b, 1974, 1982, 1989; Gerke 1959a, b, c; Russo 1974; Sodini 2002. On the basis of stylistic analysis and documented analogies with products of Eastern provenance, the thesis was formulated that some sarcophagi with figural decoration were imported into Ravenna in the early 5th century, before the establishment of an independent local workshop, mainly from the East (*Asia Minor*), and especially via Constantinople. We have almost no information about artists working in Ravenna. One exception is an artist called Daniel, who was active during the reign of the Arian, Ostrogothic king Theodoric (Cassiodorus, *Variae*, III, 19). However, it is not entirely certain whether he worked directly in Ravenna or only traded in sarcophagi (Koch 2000, 390). According to Rizzardi (1994, 189–202), it is very likely that he was one of the stonemasons of the Ravenna workshop. When we talk about imported sarcophagi, we primarily refer to the Pignatta sarcophagus and the sarcophagus of Liberius III, but also other aspects of the architecture and iconography are undoubtedly influenced by the East. The parallels with Constantinopolitan sculpture (e.g., the base of the obelisk of Theodosius) and sarcophagi from Bakirköy, Silivri Gate, Saragüzel and Yedikule are well known (cf. Deichmann 1969b, 292–307; Gerke 1959c, 109–121; Rizzardi 2004, 2007). Ravenna's favorable position on the sea and its port at Classe facilitated frequent trade contacts. Therefore, the hypothesis of the use of marble from the East makes more sense. The question remains whether the sarcophagi were finished before being imported to Ravenna or whether, as was the case with architectural decorations and sarcophagi imported from Eastern workshops and quarries, they were transported in prefabricated state and finished on site, either by foreign artists or later in a local workshop. A distinguishing feature of the Ravenna sarcophagi, as opposed to those produced by the Roman workshops, is the decoration on all four sides of the chest (as in the Eastern, Constantinopolitan and

Microasiatic sarcophagi). In addition, there are specific architectural decorations and compositional features, some of which show Eastern influences. In Ravenna, therefore, we find a synthesis of local, Roman and northern Italian traditions with the art of the Greek East, *Asia Minor* and Constantinople (cf. De Maria 1998, 485).

Only one of the thirteen Ravennate sarcophagi with figural decoration ("a figure umane"), known as the Sarcophagus of the Twelve Apostles, and nine of the forty-five Ravennate sarcophagi with purely symbolic decoration, as well as a small Roman sarcophagus, are now in the Basilica of San Apollinare in Classe (**Figs. 2a,b**), built and decorated with beautiful mosaics in the second half of the 6th century.

Most of the sarcophagi of the Ravennate circle are now in the basilicas of Ravenna, but some are also in Ferrara, Fusignano, Imola, Longana, Ostiglia, Padova, Pesaro, Milan, and in the Marche region (Mondolfo).

The sarcophagus of the Twelve Apostles (**Fig. 2b.1**) is of the "panel" type, featuring carved pilasters with cannelure, bases and leaf-spoon capitals at the corners. The architrave is adorned with stylized Lesbian (convex-concave) kyma. The decoration on the front side (**Fig. 3a**) depicts Christ seated on a throne, handing a scroll of the Law to the Apostle St. Paul, who receives it in hands covered by *pallium*. This iconography of *manibus velatis*, symbolising sacred respect and reverence, is not exclusive to Christian iconography, but is also found in imperial iconography. It can thus be seen that this represents the Eastern tradition of the *traditio legis* to Paul rather than to the Apostle Peter, who is depicted on the left of Christ, bearing a cross in the shape of a *crux patens* on his shoulder. In addition, Peter's hands are covered by a cloak on which is held a key, his symbol. The central *trinus* scene is surrounded by the figures of two apostles, both of whom are depicted with the gesture of *acclamatio*, with a disproportionately accentuated right hand. The composition is brought to a conclusion with the depiction of two apostles, each holding a crown in their cloaked hands. With the exception of the apostles Peter and Paul, who can be identified by their typological portrait (Paul with a pointed beard and Peter with a curly beard), the other apostles are unidentifiable. It is noteworthy that Christ is depicted with both the symbols of the open codex in His left hand and the iconography of the *traditio legis*. An analogous combination of these two iconographic elements can be observed in the Certossa/Bonacossi sarcophagus in Ferrara.

The sarcophagus is dated to the first half of the 5th century (De Francovich 1959; Farioli 1977; Valenti-Zucchini & Bucci 1968, 35–36; see also Diehl 1928, 63–64). However, Gerke (1969) posits that it is the final Ravennate sarcophagus to feature a human representation, and thus considers it to be of a more recent date than the Barbacian sarcophagus (dated to 440–450 or to the mid to late 5th century: De Francovich 1959, 109; Farioli 1977, 40; Valenti-Zucchini & Bucci 1968) or the already mentioned Certosa/Bonacossi sarcophagus in Ferrara (dated 450–475; Kollwitz & Herdejürgen 1979, 68). He then draws a parallel with the Constantinopolitan sarcophagi of Bakirköy and Yedikule (Gerke 1959c, 113). However, this chronology appears to be inconsistent with the style of the Rinaldo sarcophagus, which is related in style and composition to the Twelve Apostles sarcophagus. The sarcophagus is stylistically and compositionally (central *trinus* group) related to the front wall of the Rinaldo sarcophagus, which dates from the first half of the 5th century and is located in the Cathedral of Ravenna. It is also related to the back wall, which features symbolic decoration – in terms of architectural composition, the style of floral motifs and symbolic decoration (front and back wall, lid) on the sarcophagus of Archbishop Theodore in the Basilica of San Apollinare in Classe exhibits stylistic similarities to the sarcophagi of Certosa/Bonacossi, particularly in the portrayal of Christ's throne on the front wall and the disproportionate representation of the hands in comparison to the body. Other pertinent analogies include the sarcophagus of Pietro Peccatore (or Pietro degli Onesti) and the sides of the sarcophagus of Exuperantius and Maximianus (the first half of the 5th century) in the Cathedral. Furthermore, the sarcophagus of the Twelve Apostles displays a compositional equilibrium that is absent in the Barbacian or Certosa/Bonacossi sarcophagi. It can therefore be concluded that the sarcophagus is most likely to date from the final decade of the first half of the 5th century (Sekavová 2006, 116).

The back side of the sarcophagus displays a symbolic decoration in the form of two peacocks, their heads oriented towards the central medallion, which features a Latin cross of the *crux patens* type. The aforementioned representation is circumscribed by vignettes of leaves and grapes. (**Fig. 3b**).

The lateral sides of the sarcophagus exhibit a similar architectural frame to that observed on the front, which depicts the three apostles. On the right, two apostles are depicted shaking hands in a gesture of *dextrarum iunctio*, while the third holds his right hand raised to his chest and grasps a globe in his left (**Fig. 4a**). The scene on the left side is analogous to that on the right, as both depict three apostles. The central figure is depicted holding an open codex and making an *adlocutio* gesture with his right hand.

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Fig. 3.: The sarcophagus of the Twelve Apostles, San Apollinare in Classe: front (a) and back (b) sides.
3. ábra: A Tizenkét apostol szarkofágja, San Apollinare in Classe: elülső (a) és hátsó (b) oldal.

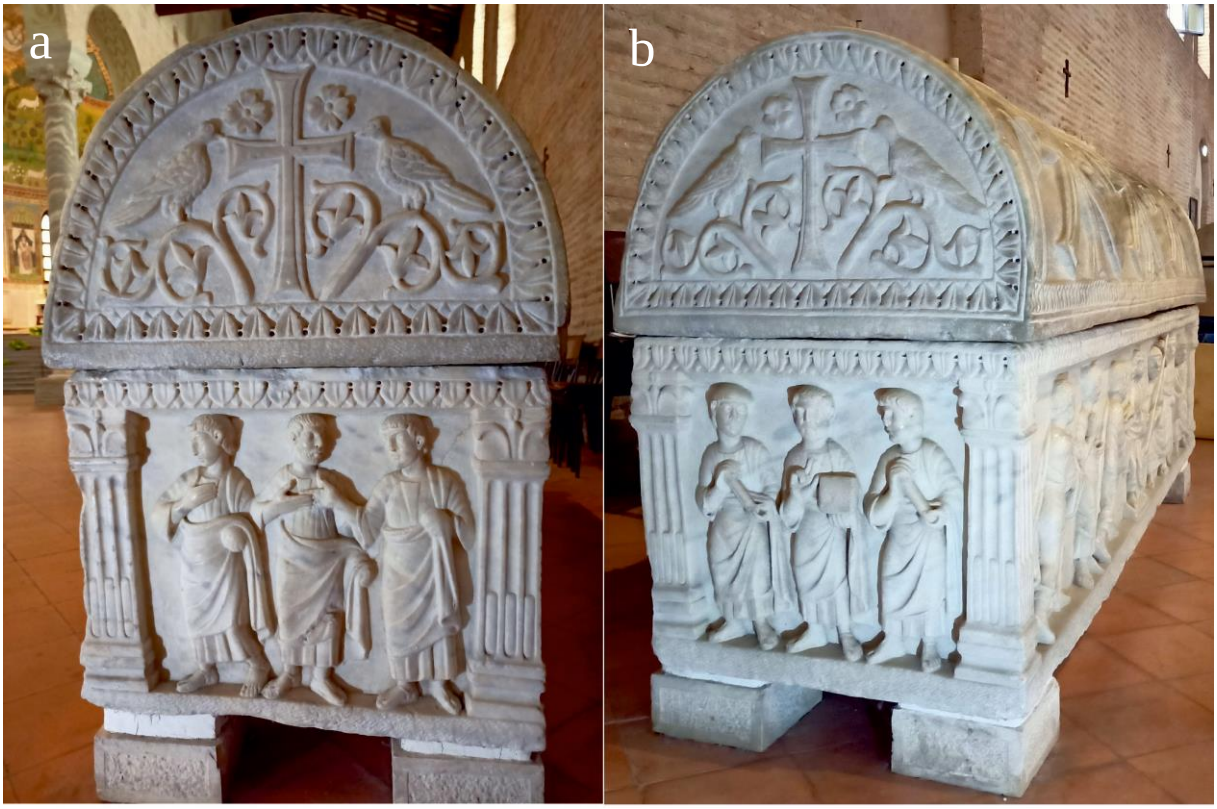

Fig. 4.: The sarcophagus of the Twelve Apostles, right (a) and left (b) lateral sides
4. ábra: A tizenkét apostol szarkofágja, jobb (a) és bal (b) oldalfelület

The apostles depicted on the lateral sides are shown with the scrolls (*volumina*) in their hands. The semi-cylindrical lid of "a baule" type features a symbolic decoration consisting of three Christological monograms on either side (**Figs. 3-4.**). Furthermore, the lunettes on the lid display Latin crosses flanked by doves in the composition of the *adoratio crucis* and vine tendrils.

The sarcophagus of Archbishop Theodorus (**Fig. 2b.2**) was relocated from the Santa Maria di Urano monastery in Bertinoro (Forlì) to the basilica of San Apollinare in Classe. The sarcophagus is categorized as the "panel" type, featuring carved pilasters with cannelure, bases and leaf-spoon capitals at the corners. These are similar in design to those seen on the Twelve Apostles sarcophagus. The architrave is adorned with a stylized representation of the Lesbian kyma. The front side's decoration (**Fig. 5a**) features a Christological monogram comprising the Greek letters XP, with the letters AΩ suspended below. Two rosettes are also depicted beneath the medallion. Furthermore, the composition features two peacocks facing each other. Two vine branches, bearing leaves and grapes, flourish behind the bodies of the peacocks. Two doves are observed below, engaged in the act

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of refreshing themselves on the grapes. The back (**Fig. 5b**) exhibits a comparable compositional structure, albeit with a central cross in lieu of the medallion. It features peacocks, doves, and a small mammal with an elongated head and a long tail (sometimes identified as a small rabbit). The structural framework of the posterior is less complex than that of the anterior, lacking both cannelure and lesbian kyma. The lateral surfaces feature symbolic decorations in the form of floral tendrils, rosettes, doves and crosses. The decoration on the left lateral surface is almost entirely absent.

The semi-circular lid (**Fig. 5.**) features a symbolic decoration comprising two crosses and a *chí-ióta* monogram with pendent Greek letters A and Ω enclosed within a laurel wreath. On the front wall is a carved inscription HIC REQVIESCIT IN PACE THEODORVS V.B. ARCHIEPISCOPVS. The sarcophagus was erroneously dated according to the deposition of Theodorus' body in 688; however, this was a secondary use of the sarcophagus. A stylistic analysis and comparisons with other Ravennate sarcophagi indicate that the dating should be revised to the mid-fifth century or slightly later (Valenti-Zucchini Bucci 1968, 8, n. 4). Analogies of the sarcophagus, both in composition and style, can be drawn with the back of the S. Isacio sarcophagus (peacocks, monograms), the sarcophagus of Twelve Apostles, the sarcophagus in Fusignano, the right lateral side of the Rinaldo sarcophagus (grapevine tendrils), the sarcophagus

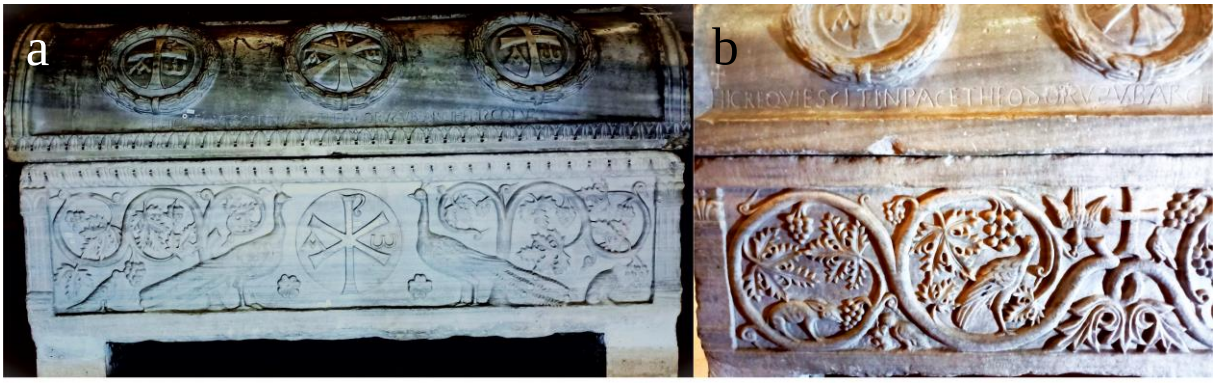

Fig. 5.: The sarcophagus of Archbishop Theodorus, San Apollinare in Classe: front (a) and back (b) sides
5. ábra: Teodor érsek szarkofágja, San Apollinare in Classe: elülső (a) és hátsó (b) oldal

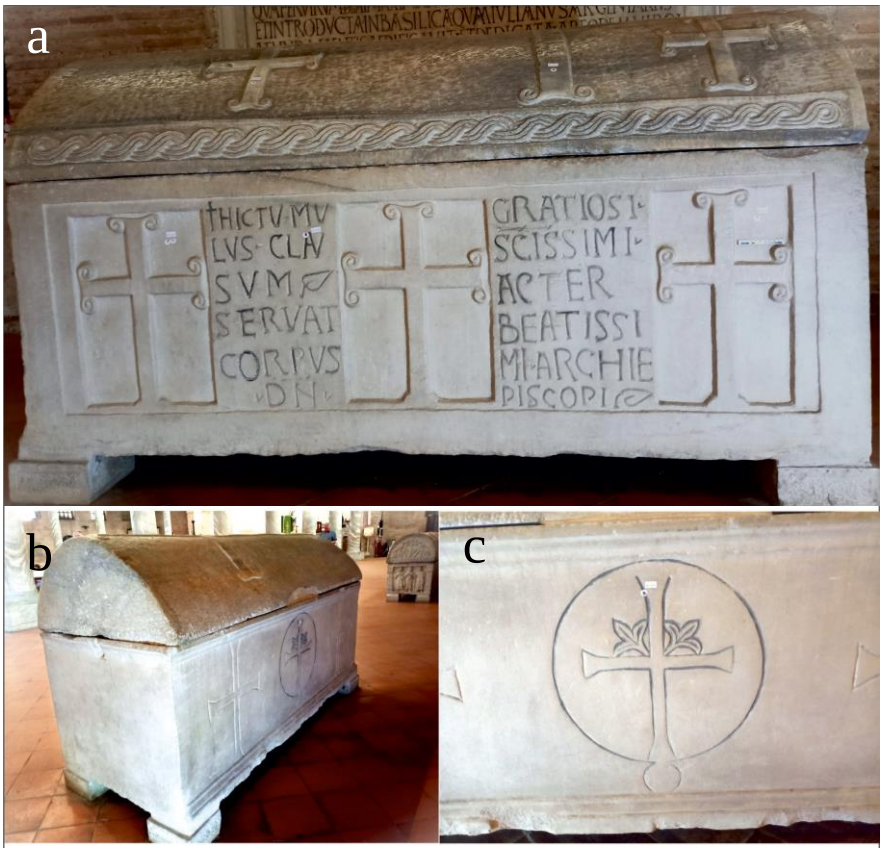

Fig. 6.: The sarcophagus of Archbishop Gratiosus, San Apollinare in Classe: front (a), back side (b) and a detail of the central cross in clipaeum on the reverse side (c).

