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ABBREVIATIONS

AAR	Analecta Archaeologica Ressoviensia (Rzeszów)
ActaArch	Acta Archaeologica (Leiden)
ActaArchHung	Acta Archaeologica Academiae Scientiarum Hungaricae (Budapest)
ActaMusPapensis	Acta Musei Papensis. A Pápai Múzeum Értesítője (Pápa)
Agria	Agria. Az Egri Múzeum Évkönyve (Eger)
AJPA	American Journal of Physical Anthropology (New York)
Alba Regia	Alba Regia. Annales Musei Stephani Regis (Székesfehérvár)
AnB	Analele Banatului. Buletinul Muzeului din Timişoara (Timişoara)
Antaeus	Antaeus. Communicationes ex Instituto Archaeologico (Budapest)
AnthrAnz	Anthropologischer Anzeiger (München)
AnthrK	Anthropológiai Közlemények (Budapest)
Antiquity	Antiquity. A Review of World Archaeology (Durham)
AÖ	Archäologie Österreichs (Wien)
Apulum	Apulum. Acta Musei Apulensis (Alba Iulia)
AR	Archeologické Rozhledy (Praha)
ArchA	Archaeologia Austriaca (Wien)
ArchBulg	Archaeologia Bulgarica (Sofia)
ArcheoSciences	ArcheoSciences. Revue d'Archéométrie (Rennes)
ArchÉrt	Archaeologiai Értesítő (Budapest)
ArchHung	Archaeologia Hungarica (Budapest)
Archiv für Anthropologie	Archiv für Anthropologie. Völkerforschung und kolonialen Kulturwandel (Braunschweig)
ArchKözl	Archaeologiai Közlemények (Budapest)
Arrabona	Arrabona. A Győri Xantus János Múzeum Évkönyve (Győr)
ASM	Archeologické Studijní Materiály (Praha)
AUB	Annales Universitatis Budapestinensis de Rolando Eötvös Nominatae (Budapest)
AVANS	Archeologické Výskumy a Nálezy na Slovensku (Nitra)
Balcanica	Balcanica. Annuaire du Comité Interacadémique de Balkanologie du Conseil des Académies des Sciences et des Arts de la R. S. F. Y. et de l'Institut des Etudes Balkaniques (Beograd)
BAR-IS	British Archaeological Reports – International Series (Supplementary) (Oxford)
BBV	Berliner Beiträge zur Vor- und Frühgeschichte (Berlin)
bioRxiv	bioRxiv. The Preprint Server for Biology
BRGK	Bericht der Römisch–Germanischen Kommission (Berlin)
BROB	Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek (Amersfoort)
BudRég	Budapest Régiségei (Budapest)
CommArchHung	Communicationes Archaeologicae Hungariae (Budapest)
Crisia	Crisia (Oradea)
CurrAnt	Current Anthropology (Chicago)

DissArch	Dissertationes Archaeologicae ex Instituto Archaeologico Universitatis de Rolando Eötvös nominatae (Budapest)
DMÉ	A Debreceni Déri Múzeum Évkönyve (Debrecen)
DocPraehist	Documenta Praehistorica (Ljubljana)
Dolg	Dolgozatok az Erdélyi Múzeum Érem- és Régiségtárából (Kolozsvár)
Dolgozatok	Dolgozatok a Magyar Királyi Ferencz József Tudományegyetem Archaeologiai Intézetéből (Szeged)
DuDolg	Dunántúli Dolgozatok (Pécs)
DuSz	Dunántúli Szemle (Szombathely)
EJA	European Journal of Archaeology (London)
Építés-Építészettudomány	Építés- Építészettudomány. A Magyar Tudományos Akadémia Műszaki Tudományok Osztályának Közleményei (Budapest)
EurAnt	Eurasia Antiqua. Zeitschrift für Archäologie Eurasiens (Bonn)
FAM	Fontes Archaeologiae Moravicae (Brno)
FolArch	Folia Archaeologica (Budapest)
FontArchHung	Fontes Archaeologici Hungariae (Budapest)
FrK	Földrajzi Közlemények (Budapest)
FSI	Forensic Science International. Genetics
FtK	Földtani Közlöny (Budapest)
GCBI	Godišnjak Centra za Balkanološka Ispitivanja Akademije Nauka i Umjetnosti Bosne i Hercegovine (Sarajevo)
Germania	Germania. Anzeiger der Röm.-Germ. Kommission des Deutschen Archäologischen Instituts (Mainz)
Gesta	Gesta. Historical Review (Miskolc)
HHR	The Hungarian Historical Review (Budapest)
HOMÉ	A Herman Ottó Múzeum Évkönyve (Miskolc)
HungArch	Hungarian Archaeology. E-Journal (Budapest)
JAA	Journal of Anthropological Archaeology (New York)
JAHA	Journal of Ancient History and Archaeology (Cluj-Napoca)
JAR	Journal of Archaeological Research (New York)
JAS	Journal of Archaeological Science (London)
JFA	Journal of Field Archaeology (Boston)
JFS	Journal of Forensic Sciences (Chicago)
JHE	Journal of Human Evolution (New York)
JIES	The Journal of Indo-European Studies (Washington, D. C.)
JLS	Journal of Lithic Studies (Edinburgh)
JPMÉ	A Janus Pannonius Múzeum Évkönyve (Pécs)
JWP	Journal of World Prehistory
KMK	A Komárom megyei Múzeumok Közleményei (Tata)
KMMK	Komárom-Esztergom Megyei Múzeumok Közleményei (Tata)
KRMK	A Kaposvári Rippl-Rónai Múzeum Közleményei (Kaposvár)
Marisia	Marisia. Studii şi Materiale. Muzeul Judeţean Tîrgu Mureş (Tîrgu Mureş)
MatArchSlov	Materialia Archaeologica Slovaca (Nitra)
MCA	Materiale şi Cercetări Archeologice (Bucureşti)
Menga	Menga. Revista de prehistoria de Andalucía. Journal of Andalusian Prehistory (Antequera)
MFMÉ	A Móra Ferenc Múzeum Évkönyve (Szeged)
MFMÉ StudArch	A Móra Ferenc Múzeum Évkönyve – Studia Archaeologica (Szeged)

MKCsM	Múzeumi Kutatások Csongrád Megyében (Szeged)
MRT	Magyarország Régészeti Topográfiája (Budapest)
Musaica	Musaica Archaeologica. Zborník Filozofickej Fakulty University Komenského (Bratislava)
Nartamongæ	Nartamongae. The Journal of Alano-Ossetic Studies. Epic, Mythology and Language (Vladikavkaz)
OA	Opuscula Archaeologica (Zagreb)
Ossa	Ossa. International Journal of Skeletal Research (Solna)
Ősrégészeti Levelek	Ősrégészeti Levelek. Prehistoric Newsletter (Budapest)
PBF	Prähistorische Bronzefunde (München)
PLoS One	PLoS One. E-Journal (San Francisco)
PNAS	Proceedings of the National Academy of Sciences (Washington, D. C.)
Pravěk	Pravěk (Brno)
Preistoria Alpina	Preistoria Alpina (Trento)
PZ	Praehistorische Zeitschrift (Berlin)
QuaternaryInt	Quaternary International. The Journal of the International Union for Quaternary Research (Oxford – New York)
Radiocarbon	Radiocarbon. An International Journal of Cosmogenic Isotope Research (Tucson)
RégFüz	Régészeti Füzetek (Budapest)
SA	Советская Археология (Moskva)
Satu Mare	Satu Mare. Studii şi comunicări. Seria Arheologie (Satu Mare)
Savaria	Savaria (Szombathely)
SbČSA	Sborník Československé Společnosti Archeologické (Brno)
SCIV	Studii şi Cercetări de Istorie Veche (Bucureşti)
SlA	Slovenská Archeológia (Bratislava)
SMK	Somogyi Múzeumok Közleményei (Kaposvár)
Specimina Nova	Specimina Nova. Dissertationum ex Instituto Historiae Antiquae et Archaeologiae Universitatis Quinqueecclesiensis (Pécs)
SSz	Soproni Szemle (Sopron)
StComit	Studia Comitatensia (Budapest)
SzIKMK	A Szent István Király Múzeum Közleményei (Székesfehérvár)
Terra Sebus	Terra Sebus. Acta Musei Sabesiensis (Sebes)
Tisicum	Tisicum. A Jász-Nagykun-Szolnok Megyei Múzeumok Évkönyve (Szolnok)
UF	Ugarit-Forschungen. Internationales Jahrbuch für die Altertumskunde Syrien-Palästinas (Kevelaer – Neukirchen– Vluyn)
UPA	Universitätsforschungen zur prähistorischen Archäologie (Bonn)
VAH	Varia Archaeologica Hungarica (Budapest)
VetZoot	Veterinarija ir Zootechnika. A scientific journal and the Official Organ of the Veterinary Academy, Lithuanian University of Health Sciences (Kaunas)
VKT	Várak, kastélyok, templomok. Történelmi és örökségturisztikai folyóirat (Pécs)
VMMK	A Veszprém Megyei Múzeumok Közleményei (Veszprém)
VýP	Východoslovenský Pravek (Košice)
WMMÉ	A Wosinsky Mór Múzeum Évkönyve (Szekszárd)
ZalaiMúz	Zalai Múzeum (Zalaegerszeg)
ZbSNM	Zborník Slovenského Národného Múzea. Archeológia (Bratislava)
Ziridava	Ziridava. Studia Archaeologica (Arad)
ZSNM	Zbornik Slovenského Národného Múzea (Ljubljana)

FOREWORD FROM THE EXECUTIVE EDITOR

As with the previous (37th) issue of the Antaeus (Yearbook of the Institute of Archaeology), the present volume brings together a selection of research papers addressing a certain time period; the Bronze Age on this occasion. The current volume, despite containing fewer studies than the previous issues, is in line with the editorial board's ambition to publish a new volume at regular – annual – intervals, even at the expense of the overall length of the publication. With the aim to assemble a broad spectrum of Bronze Age research studies from the territory of Hungary, the current issue touches upon a wide range of themes stretching across the many hundreds of years of the Bronze Age period: from the facial reconstruction of an Early Bronze Age woman, to the domestication of horses and Middle Bronze Age dress ornaments, to the study of the large, Late Bronze Age fortified settlements. These topics cover the key issues of current European Bronze Age research, including the archaeological application of DNA analyses, and the theoretical approaches of political economies, therefore the outcomes presented here will hopefully be of wide international interest. Some of the research was carried out within the framework of the Lendület/Momentum Mobility Research Group launched in 2015, supported by the Hungarian Academy of Sciences at the Institute of Archaeology, Research Centre for the Humanities.

The paper by Ágnes Kustár and her colleagues presents the facial reconstruction of an Early Bronze Age female burial. The work serves as the first facial reconstruction study where DNA data was also considered regarding the pigmentation (eye and hair colour, skin tone) of a Bronze Age individual from present-day Hungary.

The two studies put forward by Eszter Melis and Gabriella Kulcsár as main authors, both discuss the results of micro-regional settlement investigations aimed to explore Early and Middle Bronze Age settlement structures using non-destructive methods. The settlement investigations conducted by Eszter Melis and her team focussed on the region of Nagycenk, nearby Lake Neusiedl. The data published here represents a significant piece of archaeological research as information from the region occupied by the Gáta–Wieselburg culture has been lacking in the past three decades. Furthermore, the site of Nagycenk-Kövesmező is one of the few Gáta–Wieselburg settlements investigated by a modern archaeological excavation.

Gabriella Kulcsár and her team discuss the Middle Bronze Age pit burial of a mature adult female with evidence for multiple physical trauma, from Central Hungary. The study touches upon the interpretation of pit burials in the context of the settlements of Bronze Age communities who otherwise practiced inhumation and cremation as their nominal mortuary tradition.

Géza Szabó's paper examines the so-called Tolnanémedi-type hoard horizon comprised primarily of dress ornament assemblages across to the Middle Bronze Age along with a newly discovered hoard from Mucsi in Tolna county. The publication includes the reconstruction of a costume worn by high status female members of the Transdanubian Encrusted Pottery culture and provides an interpretation of the symbolism of such ornaments.

The study by Gábor Ilon provides an overview of Bronze Age moulds and their distribution in the Carpathian Basin. The paper considers the assemblage as important evidence for local metallurgy, and sheds new light on the organisation and specialisation of bronze production.

Róbert Bozi and Géza Szabó explore the question of horse domestication within the context of Bronze Age cultures in Central and Eastern Hungary, based on the evidence of horse gear made of antler appearing first during the 2nd millennium in the Carpathian Basin. The study relies on newly discovered horse remains and their associated absolute dates.

The paper by Vajk Szeverényi and his colleagues discusses the results of their most recent excavation programme conducted at Csanádpalota; a prime example of a so-called 'mega fort' or large-scale fortified settlement typical in the Late Bronze Age in Southeast Europe. Anna Priskin in her study gives a detailed insight into the production and use of grinding stones recovered at the site.

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ÁGNES KUSTÁR – DÁNIEL GERBER – SZILVIA FÁBIÁN – KITTI KÖHLER – BALÁZS GUSZTÁV MENDE – ANNA SZÉCSÉNYI-NAGY – VIKTÓRIA KISS

FACIAL RECONSTRUCTION OF AN EARLY BRONZE AGE WOMAN FROM BALATONKERESZTÚR (WESTERN HUNGARY)

Zusammenfassung: Während der Ausgrabungen, die dem Bau der Autobahn M7 vorangingen, kamen am Fundort Balatonkeresztúr-Réti-dűlő, zwischen 2003 und 2004 Funde neun verschiedener archäologischer Epochen zum Vorschein, darunter auch eine auf das Ende der Frühbronzezeit datierbare Siedlung der Kisapostag-Kultur und 12, hauptsächlich beigabenlose Bestattungen. In Grab 13 ruhte eine ungefähr 35-45 Jahre alte Frau, um deren Schädel herum kleine Metallverzierungen aufgedeckt wurden, die zu einem Kopf- oder Kappenschmuck gehörten und darauf hinwiesen, dass die Verstorbene innerhalb der Siedlungsgemeinschaft einen höheren gesellschaftlichen Rang innehatte. Der Schädel im Grab war in sehr gutem Zustand, somit ergab sich die Möglichkeit, die einstigen Gesichtszüge der Frau zu rekonstruieren, gleichzeitig war dies die erste weibliche Gesichtsrekonstruktion der ungarischen Bronzezeit. Im Rahmen unserer Studie beschreiben wir den Vorgang der plastischen Gesichtsrekonstruktion, wofür wir auch die anhand genetischer Untersuchungen gewonnenen phänotypischen Angaben (Augen- und Haarfarbe, Teint) verwendet haben.