6. ábra: Gratiosus érsek szarkofágja, San Apollinare in Classe: előlap (a), hátoldal (b) és a hátoldalon a központi kereszt részlete a clipaeumban (c).

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Certosa/Bonacossi and the front of the S. Gervasio sarcophagus in Mondolfo (Sekavová 2006, 148).

The sarcophagus of Archbishop Gratiosus (**Fig. 2b.3**), which features decoration dated to the end of the 8th century, is regarded as a reworked sarcophagus intended for subsequent use, for which the date of secondary use is known: 788 AD, date of the death of Archbishop Gratiosus (Farioli 1977, 138; Valenti-Zucchini & Bucci 1968, 58; Baldini, La Manna & Marsili 2021). The decoration on the front wall (**Fig. 6a**) is a purely symbolic and ornamental composition. It consists of three panels with Latin crosses with elaborate volutes on the arms (*crux patens*) and panels between them with a dedicatory inscription to Archbishop Gratiosus in black polychrome in carved majuscule letters:

†HIC TVMV	GRATIOSI
LVS CLAV	SCISSIMI
SVM	AC TER
SERVAT	BEATISSI
CORPVS	MI ARCHIE
DN	PISCOPI

The lid of the "a baule" type is slightly flattened and bears three crosses engraved asymmetrically, similar to the crosses on the front. The lower part of the lid is decorated with a border with an interlaced motif. The reverse (**Fig. 6b**) shows remnants of black polychromy, including three partially engraved Latin crosses (*crux patens* form), which appear to be a preliminary sketch. The central one (**Fig. 6c**) is surrounded by a *clipaeum* standing on a small globe. Two lilies grow on the cross-beam of the cross. The left side of the coffin is also decorated with a Latin cross within a flat, bordered field. The right side was left without any decoration. This sarcophagus has a close analogy in the sarcophagus of Archbishop Iohannes in the same basilica (**Fig. 14.**).

As the name "a sei nicchie" suggests (**Fig. 2b.4**), it is a type of sarcophagus with *aediculae*: the front and the back are divided into six niches in which the architecture of the central niches and the columns supporting their arches are abstracted and replaced by a symbolic scene. On the wall facing the interior of the basilica, two peacocks are drinking water from a kantharos (**Fig. 7a**), while on the back wall two lambs are refreshing themselves with palm fruits (perhaps dates) (**Fig. 7b**). In the niches adjacent to the central scene, on both walls, there are Latin crosses and palm trees on the edges. All these attributes have a strong early Christian symbolism. And in this sarcophagus we see a gradual move away from figurative representation towards purely symbolic representation in the Ravennate sarcophagi (cf. Gerke 1959c, 118–119). The row of niches is continuous throughout the sarcophagus, with two niches on each side decorated with Latin crosses. The lid of the sarcophagus is of the "a baule" type and is decorated with a matrix that resembles slices of pine cones or roof tiles. The cornice is decorated with an ovoid motif. The sarcophagus is dated to the end of the 5th – beginning of the 6th century (Valenti-Zucchini & Bucci 1968, 45; De Francovich 1959, 82–87) and it shows more compositional and stylistic similarities within the framework of the Ravennate art of the 5th and 6th centuries: the sarcophagus "a sei nicchie" in the Cathedral of Ravenna; two sarcophagi "a nicchie" and of Liberius III in the Basilica of San Francesco; the altar in the main apse in the Basilica of San Apollinare in Classe and San Giovanni Evangelista; the sarcophagus of Valentinian III in the Mausoleum of Galla Placidia; analogies of the sides are found in a tympanon of the sarcophagus "Traversari" in the Basilica of San Francesco. (Sekavová 2006, 149).

Fig. 7.: The sarcophagus "a sei nicchie", San Apollinare in Classe: front (a) and back (b) sides.
7. ábra: Az „a sei nicchie" szarkofág, San Apollinare in Classe: elülső (a) és hátsó (b) oldal

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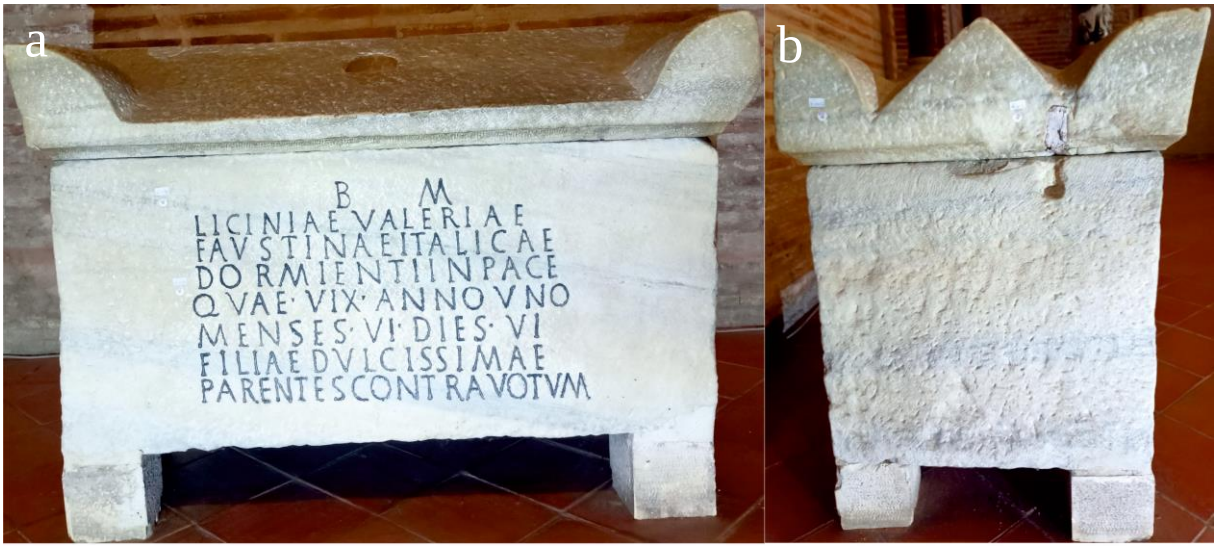

Fig. 8.: Small Roman sarcophagus of Licinia Valeria, San Apollinare in Classe: front (a) and left (b) side.
8. ábra: Licinia Valeria kis római szarkofágja, San Apollinare in Classe: elülső (a) és bal (b) oldal

The small fourth-century Roman sarcophagus of Licinia Valeria (**Fig. 2b.5**) with a low gabled lid and angular acroteria is undecorated. On the front, there is an inscription dedicated by the parents to their daughter, to Licinia Valeria, a girl died at the age of 1 year, 6 months and 6 days (**Fig. 8.**).

The sarcophagus "a tre e quattro nicchie" (**Fig. 2b.6**) has a central tympanon and is decorated with three niches on the front and four *aediculae* on the back. The simple, undecorated lid is of the "a baule" type. The right lunette of the lid depicts two opposing peacocks picking the berries from the grapes hanging from the tendrils of the vine growing from the central kantharos (**Fig. 9b**). The left lunette shows a laurel wreath with *lemniscae* on which two doves rest. In the centre of the crown there is a *chí-rhó* monogram with outstretched arms at the ends (**Fig. 9c**).

The side of the sarcophagus facing the main nave of the basilica shows architectural features influenced by pagan sarcophagi from northern Italy of the 3rd century AD (**Fig. 9a**), and it is clearly a sarcophagus reworked in the Christian spirit in the late 5th or early 6th century (Sekavová 2006, 19, 36–37, 53). A typological analogy can be found in the sarcophagus of Valentinian III in the so-called Mausoleum of Galla Placidia in Ravenna. For the dating of the sarcophagus to the last decade of the 5th century see De Francovich 1959, 81; for the dating to the first decade of the 6th century see Valenti-Zucchini & Bucci, 1968, 47. Gerke (1959c, 119–120) also finds a model for this type of triple *aedicule* with a tympanum over the central niche in northern Italian pagan sarcophagi of the 3rd century, but attributes its origin to Greek production. The reworking can be seen on the front, where the deep relief of the architectural frame (pilasters, *aediculae*, tympanum) contrasts sharply with the low relief of the Christian symbols in the niches (the central cross appearing under the open curtains and two lateral crosses with hanging letters *Alpha* and *Ómega*). The symbolism of the cross appearing from behind the half-open curtains recalls the theophany, which is also represented in figurative form, for example on the Brescia ivory lypsanotheque (where Christ *docens* is depicted in the Collegium of the Apostles) or, in its symbolic form as a *crux gemmata*, on the Milan ivory diptych (Sekavová 2006, 152). The analogy of the theophany of the cross appearing behind the open curtain can also be found in the central niche at the front of the sarcophagus in the tomb at the Silivri Gate in Constantinopol, discovered in the 1980s (Mathews 1994, 313, 317, Fig. 4). It is interesting to note that the crosses (*crux gemmata*) in the side niches are mirrored, as can be seen from the hanging letters or the decorative *rhó* at the top of the vertical arm of the cross. It is also interesting to note an additional inscription, carved between two columns on the front, which refers to Archbishop Reparatus. (**Fig. 9f**).

On the right side, in an architectural framework consisting of two pilasters with cannelure and acanthus capitals, a large volute *kantharos* with a shell at the edge of the neck is displayed below the arch. Two doves rest on columns beside the *kantharos* (**Fig. 9b**).

On the left side, in a similar architectural frame to that on the opposite side, the *Agnus Dei* is depicted on a mountain from which flow the springs of the four rivers of Paradise. Behind the head of the lamb, facing backwards, is a nimbus inscribed with the Constantinian XP monogram (**Fig. 9c**).

Fig. 9.: The sarcophagus "a tre e quattro nicchie" with the central tympanon, San Apollinare in Classe: front (a), lateral (b, c) sides, the reverse wall (d, e), and the inscription between two columns on the front (f).

9. ábra: A „a tre e quattro nicchie" szarkofág egy központi timpanonnal, San Apollinare in Classe: előlap (a), oldalsó oldalak (b, c), a hátfal (d, e) és a felirat két oszlop között az előlapon (f).

The field of the back side (**Fig. 9d, e**) is divided by four niches supported by columns. The arches of the niches are filled with decorative shells. In the two central niches there are monogrammatic crosses with outstretched arms (*crux patens*) and internal plastic modelling; in the remaining niches there are date palms.

The monumental, symbolic sarcophagus with the *adoratio crucis* and the antithetic lambs (**Fig. 2b.7**) is of the panel type, with pilasters located at the edges. The lid, of "a baule" type, is adorned with a symbolic decoration of a laurel *corona* containing a central Latin cross with the Greek letters AΩ, flanked by two peacocks standing on *lemniscae* ending in heart-shaped ivy leaves (**Fig. 10a**). The side lunettes of the lid are decorated with a beautiful symbolic motif of tendrils growing from the kantharos and the *adoratio crucis* motif with antithetic doves. The decoration on the front consists of a monumental composition of *adoratio crucis* with antithetic lambs. Behind the lambs are palm trees with fruit in low relief. The central cross is of Latin type with outstretched arms at the ends (*crux patens*) and the letters AΩ hanging from it (**Fig. 10a**). One side is decorated with the symbolism of the *adoratio crucis*, with antithetic peacocks and the central cross on a mountain from which four apocalyptic rivers flow (**Fig. 10c**). The opposite lateral side is decorated with an *Agnus Dei* with a jewelled cross (*crux gemmata*) – as a symbol of the victory – in the form of a *crux patens* and a small dove with a *corona victoriae* in its beak (**Fig. 10b**). The dating of the sarcophagus varies: according to De Francovich and Chevallier it was made in the last decade of the 5th century, while Valenti-Zucchini & Bucci (1968, 48) date it to the beginning of the 6th century (Chevallier 1961; De Francovich 1959, 47).

The sarcophagus of the Archbishop Felix (**Fig. 2b.8**) belongs to the late group of Ravennate sarcophagi dated to the 8th century, whose artistic decoration is dated to the first quarter of the same century (around 723) and is considered by some authors to be "barbarian" (Angiolini-Martinelli 1992, 162; Valenti-Zucchini & Bucci 1968, 57; see also Godoli 1997, 25, n. 36).

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Fig. 10.: The sarcophagus with *adoratio crucis* and the lambs, San Apollinare in Classe: front (a) and lateral (b, c) sides

10. ábra: A szarkofág az „*adoratio crucis*”-szal és a bárányokkal, San Apollinare in Classe: elülső (a) és oldalsó (b, c) oldal

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Fig. 11.: The sarcophagus of Archbishop Felix, San Apollinare in Classe: front (a) and back (b) wall
11. ábra: Félix érsek szarkofágja, San Apollinare in Classe: elülső (a) és hátsó (b) fal

The manner of execution and the style of decoration show a distancing from the veristic representation, typical of the production of fifth-century sarcophagi, but we can nevertheless see a transition to early medieval artistic expression (cf. Gerke 1959c, 121). The typology of the front, on the other hand, is at first sight based on the early forms of the pagan architectural sarcophagi with *aediculae* of the 3rd century, produced in northern Italy, as we have seen also in the sarcophagus "a tre e quattro nicchie". In fact, this sarcophagus was probably a pagan one, reused for the burial of the Archbishop in 723. The iconography of the *adoratio crucis* on the front side is reminiscent of the older figurative compositions of Ravennate art, but is purely symbolic. In the central niche, closed by a tympanum, there is the theophany of the Cross, flanked by the Apostles Peter and Paul in the form of antithetic lambs. Above them are the crosses as the *Vexillum Christi*. In the side niches there are hanging crowns (wreaths), while on the sides there are candelabras with lit candles. (**Fig. 11a**). The motif of lighted candles on a tall candelabra can be found in several other examples from Ravenna, such as on the sides of the Barbatian sarcophagus in the Cathedral, on the lunette of the lid of the sarcophagus in front of the Basilica of San Francesco, and on the Ravennate type sarcophagus in Ostiglia (Sekavová 2006, 93). Light, *illuminatio*, is an important element in Christian art as it represents divinity, regeneration, and new life (J 1,3–5. J 5,35. Mt 5,14–16). Candles lit on Holy Saturday symbolize the resurrection, and candles used at baptism symbolize new life in Christ. The candles adorning the sarcophagus hold both a funeral and a luminous significance, symbolizing the light of resurrection.

The lid is also very simplified and flattened, reminiscent of earlier monumental fifth-century "a baule" lids. This is a reused older lid, originally with a gabled roof. The border of the lid is decorated with a knitted pattern and is adorned with a large Latin cross running the length of the lid and two smaller ones in a floral *clipaeum* (repeated on both sides of the lid), with the Greek letters AΩ suspended from the arms of both crosses and mirrored on each cross. A dedicatory inscription HIC TVMVLVS CLAVSVM SERVAT CORPVS DOMN FELICIS SCISSI AC TER BEATISS. ARCHIEPISCOPI is situated above the lid rim (Valenti-Zucchini & Bucci 1968, 57). The sides and back are without decoration (**Fig. 11b**).

The sarcophagus with the *adoratio crucis* with the antithetic lambs and the laurel wreath or "con agnelli e ghirlanda d'alloro" (**Fig. 2b.9**) is of the panel type with rather stylised angular pilasters with floral motifs and very schematic leaf-spoon capitals. It also belongs to the group of later sarcophagi already produced locally. The main scene on the front is in very deep relief, with two lambs and a laurel wreath with *lemniscae* in the center, surmounted by oak leaves – or stylized vine leaves as some authors have suggested (Lawrence 1970, 39; Valenti-Zucchini & Bucci 1968, 53–54). In the center of the wreath there is the Latin cross with the inner profilations and outstretched arms. Behind the bodies of the lambs there are stylized palm trees (**Fig. 12a**). The stylistic analysis of the sarcophagus led to its different datings, showing that the sarcophagus was used more than once or over a longer period of time: the lid and the front of the chest are dated to the first quarter or the end of the 6th century or even to the 7th century (first quarter of the 6th century: De Francovich 1959, 119–121; the end of the 6th century: Valenti-Zucchini & Bucci 1968, 53–54; 7th century: Lawrence 1970, 39; cf. also Godoli 1997, 25, n. 38). Lateral sides are dated to the 8th (for dating to the 8th century see Lawrence 1970, 39, when she compares the capitals and the floral ornament with *transennae* from the 8th century in Bobbio, Bologna, Neapol, and Rome) or 9th century (for the first half of the 9th century see De Francovich 1959, 119–121 and for the turn of the 8th and 9th centuries see Valenti-Zucchini & Bucci 1968, 53–54). The back is without decoration. Both sides are decorated

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Fig. 12.: The sarcophagus with *adoratio crucis* and the antithetic lambs, San Apollinare in Classe: front (a) and lateral (b, c) sides

12. ábra: A szarkofág az „*adoratio crucis*”-szal és a bárányokkal, San Apollinare in Classe: elülső (a) és oldalsó (b, c) oldal

in a similar manner (**Fig. 12b, c**): the composition field is divided by two arcades, the horseshoe arch of which is decorated inside with a pearl motif. The columns supporting the arches of the edicule are also decorated with a row of pearls. The arcades are filled with a dynamic spiral-flake motif, close to the Lombard style.

The lid of this sarcophagus is of the “a baule” type, made of a different type of marble from that of the chest, and it also has different dimensions, so it seems that the lid did not originally belong to the chest (as in the case of the sarcophagus of the Archbishop Felix) (De Francovich 1959, 120). The decoration of both, the lid and the front of the chest, is dated to the 6th or 7th century (De Francovich 1959, 119–121, Lawrence 1970, 39; Valenti-

Zucchini & Bucci 1968, 53–54); while the lateral sides are dated to the 8th–9th centuries (De Francovich 1959, 121; Lawrence 1970, 39). In the centre of the right lunette is a *kantharos* surrounded by floral tendrils. The lower edges are decorated with symmetrical lilies. The dominant decoration of the left lunette is a massive Latin cross with a central disc. The cross is in the form of a *crux patens*. Two lilies grow out of the lower corners, as in the right lunette. The scenes on the two lunettes are framed by a plastic border. On the back of the lid there is a *crux patens*. The style of the sarcophagus is based on the classical concept of the earlier Ravennate production and anticipates the characteristic expression of the early medieval art (schematization, ornamentation, stylization).

Sarcophagus with the cruciferous lambs (*agnelli cruciferi*) and a central monogram (**Fig. 2b.10**) is dated to the second quarter of the 8th century or to the beginning of the same century, but its lid of the more flattened "a baule" type, seems to be older than a chest, probably dated to the 6th century (Godoli 1997, 25, n. 37; Valenti-Zucchini & Bucci 1968, 57–58). The decoration of the lid consists of the iconography of antithetic peacocks on the sides of the *kantharos*. The relief of the vase and the peacocks is in poor condition. The back side and the two side lunettes are without decoration. The decoration of the chest is limited to the *adoratio crucis* of the rather schematic lambs carrying the crosses (**Fig. 13a**). In the center of the scene is a star-shaped monogram composed of the Greek cross and the Greek letter X, the initial of Christ's name. A similar monogram can be found on the triumphal arch of the presbytery of the Basilica of San Vitale in Ravenna, dating to the second quarter of the 6th century. The sides are without decoration (**Fig. 13b**).

Sarcophagus of the Archbishop Iohannis (**Fig. 2b.11**), dated to the 8th century, finds its closest analogue in the sarcophagus of the Archbishop Gratiosus and it is also reworked from

Fig. 13.: The sarcophagus with the cruciferous lambs, San Apollinare in Classe: front (a) and left lateral (b) side
13. ábra: A szarkofág a keresztes bárányokkal, San Apollinare in Classe: elülső (a) és bal oldali (b) oldal

Fig. 14.: The sarcophagus of the Archbishop IOHANNIS, San Apollinare in Classe: front (a) and right (b) side
14. ábra: IOHANNIS érsek szarkofágja, San Apollinare in Classe: elülső (a) és jobb (b) oldal

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a pagan sarcophagus (Valenti-Zucchini & Bucci 1968, 58). The decoration on the front (**Fig. 14a**) is divided into three panels in lower relief, bearing a purely symbolic, ornamental composition of three Latin crosses with elaborate spiral finials on the arms. Between two panels of higher relief, there is an inscription dedicated to the Archbishop Iohannis. The inscription is also *de facto* identical to that on the sarcophagus of Gratiosus, albeit in a different order:

†HIC TVMV	IOHANNIS
LVS CLAVSVM	SCISSIMI
SERVAT COR	AC TER BE
PVS DN	ATISS ARCHEP

The right side features the same decoration of the Latin cross (**Fig. 14b**), the left side and the back are without decoration. The lid of the "a baule" type is rather flattened, reworked from the original gabled roof lid. The lower part of the lid is decorated with a border with an interlaced motif, identical to that on the lid of the sarcophagus of Gratiosus. Only the right lunette is decorated with a Latin cross within the medallion. The original gabled form of the lid is evidenced by a profiled border on the lunette (**Fig. 14b**).

Methodology and sampling

Compared to other fields of archaeometry, such as ceramics or metals research, there is still very little research on the use of non-destructive methods to determine the provenance of marble (Careri et al. 1992, Tykot 2012, 2015, Herrmann et al. 2015). These methods are ideally preferable to those that require sampling, even if it is of limited size. In this study, we pursued the approach of obtaining as much information as possible *in situ* and non-destructively, thereby reducing the number and quantity of samples. In the course of the investigations macroscopic and microscopic properties were analyzed, the maximum grain size was determined, and the mineralogical and chemical composition was studied *in situ*. This was followed by the collection of drill dust samples using micro-diamond drills and the analysis of carbon and oxygen stable isotope ratios.

Macroscopical and microscopical description and determination of maximum grain size (MGS) of the marbles

During the initial inspection, the macroscopic and microscopic characteristics were recorded, such as color, texture, structure, homogeneity of the material, veins, inclusions, but also the odor when scratched or drilled. One of the most commonly used parameters in marble provenance analysis is the maximum grain size (MGS). However, until a few years ago, in most cases neither numerical results nor a description of the method used to determine this very important parameter were published on the subject. In recent years, some authors have published detailed results and statistical analyses of thin sections providing very good results (Attanasio et al. 2006; Cramer 2004; Csorba et al. 2015; Unterwurzacher et al. 2005; Morbidelli et al. 2007; Zöldföldi & Székely 2004, 2005; 2008; Székely & Zöldföldi 2009; Zöldföldi 2011). However, to conduct the analysis it is necessary to remove small fragments of a few cubic centimetres from the objects. This was avoided in the first phase of the project and the maximum grain size was determined using a watch loupe. It has a diameter of 25 mm and a 20 mm glass reticule that allows a clear view through the eyepiece and provides a magnification up to 10x. It is equipped with 8 LEDs that illuminate the field of view and the distance between the graduated glass retina and the magnifier is adjusted by turning the robust ring of the graduated magnifier so that a clearly focused image can be seen on the retina. The field of view is 25 mm, the graphic scale covers 20 mm, the minimum graduation of the scale is 0.1 mm and the light source is provided by 8 LEDs.

Raman spectroscopy

Raman spectroscopy is one of the most effective methods for determining the mineralogical phase composition of a sample using Raman scattering. In this spectroscopic technique, the sample is excited by a monochromatic light source, such as a laser, and the Raman shifts are recorded. Raman shifts are frequency shifts that occur when monochromatic light is scattered by a sample and produces a different frequency to that of the original light source. This allows the energy change of the photon to be determined, which corresponds to the energy difference between the fundamental state and the excited state. This creates a unique fingerprint that can be used to identify the mineralogical phases. This spectroscopic technique is becoming increaseingly popular in archaeometry and heritage conservation as it allows a sample to be analyzed non-invasively and its constituents identified. A major advantage of Raman spectroscopy is that it is a non-destructive method of analyzing samples without the need for sample preparation. In determining the origin of marble, one of the main questions is whether the marble is calcitic or dolomitic, or a mixture of both. A Metrohm MIRA XTR Raman spectroscope was used in this study. This uses a sensitive laser light with a wavelength of 785 nm and XTR algorithms to extract the Raman data from the sample fluorescence using advanced AI and machine learning. In addition, the MIRA XTR features Orbital Raster Scanning (ORS) technology to improve sample detection and increase the accuracy of results or avoid surface damage.

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Carbon and oxygen isotope analyses

The variation in the isotopic composition of carbon and oxygen in marble carbonates (i.e., mostly calcite, $CaCO_3$ and dolomite, $CaMg(CO_3)_2$) has a number of causes. These include the different ways in which the rock was formed; the isotopic composition of the water in contact with the carbonate minerals during their formation and subsequent history; the temperature at which metamorphism took place; and successive ageing processes. In other words, marble from a particular locality, formed by a unique geological history, will have isotopic characteristics that distinguish it from marble formed elsewhere with a very different geological history. It is also reasonable to assume that the same process that led to the formation of a particular type of marble has also caused it to become relatively homogeneous within a certain area. This is influenced by isotopic equilibrium during formation and metamorphism of the calcareous rocks by fluid phases. Both hypotheses have been shown to be correct and justify the use of the isotopic method (Herz 1985, Faure 1986). In this study, powder samples were taken using a diamond drill with a diameter of 1 to 3 mm, depending on the raw material of the investigated object. In order to prevent near-surface weathering or contamination from falsifying the stable isotopic geochemistry results, the near-surface layers were first removed using a diamond grinder before samples were taken for analysis.

In the laboratory, carbonate powders were reacted with 100 % phosphoric acid at 70 °C using a Gasbench II connected to a ThermoFisher Delta V Plus mass spectrometer. All values are expressed in parts per thousand relative to V-PDB. Reproducibility and accuracy were monitored by repeat analysis of laboratory standards calibrated by assigning a $\delta^{13}C$ of +1.95 ‰ to NBS19 and -47.3 ‰ to IAEACO9 and a $\delta^{18}O$ of -2.20‰ to NBS19 and -23.2 ‰ to NBS18. Reproducibility for $\delta^{13}C$ and $\delta^{18}O$ was ±0.0x and ±0.0y (1 std.dev.; see data file for values), respectively. Standard NBS 19 was also analyzed as a quality control sample.

Results

Macroscopic and microscopic description and determination of maximum grain size (MGS)

The macroscopic and microscopic description of the objects examined is summarized **Table 1 in Appendix**. Macroscopically, the Ravenna marble can be roughly divided into two groups: the first is a white-grey, homogeneous but heteroblastic marble with typical long dark grey bands and a grain size of about 2 mm, with the darker bands tending to be of a smaller grain size. The other group is a more white, homogeneous, often spotted, coarse-grained variety with a maximum grain size of about 3mm. No fine-grained marble (i.e., <0.8(?)mm, Attanasio et al. 2006) has been found, so quarries such as Carrara can be ruled out.

The box-plot diagram in **Fig. 15.** shows the results for the maximum grain sizes. The background diagram contains a comparison of several thousand results from the MissMarble database (Zöldföldi et al. 2011). According to this, group 1 (green rectangle) with an MGS of about 2 mm can be assigned to the quarries of Proconnesos, Paros, Aphrodisias, Ephesos, possibly Miletus, while group 2 (blue rectangle) with larger MGS can be assigned to the quarries of Thassos, possibly Paros, Naxos and Thiountas.

Raman spectroscopy

In order to clarify the mineralogical composition, Raman spectroscopic analyses were carried out in situ at several points on the surface of the sarcophagi. The Raman spectroscopy analyses showed that all the sarcophagi are composed of calcitic marble (**Fig. 16.**, Raman peaks for calcite are 1087, 713 and 1436 cm^{-1}). In many sarcophagi the white and grey areas were compared. In some sarcophagi, dolomite (**Figs. 17-18.**; Raman peaks 1098 and 719 cm^{-1}) was found in addition to calcite, almost exclusively in the grey areas. Gypsum was also identified in some of the measurements (**Fig. 19.**, Raman peak at 1008 cm^{-1}). This indicates a surface transformation from calcite ($CaCO_3$) to gypsum ($Ca_2SO_4{\cdot}2H_2O$) due to the effect of an external sulphate source. Since the sarcophagi are located in protected indoor spaces, the cause of the transformation is mainly due to the use of candles in the basilica, since many (especially older) candles with a high sulfur content produce sulfur dioxide (SO_2) when they burn, which forms gypsum ($Ca_2SO_4{\cdot}2H_2O$) with the calcite ($CaCO_3$) on the surface of the marble.

Determination of $\delta^{13}C$ and $\delta^{18}O$ stable isotope ratios

As far as isotopic data are concerned, the increasing number of analyses of ancient and modern marble quarries that have appeared in literature in recent years testifies to the great popularity of this technique in archaeometric research. Paradoxically, the large amount of data available has led to an extremely complex overall picture; indeed, in an overall diagram of $\delta^{13}C$ versus $\delta^{18}O$, the fields characterizing each quarry overlap considerably, making the use of this method of investigation problematic, if not impossible (**Fig. 20.**). For this reason, these diagrams are rather used to confirm or deny the origin of possible quarries selected according to other criteria. Nevertheless, it is an important criterion because the methodology is standardized, little material is required and many

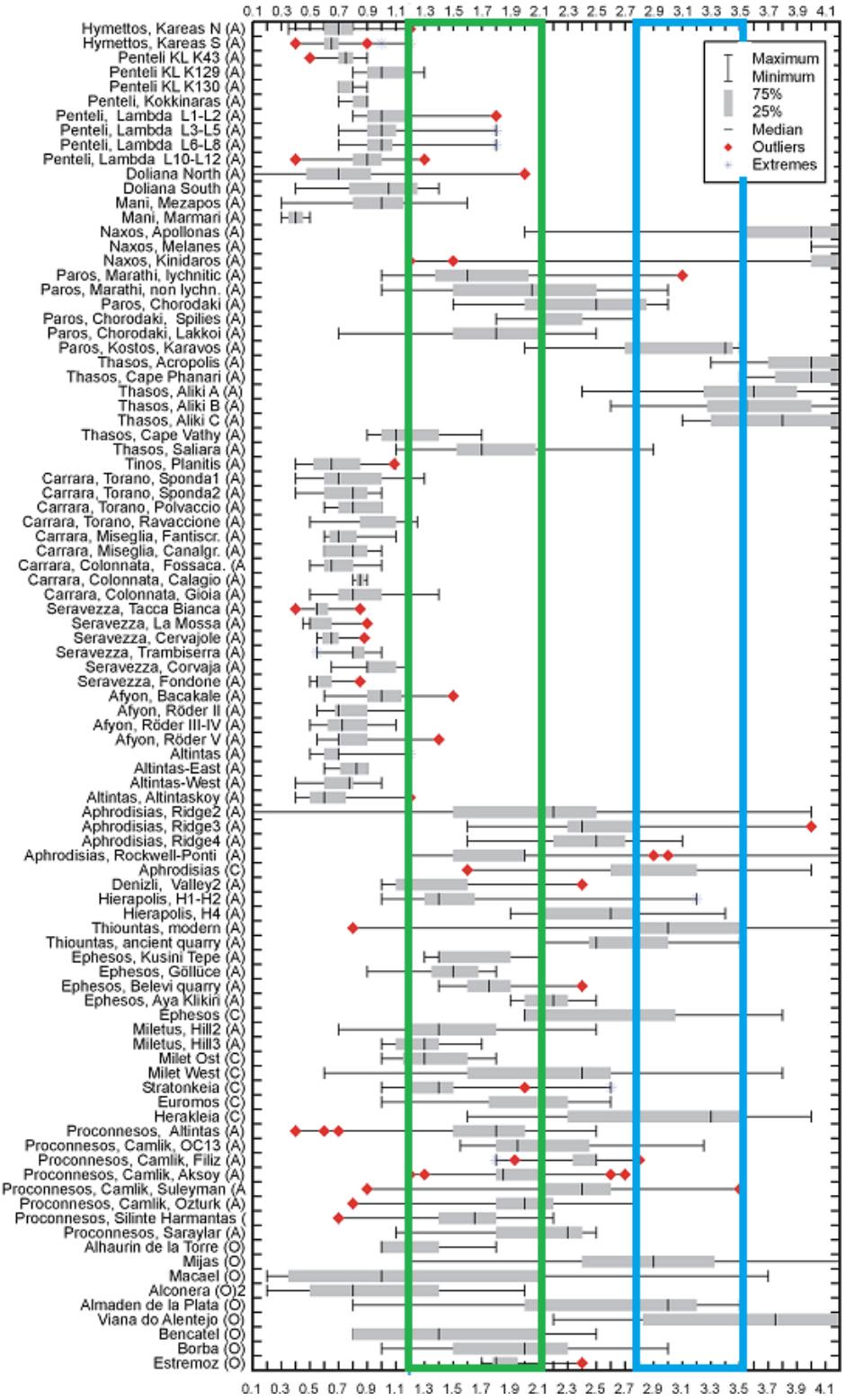

Fig. 15.: Boxplot showing the results for the maximum grain sizes. Group 1 with an MGS of about 1.2 to 2 mm (green rectangle) and group 2 with an MGS of about 2.8 to 3.7 mm (blue rectangle). The background plot contains a comparison of several thousand results from the MissMarble database (Attanasio et al. 2006; Cramer 2004; Zöldföldi 2011).