Keywords: inhumation burial, bioarchaeology, archaeogenetics, anatomy, sculpting craniofacial reconstruction, Kisapostag/Earliest Encrusted Pottery culture, Early Bronze Age, Western Hungary

At site Balatonkeresztúr-Réti-dűlő (Somogy county), on the south shore of Lake Balaton, 2976 archaeological features were discovered over an area of 45.000 m^2 during the 2003–2004 excavations (supervised by Szilvia Fábián) preceding the construction of the M7 Motorway. These features belonged to nine archaeological periods: Middle and Late Copper Age (Balaton–Lasinja, Furchenstich, Boleráz and Baden cultures), Early Bronze Age (Somogyvár–Vinkovci and Kisapostag/Earliest Encrusted Pottery cultures), Middle Bronze Age (Transdanubian Encrusted Pottery culture), Late Iron Age (La Tène D period), Migration period (Longobards), the Árpádian period (12th–13th centuries), and the Late Middle Ages (13th–15th centuries).[1] Beside settlement features associated with the Early and Middle Bronze Ages, an inhumation cemetery presumably used in the same period was also discovered. The twelve burials of the cemetery were arranged in two groups: one with six graves (Group A: Graves 1, 2, 3, 5, 6, and 7) and the other comprising four graves (Group B: Graves 4, 8, 11, and 13), and there were two more graves (Graves 10 and 45) somewhat further away. The burials were oriented N–S or NE–NW, and the deceased were laid in the burial pits in a so-called contracted position, with their legs slightly or tightly flexed, and, in most cases, with their hands placed in front of their faces. Most of the burials were without grave goods; only two burials contained jewellery, which formed part of the wear of the deceased. One of the latter is Grave 13 belonging to Group B *(fig. 1),* in which the fragments of copper or bronze beads were discovered around the skull of an adult woman. Based on these finds – and similar

1 *Honti et al. 2004; Honti et al. 2006* 26–29; *Fábián – Serlegi 2009.*

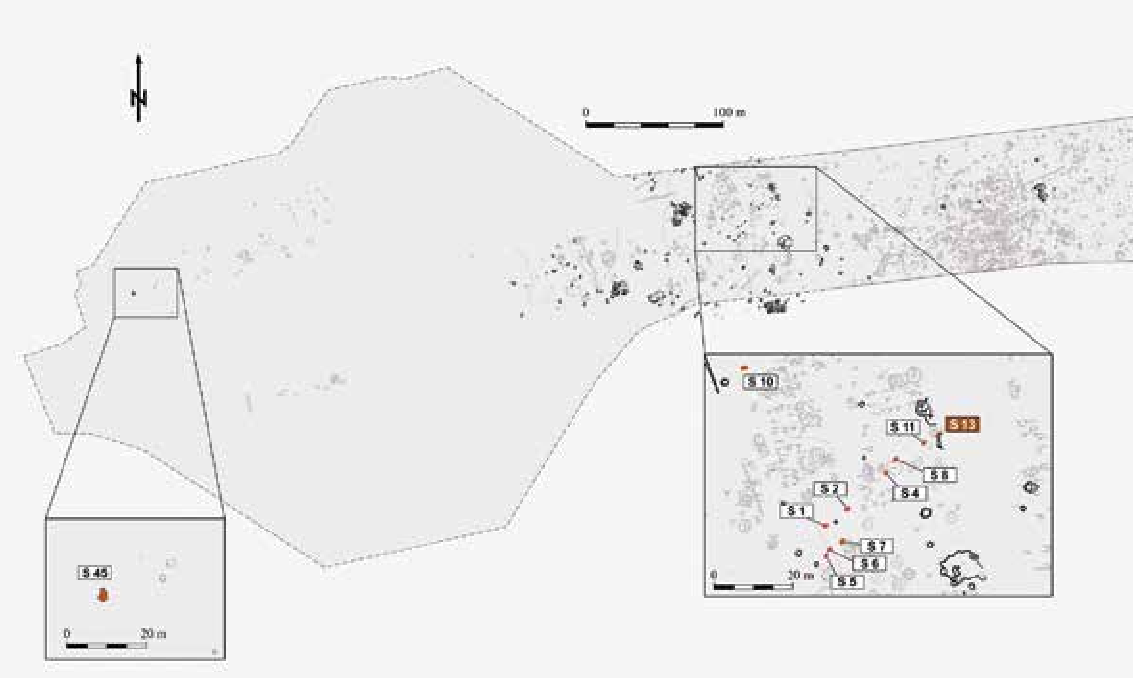

Fig. 1. The site Balatonkeresztúr-Réti-dűlő, with the position of Early Bronze Age burials; Grave 13 signed in colour (©Zsolt Viemann, ©Zsolt Réti)

burials – we assumed that the graves belonged to the Early Bronze Age.[2] Closer data were later offered by the radiocarbon analysis of samples taken from the bones of the deceased. According to these, the burials were made sometime between 2150 and 1870 BC, so they can be associated with the population of the Kisapostag/Earliest Encrusted Pottery culture.[3]

Balatonkeresztúr-Réti-dűlő Grave 13, the burial of a middle-aged woman

Archaeological and anthropological data

The woman in Grave 13, laid on her left side with her legs pulled up, was buried in a slightly different pose from the rest of the deceased as she covered her face with her right arm *(fig. 2).* During the anthropological examination of the remains comprising a relatively well-preserved skull and skeletal bones of the 35-45-year-old woman (see anthropological analysis below in details), no signs of external trauma or disease on the skeleton were detected, so the cause of death is currently unknown. According to radiocarbon tests carried out at the laboratory of the Isotope Climatology and Environmental Research Centre (ICER), Institute for Nuclear Research (ATOMKI) in Debrecen, the woman was most probably buried between 2040 and 1890 BC (DeA 21 200; 3618 ± 30 BP; 68.2%: 2023–1942 BC, 95.4%: 2120–1891; 90.9%: 2039–1891) *(fig. 3).*[4]

Fragments of copper or bronze plate beads unearthed from the grave suggest that the woman had a relatively high social status within the community living at the settlement. These tubular beads made of metal belonged to the typical headdress or cap of the era. Similar beads were

[2] *Honti et al. 2004* 13, Table III. 2; *Kiss 2020a; Gerber et al. preprint,* Supplementary.

[3] On the data of radiocarbon dating in detail: *Gerber et al. preprint.*

[4] The dates were calibrated with the 'OxCal' v4.4 software *(Bronk Ramsey 2009)* using the IntCal20 Northern Hemisphere radiocarbon calibration curve *(Reimer et al. 2020).*

Fig. 2. Balatonkeresztúr-Réti-dűlő, Grave 13 (©Szilvia Fábián, ©Zsolt Réti, ©Fanni Gerber)

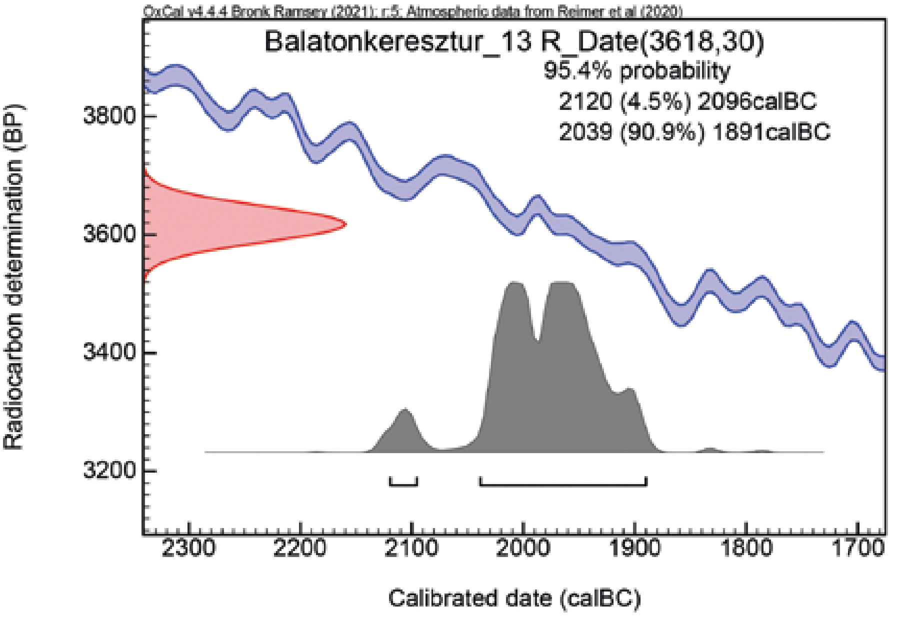

Fig. 3. Balatonkeresztúr-Réti-dűlő, calibrated AMS dating of Grave 13 (©Viktória Kiss)

found, among other things, in Grave 400 unearthed at site Ordacsehi-Csereföld nearby, the burial of a woman who died around the age of 48-57 years, and a reconstruction drawing was made of a possible way the beads were worn.[5] The analysis of the metal tubes showed that they were made of copper (instead of tin bronze), with some arsenic, silver, and antimony components (93–95% copper, 1–2% arsenic, 1.5–2% silver, 3–3.5% antimony, 0.3% lead).[6] Tubes twisted from sheet metal or wires were also worn as a necklace or sewn onto a garment, as can be seen in Grave 242 of the cemetery excavated at Bonyhád-Biogas Factory, the burial of a 30-35-year-old woman. Although the metal bead fragments discovered at Balatonkeresztúr have not been subjected to compositional analyses so far, the analyses of the beads from Ordacsehi and Bonyhád show that the pieces dating to the Early Bronze Age and the beginning of the Middle Bronze Age were made of copper,[7] even though tin bronze tools and weapons emerged in the region around 2000/1900 BC.[8] Unalloyed copper with low arsenic, antimony, and silver contents, which could be shaped easily, was a more suitable raw material for the production of these beads.[9] This material most probably have come from the territory of the Slovak Ore Mountains.[10]

We determined the age of the individual at the time of death on the basis of the wear of the teeth, the ossification of the cranial sutures, and the ribbed surface of the *facies symphyseos*.[11] The sexualisation value (-0.81) has a feminine character.[12] We recorded the metrics of skulls and long bones,[13] based on which we defined the most important indices and carried out categorisation.[14]

5 *Somogyi 2004; Somogyi 2007.*
6 *Költő 2004.*
7 *Szabó 2010; Kovács et al. 2019.*
8 *Kiss 2020b.*
9 *Kovács et al. 2019.* In the second half of the Middle Bronze Age, however, similar ornaments for clothing were already made of tin bronze, see *Kiss – Barkóczy – Vízer 2013; Maróti – Káli 2021.*
10 *Duberow – Pernicka – Krenn-Leeb 2009; Kiss 2020b.*
11 *Nemeskéri – Harsányi –Acsádi 1960; Sjøvold 1975; Miles 1963; Perizonius – Pot 1981.*
12 *Éry – Kralovánszky – Nemeskéri 1963.*
13 *Martin – Saller 1957.*
14 *Alekseev – Debec 1964.*

Additionally, we calculated the height of the individual based on the size of the long bones.[15] The stature (158.7 cm) is large-medium.[16] In absolute terms, the values of the skull are medium-long, wide, and high (*brachy-*, *chamae-*, and *tapeinocran*). The frontoparietal index is narrow *(stenometop)*. In a vertical view, the brain case is pentagonoide-shaped, while viewed from the *occipitale*, it is house-shaped. The nape has a curvoccipital profile. The *glabella* is grade 2 and the *protuberantia occipitalis externa* is grade 2.[17] In absolute terms, the face is medium-high, and the upper face is high. The orbital cavities are *mesokonch*. The nose is *mesorrhin*. Of the anatomical variations,[18] suture bones can be observed on both sides of the lambda suture. Of the 29 preserved teeth, cervical caries can be seen in the lower left 2nd molar. The lower left 3rd molar fell out during the individual's life. The degree of abrasion is grade 4–5.[19]

The skull in the grave has been preserved in a very good condition, which allowed us to carry out the reconstruction of the woman's facial features. This was, at the same time, the first female facial reconstruction from the Bronze Age in Hungary.[20]

Archaeogenetic methods and results

The archaeogenetic studies were carried out at the Institute of Archaeogenomics, Research Centre for the Humanities (Eötvös Loránd Research Network) with up-to-date methodology. Samples were taken from Early Bronze Age human remains found at the site, in accordance with the international standards: from the *pars petrosa* bone or, in the absence of it, from the tooth. In the case of the woman from Grave 13, belonging to the Kisapostag/Earliest Encrusted Pottery culture, the samples were taken from the petrous bone. DNA library creation and preparation for shotgun sequencing were carried out in dedicated sterile laboratory facilities following the most recent methodology.[21] An average of 5 million randomly selected DNA fragments were subjected to shotgun sequencing per sample, using the sequencing platforms Illumina MiSeq and NovaSeq. Bioinformatical analyses consisted of raw sequencing read filtering and mapping to the human reference genome (hg19 version) and post-filtering. We used the 1.240 million panels to call SNPs (Single Nucleotide Polymorphism, frequently used genomic markers in ancient DNA analyses), from which an average of 101 thousand SNPs were retrieved from the population of this study. This was sufficient amount for various population genetic analyses, including PCA and allele-frequency-based methods, and also even for a – limited – phenotypic variant discovery. For the latter, we were mainly interested in clinical and pigmentation variants, for which we used existing panels (e.g. Hirisplex) arbitrarily extended with database data.[22] The variant calling of the woman found in Grave 13 yielded a total of 104 929 SNPs from the 1.240 million panels. The composition of her nuclear genome fits in the Kisapostag/Earliest Encrusted Pottery culture-associated genomes available so far.[23] This group comprised the genetic material[24] of all the three major European genetic components: the Mesolithic hunter-gatherer indigenous population who lived here before the advent of agriculture, the Anatolian farming people who arrived in the Carpathian Basin in the Neolithic Age, in the 6th millennium BC, as well as the shepherds who

[15] *Sjøvold 1990.*
[16] *Martin – Saller 1957; Alekseev – Debec 1964.*
[17] See note 13.
[18] *Hauser – De Stefano 1989.*
[19] See note 11.
[20] For the Bronze Age facial reconstruction based on a male burial excavated in Tiszafüred, which is the first reconstruction from the Bronze Age in Hungary, see *Kustár et al. 2020.*
[21] *Dabney et al. 2013; Rohland et al. 2015; Lipson et al. 2017.*
[22] *Walsh et al. 2014; Walsh et al. 2017; Chaitanya et al. 2018.*
[23] *Gerber et al. preprint.*
[24] *Haak et al. 2015; Fu et al. 2016; Lipson et al. 2017.*

moved here from the east at the dawn of the Bronze Age, in the first third of the 3rd millennium BC. Interestingly, an increased hunter-gatherer ancestry, previously unknown from this era clearly separates the Kisapostag/Earliest Encrusted Pottery culture associated individuals from other known Bronze Age populations of Europe.[25] After their arrival to the Transdanubia, their specific genetic makeup thinned out generation by generation, but remained characteristic for centuries in the region. The exact origin of their peculiar genetic makeup is yet to be described. Based on the paternal (Y-chromosome) relations discovered in the Balatonkeresztúr cemetery, the communities of the culture may belong to a fundamentally patriarchal society. Female exogamy – a general phenomenon in the Bronze Age – can also be observed among them based on admixture proportions, although this may have been limited, as the woman buried in Grave 13 was born and lived in the vicinity of the site according to local Sr isotope signature and had the specific genetic features of the Kisapostag/Earliest Encrusted Pottery population. Data from other sites[26] also support that communities belonging to the culture may have been based on families along the male line or a clan-type society. The 35-45-year-old woman had a pre-eminent position in this society according to the metal grave goods. Since she was found together with closely related individuals, we can hypothesise that she was part of those familiar groups despite not having any blood relationship with them up to a second degree. Her phenotypic traits can be estimated through the variants of her MC1R, OCA2, HERC2, SLC24A4, TYR, IRF4, TYRP1, PIGU, and RALY genes. Considering the results, despite her minor steppe heritage, she blended into the Neolithic pigmentation patterns.[27] Fundamentally, she had rather creole-toned skin and brownish blond hair of a darker shade. Her face may have been freckled and her eye colour was shaped by both the genetic variants responsible for blue and brown pigmentation.

In the absence of written records from the Bronze Age, the names of the middle-aged woman and her contemporaries are not known. We named this woman Jelena after the date when her grave was discovered (name day Jelena/Ilona on 18 August)[28] and the results of the genetic tests, as she belonged to J2b1 mitochondrial haplogroup or maternal lineage.

Facial reconstruction

Facial reconstruction can be used to represent the facial features of people who lived in the past. Currently, it is predominantly used by the police in forensic identification to reveal the identities of unknown corpses. In medicine, facial surgeons (maxillofacial surgeons) and plastic surgeons also use the technique of facial reconstruction to plan surgeries for replacing both bones and soft tissues.

The skull of the woman buried in Grave 13 at Balatonkeresztúr is in good condition. The right zygomatic bone is damaged, and the right temporal squama is incomplete *(fig. 4).* According to the anthropological examination of the skeleton, Jelena's stature was large-medium (approximately 159 cm) with a gracile skeleton. The age of about 35-45 years is slightly higher than the average age of the local Bronze Age population.

The facial reconstruction was started by making the exact copy of the original skull. To maintain the intactness of the skull, we used rapid prototyping technology that is sufficiently accurate and does not damage the bones. The computed tomography (CT) scan of the skull was

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25 *Olalde et al. 2018.*

26 *Gerber et al. preprint.* See also the examination of individuals, from a slightly younger period contemporaneous with the mass grave discovered at Balatonkeresztúr, from site Jagodnjak (Croatia): *Freilich et al. 2021.*

27 In detail see *Gerber et al. preprint.*

28 See name days in Hungary: https://hu.wikipedia.org/wiki/Magyar_n%C3%A9vnapok_list%C3%A1ja_bet%C5%B1rendben [last accessed 20.02.2022].

Fig. 4. The skull of the Bronze Age woman from Balatonkeresztúr-Réti-dűlő site, Grave 13; front view and side view; top view and rear view (©Dániel Gerber)

taken at the Medical Imaging Centre of Semmelweis University, and then, the plastic copy was made by Varinex Inc. using selective laser sintering technology *(fig. 5).*

The features of the skull

The characteristics of the skull foreshadowed the features of the reconstructed face *(fig. 4).* The skull is small in absolute size, fine-boned, and feminine. According to the cranial (length-breadth) index, the skull is short and low, the forehead is narrow and convex. The occiput is curved, the muscular joints *(linea nuchae superior et suprema)* are prominent, the external occipital protuberance *(protuberantia occipitalis externa)* is well-developed, and although the mastoid process *(processus mastoideus)* is small, the neck muscles must have been quite strong. The nasal cavity is medium wide *(mesorrhin)*, the lower edge is sharp *(anthropin)*, which together suggest nasal wings of medium width. The nasal root is shallow and the bony part of the nasal dorsum is straight. The distal end of the nasal bones was broken, so we completed it with wax. The anterior

Fig. 5. The plastic copy of the skull of the Bronze Age woman from Balatonkeresztúr-Réti-dűlő site, Grave 13 in 3D made with selective laser sintering (SLS) technology (©Varinex Inc., ©Ágnes Kustár)

nasal spine *(spina nasalis anterior)* is mid-sized, turned slightly upward, which, along with the nasal bones moderately protruding from the plane of the face, is suggestive of a moderately protruding cartilaginous ridge of the nose *(nasus externus)*.

The orbital cavities are medium high *(mesokonch)*, rounded in shape, and have slightly inverted upper edges. The distance between the two orbital cavities is relatively small. The zygomatic bone is low and smooth, the zygomatic arch is slender, and the canine fossa *(fossa canina)* is shallow. It is characteristic that because of the prognathism *(prognathia)* of the alveolar processes of both the upper jaw *(maxilla)* and lower jaw *(mandibula)*, the front teeth protrude considerably. As a result, the lips are expected to be rather full and also protruding. The lower jaw *(mandibula)* is small and low; the body *(corpus)* of the mandible is medium thick. The ramus of the mandible *(ramus mandibularis)* is low, the condylar heads of the mandible are small, yet the mandibular notch is nearly rectangular with a moderately developed muscle adhesion surface. The chin is slightly protruding, tapering towards its point. The triangular eminence of the chin *(trigonum mentale)* is pointed.

The process of facial reconstruction

During the facial reconstruction, we rebuilt the soft tissues of the face on the plastic skull based on the shape of the bones so that they would faithfully reflect the original facial features. The reconstruction of the face was made with a traditional sculptural anatomical technique following scientific methodological guidelines.[29] The muscles modelled from plastiline were rebuilt onto the bones according to their real attachment points.[30] The thickness of the muscles was estimated from the roughness of the bone surface measured at 45 points of the skull and using a table of scientifically collected data.[31]

First, the measuring pins (markers) indicating the thickness of facial muscles and other soft tissues were fixed at 45 points on the plaster copy of the skull. The lengths of the markers were set according to the values of average soft tissue thickness as indicated in *Table 1*. Long pins were used to mark important morphological points (the corners of the eyes and mouth, the orifice between the lips) that would disappear under the layers of plastiline during modelling.

The eyes were replaced with eyeballs made of synthetic resin of a size (25 mm) that fit the eye sockets. The septal nasal cartilage *(septum nasi cartilagineum)* was constructed of harder wax to preserve the shape of the external part of the nose while modelling. The ridge of the nose and the cartilage of the tip of the nose were made of plastiline. The size of the external nose and the position of the tip of the nose were inferred from the shape of the nasal bones, the proportions of the nasal cavity, and the direction of the nasal spine.[32] The course and thickness of the mimetic muscles were reconstructed from the attachment of the muscles to the bones. We first reconstructed the deeper-lying muscles and then the upper muscle layer based on anatomical normalities, taking into account the unique characteristics of the bones *(figs. 6–7)*.

In the 'sculpting phase' of facial reconstruction, we modelled the details of the face. The principles of sculptural form helped the harmonious fitting of the parts of the face and their shaping into an organic whole.

The features of the reconstructed face

The reconstructed head shape faithfully reflects the shape of the skull. The head is broad and short. The forehead is narrow and convex. The *glabella* (the area between the eyebrows) and the brow ridges are a little prominent and slightly arched. The face has a medium width, tapering towards the mental protuberance. The neck is relatively strongly built.

The nasal root is moderately deep, while the nasal ridge is quite prominent and has a straight line. Due to the slightly rising nasal spine, the tip of the nose is turned somewhat upward, and it is tapering. In the frontal view of the face, the nasal root is narrow, the nasal ridge and the wings of the nose are medium broad. Based on the location of small eminences *(tuberculum palpebrale)* indicating where the medial and lateral palpebral ligaments *(ligamentum palpebrale mediale et laterale)* joined the inner and outer edges of the eye cavities *(orbita)*, the eye slits are horizontal. The eyes are located rather close to each other, with a medium-thick fold over the eyelids. The mouth is medium wide and quite full. Due to the protrusion of the front teeth, the lips are also protruding, and the upper incisors stick out a bit. The jaw is not pronounced, the mental eminence is slightly protruding. The unique characteristics of the ears cannot be seen on the skull, so the dimensions of the ears have been adapted to those of the nose and their shape is harmonious with other features of the face *(fig. 8)*.

The nutritional status cannot be inferred from the surface of the bones, either. We modelled the face assuming moderate nutrition.

The middle-aged woman lived for about 35-45 years, so on the reconstructed face – mainly on the forehead and at the nasal root – we already indicated the mimetic wrinkles typical of individuals of the mature *(maturus)* age group (40–60 years).

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[29] *Gerasimov 1949; Gerasimov 1971; Taylor 2000; Prag – Neave 1997.*

[30] *Kustár – Skultéty 1996* 179–190; *Sjøvold 1981* 203–204.

[31] *Röhrer-Ertl – Helmer 1984* 369–398.

[32] *Rynn – Wilkinson 2006* 364–373.

Measuring point	Degree	Thickness (mm)
Bregma (b)	1	4
Metopion (m)	1	4
Glabella (g)	1	5
Nasion (n)	1	4
Rhinion (rhi)	1	2
Philtrum (ph)	1	7
Labiomentale (lab)	1	7
Pogonion (pog)	1	8
Gnathion (gn)	1	7
Arcus sup.medialis (acm)	1	7
Arcus sup.lateralis (acl)	1	4
Ectoconchion (ek)	1	3
Orbitale (or)	1	3
Dacryon (da)	1	2
Lacrimale (la)	1	2
Lat.apertura pir. (lat.ap)	1	2
Alare (al)	1	3
Subspinale lat. (ss lat)	1	9
Caput mandibulae (cap)	1	3
Gonion (go)	2	4
Zygion (zyg)	1	2
Facies zygomaticus (fac.zyg)	1	4
Zygomaxillare (zm)	1	3
Proc.mastoideus (mast)	1	3
Lambda (l)	2	5
Opisthocranion (op)	2	5
Subnasale (sn) (H11)*		13
Labrale superius (ls)(H12)*		11
Labrale inferius (li)(H13)*		12
Mid mandibular border (mmb)(H28)*		11.5
Euryon (eu)(H29)*		5.5

Grades according to bone relief : 1. Very gracile, smooth
2. Less gracile, a little rough
3. Rough
4. Robust, very rough

* H11-H29 measurements according to Helmer (1980 in *Röhrer-Ertl – Helmer 1984*)

Table 1. The thickness data of soft tissues on the skull from Balatonkeresztúr-Réti-dűlő site, Grave 13

a

b

Fig. 6. a. The pins indicating the thickness of soft tissues were fixed on the plaster copy of the plastic skull from Balatonkeresztúr-Réti-dűlő site, Grave 13, and the eyes were replaced with plastic eyeballs (©Dániel Gerber); b. The muscles of mastication, the upper lips, and the external nose were modelled from plastiline. The corners of the mouth were marked with long needles (©Dániel Gerber)

Fig. 7. The reconstructed muscles of the right side of the face, already covered with skin. On the left side of the face, the layers of the mimetic muscles are still visible: the complex circular muscle around the orifice of the mouth and forming the majority of the lips *(m. orbicularis oris)*, and the mimetic muscles radiating into the mouth (from above: *m. levator labi superioris alaeque nasi, m. zygomaticus minor et major;* from below: *m. mentalis, m. depressor labi inferioris, m. depressor anguli oris*) (©Dániel Gerber)

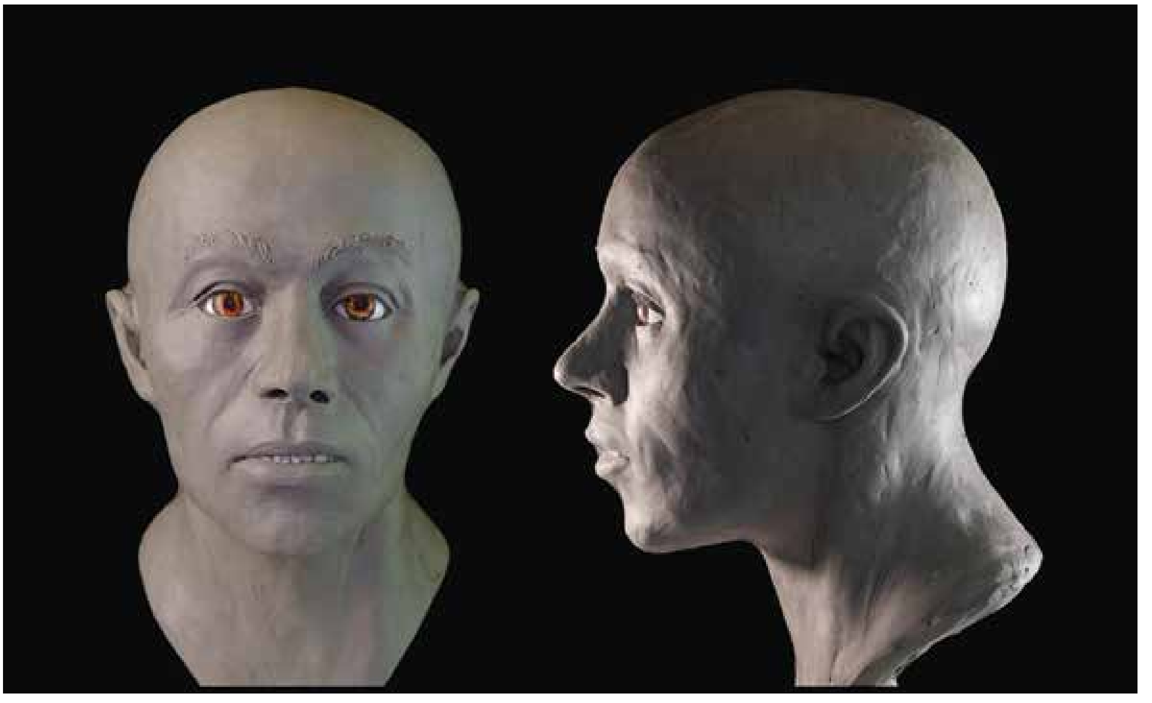

Fig. 8. The finished facial reconstruction of Balatonkeresztúr-Réti-dűlő, Grave 13; front view and side view (©Ágnes Kustár, ©Dániel Gerber)

Fig. 9. The plaster cast with lifelike colouring for the purpose of facial reconstruction from Balatonkeresztúr-Réti-dűlő, Grave 13 and with hair made of a wig; front view, side view (©Zsuzsa Herceg, ©Dániel Gerber)

Fig. 10. Lifelike coloured facial reconstruction of the woman called Jelena from Balatonkeresztúr-Réti-dűlő, Grave 13, half profile (©Ágnes Kustár, ©Zsuzsa Herceg, ©Dániel Gerber)

Phenotypic characteristics: eye colour, hair colour, and skin tone

Genetic data suggest creole-toned, freckled skin and light, bluish eyes with multiple brown pigments. The eyes, the lifelike skin colouring, and the reconstruction of the hair were prepared by restorer Zsuzsa Herceg accordingly *(figs. 9–10)*. The hairstyle was made of a darker-toned blondish brown wig with a braid of hair based on the depictions of contemporary women's fashion.[33]

Conclusions

Recent research has revealed that, in the beginning, the communities of the Early Bronze Age Kisapostag/Earliest Encrusted Pottery culture used inhumation to bury the dead. They placed the deceased in the grave on their sides in a sleeping position, with their legs pulled up, often without any grave goods. Less frequently, they put a small beaker next to the head and decorated the body with small pieces of jewellery (tiny tubular beads made of sheet copper and hair rings). In a later period of the culture, cremation burials became more and more dominant.[34] The graves of the twelve individuals arranged in two groups at the Balatonkeresztúr site followed inhumation burial rites mentioned above. The woman around the age of 35-45 years discovered in Grave 13 presented in our paper was buried in a slightly different position from the other deceased. According to radiocarbon tests, her burial most probably took place between 2040 and 1890 BC. Based on the data of the anthropological analysis, she must have been approximately 159 cm tall, which can be considered the average height of females in this era. Of her 29 preserved teeth, only one was affected by dental caries. There was no sign of an external injury or illness on her body, so the cause of her death is currently unknown. Copper or bronze bead fragments associated with the headdress or cap ornament found in the grave suggest that she had a relatively high social status within the community living at the settlement.

The composition of the nuclear genome of the woman called Jelena by our research team fits into the dataset available so far on the population of the Kisapostag/Earliest Encrusted Pottery

[33] *Kiss 2019* fig. 4. 5, 11.

[34] *Somogyi 2004; Szabó 2010; Kiss 2012; Hajdu et al. 2016; Kiss 2020a.*

culture. At the same time, the increased hunter-gatherer ancestry of her group is unique in this period, which clearly differentiates this community from the hitherto known Bronze Age populations of Europe.[35] In terms of family ties, Jelena did not have any first-degree relatives at the site, only possible second-degree relations among the deceaseds at Balatonkeresztúr.[36] Concerning her phenotypic characteristics, despite her steppe links, she was more similar to the Neolithic[37] people known so far: her skin was rather creole-coloured and had brownish blond hair of a darker shade. Her face may have been freckled, and her eyes were determined by genes responsible for both blue and brown pigmentation.[38]

The delicate-boned feminine skull, preserved in very good condition, allowed us to carry out the reconstruction of the woman's facial features. This was the first female facial reconstruction from the Bronze Age in Hungary. The completed work is also unique from the aspect that this was the first time in the history of Hungarian archaeological investigations when phenotypic features revealed by genetic analyses could be incorporated into the reconstruction. During the facial reconstruction, the soft tissues of the face were added to a plastic skull made with 3D printing technology after the CT image of the original skull to reflect the former facial features faithfully. The reconstruction of the face was carried out with traditional methods used in sculpture and anatomy following scientific methodological guidelines. The extent of nutrition could not be inferred from the surface of the bones, so we assumed normal nutrition, and modelled the face accordingly. On the reconstructed face – primarily on the forehead and at the nasal root – we already indicated mimetic wrinkles characteristic of mature people. The hair was braided in accordance with women's fashion reflected by contemporary clay figurines. The lifelike facial reconstruction allows us to get to know the face of a Bronze Age woman first time in Hungary, who lived near Lake Balaton four thousand years ago.[39]

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[36] *Gerber et al. preprint*, Supplementary Material fig. S.2.3.3.

[37] *Mathieson et al. 2015.*

[38] *Gerber et al. preprint.*

[39] The processing of the burial and the facial reconstruction were carried out with the support of the Lendület/Momentum programme of the Hungarian Academy of Sciences, in the frames of the Lendület/Momentum Mobility Research project "From Bones, Bronzes, and Sites to Society: Multidisciplinary Analysis of Human Mobility and Social Changes in Bronze Age Hungary (2500–1500 BC)" (LP2015-2). We owe special thanks for the Medical Imaging Centre of Semmelweis University for the CT scan of the skull, and for restorer Zsuzsa Herceg for the lifelike colouring of eyes, and skin, and the reconstruction of the hair.