15. ábra: A maximális szemcseméreteket bemutató dobozdiagram. Az 1. csoport körülbelül 1,2–2 mm-es MGS-sel (zöld téglalap) és a 2. csoport körülbelül 2,8–3,7 mm-es MGS-sel (kék téglalap). A háttérdiagram a MissMarble adatbázis több ezer eredményének összehasonlítását tartalmazza (Attanasio et al. 2006; Cramer 2004; Zöldföldi 2011)

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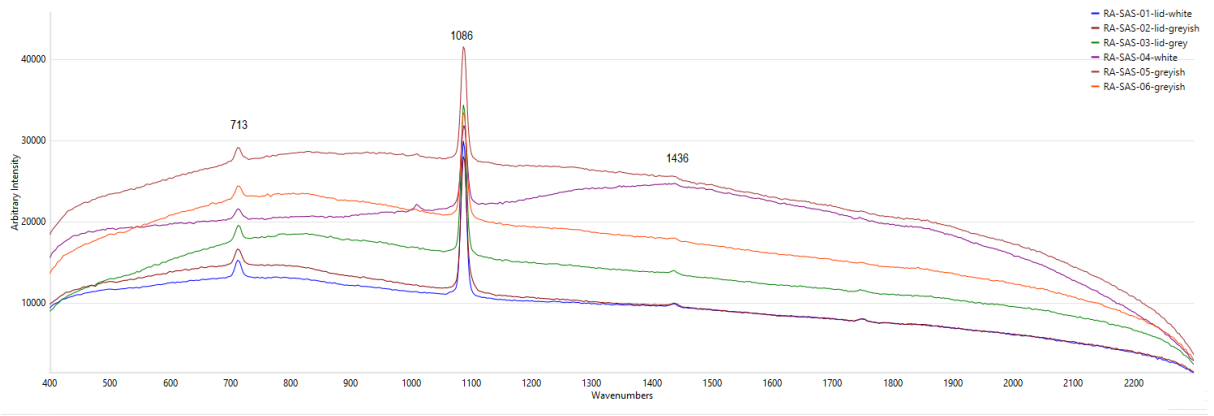

Fig. 16.: Raman spectra of several sarcophagi with calcite (1087, 713 and 1436 cm^{-1}) as the main mineral

16. ábra: A kalcitot (1087, 713 és 1436 cm^{-1}) fő kőzetalkotó ásványként tartalmazó szarkofágok Raman spektruma

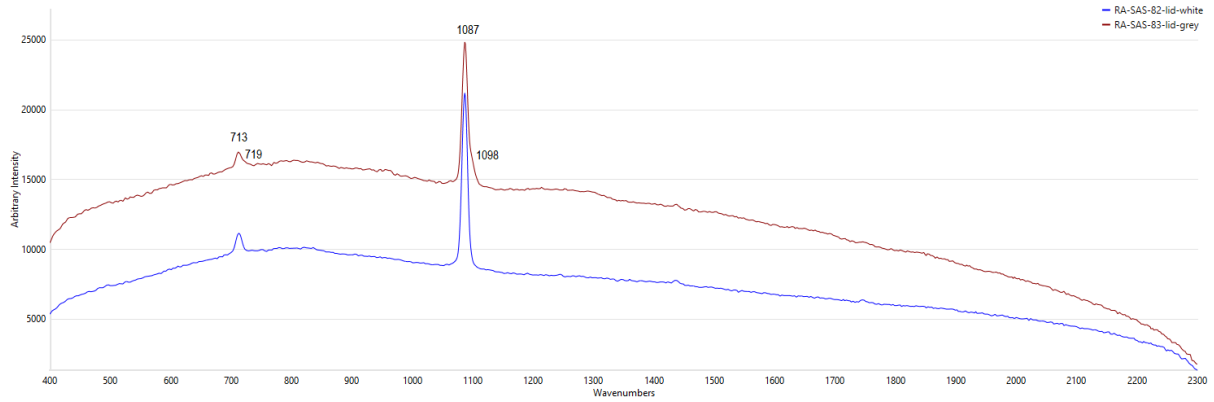

Fig. 17.: Raman spectra from the lid of the sarcophagus #11, sarcophagus of Iohannis, with calcite (1087, 713, 1436 cm^{-1}) as the main mineral and dolomite (1098 and 719 cm^{-1}) as the accessory mineral in the grey part

17. ábra: Raman spektrumok a 11. számú szarkofág, Iohannis szarkofágjának fedeléről, a szürke részen a kalcit (1087, 713, 1436 cm^{-1}) mint fő és a dolomit (1098 és 719 cm^{-1}) mint járulékos kőzetalkotó ásvány jelenik meg

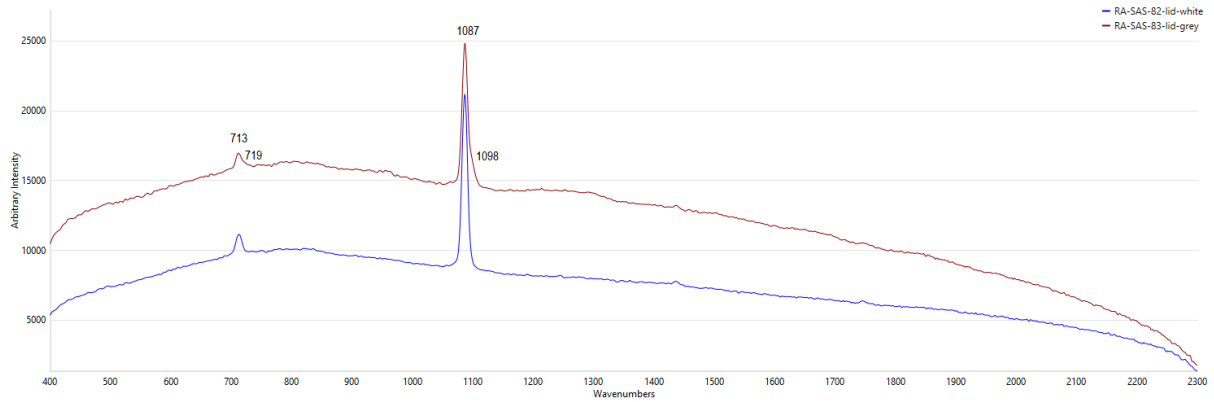

Fig. 18.: Raman spectra from the lid of the sarcophagus #10, with the cruciferous lambs (“agnelli cruciferi”), with calcite (1087, 713 cm^{-1}) as the main mineral and dolomite (1098 cm^{-1}) as the accessory mineral in the grey part

18. ábra: Raman spektrumok a 10. szarkofág fedeléről, a keresztes bárányokkal („agnelli cruciferi”), a szürke részen a kalcit (1087, 713 cm^{-1}) mint fő és a dolomit (1098 cm^{-1}) mint járulékos kőzetalkotó ásvány jelenik meg

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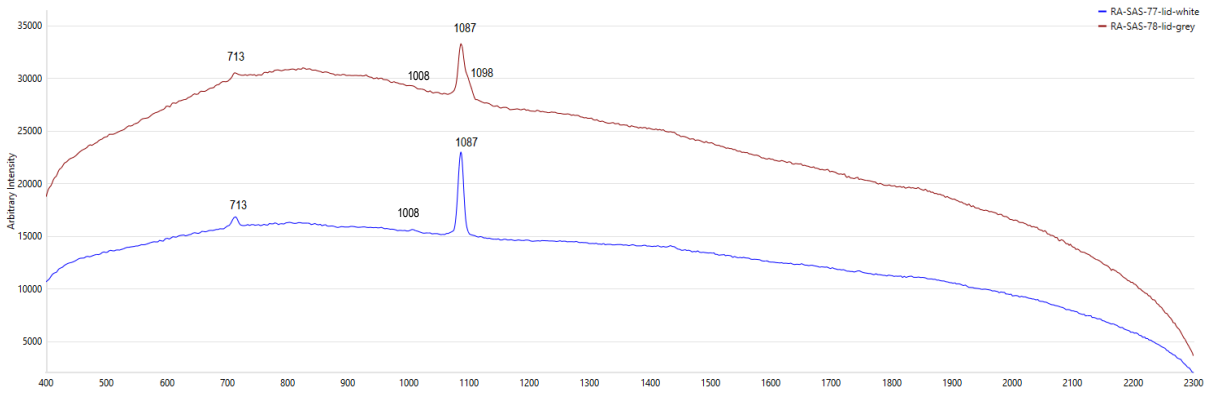

Fig. 19.: Raman spectra of various sarcophagi, with calcite (1087, 713 and 1436 cm^{-1}) as the main mineral and gypsum (1008 cm^{-1}) as a weathering product

19. ábra: A kalcitot (1087, 713 és 1436 cm^{-1}) fő kőzetalkotó ásványként és a gipszet (1008 cm^{-1}) felületi átalakulási termékként tartalmazó szarkofágok Raman spektruma

thousands of data are available (e.g. Herz 1985, Attanasio et al. 2006, Zöldföldi et al. 2011).

Based on the results, the stable isotope compositions of the raw material of the sarcophagi overlap with the isotope signals of following quarries: Thassos and Paros (Greece, **Fig. 20.**), Proconnesos, Miletus, Muğla, Altintas, possibly Hierapolis (Asia Minor, modern Turkey, **Figs. 21-22.**). Based on the stable isotopes, Carrara/Serravezza could also be considered as a possible source (**Fig. 23.**), but this can be excluded due to the different grain sizes mentioned above. Four samples (11, 18, 19, and 27) are outside of these isotopic ranges, therefore, these values are checked first and the samples are analyzed further, possibly using samples from a second sampling or by determining the $^{87}Sr/^{86}Sr$ isotope ratios, thin section microscopy, and cathodoluminescence analysis, in order to get more insights into their provenance.

To answer the provenance question and get more reliable information of the isotopic and MGS results, 3D diagrams were constructed. The trivariate assignment methods using isotopic signatures (MGS, $\delta^{13}C$ and $\delta^{18}O$) of Anatolian, Greek and other known marbles was used in this study to establish their provenance among of bivariate plots ($\delta^{13}C$, $\delta^{18}O$). Comparing the two methods, the trivariate method allows a better selectivity and a much more secure assignment of provenance. The major difficulty of the trivariate method is the scarcity of data in literature, where all three values are published on the very same sample. Significant differences can be observed using the 3D diagrams (MGS, $\delta^{13}C$ and $\delta^{18}O$) of the marbles in the Eastern Mediterranean Region (**Fig. 24.**). As **Fig. 25.** clearly shows, samples 7 and 8 can very probably be assigned to the so-called non-lychnitic marble quarries on the island of Paros. Furthermore, with the help of the 3D diagrams, samples can be clearly assigned to the marble quarries on the islands of Marmara and Thasos (**Fig. 26.**).

Conclusion

The provenance of the marble of eleven sarcophagi now in the basilica of San Apollinare in Classe near Ravenna was analyzed. The non-destructive investigations (macroscopic and microscopic description, determination of grain size analyses and mineralogical investigations by the means of Raman spectroscopy), combined with minimally invasive sampling and the determination of stable isotopes, have led to the following results.

The results of the analyses suggested that the majority of the chests (8 out of a total of 11) were very probably made of Proconnesian marble, two were probably made of Paros marble and one was probably from the quarry in Denizli although this has to be confirmed by further analyses. As far as the lids of the sarcophagi are concerned, the dominance of Proconnesian marble is not as obvious as in the case of the chests: only four lids have been reliably identified as being made of Proconnesian marble, while the other three lids are made of Thassian marble and only two lids are made of Paros marble. Two lids can be identified as coming from the quarries of Marmara Island (Proconnesos) or from Thassos. However, as these two kinds of marble belong to the same geological unit, further investigations are required based on $^{87}Sr/^{86}Sr$ isotope ratios, thin section preparation, statistical grain size distribution analysis and cathodoluminescence observations will confirm one of the proposed provenances.

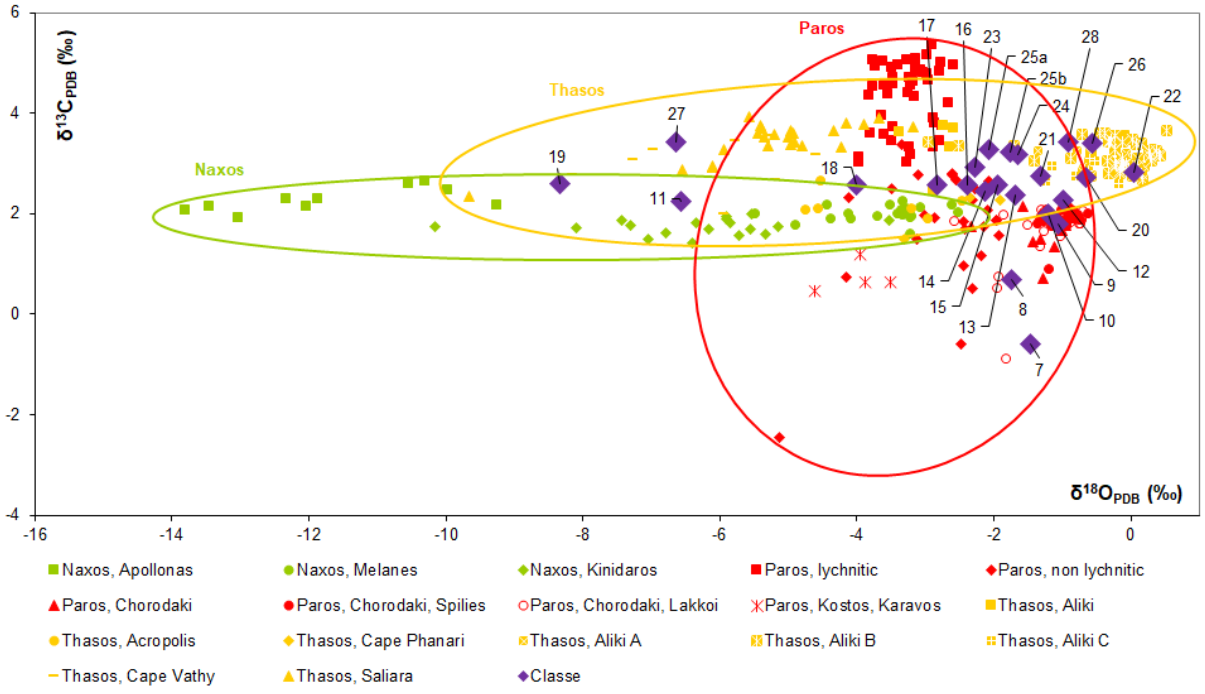

Fig. 20.: Data set of $\delta^{13}C$ versus $\delta^{18}O$ isotopic compositions (in ‰, relative to PDB) from the sarcophagi in San Apollinare in Classe compared with the data set of middle to coarse grained (MGS>1.5 mm) marble from Greece

20. ábra: A San Apollinare in Classe-i szarkofágok $\delta^{13}C$ és $\delta^{18}O$ izotópos összetételének adatai (‰-ben, a PDB-hez viszonyítva), összehasonlítva a Görögországból származó közepes és durva szemcséjű (MGS>1,5 mm) márványok adathalmazával