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ESZTER MELIS – VIKTÓRIA KISS – GABRIELLA KULCSÁR –
GÁBOR SERLEGI – BENCE VÁGVÖLGYI

BRONZE AGE MICROREGIONAL SETTLEMENT INVESTIGATIONS IN THE LOCALITY OF NAGYCENK (NORTHWESTERN HUNGARY)

Zusammenfassung: In der Grenzregion Ostösterreichs, der Südwestslowakei und Westungarns sind relativ viele, auf die Zeit zwischen 2200/2100 und 1600/1500 v. Chr. datierbare Körperbestattungen, beziehungsweise Gräberfelder bekannt. Anhand der Riten und Beigaben, doch in erster Linie anhand der Keramiktypen dieser Bestattungen isolierte man am Anfang des 20. Jahrhunderts diese bronzezeitliche archäologische Kultur, die in der ungarischen Fachliteratur Gáta-Kultur, in der internationalen Fachliteratur Wieselburger Kultur genannt wird. Aufgrund der terminologischen Unterschiede wird diese Epoche in Österreich und in der Slowakei in die frühe, und in Ungarn in das Ende der frühen und in die mittlere Bronzezeit datiert. Der sogenannten Gáta–Wieselburg-Kultur können auf dem Gebiet des heutigen Österreichs über 1000, in Ungarn insgesamt 220 Gräber zugeordnet werden. Im Vergleich mit den Bestattungen und Streufunden sind in der Region weniger Siedlungen aus der frühen und mittleren Bronzezeit bekannt. Deshalb gilt der am Rande Nagycenks (Großzinkendorf) gelegene Fundort, den János Gömöri während der Kurvenkorrektur der Eisenbahngleise untersuchte, als herausragend, die Mitarbeiter des Soproner Museums deckten hier nämlich 150 m nordwestlich von 27 Körperbestattungen der Gáta–Wieselburg-Kultur Siedlungsspuren aus womöglich demselben Zeitalter auf. Die Forschungsgruppe Lendület/Momentum Mobilität des Archäologischen Instituts im Geisteswissenschaftlichen Forschungszentrum begann 2018 mit der Analyse der zum Gräberfeld und der Siedlung gehörenden Mikroregion. Das in vorliegender Studie aufgearbeitete Siedlungsmaterial deuten wir in breiterer Umgebung unserer mikroregionalen Forschungsarbeit und in Verbindung mit den bronzezeitlichen, im Tal des Arany-Bach beobachteten Niederlassungen, darüber hinaus widmen wir uns weiteren siedlungsgeschichtlichen Daten des Verbreitungsgebiets der Kultur.

Keywords: settlement, microregion, Early and Middle Bronze Age, Gáta–Wieselburg culture, Northwestern Hungary

Inhumation burials and even entire cemeteries dating to between 2200/2100 and 1600/1500 BC have long been known from the regions bordering Eastern Austria, Southwestern Slovakia and Western Hungary. From the beginning of the 20th century archaeological research came to refer to these assemblages as remnants of the Gáta (Hungary) or Wieselburg (Austria and Slovakia) cultural complex, characterised by inhumation burial traditions, and distinctive grave goods, particularly ceramic vessels *(fig. 1)*.[1] Since each country employed its own chronological terminologies, the duration of the cultural complex falls to the Early Bronze Age in the territories of Austria and Slovakia, and to the Middle Bronze Age in Hungary.[2] Today, over a 1000 burials

[1] *Miske 1917; Menghin 1921.*

[2] *P. Fischl et al. 2015; Kiss et al. 2019* 17–176. In this study, unless otherwise stated, the chronological classification developed by István Bóna specifically for the Hungarian Bronze Age (*Bóna 1975* 23–27) is being used.

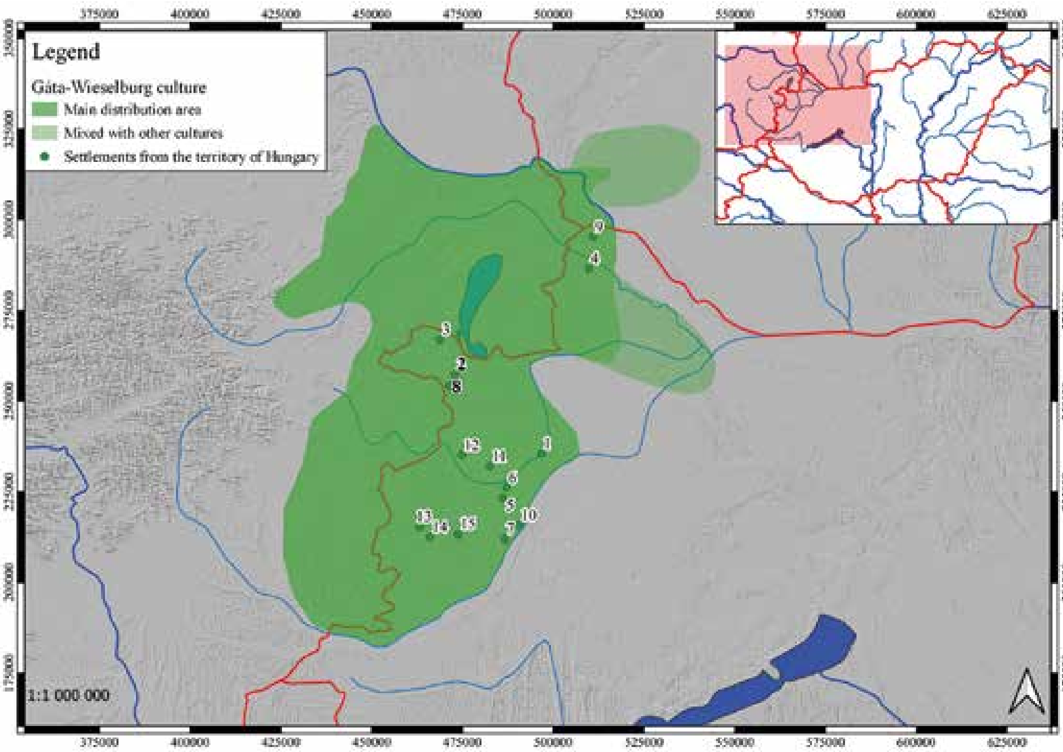

Fig. 1. The distribution of the Gáta–Wieselburg culture (after *Krenn-Leeb 2011* Abb. 1, *Nagy 2013* Abb. 1 and *Melis in prep.*) and its known settlement sites in Hungary (see *Table 1* the sites of the research area are in bold)

associated with the Gáta–Wieselburg culture are known from Austria,[3] while there are about 220 graves documented from Hungary.[4] As opposed to burials, however, Early and Middle Bronze Age settlement sites are less well explored in the region. Therefore, the occupation site examined by János Gömöri during the correction of the nearby railway track in the vicinity of Nagycenk is particularly significant, especially that about 150 m to the northwest from here, 27 inhumation burials along with evidence for prehistoric occupation were documented by representatives of the Museum of Sopron.[5] In 2018, the Nagycenk settlement site and mortuary features were investigated by the Momentum Mobility Research Group in detail within the framework of a microregional research project.[6] The current study presents the interpretation of the settlement data placed in the broader context of the Arany Stream microregion and considers its role within Bronze Age networks of occupation.

Where might be the settlements linked to the Gáta–Wieselburg burial grounds located?

The issue presented here, as it was touched upon in the introduction, is the lack of archaeological evidence for Bronze Age settlements from the region of Eastern Austria and Western Transdanubia. The site inventory collated in 1987, refers to several occupation sites linked directly to the Gáta–Wieselburg culture: e.g. Fischamend, Großhöflein/Föllik (Nagyhöflány, Austria), Leithaprodersdorf (Lajtapordány, Austria), Mannersdorf an der Leitha, Parndorf (Pándorfalu,

3 *Krenn-Leeb 2011* 12; *Aspöck 2018.*
4 *Melis 2020a* 77–79.
5 *Gömöri – Melis – Kiss 2018.*
6 *Melis et al. in print.*

Austria), Schwechat, Sommerein (Lajtasomorja, Austria), unfortunately, however, these sites remain unpublished.[7] Although non-destructive investigations have been carried out on an area of 600 km² along the Austrian course of the Leitha River, the data has limited relevance from the perspective of Central European Early Bronze Age settlement networks.[8]

The only recently published so far is Bratislava-Rusovce (Oroszvár, Slovakia). Here, pits and a few postholes were discovered within a 1 km radius north and south of the Gáta–Wieselburg culture's cemetery.[9] Archaeological investigations were limited to the construction sites of residential buildings, therefore, larger prehistoric structures and their layout could not be fully observed.[10]

From the territory of county Vas in Hungary, Marcella Nagy mentions settlement features associated with the Gáta–Wieselburg culture present at altogether five archaeological sites.[11] More recent excavations and the re-assessment of already existing collections increased the number of Gáta–Wieselburg settlements in county Vas and Győr-Moson-Sopron in Hungary. At present, there are around 15 settlement sites recorded from the two counties together *(fig. 1, Table 1)*.[12] In most cases, these sites were indicated by the presence of stray finds (e.g. at hilltop occupations),[13] or domestic features dating to the transition period between the Early and Middle Bronze Age.[14] The identification of such remains is difficult due to multiple phases of occupations spanning across several Bronze Age periods (e.g. Tumulus culture, *Litzenkeramik*, Věteřov). For example, 800 m southeast from the burial ground of Hegyeshalom-Újlakótelep, the settlement features of the Gáta–Wieselburg culture were discovered alongside refuse pits associated with the Tumulus culture.[15] Furthermore at Hegyfalu, mixed Gáta–Wieselburg and Tumulus culture assemblages came to light during the excavation of a building structure.[16] Although it has been observed at confirmed Gáta–Wieselburg sites in Austria that the Bronze Age settlements were located farther away from cemeteries.[17] Examples from Rusovce (Oroszvár, Slovakia), Nagycenk, Hegyeshalom and Szakony indicate that the burial grounds were established within a 1 km radius of the settlement, sometimes even closer, only a few hundred metres away.

The lack of information regarding Gáta–Wieselburg occupation sites is not unusual from the period of the Early and Middle Bronze Age. There are numerous settlement sites known from the territories of the contemporary Kisapostag-Early Encrusted Pottery culture and the Transdanubian Encrusted Pottery culture, however, most of these sites have also been inventoried

[7] *Leeb 1987* 236–237.

[8] *Doneus – Griebl 2015.*

[9] *Kőszegi 1958; Bóna 1975* 237–241; *Bazovský – Šefčáková 1999.*

[10] *Bartík et al. 2016.*

[11] *Nagy 2013* 79–80, Abb. 1.

[12] *Melis in prep.* The site of Fertőszéplak-Téglagyár has been inventoried based on the presence of a single settlement feature (clay quarry – *Bóna 1975* 232; *Leeb 1987* 277). Ceramic vessels and animal bones came to light from an uncertain context when sourcing clay at the same location *(Nováki 1956)*, these have also been classified as stray finds.

[13] Fertőboz-Gradinahegy: *Nováki 1975* 328, fig. 4; Fertőrákos-Kecskehegy: *Nováki 1997* 29–32. These two fortified settlements were dated to the Gáta–Wieselburg period by previous research, however the assemblages collected from here are still being processed, therefore it is yet to be confirmed if these could indeed be considered as Gáta–Wieselburg settlements. The radiocarbon date from the site made the Bronze Age dating of the fortification questionable, therefore it is more likely that the site functioned as a hilltop settlement during the Middle Bronze Age.

[14] E.g. Hegyfalu-Kőris-patak mente: *Mladoniczki – Mrenka 2019* 51.

[15] *Aszt 2008; Melis 2020b; Melis in prep.*

[16] *Károlyi 1984* 133–143.

[17] *Krenn-Leeb 2011* 19.

No.	Site name	Reg. no.	Site type	Archaeological investigation	Reference
1	Dénesfa-Szikes-dűlő	1678	settlement (surface scatter)	1975. Field survey by Sándor Faragó	Central Official Archaeology Database
2	**Fertőboz-Gradinahegy**	**1704**	**hilltop settlement, stray finds**	**1963–1964. Excavation by Gyula Nováki**	***Nováki 1964a; Nováki 1964b; Nováki 1965a; Nováki 1965b***
3	Fertőrákos-Kecskehegy	47593	hilltop settlement	1948. Excavation by Gyula Nováki	*Nováki 1952; Nováki 1997* 118–134
4	Hegyeshalom-Országúti-dűlő	53597	settlement	2007. Excavation by Ágnes Aszt, 2014–2015. Krisztina Pesti and Róbert Herbály, 2016. András Hargitai	*Aszt 2008; Melis 2020b* 357
5	Hegyfalu-Kőris-patak mente	67183	settlement	2012. Excavation by Réka Mladoniczki and Attila Mrenka	*Mladoniczki – Mrenka 2019* 51
6	Hegyfalu-Tehenészet	42979	settlement	1972. Excavation by Mária Károlyi	*Károlyi 1984; Nagy 2013* 79; *Kolonits 2020* Table 1
7	Ikervár-Pinkóci-dűlőtől É-ra	77109	settlement, ceramic hoard?	2010. Excavation by Marcella Nagy	*Nagy et al. 2012* 99, personal communication; *Kolonits 2020* Table 1
8	**Nagycenk-Kövesmező**	**61358**	**settlement, burial, ceramic hoard**	**2004–2005. Excavation by János Gömöri**	***Zoffmann 2008; Gömöri 2012* 12–13; *Gömöri 2016; Gömöri – Melis – Kiss 2018***
9	Rajka-Hosszú-szántók	54025	settlement	1996. Excavation by András Figler	Central Official Archaeology Database
10	Sárvár-Szaput-dűlő and Móka-dűlő II.	34889, 34894	settlement	2002. Excavation by Péter Kiss and Ildikó Katalin Pap	*Békei 2007; Nagy 2013* 79–80; *Kolonits 2020* Table 1
11	Simaság-Kavicsbánya and Kavicsbányától Ny-ra	43147 (49118)	burial, settlement remains (surface scatter)	1962. Field survey by Terézia Buócz	*Károlyi 1975* 186–187; *Ilon 1996* 27; *Nagy 2013* 80; *Kolonits 2020* Table 1
12	Szakony-Kavicsbánya	34028	burial, settlement	1964. Excavation by Gyula Nováki	*Nováki 1965c; Ilon 1996* 27
13	Szombathely-Reiszig erdő alatti dűlő	67939	settlement	2002. Excavation by Gábor Ilon	*Horváth – Wild 2017* 105
14	Szombathely-Romkert	22816	settlement	1980. Excavation by Terézia Buócz	*Károlyi 2004* 179, fig. 135; *Nagy 2013* 80; *Kolonits 2020* Table 1
15	Vép-Mejc földek	43104	settlement	2007. Excavation by Ottó Sosztarits	*Nagy 2013* 80; *Kolonits 2020* Table 1

Table 1. The settlement sites of the Gáta–Wieselburg culture in Hungary (the sites of the research area are in bold)

based on preliminary field survey reports.[18] In the majority of cases, these are horizontal, single-layer occupation sites surrounded by a ditch. However, hilltop settlements and fortified settlements situated in mountainous areas also occur.[19] Similarly, from the territories of Austria, Germany, the Czech Republic and Slovakia inhumation cemeteries and burials of the contemporaneous Únětice culture complex have been dominating in the archaeological publications.[20] Thanks to large-scale and targeted investigations there are now considerable amount of information available regarding the construction of buildings and settlement layout of the Únětice culture complex.[21]

The archaeological sites at Nagycenk and its the microregion

The archaeological record testifies to that the region of Lake Neusiedl/Fertő had always been a significant meeting zone for populations settled between the Carpathian Basin and the western territories of Central Europe. This area corresponds with the distribution of the Gáta–Wieselburg culture stretching between the Rába River and the Vienna Basin dating to the late Early Bronze Age and to the entire period of the Middle Bronze Age (2200/2100–1600/1500 BC) *(fig. 1).*[22] In 2004–2005, during the course of an archaeological investigation led by János Gömöri at Nagycenk-Lapos-rét and at Nagycenk-Kövesmező two, previously unknown Gáta–Wieselburg sites (a settlement and a cemetery) were documented.[23] The eastern shores of Lake Fertő (today in the territory of Hungary) and the fields surrounding modern villages in the closer region are rich in archaeological finds, many of these are Bronze Age assemblages.[24] Therefore the boundaries of our microregional study have been drawn along the southern fringes of the Fertő Basin, marked by the Middle Bronze Age hilltop settlement of Fertőboz-Gradinahegy excavated by Gyula Nováki.[25] The study region covers an area of 14 km², stretching from the Arany Stream, through the Ikva Valley to the peripheries of the Fertő Basin; our aim was to provide a cross-section of the region's archaeological topography, focusing primarily on Bronze Age remains *(fig. 2).*

Environment and geography

The microregion under study is situated within the so-called Western Hungarian periphery region, stretching across the Sopron–Vas plain, covering the territories of the Ikva floodplains, the Arany Stream Valley, the Fertő Basin and the areas northwest between the Fertőmellék hills and the Sopron Basin. Administratively it is located in the county of Győr-Moson-Sopron, more precisely in the vicinity of Nagycenk and Fertőboz, including the neighbouring areas of the Hidegség, Pereszteg, Kópháza and Sopron to a smaller extent. Its southern boundary is marked by a 1 km wide strip that runs along the now regulated Hungarian course of the Arany Stream; its northern fringes are represented by the Kisalföld and the Western Hungarian periphery region.[26] The exact perimeters of the study area correspond with current boundaries of fields under cultivation.

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18 *Bándi 1967; Csányi 1978; Torma 1972; Nováki 1979; Honti – Kiss 1996; Honti – Kiss 1998; Vadász 2001; Kiss – Somogyi 2004.*

19 *Kiss 2003; Kiss 2012a* 205–216.

20 E.g. Rebešovice (Czech Republic): *Ondráček 1962;* Grossbrembach (Germany): *Ullrich 1972.*

21 *Meller et al. 2019.*

22 *Leeb 1987; Gömöri 2012* Abb. 108; *Nagy 2013* Abb. 1; *Melis 2017* fig. 1.

23 *Gömöri 2011; Gömöri 2012; Gömöri 2016; Gömöri – Melis – Kiss 2018.*

24 *Gömöri 2012* 272–276.

25 So far, there has been a single preliminary site report available from here *(Nováki 1964a; Nováki 1964b; Nováki 1965a; Nováki 1965b).* The Bronze Age assemblages are currently being processed by Katalin Jankovits within the remit of the Momentum Mobility Research Project *(Jankovits in prep.).*

26 *Dövényi 2010* 370.

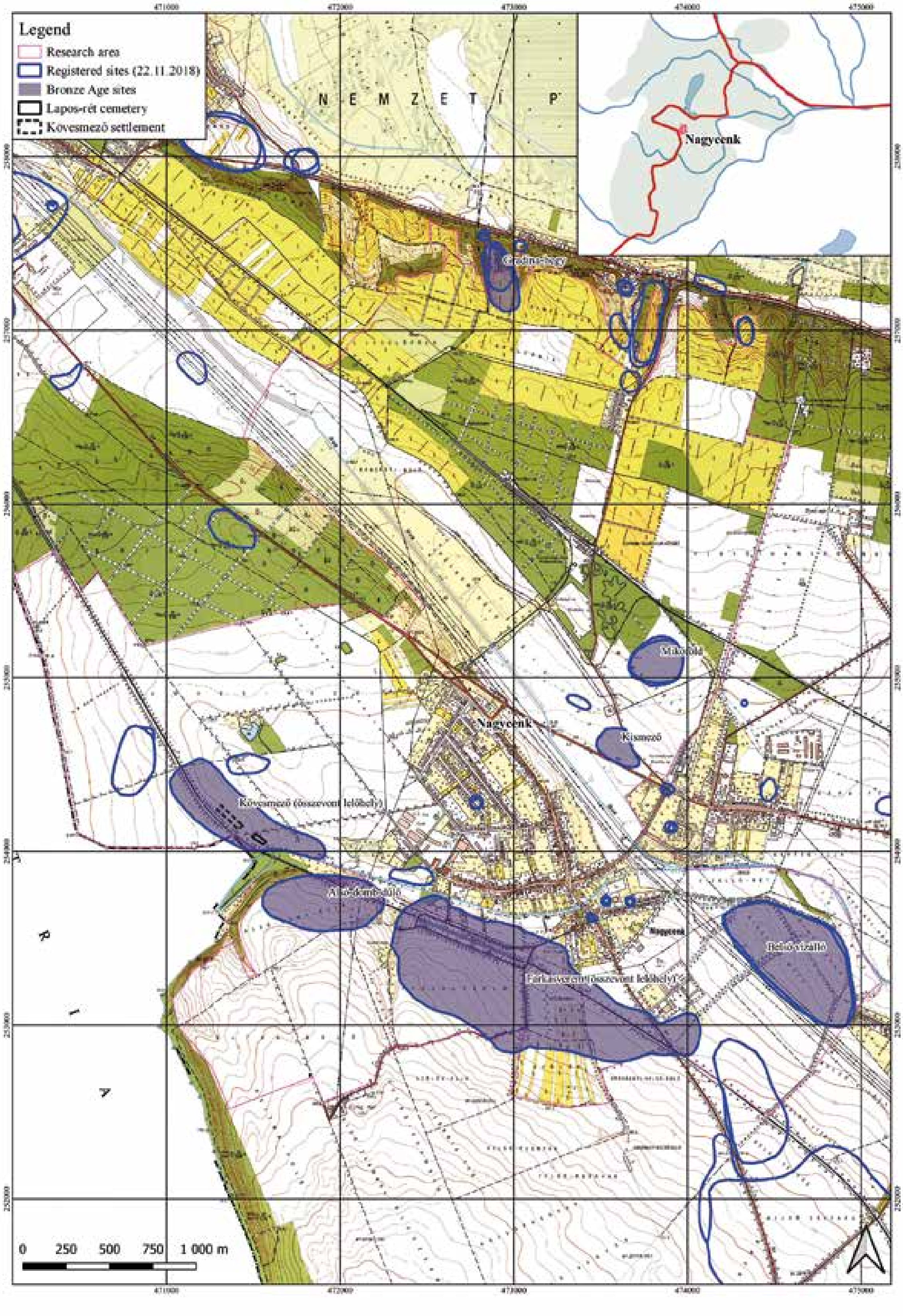

Fig. 2. The study area showing the inventoried sites (data collected by 22.11.2018), with the location of the Nagycenk-Kövesmező and the Nagycenk-Lapos-rét excavations

At present, the alluvial plains of the Ikva River consisting mainly of gravel have eroded away. The alluvial gravel deposits remain intact only along the southern edges of the Fertő Basin, from Balf to Hegykő. The river bed consists of layers of the so-called Sopron mica, its depth varies measuring approx. 2.5 km in the Nagycenk depression. The Ikva floodplain is surrounded by the Sopron Hills, the Fertő Basin and the Répce River plain. The landscape is enveloped by a variety of alluvia deposited at different chronological periods shaped into terraces by erosion.[27]

The entire microregion represents the water catchment area of the Ikva River; its longest tributary, the Arany Stream (19 km, 135 km²) joins the main flow of the Ikva at Nagycenk – however, only 20 km² of the water catchment lies currently within the administrative boundaries of Hungary. Depictions on historical maps indicate[28] that the Kiscenk section of the Ikva was regulated in the first half of the 19th century. Maps produced for the First Military Survey of the Habsburg Empire (Kingdom of Hungary 1782–1785) show the confluence of the Arany and Ikva Streams before regulation *(fig. 12. 2)*. The Ikva plain consists primarily of alluvial gravel formed into terraces by later erosion events, covered by mixed deposits of fine glacial clays, sands, and loesses sitting in the lower lying areas. Farther away the Arany and the Ikva Streams are fringed by Holocene riverine deposits and Pleistocene sand-gravel alluvia. Along the southern shores of the Arany Stream and the southern peripheries of the Fertő Basin tertiary clay and aleurite formations dominate.[29] On top of these deposits covering the Ikva Plain forest soils (82%) and brown soils (52%) developed. Brown forest soils with the occasional clay inwash frame the microregion from the south (18%), the soils developed dominantly on thin (40–60 cm) gravel alluvia blanketed by riverine clays in places, and only in the area surrounding Nagycenk were the soils established on tertiary glacial deposits. These latter consist of aquitard clayey loames. Across the floodplains of the Ikva riverine deposits and alluvial soils dominate.[30]

Archaeological investigations

Although the county of Győr-Moson-Sopron and the territories of Nagycenk and Fertőboz were not included in the surveys carried out for the volumes of the Hungarian Archaeological Topography,[31] thanks to the efforts of the Museum of Sopron's staff, the region can now be considered archaeologically well-evaluated. János Gömöri has been playing a key role in these projects, both on the field and in the publication of the data as well.[32] According to his observations the archaeological assemblages (of various periods) seem to occur most densely along the shores of the Arany Stream, indicating that the Arany Valley could have been used for occupations throughout a number of different time periods. Furthermore, it is likely that an important route of communication ran through the valley since prehistory. The assemblages collected from here show similarities with sites located along the southern shores of Lake Fertő.

The pioneering works of Gyula Nováki represent an important step in the research of fortified settlements along Lake Fertő. Nováki established the dating of the Fertőrákos-Kecskehegy and Fertőboz-Gradina-hegy settlements to the Early and Middle Bronze Age. The site of Gradina-hegy – which lies within our study area – was investigated by Nováki in 1963–1964, confirming

[27] *Dövényi 2010* 370.

[28] The planned regulation of the Ikva River, the Arany Stream and their artificial courses between Nagycenk and Kiscenk in 1805. (https://maps.hungaricana.hu/hu/OSZKTerkeptar/631/ [last accessed: 13.06.2022])

[29] *Gyalog 2005.*

[30] *Dövényi 2010* 371–372.

[31] *Bondár 2017; Jankovich 2010.*

[32] *Gömöri 2012; Gömöri 2016.*

its classification to the period of the Gáta–Wieselburg culture, although a few fragments of *Litzenkeramik* also came to light from the location.[33]

In the early 2000s, track correction works were carried out on the railway line connecting Sopron and Szombathely; including the section at Nagycenk on the northern shores of the Arany Stream, right next to the Austrian border. The construction affected the southwestern sector of the archaeological site, therefore it was possible to investigate an area of 100×60 m at Lapos-rét dűlő, northwest of the Arany Stream. The excavation was led by János Gömöri and representatives of the Museum of Sopron in 2004–2005. On the southern slopes of the largely waterlogged field towards the Arany Stream refuse pits of the Late Neolithic Lengyel culture came to light,[34] while the southern sector of the Gáta–Wieselburg cemetery was discovered between remains of Árpádian-period *Tóthczenk*[35] buildings. Between March and April in 2005, settlement features[36] were unearthed at Nagycenk-Kövesmező on an area approx. 3700 m², 150–200 m north of the Bronze Age cemetery; the archaeological assemblages discovered from here correlate well with the finds from the associated burial site *(fig. 2)*.[37]

Between 2015 and 2019 a range of different investigations were carried out prior to the construction of Road M85; field surveys, geophysical examinations, trial trenching and excavations were all conducted along the southern shores of the Arany Stream, making it possible to gain a detailed insight into the archaeological topography of the area. As a result, the number of identified archaeological sites increased, and multi-period occupation sites were observed in more detail across a large area. The investigations identified a section of a settlement associated with the *Litzenkeramik* and the Maďarovce–Tumulus culture at Nagycenk-Alsó-domb-dűlő, and an outstandingly rich Bronze Age burial ground of the Gáta–Wieselburg culture at Nagycenk-Farkasverem.[38] In the study area covering 14 km² altogether 20 archaeological sites have been identified, equating to the density of 1.43 site/km² which is considered high in the context of Hungary.[39]

In 2018, the Momentum Mobility Research Group coordinated by the Institute of Archaeology at the Research Centre for Humanities began a microregional project focusing on the area surrounding Nagycenk following the investigations in 2004–2005 which unearthed Bronze Age burials and part of a settlement.[40] The first step in our methodology was to carry out systematic field surveys covering a large area in order to establish the extent and outline the boundaries of sites belonging to different periods. Although there were several large sites located within the study area, these usually represented a palimpsest of different occupations both in terms of time and also of type. Therefore in the heritage inventory these sites are referred to as 'site-complexes'[41] (e.g. Nagycenk-Lapos-rét and Nagycenk-Kövesmező were inventoried as one site-

[33] *Nováki 1964a; Nováki 1964b; Nováki 1965a; Nováki 1965b; Bándi 1972* 42, Map 1, 16a; *Nováki 1975* 328, fig. 4; *Gömöri 2012* 16.

[34] *Gömöri 2007; Gömöri 2011.*

[35] *Gömöri 2016.*

[36] A few shallower pits and find concentrations documented between regular grave-pits might represent the decayed burials of the Gáta–Wieselburg culture.

[37] Archaeological investigations carried out by János Gömöri at Nagycenk-Kövesmező: 27.10.2004. – 24.03.2005: Nagycenk-Lapos-rét: a cemetery of the Gáta–Wieselburg culture, a settlement of the Lengyel culture, and a village dating to the Árpádian period *(Gömöri 2007, Gömöri 2011, Gömöri 2012, Gömöri 2016, Gömöri – Melis – Kiss 2018),* 30.03.2005. – 02.05.2005: Nagycenk-Kövesmező: traces of a Bronze Age settlement, 05.–06.2005: Observation of the most recent riverbed of the Arany Stream, Bronze Age find concentrations.

[38] *Savanyú 2020a; Savanyú 2020b;* Bálint Savanyú and Attila Mrenka, personal communication.

[39] C.f. *Stribányi – Mesterházy – Padányi-Gulyás 2012* 9, fig. 19.

[40] *Melis et al. in print.*

[41] *Rényi – Stibrányi 2011* 190.

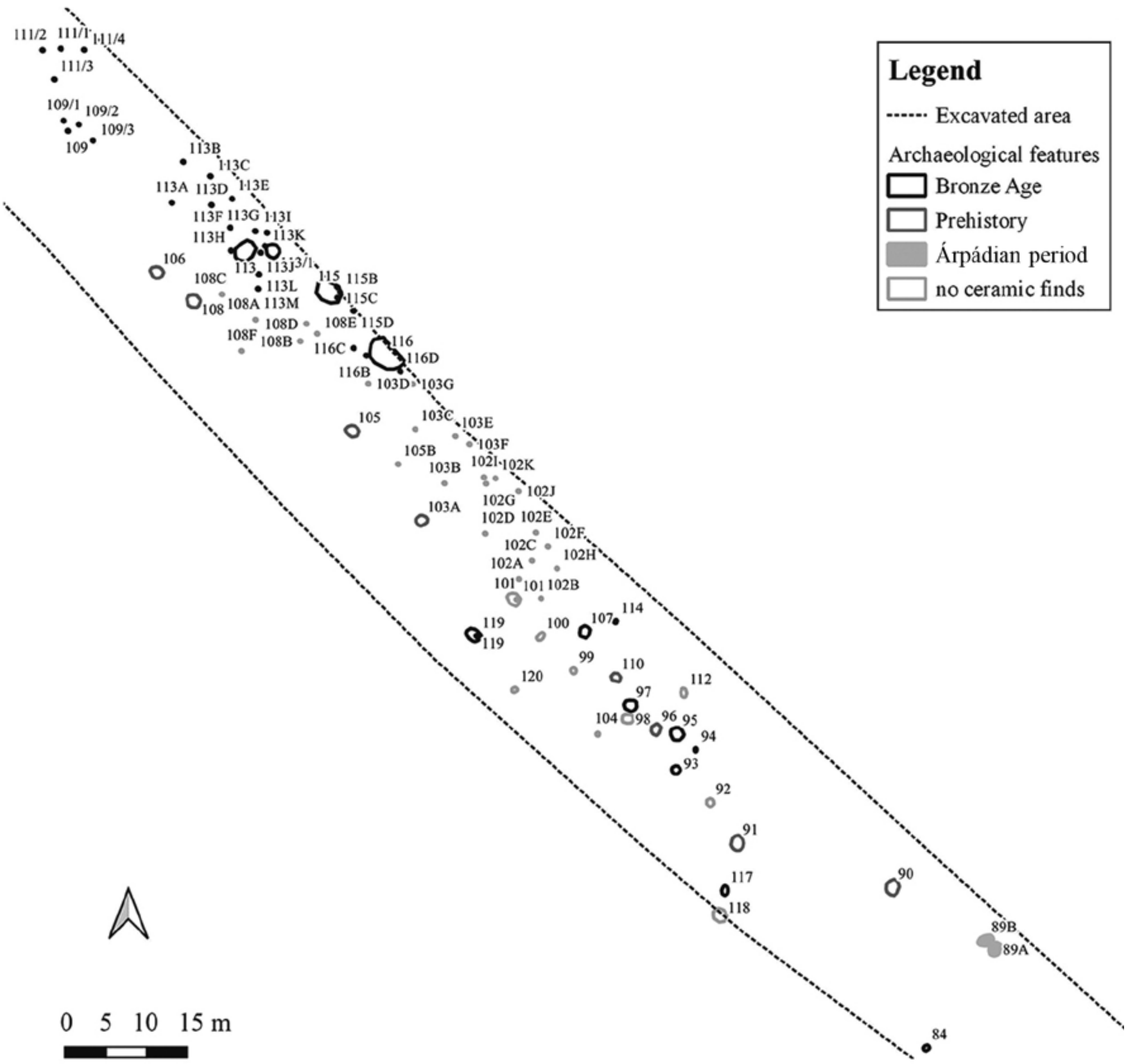

Fig. 3. Features discovered at Nagycenk-Kövesmező in 2005
(after the documentation plan by KÖH 600/2575/2009)

complex: Nagycenk-Kövesmező). During the field surveys conducted at these multi-period site-complexes, our primary aim was to identify Bronze Age settlement features, along with the identification of so far unknown sites based on ceramic surface collections.