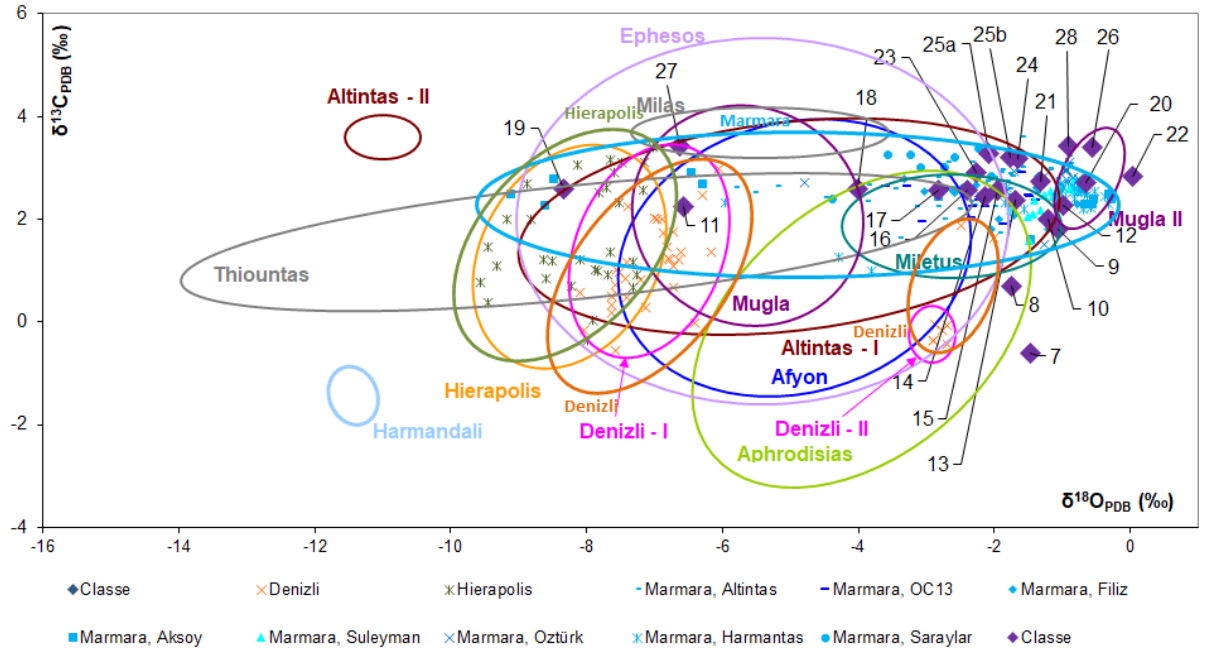

Fig. 21.: Data set of $\delta^{13}C$ vs. $\delta^{18}O$ isotopic compositions (in ‰, relative to PDB) from the sarcophagi in San Apollinare in Classe compared with the data set of middle to coarse grained (MGS<1.5 mm) marble from *Asia Minor*

21. ábra: A San Apollinare in Classe-i szarkofágok $\delta^{13}C$ és $\delta^{18}O$ izotópos összetételének adatai (‰-ben, a PDB-hez viszonyítva), összehasonlítva a Kis-Ázsiából származó, közép- és durva szemcsés (MGS<1,5 mm) márványok adathalmazával

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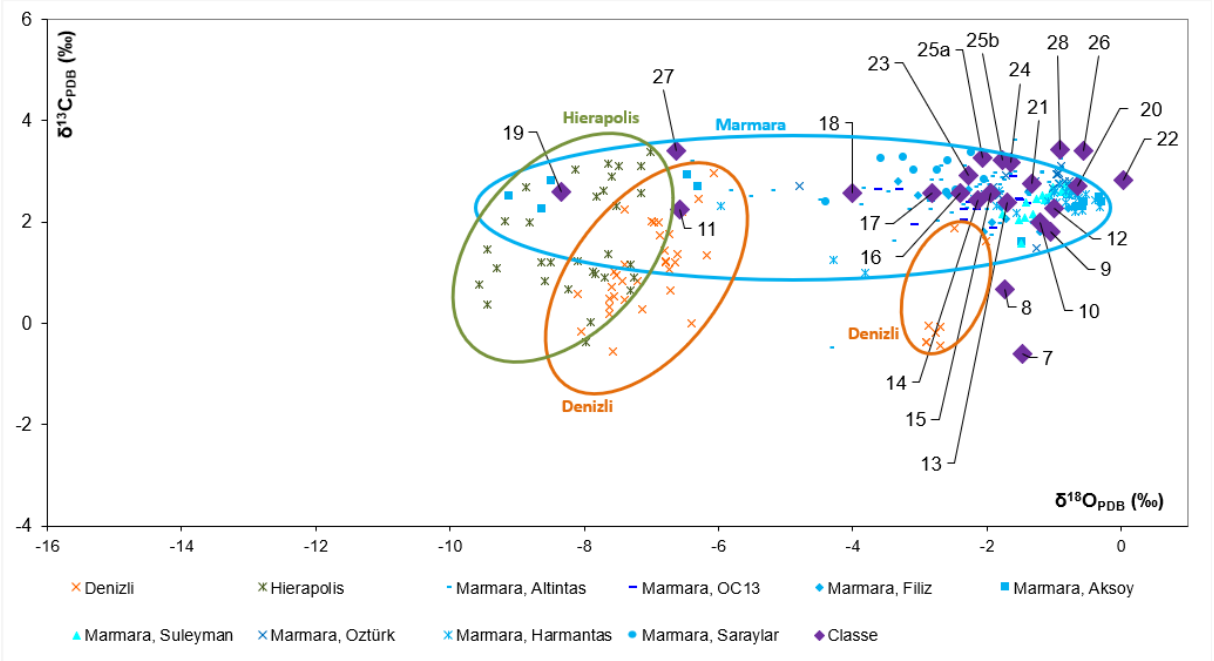

Fig. 22.: Data set of $\delta^{13}C$ vs. $\delta^{18}O$ isotopic compositions (in ‰, relative to PDB) from the sarcophagi in San Apollinare in Classe compared with the data set of selected middle to coarse grained (MGS<1.5 mm) marble from *Asia Minor*

22. ábra: A San Apollinare in Classe-i szarkofágok $\delta^{13}C$ és $\delta^{18}O$ izotópos összetételének adatai (‰-ben, a PDB-hez viszonyítva), összehasonlítva néhány Kis-Ázsiából származó, közép- és durva szemcsés (MGS<1,5 mm) márvány adathalmazával

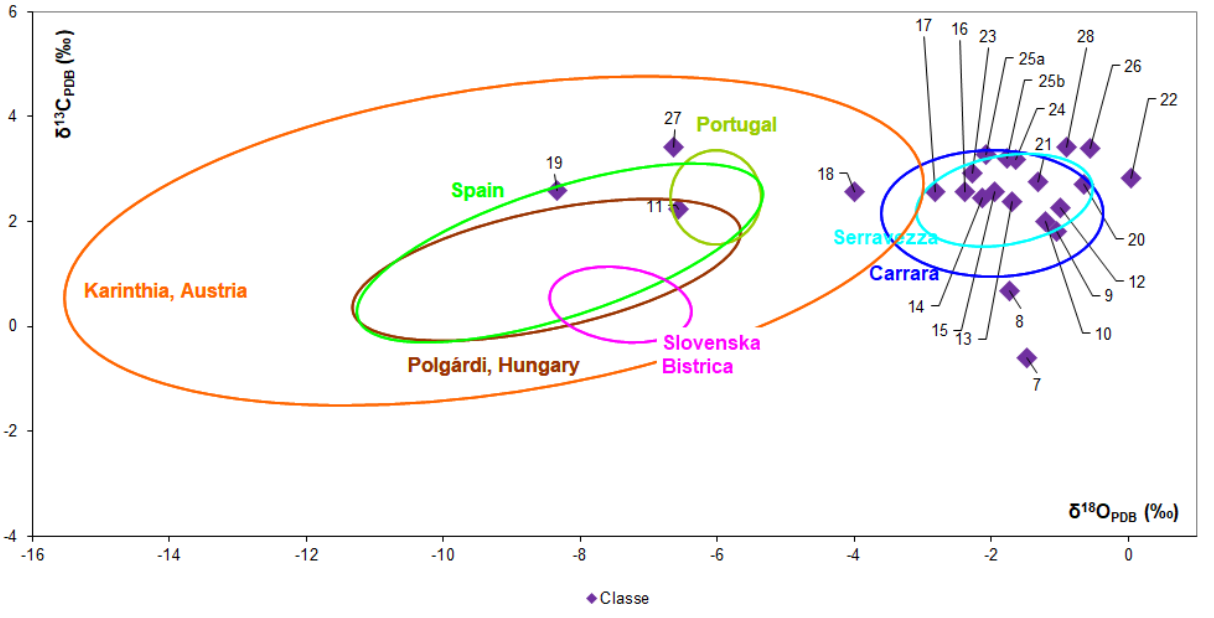

Fig. 23.: Data set of $\delta^{13}C$ vs. $\delta^{18}O$ isotopic compositions (in ‰, relative to PDB) from the sarcophagi in San Apollinare in Classe compared with the data set of middle to coarse grained (MGS<1.5 mm) marble from Europe

23. ábra: A San Apollinare in Classe-i szarkofágok $\delta^{13}C$ és $\delta^{18}O$ izotópos összetételének adatai (‰-ben, a PDB-hez viszonyítva), összehasonlítva az európai közép- és durvaszemcsés (MGS<1,5 mm) márványok adathalmazával

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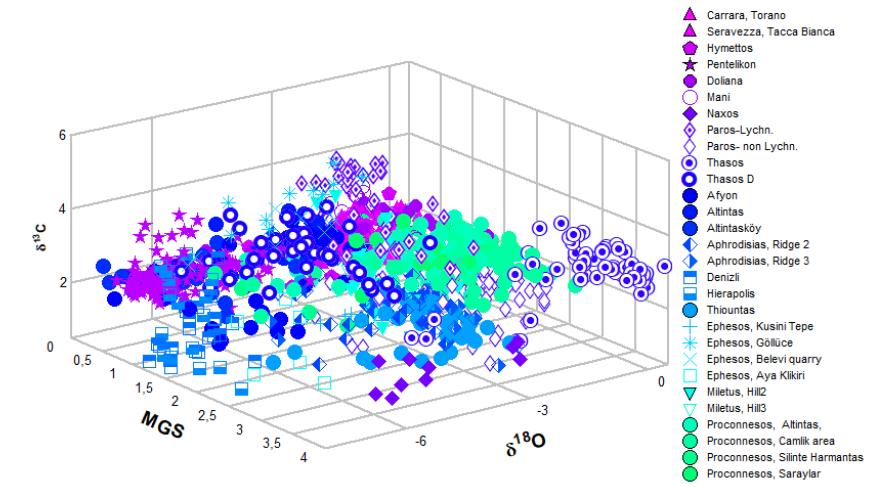

Fig. 24.: 3D plots (MGS, $\delta^{13}C$ and $\delta^{18}O$) of marbles from the Eastern Mediterranean area

24. ábra: A Földközi-tenger keleti térségéből származó márványok 3D diagramja (MGS, $\delta^{13}C$ és $\delta^{18}O$)

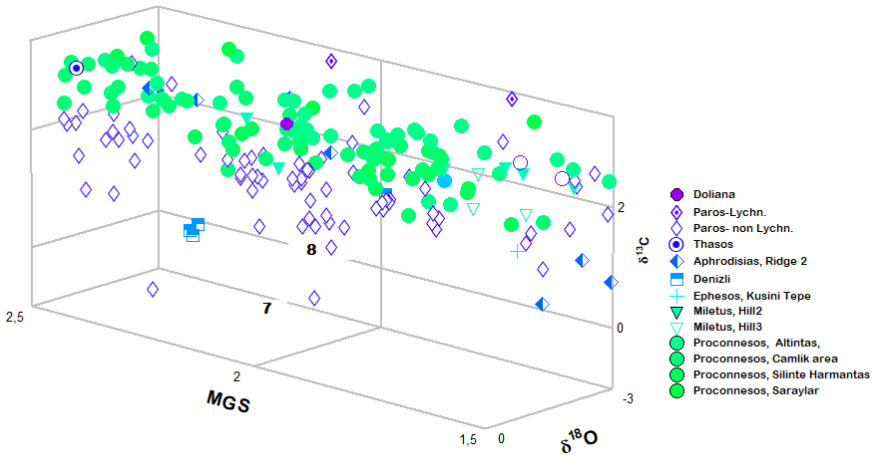

Fig. 25.: Comparative 3D diagram (MGS, $\delta^{13}C$ and $\delta^{18}O$) of samples 7 and 8 with the marble quarries of the eastern Mediterranean

25. ábra: A 7. és 8. minta, valamint a Földközi-tenger keleti részén található márvány-bányák összehasonlító 3D diagramja (MGS, $\delta^{13}C$ és $\delta^{18}O$)

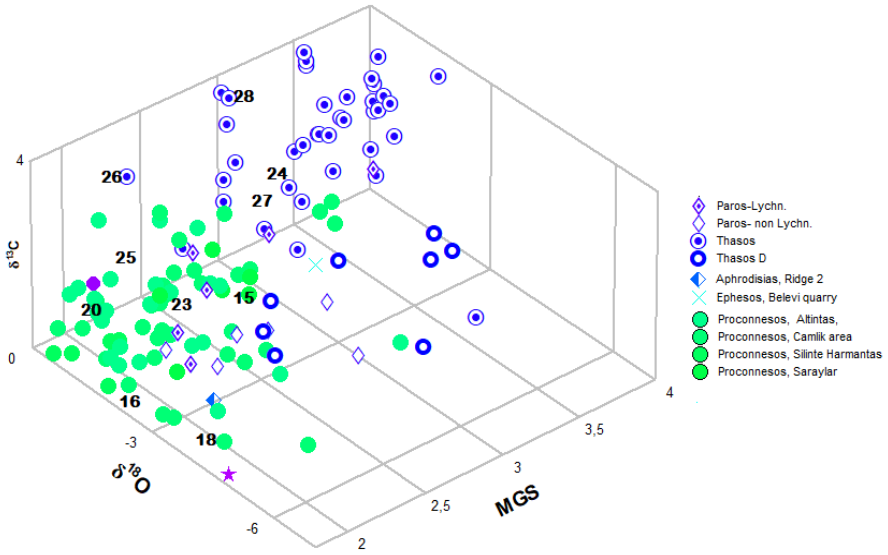

Fig 26.: Comparative 3D diagram (MGS, $\delta^{13}C$ and $\delta^{18}O$) of several sarcophagi from the Basilica of San Apollinare in Classe and the marble quarries of the Eastern Mediterranean

26. ábra: A San Apollinare in Classe bazilikából származó számos szarkofág és a Földközi-tenger keleti részén található márványbányák összehasonlító 3D diagramja (MGS, $\delta^{13}C$ és $\delta^{18}O$)

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On the basis of these analyses, it seems that in addition to the famous and widely used marble from Proconnesos, the calcitic marble from Thassos was also used in the northern Adriatic region in Late Antiquity. Even the quarries on the island of Paros and those in *Asia Minor* cannot be definitively ruled out. Future large-scale studies in Ravenna and other sites in the northern Adriatic are needed to continue to build a more complete picture of marble provenance and trade networks, but it is already possible to confirm that, in addition to the famous Proconnese marble, more types of white or white-greyish marble were present in the Ravennate region.

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Contribution of authors

Helena Tůmová Conceptualization, Investigation, Writing – Original text. **Zöldföldi Judit** Formal analysis, Investigation, Writing – Original text. **Enrico Cirelli** Supervision, Data curation, Resources.

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DENDROCHRONOLOGICAL STUDY OF WOODEN CONSTRUCTIONS UNEARTHED FROM A SUBALPINE PEAT BOG FROM MARAMUREŞ MTS., ROMANIA

DENDROKRONOLÓGIAI VIZSGÁLATOK A MÁRAMAROSI-HAVASOK (ROMÁNIA) TERÜLETÉN ELHELYEZKEDŐ SZUBALPESI TŐZEGLÁPBÓL ELŐKERÜLT ÁCSOLT FASZERKEZETEKEN •

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Abstract

Two simple wooden constructions were found in a peat bog, called 'Vinderel 3', located in the Maramureş Mts. (Romania). They were constructed from spruce timber and a 67-year-long floating chronology, called MM8, was developed using the cross-dated tree-ring width series of six samples. An AMS ^{14}C age dates the wood and provides target intervals for dendrochronological cross-dating to the late-18th century and the mid-17th century. Running statistics with the nearby reference chronologies peaked at 1664 CE, suggesting the possible felling date of the timber contributing to MM8. The wooden constructions were likely built soon after the felling date in the early second half of the 17th century CE. We think that the timbered constructions can be installed at the edge of the former lake, on the one hand, to protect the lakeshore from trampling, on the other hand, to protect the drinking livestock from slipping to the swampy peat bog. These wooden constructions, with their inferred likely date to the mid-17th century CE provided the earliest material evidence for the agropastoral activity in the subalpine zone of the Maramureş Mts.