Over half of the study area (approx. 750 ha) was under modern cultivation. On these areas we carried out systematic field surveys specifically developed for regional projects.[42] Field walking was conducted in grids of 25 metres in alignment with the EOV coordinates. Archaeological material was collected by walking each grid in strips from north to south. The exact location of each find was documented by a hand-held GPS and the material was bagged every 50 metres. Therefore these 50×50 m grids (aligned with the EOV coordinates) formed the basic units of our surface collections.[43] Later, the finds were being processed and classified according to these units, before the information was entered and plotted using a geoinformatics software (QGIS) *(fig. 12. 1).*

42 *Mesterházy 2013.*
43 *Neumann et al. 2014; Füzesi et al. 2015.*

The systematic surface collections conducted on an area of nearly 500 ha in 2018–2019 produced 521 units containing 2028 ceramic fragments which have been identified and processed. This method made it possible to investigate large areas in detail located in the southern half of the microregion along the Arany Stream.[44] This was supplemented by review of the archaeological material excavated at the Bronze Age settlement site of Nagycenk-Kövesmező in 2005, and the preliminary results of the investigations conducted prior to the construction of Road M85.

The settlement features and archaeological assemblages of Nagycenk-Kövesmező

In 2005, about a 150 m north of the Gáta–Wieselburg burials[45] at Nagycenk-Lapos-rét a number of settlement features were discovered during railway track correction works *(fig. 3)*. The excavation was carried out by the staff of the Sopron Museum under the supervision of János Gömöri. The area was investigated in a 22–24 m wide strip which contained evidence of occupation in a length of 165 m. Domestic refuse pits and postholes (apart from one – pit no. 107) did not contain much archaeological material. However, the archaeologist documented and collected the material from so-called 'find concentrations' as well which became visible right after stripping away the top soil. With the aid of the small amount of ceramic fragments the majority of settlement features could be classified as prehistoric, apart from refuse pits located in the southeast (pit nos 89A–B) which were identified as Árpádian-period. Some archaeological features lacked material completely, and in most cases ceramic pieces were poorly preserved which made their classification difficult. The next section will provide the description of Bronze Age domestic features and the archaeological material these contained.[46]

Pit no. 84 *(fig. 3. 84; fig. 4. 1–9)*

It first appeared as a concentration of ceramics on the stripped surface. The feature turned out to be a refuse pit of 60–70 cm in diameter.

Ceramics[47] (81 pieces), 7 vessels for serving or consumption, 12 vessels for cooking or storage.

Diagnostic pieces:

1. Body sherd of a jug/cup with erdoded exterior. Impressed or stamped double zig-zag pattern on the side (created by a comb-like implement) to which incised line bundles join. Brownish grey in colour, the clay fabric is rich in sand and quartz inclusions. Wth: 0.6 cm, 3.5×3.1 cm *(fig. 4. 2)*.
2. Fragment of a jug with a bulging belly. It is decorated with a pair of incised and striped triangles. Reddish brown in colour, the clay fabric is rich in sand and mica. Wth: 0.5 cm, 3.9×3.9 cm *(fig. 4. 4)*.
3. Truncated-cone shaped bowl. Its rim is outcurving. The exterior is uneven, fired to a patchy reddish brown colour. The clay fabric is rich in small quartzite and grog. Wth: 0.4–0.6 cm, Rd: 9 cm, Bd: 6 cm, H: 3 cm *(fig. 4. 3)*.
4. Fragments of an ovoid cooking pot with short, outcurving neck. Grey in colour with reddish spots. Clay fabric is rich in small quartzite and grog. Wth: 0.5 cm, H: 6 cm, Rd: 16 cm *(fig. 4. 5)*.
5. Fragments of a cooking pot with long outcurving neck. Light greyish brown in colour with grey patches. Exterior was burnished originally. Clay fabric is rich in quartzite inclusions and grog to a lesser extent. Wth: 0.4–0.7 cm, Rd: 20 cm, Bd: 9 cm *(fig. 4. 6)*.

[44] *Melis et al. in print.*

[45] *Gömöri – Melis – Kiss 2018.*

[46] Abbreviations: Wth: wall thickness, Rd: rim diameter, Bd: base diameter, H: height, L: length, W: width, Th: thickness.

[47] The fragment pieces collected are in brackets, followed by the estimated number of consumption or cooking vessels.

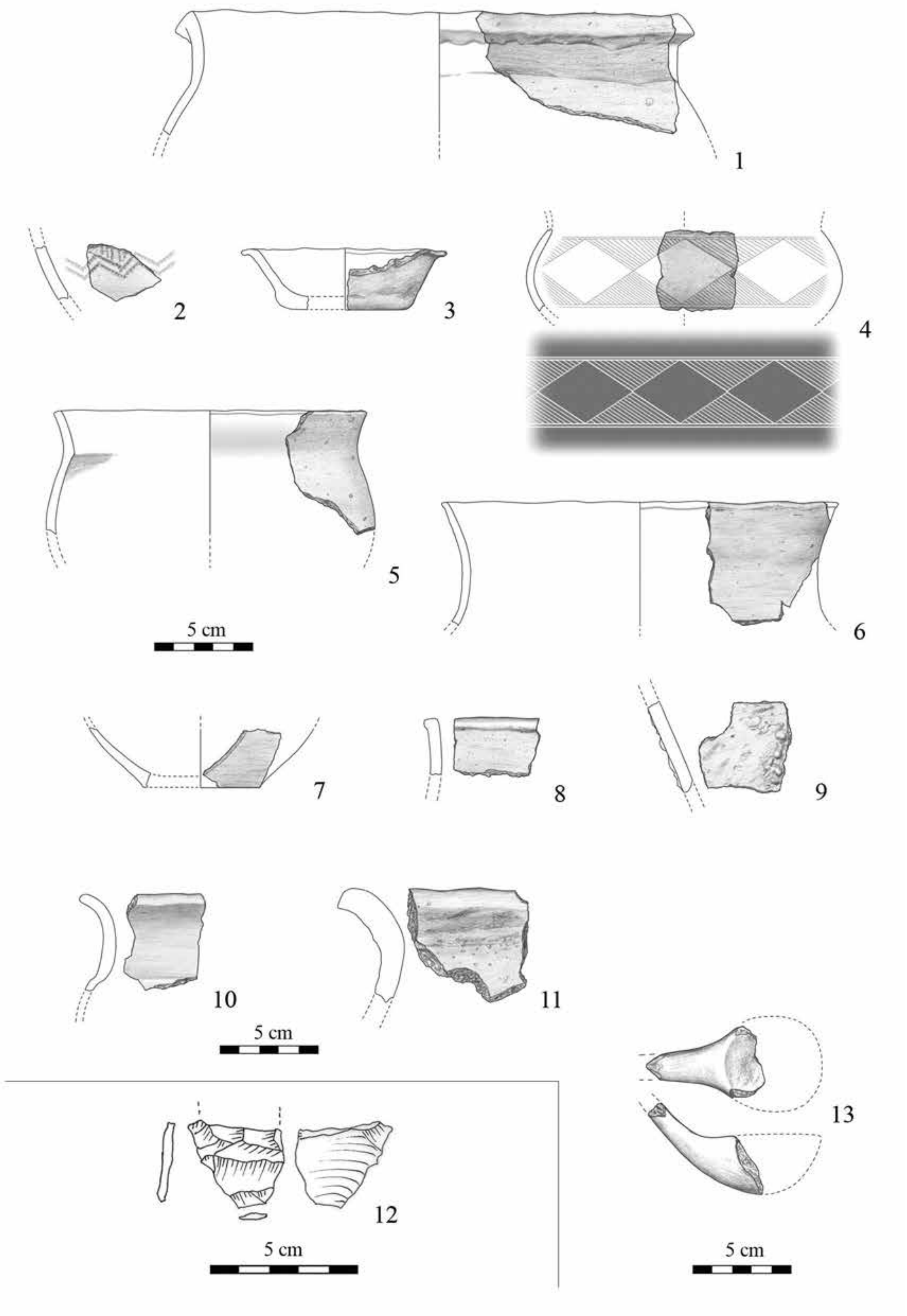

Fig. 4. 1–9. Ceramic fragments from pit no. 84 and its surroundings; 10–11. Ceramic sherds from 'find concentration' no. 97; 12. Stone tool from 'find concentration' no. 97; 13. Ceramic spoon found alongside pit no. 95 (1–11, 13: ©László Gucsi; 12: ©Anna Priskin)

6. Fragment of a large cooking pot with horizontally cut and thickened rim. Its exterior is moderately burnished, light brown in colour. The clay fabric contains sand and small quartzite inclusions. Wth: 0.6 cm, 2.9× 4 cm *(fig. 4. 8).*
7. Base fragment of a cup with burnished exterior which is light brown in colour with grey patches. Fabric contains mica and grog. Wth: 0.4 cm, H: 4 cm, Bd: 3 cm *(fig. 4. 7).*
8. Lower body fragment of a large pot. With splashed, uneven exterior. Reddish brown in colour, clay fabric is rich in sand and small quartzite. Wth: 0.7 cm, 4,2×4,3 cm *(fig. 4. 9).*
9. Fragments of a storage vessel found north of pit no. 84. It has a collared rim and an impressed channel on its shoulder. Dark grey in colour, the clay fabric is rich in small-medium quartzite inclusions. Wth: 0.6–0.9 cm, H: 6.5 cm, Rd: 24 cm *(fig. 4. 1).*

Animal bones:

Fragment of a cattle's right *maxilla* (with 2nd upper molar *in situ*).

Pit no. 93 *(fig. 3. 93)*

Round, shallow pit that became visible right under the plough soil. Diameter: 82–92 cm, depth: 7–10 cm.

Ceramics (21 pieces), 3 vessels for serving or consumption, 3 non-diagnostic fragments of vessels used for cooking or storage.

Posthole no. 94 *(fig. 3. 94)*

Posthole with straight vertical sides and ovoid in plan. Depth: approx. 10 cm, D: 43 cm. In the section the gravel layer embedded in the clay matrix is discontinued at this point.

Ceramics (60 pieces), 5 vessels for consumption or serving, 7 vessels for cooking or storage.

Diagnostic pieces:

1. The lower section of a medium-sized cooking pot with rusticated exterior. Wth: 0.6 cm, 3.9×3.1 cm.

Pit no. 95 and its surroundings *(fig. 3. 95; fig. 4. 13)*

The feature consists of two small find concentrations sitting in a shallow depression.

Ceramics (30 pieces), 4 vessels for consumption or serving, 4 vessels for cooking or storage, 1 ceramic object of some kind.

Diagnostic pieces:

1. Body sherds of a grey amphora with biconical belly. The exterior is uneven, the clay fabric contains small and medium sized quartzite inclusions. Wth: 0.8–0.9 cm, H: 6.7 cm.
2. A neck fragment collected north of pit no. 95. from an area of 10×10 m. The sherd is burnished, reddish brown in colour with a lightly impressed channel. The clay fabric is rich in sand and small quartzite inclusions. Wth: 0.5 cm, H: 3.5 cm.
3. A ceramic spoon collected north of pit no. 95. from an area of 10×10 m. It is yellowish brown in colour, the handle and the root of the handle present. Wth: 0.6 cm, 6.4×3.4 cm *(fig. 4. 13).*

Feature no. 97 'find concentration' *(fig. 3. 97; fig. 4. 10–12)*

According to the plan the find concentration appeared above the subsoil.

Ceramics (26 pieces), 7 vessels for consumption or serving, 2 vessels for cooking or storage.

Diagnostic pieces:

1. Deep bowl with channelled neck and outcurving rim. Dark grey in colour, its clay fabric is rich in small quartzite inclusions and mica. Wth: 0.7 cm, 4.8×3.8 cm *(fig. 4. 10).*
2. Fragments of a thick walled storage vessel with strongly outcurving rim. Light brown in colour, its clay fabric contains small quartzite. Wth: 1–1.4 cm, H: 2.1–5.8 cm, Rd: 25 cm *(fig. 4. 11).*

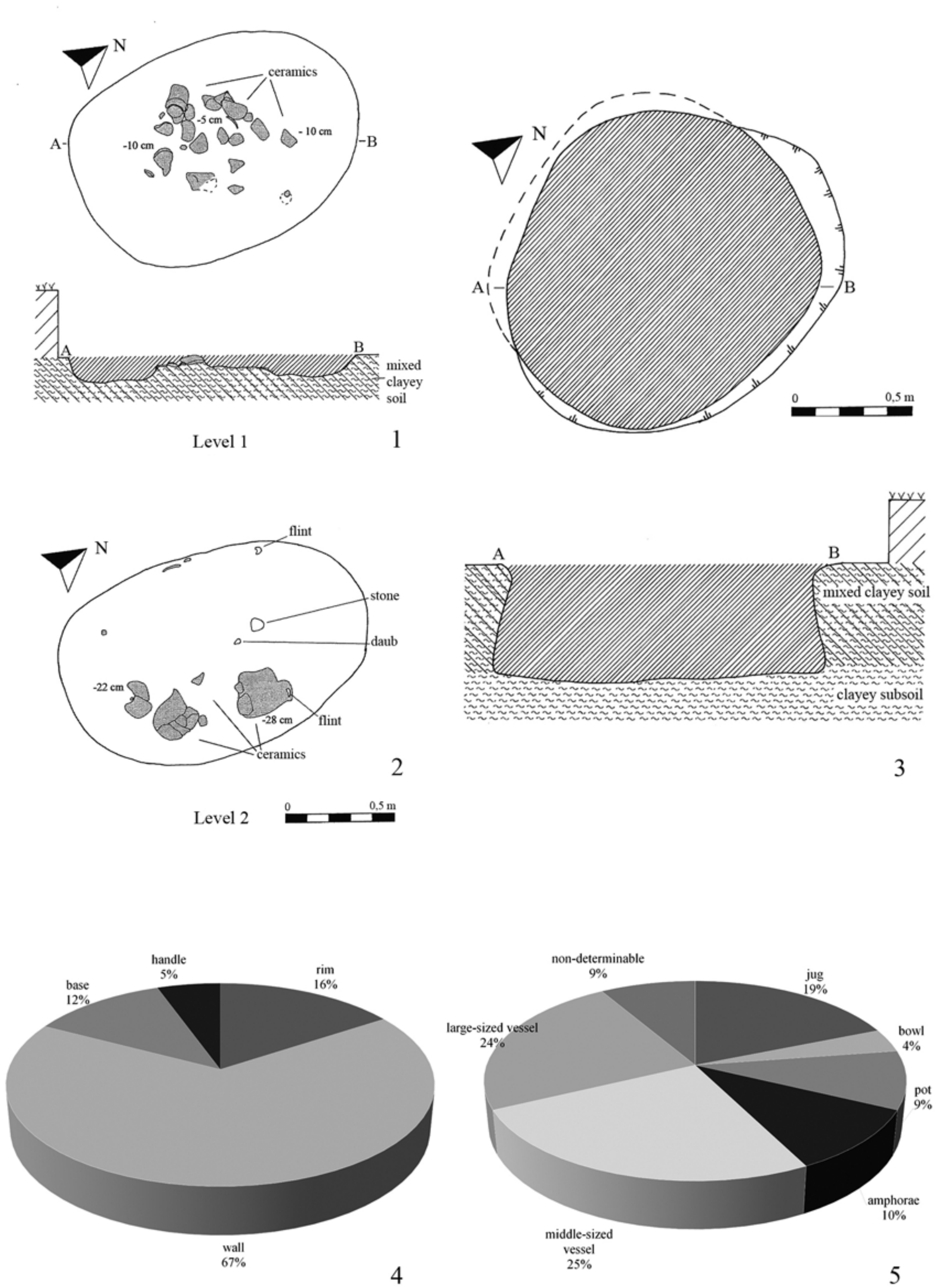

Fig. 5. 1. Context no. 1 in plan and in section of pit no. 107; 2. Context no. 2 in plan of pit no. 107; 3. The plan and section of pit no. 107; 4. Proportion of ceramic fragments from pit no. 107; 5. Proportion of ceramic vessel types from pit no. 107

Stone:

1. Proximal fragment of a shaping flake. It is trapezoidal in cross-section, bulb of percussion is large, the striking platform is faceted. Its sides become broader towards the middle section of the flake. On the ventral side there is evidence for the removal of several flakes. Raw material: radiolarite from Szentgál. L: 1.97 cm (incomplete), W: 2.47 cm, Th: 0.29 cm *(fig. 4. 12).*

Pit no. 107 *(fig. 3. 107; figs. 5–7; fig. 8. 1–4)*

It appeared as an oval patch following the removal of the top soil. Its diameters are 94 and 127 cm. Depth: 45 cm. Larger ceramic fragments were documented *in situ* in two of the fills: 1) at the depth of -10 cm *(fig. 5. 1)* and 2) at 22–28 cm *(fig. 5. 2)*. The second fill context contained the fragments of three larger vessels (Vessel nos. 18–20). After the pit was emptied, it turned out to be a rounded, beehive-shaped feature which was utilised secondarily as a domestic refuse pit *(fig. 5. 3).*

Ceramics (632 pieces), 59 vessels for consumption or serving, 39 vessels for cooking or storage *(fig. 5. 4–5).*

Diagnostic pieces:

1. Small-sized cooking pot with curved body, an oval knob attached to its neck. Greyish brown in colour, the burnishing on the exterior eroded. Clay fabric is rich in small-medium sized quartzite inclusions. Wth: 0.8 cm, 4.9×5.5 cm *(fig. 7. 3).*
2. Body sherds of an ovoid cooking pot with rusticated exterior. It is dark grey and light brown in colour, with clay residue sitting in the rusticated cravices. Wth: 0.7 cm, 5.2×13.5 cm *(fig. 7. 5).*
3. Body sherds of an ovoid cooking or storage vessel with deeply rusticated exterior. Reddish brown in colour, clay fabric is rich in small quartzite and mica. Wth: 0.7–1 cm, H: 1.8–6.9 cm *(fig. 7. 8).*
4. Body sherds of a large, cylindrical cooking pot with rusticated exterior. Brownish grey in colour, clay fabric is rich in small quartzite and mica. Wth: 0.6–0.8 cm, H: 1.9–5.8 cm *(fig. 7. 6).*
5. Truncated-cone shaped bowl with thick, diagonally cut inwards turning rim. It has a burnished exterior and patchy grey colour. Its clay fabric is rich in small-medium quartzite inclusions. Traces of smoothing present on the interior of the rim by some kind of plant stem. Wth: 0.6–0.7 cm, 11.4×8.7 cm, Rd: 24 cm *(fig. 6. 1).*
6. Small fragment of a truncated-cone shaped bowl with thick, diagonally cut inwards turning rim. It has a burnished exterior and light brown colour. Its clay fabric is rich in sand and small quartzite inclusions. Wth: 0.6 cm, 2.1×1.9 cm *(fig. 6. 2).*
7. Shoulder fragments of a dark grey ovoid amphora. Unevenly smoothed exterior, triangular ribs below the neck. Its clay fabric rich in small-medium quartzite inclusions. Wth: 0.6 cm, 11.3×5.5 cm *(fig. 7. 1).*
8. Fragments of a dark grey coloured amphora. Its exterior is burnished, the fracture surfaces are reddish in colour. There is a plastic rib running on the shoulder. Its clay fabric is rich in sand and small quartzite. Wth: 0.7–0.8 cm, H: 1.4–4.5 cm *(fig. 6. 4).*
9. Shoulder fragement of a dark grey amphora with a triangular rib below. The burnished exterior is eroded. The clay fabric is rich in sand and small quartzite inclusions. Wth: 0.6 cm, 3.8×3.3 cm *(fig. 6. 5).*
10. Fragments of a biconical jug. Grey in colour, the burnished exterior is eroded. Lightly insiced line on the upper half of the belly. Its clay fabric is rich in sand and small quartzite. Wth: 0.6–0.8 cm, H: 1.5–7.6 cm *(fig. 6. 7).*
11. Body sherd of a dark grey amphora with a curving neck. A small rib is visible at the root of the neck. Good quality vessel. Its clay fabric is rich in small quartzite and mica. Wth: 0.7 cm, 7.2×4.5 cm *(fig. 6. 6).*
12. Outcurving rim fragment probably belonging to an amphora. Reddish brown in colour, its clay fabric rich in small-medium quartzite inclusions. Wth: 0.6 cm, H: 3.9 cm, Rd: 17 cm *(fig. 6. 9).*
13. Fragment of a cooking pot with outcurving rim. It is reddish brown in colour with grey patches. Its clay fabric is rich in sand and small quartzite inclusions. Wth: 0.7 cm, H: 4.7 cm, Rd: 15 cm *(fig. 6. 8).*

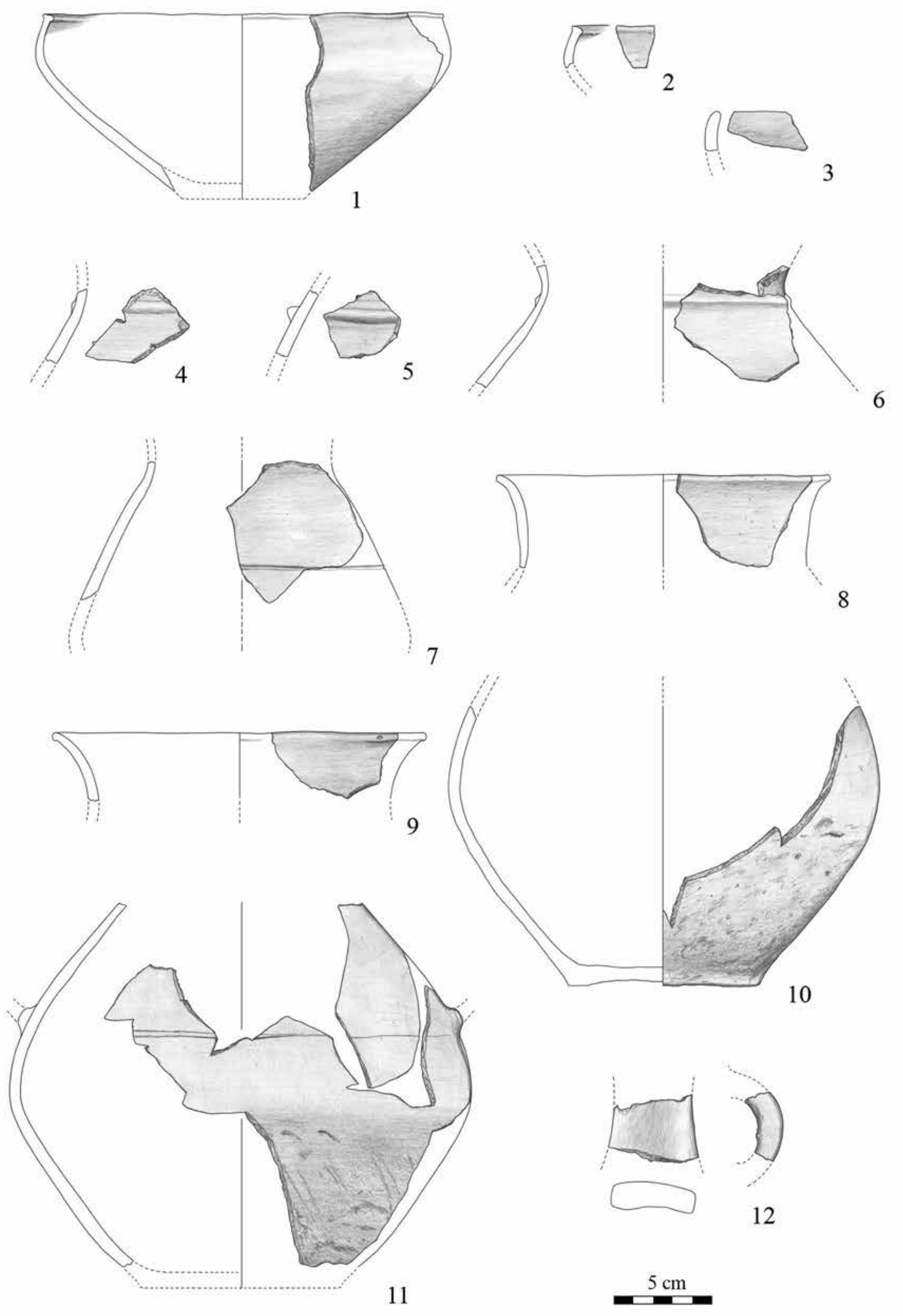

Fig. 6. Ceramic fragments from pit no. 107 (©László Gucsi)

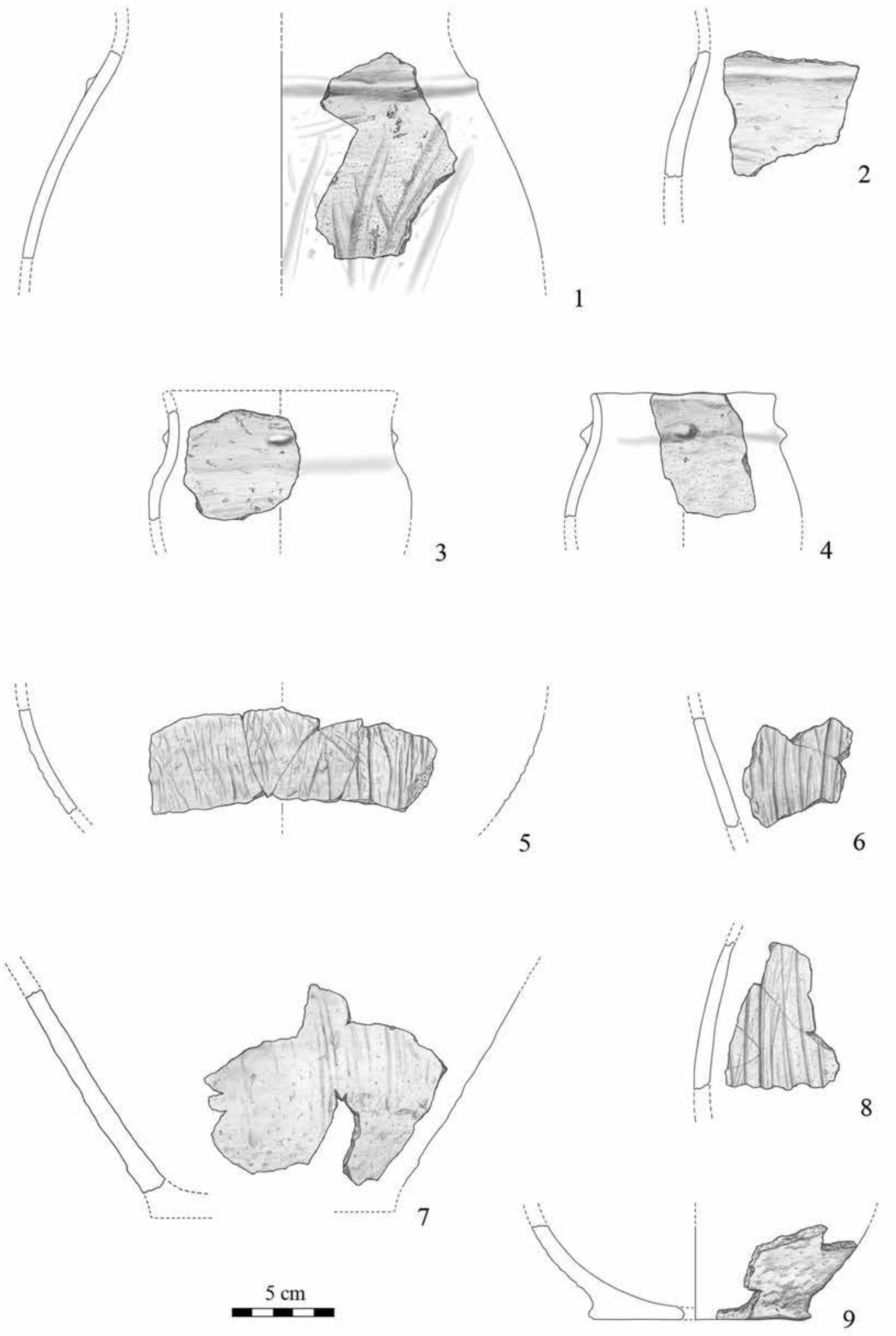

Fig. 7. Ceramic fragments from pit no. 107 (©László Gucsi)

14. Fragment of a bowl with inwards turning rim. Grey in colour, its clay fabric is rich in sand and mica. Wth: 0.6 cm, 1×1.8 cm *(fig. 6. 3).*
15. Fragment of a wide strap handle, probably belonged to an amphora. Dark grey in colour with light brown patches. Its clay fabric is rich in small-medium sized quartzite. W: 1.5 cm, 4.3×3.3 cm *(fig. 6. 12).*
16. Fragments of an ovoid amphora. The burnishing on its exterior eroded, there is a plastic rib running along its shoulder. Its clay fabric is rich in small-medium sized quartzite. Wth: 0.7–0.9 cm, H: 2.6–6.4 cm *(fig. 7. 2).*
17. Base fragments of a simple grey cooking pot with uneven exterior. Its clay fabric is rich in small-medium sized quartzite. Wth: 0.8–0.9 cm, H: 2.9–4.3 cm, Bd: 12 cm *(fig. 7. 9).*
18. Vessel fragments from the second fill context (-22–28 cm). Base and body sherds of a globular amphora. Brownish grey in colour with eroded burnishing on its exterior. Its clay fabric rich in sand and quartzite. Wth: 0.6–0.7 cm, 14.8×19.5 cm *(fig. 6. 10).*
19. Vessel fragments from the second fill context (-22–28 cm). Body sherds of a globular amphora with two strap handles. There are horizontal incised lines on the belly below the strap handles. Dark grey in colour with burnished exterior. The stumps of the handles and sherds belongig to the lower half of the vessel show traces of polishing suggesting that the vessel was repurposed in some way (perhaps used as a bowl) at a later stage. Wth: 0.5–0.8 cm, 15×17 cm *(fig. 6. 11).*
20. Vessel fragments from the second fill context (-22–28 cm). Larger, biconical cooking pot with a funnel neck and four pointy, vertical knobs at the root of the neck. The vessel is light brown in colour with dark grey patches. The exterior on the neck is burnished, on the upper body is rusticated, and unevenly smoothed and on the lower body. Wth: 0.7–0.8 cm, H: 1–25 cm, Rd: 21 cm *(fig. 8. 1).*
21. 1 metre north of pit no. 107 fragments of a cooking pot were found. The lower half of the body is unevenly smoothed and rusticated on the exterior. Light brown in colour, clay fabric is rich in small-medium quartzite inclusions. Wth: 0.9 cm, H: 1.2–9.2 cm *(fig. 7. 7).*
22. Small ovoid cooking pot found at the bottom of pit no. 107. The vessel is light grey in colour, and shows signs of secondary burning. It has a curving neck and a triangular plastic knob at the root of the neck. Its clay fabric is rich in sand and small quartzite inclusions. Wth: 0.8 cm, 6×4 cm, Rd: 10 cm *(fig. 7. 4).*

Bronze: A small amount of bronze crumbs (size of a few mm) from the fill of the pit.

Stone:

1. A core rejuvenation flake. There is a median rib visible on its dorsal side. The flake is triangular in cross-section. The striking platform is point-like, the bulb of percussion is small. The right edge is thinning, along the left edge and on the left side of the dorsal surface there traces of the cortex visible. Its distal end is step-like. Raw material: mustard yellow radiolarite with manganite spots. L: 3.754 cm, W: 1.283 cm, Th: 0.865 cm *(fig. 8. 4).*
2. A core rejuvenation flake. The striking platform is wing-shaped, with a large bulb of percussion. Several flakes have been struck off its dorsal surface. Its two edges are parallel lengthways on the proximal end before it widens on the left side towards the distal end, where the cortex is still visible. Raw material: dark brown radiolarite with manganite spots. L: 3.452 cm, W: 3.485 cm, Th: 1.075 cm *(fig. 8. 2).*
3. The distal fragment of a microblade, with two parallel ribs on its dorsal surface. Trapezoidal in cross-section. The distal end is oblique and rounded. Its right edge slightly curved, the left is straight, sickle gloss visible on both. Raw material: radiolarite from Szentgál. L: 0.856 cm, W: 0.691 cm, Th: 0.109 cm *(fig. 8. 3).*

Animal bone:

1 fragment of a diaphysis of a cattle *tibia*.

1 fragment of a right *proximal metatarsus* of a sheep/goat.

1 fragment of a pig *incisor* from the mandible.