Kivonat

Két egyszerű, lucfenyőből készített faszerkezet került elő a Máramarosi-havasokban (Románia) található "Vinderel 3" nevű tőzeglápból. Az évgyűrűszélesség mintázatok szinkronizálásával hat adatsorból egy 69 évet lefedő átlagos évgyűrűszélesség kronológiát (kódjele: MM8) lehetett létrehozni. Egy AMS ^{14}C adat faanyagot a 18. század végére és a 17. század közepére keltezi, és célintervallumokat biztosít a környező területekről rendelkezésre álló luc referencia-kronológiákkal végrehajtott dendrokronológiai keltezéshez. A közeli referencia-kronológiákkal futóablakban számított t-statisztika a csúcsot Kr. u. 1664-ben érte el, ami a faszerkezetekhez kivágott faanyag lehetséges kivágási időpontját sugallja. A faépítményeket valószínűleg nem sokkal a fák kivágása után, a 17. század második felében készíthették. Úgy gondoljuk, hogy az ácsolt

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faszerkezeteket az egykori tó szélén állíthatták fel, egyrészt a tópart védelmére a taposástól, másrészt annak érdekében, hogy megelőzzék, hogy az ivó állatok a mocsaras tőzeglápba csússzanak. Ezek az ácsolt faszerkezetek, amelyek valószínűsíthetően a Kr. u. 17. század közepére datálhatók, a Máramarosi-havasok szubalpin zónájában folytatott legeltető állattartás legkorábbi tárgyi bizonyítékai.

KEYWORDS: TREE RING, RADIOCARBON, ARCHAEOLOGY, CARPATHIANS, EARLY MODERN AGE

KULCSSZAVAK: ÉVGYŰRŰ, RADIOKARBON, RÉGÉSZET, KÁRPÁTOK, KORA ÚJKOR

Introduction

Wood is an essential raw material used for artefacts and construction for almost half a million years (Barham et al. 2023). Wooden tools for foraging and hunting appeared since ~400 ka in Europe (Aranguren et al. 2018, Thieme 1997). Owing to the environmental conditions, wood is widely used in the material culture of subalpine pastoralism in Europe. Mountain people used wood in the construction of both buildings and tools for everyday usage.

Archaeological research of the alpine/subalpine belt of the Carpathians provided evidence for long-lasting human activity at the high-elevation lands (Andronic & Niculică 2012, Bobînă 2015, Dragoman et al. 2018). The history of alpine/subalpine grazing and its impact on mountain vegetation has been reconstructed in recent decades in the Romanian Carpathians based on information mainly derived from documentary, ethnoarchaeological, and palaeoecological data but direct archaeological material evidence is rare. The documentary evidence of pastoralism in the Romanian Carpathians dates to the 13th century (Idu 1999). However, palaeoecological data (e.g., Feurdean & Willis 2008, Tanţău et al. 2003, Jakab et al. 2023) indicated the appearance of seasonal grazing at high elevation much earlier than the written sources indicate. For instance, alpine grazing on naturally open meadows in the Retezat Mts. (South Carpathians) was very likely as early as 4200 years ago (Vincze et al. 2017). Based on the sedimentary records of two subalpine lakes, (Lake Gropile in the Rodna Mts. and Lake Vinderelu in the Maramureș Mts.) anthropogenic impact became evident 2800 years ago the Eastern Carpathians, when landscape openness, pasturing, and disturbance of soil cover increased and intensified over the last four centuries (Florescu et al. 2024).

One of the last European colonization that affected a nearly intact landscape was the Wallachian colonization of the mountainous parts of the Carpathians by shepherds starting in the 12th to 13th century in the Southern Carpathians (contemporary Romania) and reaching the Western Carpathians during the 16th to 17th century (Štika 2007, Kłapyta 2013, Wistuba et al. 2018).

Ethnoarchaeological (Maxim 1988-1991) sources support the multi-centennial tradition of alpine grazing in the Romanian Carpathians. However, accurate dating of sporadic settlement remains, exploring the historical dimensions of population movements (e.g., the presence or absence of shepherding in pre-medieval and early modern times) suggested by the finds (Bartosiewicz & Greenfield 1999) is necessary.

Dendrochronological analysis of the wooden constructions proved to be an effective tool for evaluating the settlement and building history in many European mountain regions (Büntgen et al. 2006, Opala & Kaczka 2007, Shindo & Giraud 2021). Dendrochronological analysis of abandoned shepherds' buildings in the Polish High Tatras showed that the oldest preserved constructions date back to the 18th century providing direct evidence for the ~250-yr-long tradition of pastoral activity in that particular region (Opala & Kaczka 2007).

This paper presents wooden constructions providing direct material evidence (pastoral wooden structure) of subalpine agropastoral activity in the early modern times in the Maramureș Mts. (Eastern Carpathians). Dendrochronological and radiocarbon data are evaluated to date the timber, estimate the construction period, and infer implications about the agropastoral activity in the subalpine zone of the Maramureș Mts.

Material and methods

Site description and the stratigraphic context of the wooden construction

The study site (1530 m a.s.l., N47°54'11", E24°26'37") was a peat bog, called 'Vinderel 3', located in the Farcău Massif, Maramureș Mts. (Romania). Peat deposits were formed in a landslide concavity ('slope pocket') on the western slope of the Farcău Massif (**Fig. 1**). Currently, the peat bog is surrounded by entirely treeless subalpine pastures (**Fig. 1**) and based on cartographic evidence (Jankó 2007) the study site had been deforested at least since 1859 CE (Árvai et al. 2016).

Subfossil logs were found in large quantities in the peat deposit (Árvai et al. 2016) and seven floating synchronized sets of tree-ring width series, coded from MM1 to MM7, were created from the collect-

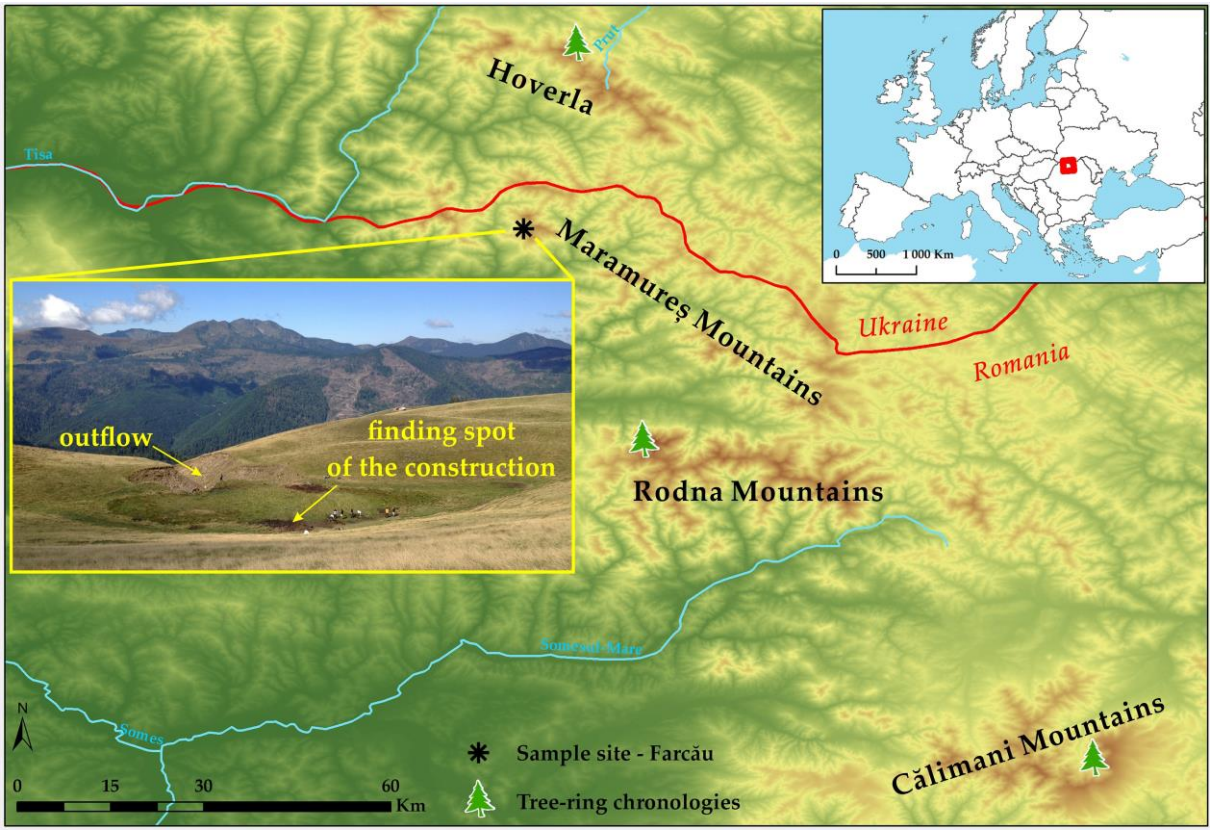

Fig. 1.: Location of the study area. The location of 'Vinderel 3' peat bog is indicated by asterisk on the digital terrain model, while red rectangle in the inset map shows the area zoomed in the main map within Europe. The location of the spruce chronologies available from nearby ranges and used as reference in crossdating trials are marked by the tree symbols. The site photo illustrates the currently treeless surroundings of the peatbog and the position of the outflow of the peatbog and the finding spot of the timbered constructions.

1. ábra: A kutatási terület elhelyezkedése. A "Vinderel 3" tőzegláp helyét csillag jelzi a digitális terepmodellben, míg a kinagyított területet Európán belüli elhelyezkedését a piros téglalap jelöli. A szomszédos hegységekből rendelkezésre álló és a dendrokronológiai szinkronizálási kísérletek során referenciaként használt lucfenyő kronológiák helyét a fenyő szimbólumok jelölik. A helyszíni fotó a tőzegláp jelenleg fátlan környezetét, valamint a tőzegláp kifolyójának és a vizsgált faépítmények lelőhelyét szemlélteti.

ed samples spanning from 47 to 259 years and dated between the 3rd and 11th centuries AD by the aid of ^{14}C analysis (Árvai 2019).

Beside the subfossil logs, two wooden constructions were also excavated from the peat bog between the 3rd and 8th of September 2013. The wooden structures are situated at a relatively shallower depth in the peat deposit compared to the usual occurrence of the subfossil logs. Their finding spot was situated principally opposite the outflow point of the peat bog (**Fig. 1**). Traces of human wood processing were clearly recognizable on the timber structures (**Fig. 2**). The smaller elements were longitudinally halved stakes which were fixed without the use of nails or stables in axe-carved grooves. Cross sections were sawn from three larger logs and three smaller stakes (**Fig. 2**, **Table 1**). Important to note that bark remains were observed on one of the larger elements (MUR032).

The archaeological value of the wooden structures could not be determined, and as their transportation was logistically unsolvable, we placed them back to their original location after sampling. They can be found based on the accurate coordinates above, if further inspection is needed or interesting. This approach agrees with international calls for in situ preservation of dendroarchaeological samples (Creasman 2012).

Xylological and dendrochronological analysis

Cross sections of the dried samples were mechanically sanded with successively finer wood abrasives to expose ring details to the cellular level (Stokes and Smiley 1968) following the sample preparation protocol of the Budapest Tree-Ring Laboratory (Kern et al. 2024). Based on the basic macroscopic xylological features, such as the texture of the tracheids and the earlywood-latewood transition, the samples belonged to the same

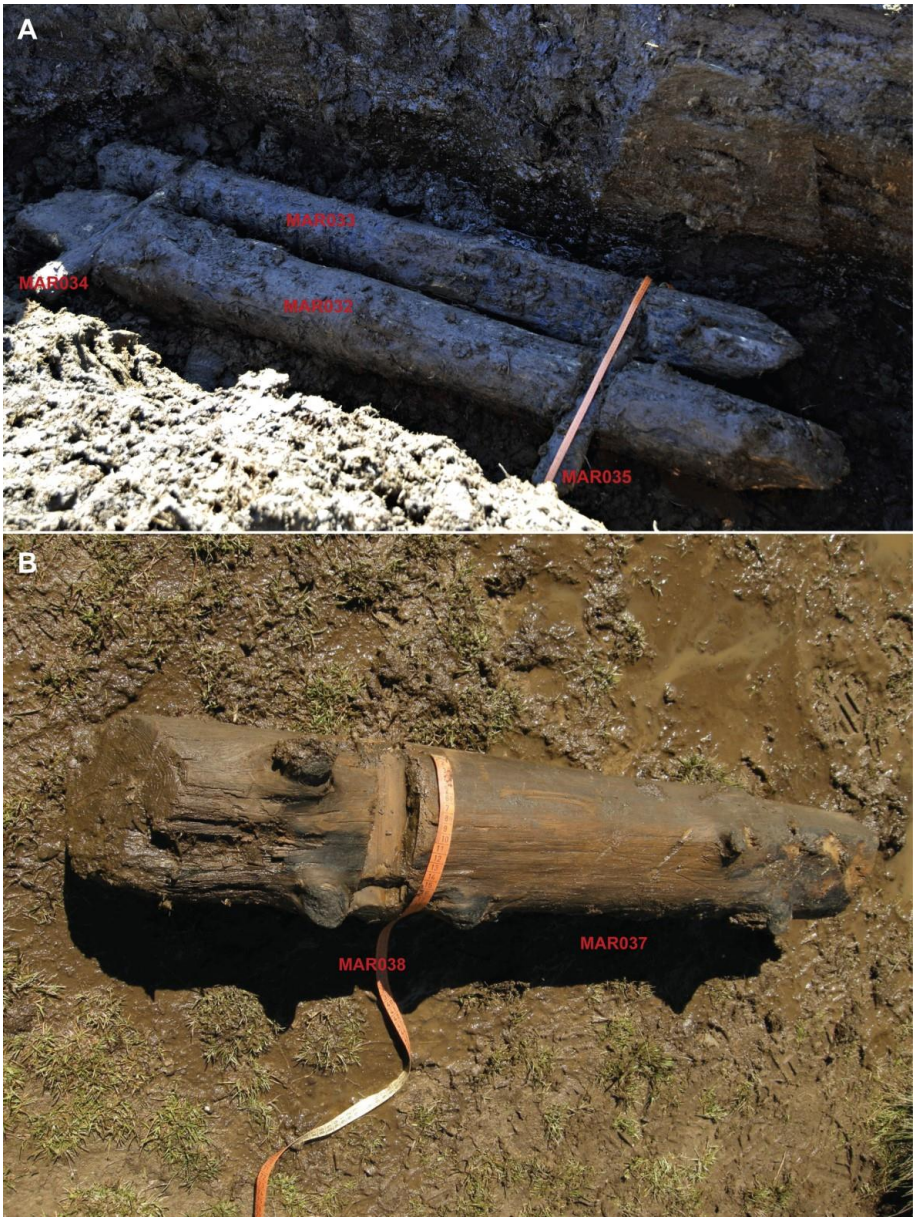

Fig. 2.: Timbered constructions excavated from 'Vinderel 3' peat bog (Maramures Mts., Romania). A: two larger logs fixed parallel along their longitudinal axes with halved stakes. B: A single log with a similarly inserted halved stake fragment.

2. ábra: A 'Vinderel 3' tőzeglápból (Várkő, Máramarosi-havasok, Románia) 2013 szeptemberében kiemelt faszerkezetek. A: két nagyobb rönk, amelyeket hossztengelyük mentén párhuzamosan rögzítettek felezett karókkal. B: egyedi rönk, hasonlóan behelyezett felezett karó töredékével.

Table 1: Synchronized positions and corresponding dendrochronological statistics of the mean annual ring-width chronology of the samples collected from two timbered structures found in the Maramures Mts. and calculated using.

1. táblázat: A Máramarosi-havasokban talált ácsolt faszerkezetekből gyűjtött minták szinkronizált pozíciója és az átlagos évgyűrűszélesség-kronológiával számított dendrokronológiai statisztikák.

Sample code	Position in the synchronized dataset	Crossdating to the mean ring-width chronology	
	First ring / last ring	GLK%	t_{BP}
MAR032	23/67	66 *	4.4
MAR033	1/66	81 ***	12.4
MAR034	37/67	68 *	4.3
MAR035	37/63	75 **	3.4
MAR037	29/67	80 ***	7.2
MAR038	40/67	80 ***	3.8

Probability level accompanied with GLK% is indicated by asterisks as follows: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

species, so MAR032 was selected for detailed wood anatomical analysis to clarify the wood species (Tuzson 2016). Thin sections (5–20 µm) were prepared using a sliding microtome (Thermo Scientific Microm HM 430) in the three main anatomical directions (tangential, longitudinal, and transversal) following standard protocol (Mihalik et al. 1999, Antalfi 2015, Antalfi & Fehér 2015). The preliminary anal-ysis was carried out using a stereomicroscope (Nikon SMZ-2T), while a Zeiss optical microscope was used to get higher magnification to identify characteristic xylological features. Wood identify-cation was performed based on the observed anato-mical characteristics compared to reference data-bases (Hollendonner 1913, Schweingruber 1990, Butterfield et al. 1997).

A LINTAB digital-positioning table and TSAP Win 4.68 software (Rinn 2005) were used to measure the tree-ring width with a precision of 0.01 mm using the facilities of the Budapest Tree-Ring Laboratory (Kern et al. 2024). Tree-ring widths were measured at least along two radii in each sample and the series were synchronized. Finally, the mean tree-ring series was determined for each disk and used in the analysis. Visual and statistical methods were used to synchronize these individual mean curves.

The longest reference chronologies with fixed calendar dates (so-called master chronologies) for the same species are available from 1698 CE (Hoverla, Charnagora Mts.; Kaczka & Büntgen, 2007) ~30 km northward, from 1635 CE (Pietrosul Rodnei, Rodna Mts.) ~35 km southward and from 1551 CE (Călimani Mts.) ~100 km southeastward (Popa & Sidor 2010, Sidor et al. 2015) in the sur-rounding region (**Fig. 1**). Standard dendrochrono-logical statistics such as percentage of agreement (GLK%, Eckstein & Bauch 1969, Buras & Wilmking 2015) and modified t value (t_{BP}, Baillie & Pilcher 1973) were used to evaluate crossdating results.

Radiocarbon analysis

Two rings were removed from MAR033 represent-ing cambial ages 58th and 59th of growth. Samples were pretreated by the conventional acid-alkali-acid (AAA) treatment. Measured targets were prepared using sealed-tube graphitization method (Molnár et al. 2013a, Rinyu et al. 2013). The $^{14}C/^{12}C$ ratio and the necessary $^{13}C/^{12}C$ correction were measured by accelerator mass spectrometry (AMS) on the EnvironMICADAS ^{14}C facility in the Hertelendi Laboratory of Environmental Studies in Debrecen, Hungary (Molnár et al. 2013b). The radiocarbon ages were calculated according to Stuiver & Polach (1977). Calibration of ^{14}C dates to calendar years was performed by the OxCal v.4.4.4 (Bronk Ramsey 2009) program in conjunction with the IntCal20 (Reimer et al. 2020) dataset. Calibrated ages are reported with 95% probability with interval boundaries given in the cal AD timescale.

Results and discussion

Xylological and dendrochronological assessment

The wood anatomical analysis revealed distinct boundaries between earlywood and latewood (**Fig. 3a**). Resin ducts were observed both between tracheids and in the rays. Bordered pits were visible in the walls of the longitudinal parenchyma cells in the radial section (**Fi. 3b**). Rays are heterogeneous built from parenchyma and tracheid cells. The wall of ray tracheids is smooth with small, bordered pits at the thicker sectors. Piceoid pits counted as 1 to 5. The height of the uniseriate rays in the tangential section ranges from 1 to 26 cells (**Fig. 3c**). Biseriate rays can be observed at the resin ducts. Based on these xylological features, the wood of MAR032, and very likely all the other samples in the studied constructions is Norway spruce (*Picea abies* (L.) Karst.).

Fig. 3.: Microscopic anatomical features of MAR032 sample. Cross (A) radial (B) and tangential (C) sections. Red bars at the lower right corner of the images indicate the 100 µm scale.

3. ábra: A MAR032-es minta mikroszkópos felvételei. Keresztmetszeti (A) sugárirányú (B) és érintőirányú (C) metszet. A 100 µm-es méretskálát a fotók jobb alsó részén látható vörös sávok jelölik.

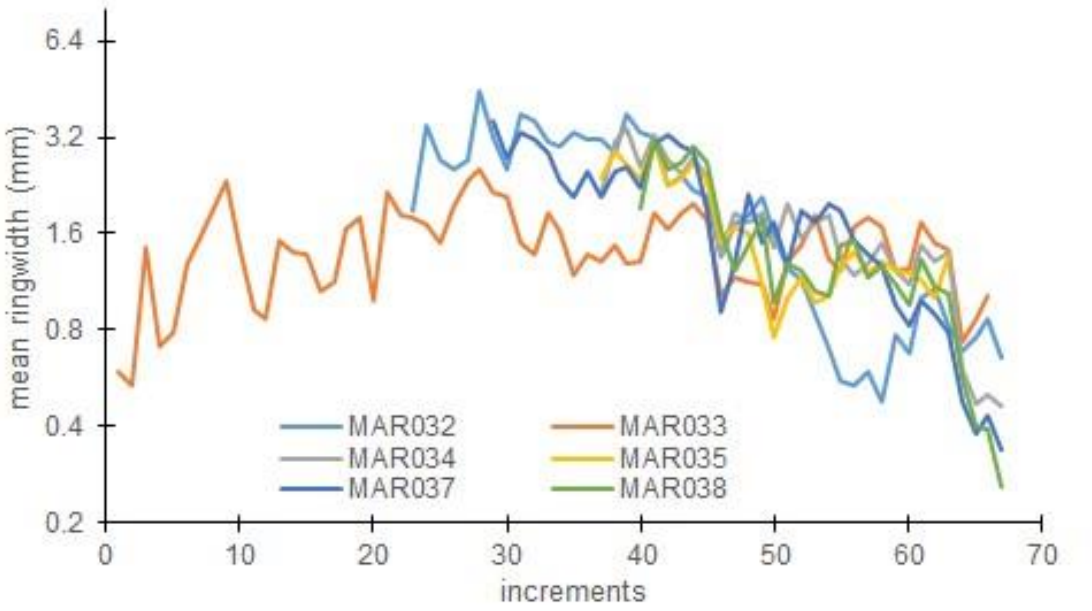

Fig. 4.: Synchronized dataset of ringwidth curves of the wooden construction found in peat bog 'Vinderel 3' locating in the Farcău Massif, Maramureș Mts. (Romania).

4. ábra: A 'Vinderel 3' tőzeglápból (Várkő, Máramarosi-havasok, Románia) 2013 szeptemberében kiemelt, ácsolt szerkezetek évgyűrűszélesség-idősorainak szinkronizált halmaza.

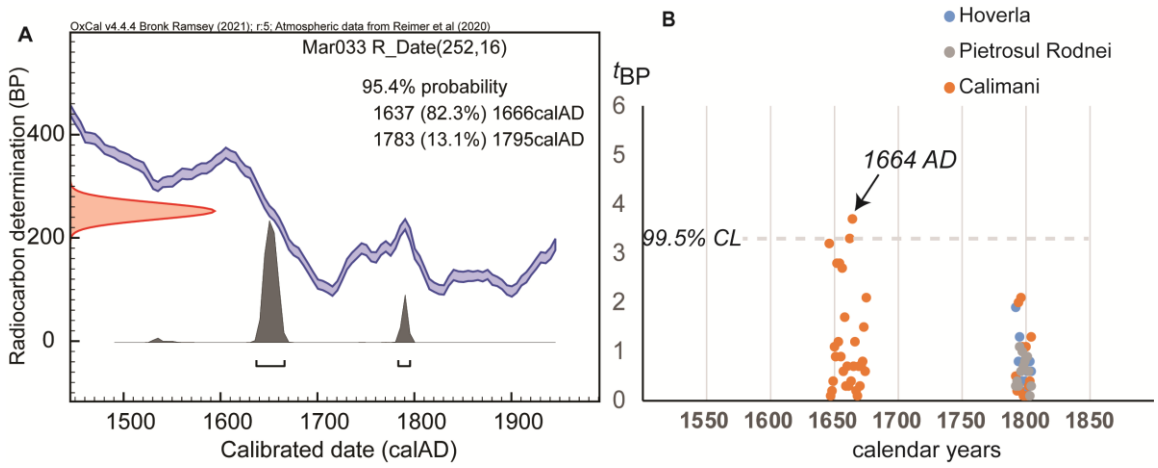

Fig. 5.: Radiocarbon calibration and running crossdating statistics calculated in running windows between mean ringwidth of MM8 and nearby spruce reference chronologies. (A) The blue band shows the distribution of the IntCal20 data and the red curve on the left indicates the ^{14}C age of the 58th and 59th growth rings of MAR033. The probability distribution of the calibrated ages is shown in grey. (B) Modified t value (t_{BP}, Baillie & Pilcher 1973) calculated for each year over the range indicated by the calibrated 95% probability intervals between MM8 and nearby spruce references: Hoverla (Kaczka & Büntgen 2007), Pietrosul Rodnei and Calimani Mts. (Popa & Sidor 2010, Sidor et al. 2015). Dashed horizontal line shows t_{BP}=3.2 approximating the empirically-determined 99.5% confidence level (Fowler & Bridge 2017) regarding the overlapping series length (n = 67).

5. ábra: Radiokarbon kalibráció és az MM8 és a közeli lucfenyő referencia-kronológiák átlagos gyűrűszélessége között számított szikronizálási statisztikák. (A) A kék sáv az IntCal20 adatok eloszlását mutatja, a bal oldali piros görbe pedig a MAR033 58. és 59. évgyűrűjének ^{14}C korát jelzi. A kalibrált korok valószínűségi eloszlása szürkével látható. (B) Az MM8 és a közeli lucfenyő-referenciák (ú.m. Hoverla (Kaczka &Büntgen 2007), Pietrosul Rodnei és Kelemen-havasok (Popa & Sidor 2010, Sidor et al. 2015)) között a kalibrált 95%-os valószínűségi intervallumok által jelzett tartományba eső évekre számított módosított t-érték (t_{BP}, Baillie & Pilcher 1973). A szaggatott vízszintes vonal a t_{BP} =3,2 értéket mutatja, amely megközelíti az empirikusan meghatározott 99,5%-os megbízhatósági szintet (Fowler & Bridge 2017) az átfedő sorozatok hosszára vonatkozóan (n = 67).

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The number of counted complete rings in the disks ranged between 27 and 66 (**Table 1**, **Fig. 4**). Crossdating statistics ranged from 66 to 81 and from 3.4 to 12.4 for GLK and t_{BP}, respectively (**Table 1**) supporting the visual impression of strong synchronicity between the variability of tree-ring width series of the samples (**Fig. 4**). The last extant ring in MAR032, MAR034, MAR037, and MAR038 coincides and defining the last ring of the tree-ring dataset and suggesting that the separately found objects were produced at the same time using the same timber source. The synchronized set of tree ring series and the mean tree-ring width chronology spans 67 years and is coded as MM8.

Dating the timber, estimating the construction date

Radiocarbon age (**Fig. 5a**) obtained from the construction timber of MAR033 points to a much younger age compared to the ages obtained from the subfossil material (Árvai et al. 2016), agreeing with the relative stratigraphical position of the wooden constructions. Due to the fluctuations of the atmospheric ^{14}C activity during the past centuries, calibrated ages are split up into separate intervals pointing to the late 18th century and the mid-17th century (**Fig. 5a**). These calibrated intervals can effectively delimit the timeframe over which the dendrochronological synchronization against potentially available master chronologies can be examined (e.g., Reinig et al. 2018, Helama et al. 2023).

Target intervals for the dendrochronological crossdating tests were inferred after shifting the calibrated intervals by +9yr, considering the 9 rings from the ^{14}C dated segment to the last ring of the synchronized dataset. The shifted target intervals are 1646–1675 CE and 1792–1804 CE. Each nearby spruce master chronologies are available in the recent target interval, however the Hoverla reference chronology (Kaczka & Büntgen 2007) does not reach back to the previous one. In addition, only a single series represent the Piertrosul Rodnei chronology before 1756 CE and even the overlapping years are vanishing from 41 (in 1675) to 11 (in 1645) so only the Călimani reference chronology (Popa & Sidor 2010, Sidor et al. 2015) was used in the earlier target interval. The 67-yr-long mean tree-ring width chronology (MM8) was compared to these regional reference chronologies using the t_{BP} statistics calculated for each position within the target intervals.

Crossdating against the nearby master chronologies suggested a lack of synchrony for the late 18th century (**Fig. 5b**). However, few positions displayed considerably stronger crossdating in the former target interval. The peak value at 1664 CE (t_{BP}: 3.7) exceeds the empirically determined 99.5% confidence level (Fowler & Bridge 2017). Crossdating tests were run with the Transylvanian spruce datasets from the Medieval and Early Modern ages (Tóth & Botár 2021), but no reliable synchronicity was found further arguing for the local (i.e., Eastern- or Northeastern Carpathian) origin of the timber. Taking into consideration that the probability of the calibrated ages also heavily weighted to the mid-17th century interval, we tend to accept that the possible felling date of the timber contributing to MM8 is 1664 CE and the wooden constructions were assembled soon after the felling date in the early second half of the 17th century CE.

Implications for the agropastoral activity of the subalpine zone of the Maramureş Mts.

Considering the potential utilization of the construction one can assume that it was sort of dam construction to retain water since these plateaus, far up above the water-rich valleys, are water-scarce places, and only in hollows animal watering is possible. However, we tend to exclude this explanation considering that the constructions were located just opposite to the potential run-off, tapping side of the peat bog.

But the hollows turn into swampy lakes, and those can be dangerous for the livestock, because they cannot get out of the swamp/peat bog. Trapped animals can be exposed to attack of the predators (e.g., wolves) and have no chance to escape (especially horses which were very valuable). Worth mentioning that a horseshoe and an oxenshoe (**Fig. 6a**) were found near the wooden construction, supporting the notion that domesticated animals visited the site. The imagined appearance of the wooden construction during utilization was reconstructed in a drawing form (**Fig. 6b**).

In other words, it is a mixed structure that acts as both a low boundary fence and a retaining wall. By this way the constructors could allow the livestock close to the water, but prevent them from slipping into the swamp, so they stabilized the bank but kept the water available for drinking, i.e. they did not erect a higher fence-wall construction.

The presented wooden construction and its inferred likely date to the mid-17th century CE provided material evidence for the agropastoral activity in the subalpine zone of the Maramureş Mts. Interestingly, the inferred construction date of the wooden structures points shortly after the onset of intensification of increased and intensified landscape openness, pasturing, and disturbance of soil cover c. 400 years ago (Florescu et al., 2024), as reconstructed partly from the sedimentological changes of Lake Vinderel situated only ~1200 m from 'Vinderel-3' peat bog. The inferred construction date of this wooden construction corresponds with the Wallachian (shepherd) colonization in the

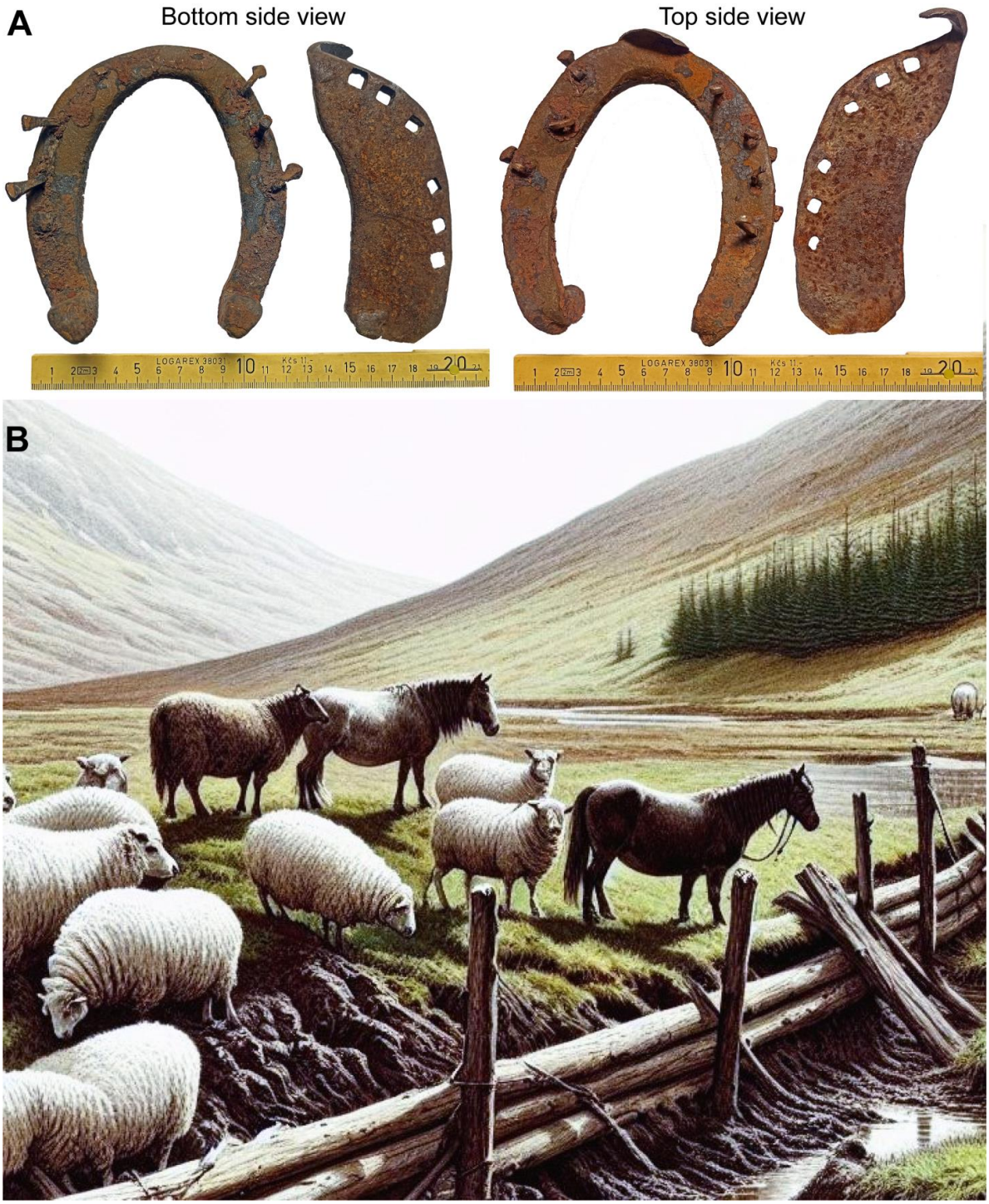

Fig. 6.: A horseshoe and an oxenshoe (A) found near the timbered structures. A visual reconstruction of a stake-fixed beam structure at the edge of the peat-bog (B). The digital visual reconstruction was created using Bing Image Creator.

6. ábra: Az ácsolt szerkezetek közelében talált lópatkó és marhapatkó (A). A vizenyős terület szélén karókkal rögzített gerendaszerkezet látványrekonstrukciója (B). A digitális látványrekonstrukció a Bing Image Creator segítségével készült.

Western Carpathians (Kłapyta 2013, Kapustová et al. 2018) so probably belongs to an established stage of pastoral activity of the subalpine zone of the Maramureș Mts. since based on the historical data Wallachian expansion has reached this region already in the 14th century (Bélay 1943, Popa 1969, Kłapyta 2013, Wistuba et al. 2018). In the 16th century, under Ottoman financial pressure, Transylvanian nobles sought to exploit the potential of mountain farming (Tóth 2024).

Dendrochronological and radiocarbon evidence from these wooden constructions provided the currently earliest material evidence for the agropastoral activity in the subalpine zone of the Maramures Mts. It argued at least 350-years old tradition of subalpine grazing in this sector of the Eastern Carpathians.

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Contribution of authors

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Közlemények

*

T. Dobosi Viola (1942 – 2025) •

T. Dobosi Viola évtizedeken át vezette a Magyar Nemzeti Múzeum őskőkori gyűjteményét. Fontos feltárásokat végzett jelentős középső és felső paleolitikus régészeti lelőhelyeken. Szívügye volt a vértesszőlősi feltárás helyszínén létrehozott szabadtéri kiállítóhely, melynek értékét mindig szem előtt tartva, a nehézségeken felülemelkedve, intézte a kiállítóhely minden kisebb és nagyobb ügyét.

Tudományos munkáját már a nyolcvanas években interdiszciplináris szemlélettel elkészített kismonográfiák, és vaskos köteteket kitevő feldolgozások fémjelezték, melyek révén nemzetközi elismertségre tett szert.

Nyugdíjba vonulása után is éveken keresztül tárigazgatóként állt a frissen létrehozott Régészeti Tár élén.

Nyugodjon békében.

Eddig a rövid hír, amihez nincs sok hozzátenni való. Viola munkásságát tanulmányok, kutatások sora fogja elemezni, felhasználni: munkatársai, kollégái, barátai pedig szomorúan próbáljuk elfogadni hiányát, feldolgozni az űrt, ami nélküle ránk maradt. Ennek a rövid tanulmánynak nem lehet célja az életmű teljes értékelése: az Archeometriai Műhely alapvető célkitűzései szerint, elsősorban a társtudományok és az interdiszciplináris kutatások szempontjából kiemelkedően fontos kutatásokról szeretnék összefoglalót adni.

Viola szakterülete, az őskőkor (paleolitikum) kutatása a régészeten belül mindig is a tudományok összességének együttes alkalmazásával próbálta szóra bírni a "szegényes" leletanyagot, ami a legkorábbi időkből ránk maradt. Az őskőkor kutatóinak legkorábbi generációja vagy közismert "polihisztor", mint Herman Ottó, vagy erős természettudományos hátterű, többnyire földtudományokban érintett paleontológus, mint Kadić Ottokár, Kormos Tivadar vagy az antropológus végzettségű Hillebrand Jenő voltak. A Magyar Nemzeti Múzeum őskőkori gyűjteményének kialakítója és egyben Viola mentora, Vértes László is erős természettudományos háttér mellett vezette a gyűjteményt és az aktuális feltárásokat. A már hagyományos földtudományi és paleontológiai háttér mellett bevezette a magyar régészetbe a statisztikai szemléletet is.

Viola a páratlan gazdag gyűjtemény mellett az interdiszciplináris szemléletet és a kivételes munkabírást is "megörökölte", és hozzáadott értékként saját személyes kutatói és emberi tulajdonságait - rendszeretetét, világos, egyenes gondolkodását, feltétlen kutatói és szakmai tisztességét - hozta a rendszerbe. Ideális partner volt az interdiszciplináris kutatásokban, aki tökéletesen ismerte a saját szakterületét, eredményeit és korlátait, nyitott szemmel és optimista várakozással tekintett a társtudományok eredményeire, amelyek gazdagították, kiegészítették a régészeti értelmezést. Nem volt híve a százszerzős hivatkozásoknak, inkább a saját név alatt megjelentetett rövidebb közleményeket pártolta, amelyeknek régészeti értelmezése, az ismeretek kontextusába való beillesztése természetesen a régész dolga. A társtudományok eredményeit az ismeretek napi szintjén be kell illesztenünk abba a nagy mozaikjátékba, amelyet az őstörténet jelent, elsősorban az őskőkor tekintetében.

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Viola interdiszciplináris munkássága, öröksége több szinten is jelen van az őskőkor, és tágabb értelemben, az őstörténet kutatásában. Elsősorban a kiemelkedően fontos, klasszikus magyarországi paleolit lelőhelyekről megjelent és részben ma is formálódó monográfiák esetében, mint Vértesszőlős (alsó paleolitikum, **1. melléklet**), Bodrogkeresztúr-Henye (felső paleolitikum **2. melléklet**) vagy a jelenleg is szerkesztés alatt álló Tata-Porhanyó (középső paleolitikum). A régészeti anyag feldolgozása mellett, amelynek kronológiai, ökológiai, topográfiai és proveniencia – kapcsolat rendszeri értelmezéséhez a társtudományok értékes adatokat szolgáltattak, elvégezte azt az integráló-értelmező munkát is, ami az interdiszciplináris együttműködés lényege.

A társtudományokkal való szoros együttműködés jegyében "Régészeti Továbbképző Füzetek" néven sorozatot szerkesztett a szakma szélesebb nyilvánossága számára (**3. melléklet**), amelyben az alkalmazható természettudományos módszerek mellett olyan kérdések is szóba kerültek, mint a hiteles és esztétikus tárgyrajz és rekonstrukció vagy az intenzív terepbejárás, roncsolás mentes leletfelderítési módszerek vagy az ásatások során előkerülő információ maximalizálását szolgáló finom feltárási módszerek és az iszapolás.

Kezdettől fogva támogatta a kőeszköz nyersanyag vizsgálatokat: mérföldkövet jelentő tanulmányában (Dobosi 1978, A pattintott kőeszközök nyersanyagáról) a petrográfiai szemléletű proveniencia vizsgálatok mellett érvelt, R. Baranyai Lívia aktív, de anonim közreműködésével. Kezdetektől fogva lelkesen és hatékonyan támogatta a Magyar Nemzeti Múzeumban létesített összehasonlító nyersanyaggyűjtemény (Litotéka) felállítását és annak katalógusában szerzőként működött közre (Biró & Dobosi 1991, Biró et al. 2000)

Társszerzőkkel együtt írott tanulmányaiban az archeometria változatos területein ért el fontos eredményeket (proveniencia vizsgálatok: neutron aktivációs mérések "szürke tűzköveken", Varga I. közreműködésével; (Dobosi et al. 1991), hegyikristály eszközök kutatása fluid zárványok vizsgálatával (Dobosi & Gatter 1996), prompt gamma aktivációs mérések segítségével (Kasztovszky et al. 2002, 2005, 2008, 2009). A Bodrogkeresztúr monográfiában a lelőhely akció rádiuszának és távolsági kapcsolatainak elemzésekor a társszerzők további geokémiai, geokronológiai és ásványtani módszereket (PIXE-PIGE, FTD (hasadási nyomvonal detektálás; **2. melléklet**) is használtak, melyek eredményeit Viola integrálta a régészeti feldolgozásba.

Számos közleményében foglalkozott a természettudományos kormeghatározás lehetőségeivel és annak régészeti interpretációjával: így a hagyományos, paleontológiai alapú kormeghatározással (Dobosi & Vörös 1979, 1986, 1987, 1994) illetve integrált, paleontológiai és rétegtani szemléletű kormeghatározással (pl. Dobosi et al. 1983, 1989).

A régészettudományba forradalmi változásokat hozó radiokarbon kormeghatározást értékelő, Vértes Lászlótól származó posztumusz tanulmányhoz írott utószón kívül munkáiban jelentősen támaszkodott az abszolút kronológia, különösen a C-14 vizsgálatok eredményeire (Dobosi & Hertelendi 1993, Dobosi & Szántó 2003).

A vértesszőlősi tűzhelyek égett csontjainak vizsgálatára munkatársaival röntgen pordiffrakciós (XRD), Fourier transzformációs infravörös (FTIR) és Raman spektroszkópiai módszereket alkalmaztak (Dobosi 2006b, Mihály et al. 2008); a vizsgálati eredmények az Archeometriai Műhely 2006/3 számában külön tanulmányként jelentek meg. A vizsgálatok megerősítik a csontok égett voltát és valószínűsítik ezek (zsíros csontok) tüzelőanyagként való használatát.

Munkásságának fontos részét képezik azok a tanulmányok, melyek külső (=nem-régész) kutatók számára foglalják össze, mit adhat a régészet a társtudományok számára.

Így összegyűjtötte az elefántcsontból (pontosabban, mamutcsontból) készült régészeti leleteket (Dobosi 2001a, 2002c) és az édesvízi =travertin) mészkő lelőhelyek régészeti adatait, ahol az emberi tevékenység nyomai "index fosszilia"-ként szolgálnak a geológusok számára (Dobosi 2003a). A Gömöri János által szerkesztett kézművesipar-történeti sorozat keretében a fa (Dobosi 2005a, 2007b) illetve a csont és a bőr (Dobosi 2009b, 2010b) őskőkori felhasználásáról készített összefoglalót. Homola Istvánnal közös tanulmányaiban vizsgálta a kőeszközök szerszámként való használatát és azok rokonságát a mai kéziszerszámokkal (Dobosi & Homola 1989)

Kétszer is összeállította a magyarországi őskőkori lelőhelyek kataszterét (Dobosi 1975a, 2005b), fontos alapadatokat szolgáltatva a negyedidőszak régészeti és természettudományos kutatásához.

Az őskőkori és őskori ipartörténeti jelentőségű lelőhelyek közül több bányahellyel is foglalkozott, így a lovasi festékbányával (ahol ásatásokat is végzett, Dobosi 1999a, Dobosi & Vörös 1979, Dobosi 2006a) és történeti jelentőségű kőbányákkal is (Dobosi 1983)

Tudományos munkáján kívül kiemelendő tudományos ismeretterjesztő tevékenysége, kiállítási vezetői, a Magyar Régészet az Ezredfordulón őskőkori fejezetei (Dobosi 2003b-e) és a tatai Átalér

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lelőhelyeinek gyönyörűen illusztrált terepi vezetője (Dobosi 1999b).

Dobosi Viola életművének régészeti eredményeit további megemlékezések, tanulmányok sora hivatott bemutatni. Valamennyien, akiknek szerencsénk volt együtt dolgozni, gondolkodni Violával, felelősek vagyunk azért, hogy eredményei, munkái beépüljenek napjaink és a jövő kutatásába is.

Mellékletek

1. melléklet: Tartalomjegyzék, Kretzoi, M. – Dobosi, V.T., (Eds) Vértesszőlős, Man, Site and Culture.

2. melléklet: Tartalomjegyzék, Bodrogkeresztúr-Henye (NE- Hungary) Upper Palaeolithic site.

3. melléklet: Tartalomjegyzék, Régészeti Továbbképző Füzetek I-IV

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régész

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Gömöri János emellett arra is felhívja a figyelmet, hogy az iparrégészeti leletek és objektumok archeometriai vizsgálatairól híreket közlő prominens forrásként a https://archeoindustrysites.com/ weboldal továbbra is számot tart az érdeklődők figyelmére.

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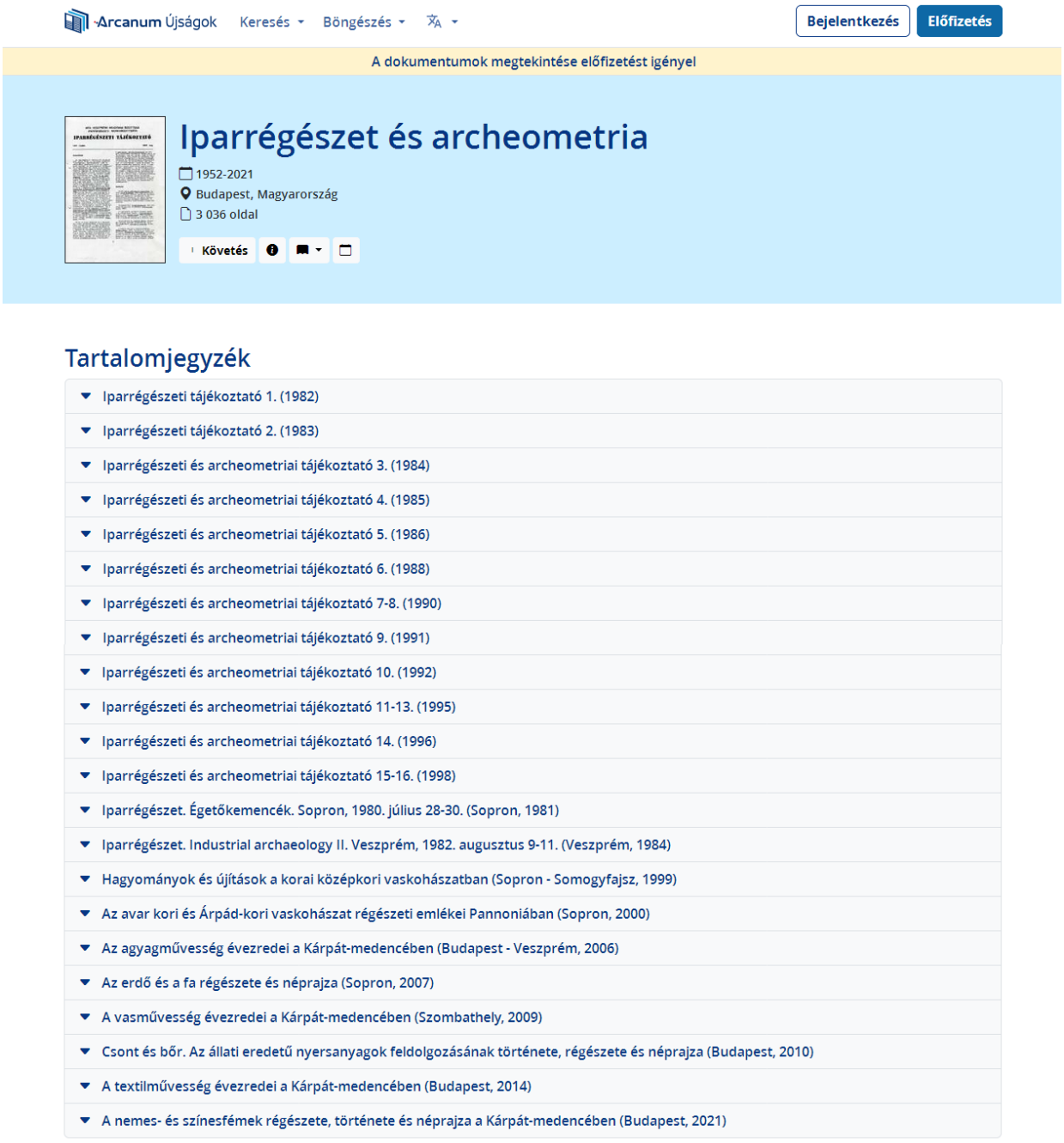

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