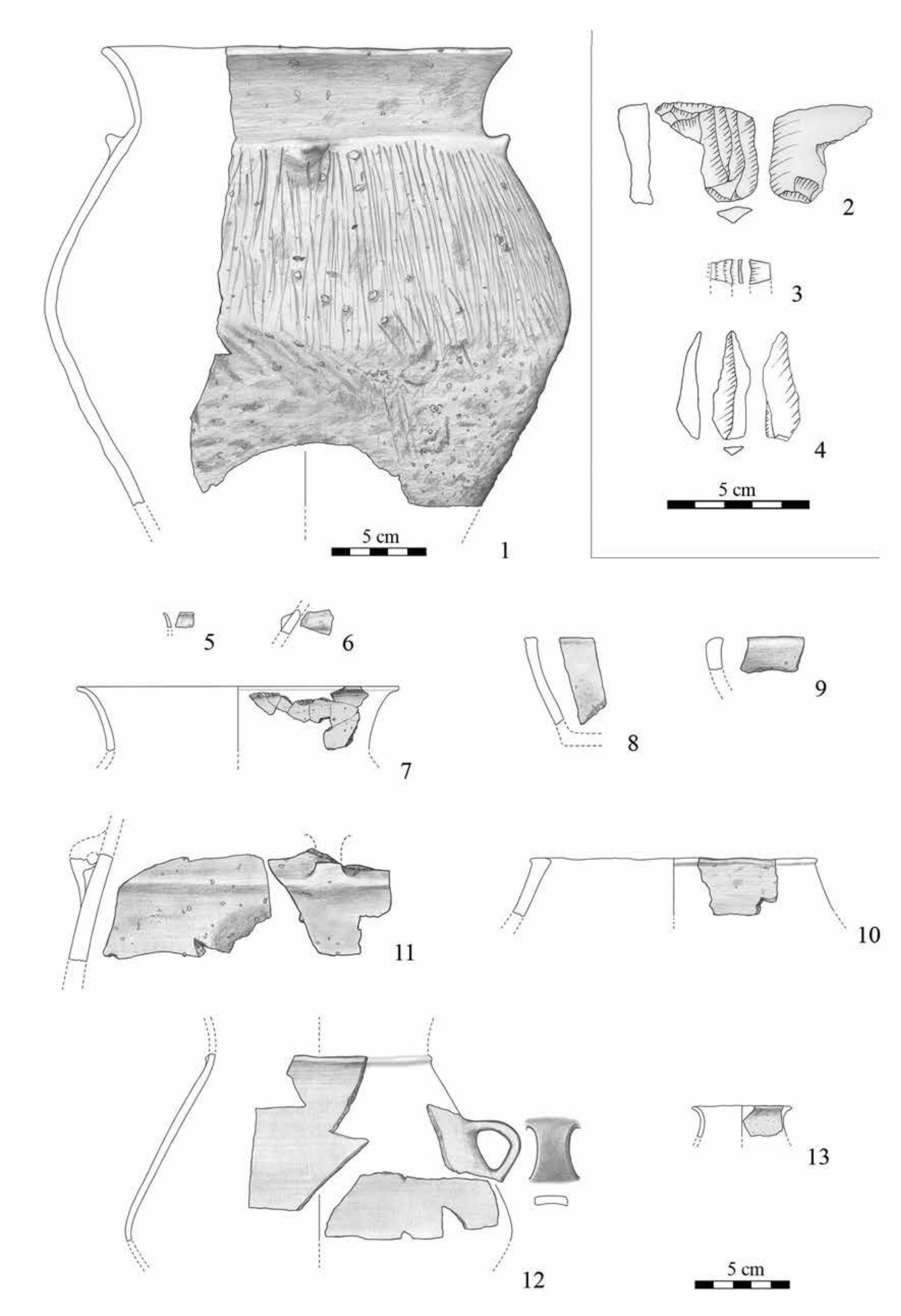

Fig. 8. 1. Ceramic vessel from pit no. 107; 2–4. Stone tools from pit no. 107; 5–7. Ceramic sherds from feature no. 111; 8–10. Ceramic fragments from feature no. 113; 11. Ceramic sherds from 'find concentration' no. 114; 12. Ceramic fragments from feature no. 109; 13. Ceramic sherd from pit no. 119 (1, 5–13: ©László Gucsi, 2–4: ©Anna Priskin)

Feature no. 109 *(fig. 3. 109/1–3; fig. 8. 12)*

According to the site plan the features represent 3 postholes situated 2–3 m away from each other (109/1–3). The three postholes surrounded fragments of a jug, under which another posthole came to light (109).

Ceramics (19 pieces), 1 vessel for consumption or serving.

1. Body sherds of a jug with biconical belly, and a strap handle. The root of the neck is decorated with plastic ribs. It is dark grey in colour, its clay fabric is rich in small-medium quartzite inclusions. Wth: 0.5–0.7 cm, H (partial): 10.5 cm *(fig. 8. 12).*

Feature no. 111/1–4 *(fig. 3. 111/1–4; fig. 8. 5–7)*

Three postholes aligned in an E–W direction unearthed in the northern sector of the excavation area. Later on one more posthole was found slightly south of the previous three (these were numbered: 1–4). Fragments dating to the Neolithic Lengyel culture and the Árpádian period (7 pieces) were found in the nearby area. From the postholes Bronze Age ceramic sherds were documented, and larger amounts of charcoal was recorded in posthole 111/1.

Ceramics (135 pieces), 23 vessels for consumption or serving, 18 vessels for cooking or storage.

Diagnostic pieces:

1. Fragment of a deep bowl with outcurving rim. The burnishing on its exterior eroded. Its clay fabric is rich in small-medium quartzite inclusions. Wth: 0.6–1.1 cm, 7.5×11.5 cm, Rd: 20 cm *(fig. 8. 7).*
2. Outcurving rim fragment of a small cup. Its clay fabric contains sand and small quartzite. Wth: 0.4 cm, 1.6×1.9 cm *(fig. 8. 5).*
3. Fragments of a greyish brown cooking pot found on a 5×5 m area near the postholes no. 111. A rib is running along the shoulder, the vessel’s lower half is rusticated. Its clay fabric tempered with grog and mica. Wth: 0.6–0.9 cm, H: 1.3–4.1 cm *(fig. 8. 6).*

Feature no. 113 *(fig. 3. 113, 113/1, 113A–H; fig. 8. 8–10)*

Posthole no. 113A came to light 6-7 m north of measurement point 435 + 00, containing large amount of charcoal. East of this posthole, further 12 postholes were found (B–H) associated with feature no. 113. The shallower, smaller postholes were aligned in rows running from the southeast to the northwest. In between the rows in the southeast, two groups of find concentrations were identified (113, 113/1).

Ceramics (142 pieces), 23 vessels for consumption or serving, 16 vessels for cooking or storage.

Diagnostic pieces:

1. Body sherds of a cooking pot with a narrow neck, thick but straight cut rim. It is dark grey and reddish brown in colour, its clay fabric is rich in sand and quartzite. Wth: 0.7 cm, H: 1.6–3.2 cm, Rd: 12 cm *(fig. 8. 10).*
2. Fragments of a flowerpot shaped bowl with straight cut rim. It is light brown and grey in colour, clay fabric is rich in small quartzite. Wth: 0.5 cm, 5.1×2.2 cm *(fig. 8. 8).*
3. Rim fragments of a globular bowl with inwards turning rim, found next to the ‘find concentration’ of no. 113. It is grey in colour, its clay fabric is rich in small quartzite. Wth: 0.8 cm, 1.8×2.8 cm *(fig. 8. 9).*

Daub:

2 pieces, Reddish on the outside, greyish black on the inside, tempered with chaff. Conical in shape. 3.4×2.9 cm, 2.3×1 cm.

Feature no. 114 ‘find concentration’ *(fig. 3. 114; fig. 8. 11)*

4-5 m away from pit no. 107, fragments of a larger Bronze Age vessel were observed on the surface.

Ceramics (18 pieces), 1 vessel for consumption or serving.

1. Fragments of an amphora with thick walls. In the upper section of the belly a plastic rib is visible (with triangular cross section). The strap handle attaches to this point. It is orange and grey in colour with eroded burnishing on the exterior. Its clay fabric is rich in sand, small quartzite and mica. Wth: 0.9–1 cm, H: 1.6–5.5 cm *(fig. 8. 11).*

Feature no. 115 *(fig. 3. 115, 115B–D)*

Feature no. 115 represented a 'find concentration' around which three postholes were identified (115B–D). Bronze Age ceramic sherds were documented in relatively large numbers from the nearby area.

Ceramics (80 pieces), 21 vessels for consumption or serving, 13 vessels for cooking or storage.

Diagnostic pieces:

1. Fragments of a small cooking pot with curving neck and outcurving rim. Well-made vessel, light brown and grey in colour, with slightly eroded exterior. Its clay fabric is rich in small quartzite inclusions. Wth: 0.6 cm, H: 2.6–3 cm.
2. Base fragment of a small dark grey coloured cup. Its clay fabric is rich in sand and small quartzite. Wth: 0.4 cm, 2.6×2.4 cm.

Feature no. 116 *(fig. 3. 116, 116B–D)*

Feature no. 116 represented a 'find concentration', right next to a row of three postholes running in NW–SE direction (116B–D). Bronze Age sherds were collected in relatively large numbers from the nearby area.

Ceramics (40 pieces), 7 vessels for consumption or serving, 6 vessels for cooking or storage.

Diagnostic pieces:

1. Fragments of a globular bellied small cup. Grey in colour, its clay fabric is rich in sand and small quartzite. Wth: 0.3–0.4 cm, H: 1.7–2.7 cm, Rd: 10 cm.

Pit no. 117 *(fig. 3. 117)*

Round (diameter approx.: 150 cm), shallow (depth: 40 cm) pit with a charcoal-rich fill.

Ceramics (6 pieces), 2 vessels for consumption or serving.

Diagnostic pieces:

1. Fragments of a jug with a biconical belly. Light brown in colour, its clay fabric is rich in small quartzite. Wth: 0.6–0.7 cm, H: 1.4–3.7 cm.

Pit no. 119 *(fig. 3. 119; fig. 8. 13)*

Ovoid, shallow pit with a posthole in its eastern section. The fill contained ceramic sherds and charcoal.

Ceramics (3 pieces) 2 vessels for consumption or serving, 1 vessel for cooking or storage.

Diagnostic pieces:

1. Fragments of a cup with outcurving rim and truncated-cone shaped neck. Light brown in colour with grey patches, its clay fabric is rich in small quartzite. Wth: 0.5 cm, H: 2.8 cm, Rd: 8 cm *(fig. 8. 13).*

Interpretation of the archaeological material from the settlement of Nagycenk-Kövesmező

Ceramics

The excavations carried out at the Nagycenk-Kövesmező site yielded altogether 1293 pieces of Bronze Age ceramic sherds, which likely to represent at least 165 vessels used for consumption or serving and 121 vessels used for cooking or storage. Half of the fragments were documented from pit no. 107, the rest of the sherds collected from elsewhere – these were generally small in size and poorly preserved. Only a couple of these fragments were identified to have belonged to the same vessel.

Pit no. 84 represented the second richest feature at the site in terms of ceramic sherds, located 30 m to the southeast from the rest of the Bronze Age features *(fig. 3. 84).* The ceramic assemblage from here turned out to be distinct from the rest of the finds. The zigzag and line bundle motifs visible on a body sherd *(fig. 4. 2)* – created by using a comb-like flat implement – are most likely belonged to a Bell Beaker style vessel. Similar, impressed patterns can be found on ceramics associated with the Bell Beaker complex and its communities located around Budapest and Moravia.[48] The fragment with an incised triangle *(fig. 4. 4)* represents a pattern occurring characteristically on the so-called Dřevohostice-type jugs,[49] which are the typical vessels of Corded Ware graves in Moravia.[50] The triangle motif with a striped line pattern inside is a frequently occurring decoration element placed on the bellies of jugs, however, in the Western territories of the Corded Ware complex it was created by using the cord-impression technique instead of incisions.[51] Similarly decorated jugs are known from the burials of Slaný from Bohemia, with associated radiocarbon dates.[52] The triangle motif with a striped line pattern (with or without white encrustation) became a widely employed decoration style at the beginning of the Early Bronze Age (Phase 1–2), occurring mainly on pedestalled bowls with decorated interiors[53] and on Bell Beaker style vessels.[54] Therefore, the reconstruction here depicts a pattern with encrustation, despite the lack of white inlay present in the grooves (*fig. 4. 4* below). The broader, globular belly fragment from Nagycenk resembles the vessel shapes occurring in the Somogyvár–Vinkovci culture,[55] some of which representing the clear influences deriving from Southeastern Europe.[56] However, these latter are generally without decoration, or only with scarce zigzag motifs on their bellies.[57] The style and decoration of the Nagycenk vessel therefore corresponds well with the ceramic traditions of the Somogyvár–Vinkovci/Bell Beaker circle in the Carpathian Basin during the second phase of the Early Bronze Age.

Similar vessels to a small, conical bowl (with complete profile fragment – *fig. 4. 3*) were widespread in the Early Bronze Age. They occur among the burial furniture and on the settlements of the Bell Beaker groups occupying the area around Budapest, representing local ceramic variants *(Begleitkeramik).*[58] They also appear in the distribution of the Makó–Kosihy–Čaka and the Somogyvár–Vinkovci culture complexes and the Moravian group of the Corded Ware population.[59] Cooking pots with curving necks *(fig. 4. 5, 6)* and a base fragment of a cup *(fig. 4. 7)*

48 *Ondráček – Dvorák – Matějíčková 2005* Taf. 44. 4, 11, 15, Taf. 55. 35, Taf. 57. 6, 9, Taf. 60. 15; *Endrődi – Reményi 2016* fig. 100.

49 *Buchwaldek 2002* Abb. 1. 1; *Peška 2013* fig. 82.

50 Dřevohostice I. group 7 barrow 15: *Šebela 1999* Pl. 16. 3, 7, 10; Marefy IV, burial 6: *Šebela 1999* Pl. 57. 6; Prízaky: *Šebela 1999* Pl. 64. 3; Sivice I, 1. burial: *Šebela 1999* Pl. 96. 6; Tovačov I, burial 2: *Šebela 1999* Pl. 110. 4.

51 *Šebela 1999* Pl. 32, 10, Pl. 36. 1.

52 KIA-11798: 3854 ±3 9 BP, 2447–2209 cal BC (68.3%), 2460–2203 cal BC (95.4%). *Furholt 2003* Taf. 107. 1.

53 *Kulcsár 2009* fig. 27. 4–5, 7–8, fig. 28. 2–3, fig. 29. 2, 6–7, fig. 30. 3–4, 6–10, fig. 58. 1, 3, fig. 59. 1–9, fig. 60. 2, 5–6, 9, fig. 61. 1.

54 *Endrődi 1992* fig. 85. 5, 6.

55 *Kulcsár 2009* 290–292, fig. 52. II/9–10.

56 *Buchwaldek 2002; Kővári – Patay 2005* fig. 28. 2, fig. 29. 3; *Peška 2013* 129–131, fig. 82.

57 *Kulcsár 2009* 98, fig. 20. II/1.

58 *Endrődi 1992* fig. 19. 5, fig. 22. 7, fig. 45. 2, 4, fig. 62. 8; *Patay 2013* fig. 12. 6, fig. 21. 6; *Endrődi – Reményi 2016* fig. 91.

59 *Kalicz 1984* Taf. XXIII. 11; *Šebela 1999* Pl. 3. 12, Pl. 5. 4, 8, 9, Pl. 15. 2, Pl. 20. 4, Pl. 45. 4, Pl. 196; *Aszt 2001* 217, Pl. I. 3; *Kulcsár 2009* 120–121, 307, fig. 25. VIII/1–5, fig. 56. VIII/3–6.

are generic Early Bronze Age pieces, only distinguished by their grog tempering from the rest of the ceramic assemblage documented both at the Nagycenk settlement and the cemetery.[60] Analogues of a cooking pot with thick, but horizontally cut rim *(fig. 4. 8)* are well known from the site east of Szombathely-Bogáca Stream, found alongside a Bell Beaker fragment.[61] A fragment of the so-called 'thickened rim with triangular cross-section' came to light north of pit no. 84, probably belonged to a large cooking ot storage pot *(fig. 4. 1)*. Similar elaboration of the rim is common in the Makó–Kosihy–Čaka culture complex,[62] and in the Moravian group of the Corded Ware.[63] It also occurs in the assemblages of the Bell Beaker groups nearby Budapest,[64] and in the Oggau- and Leithaprodersdorf assemblages in Western Transdanubia, which could be considered as representatives of late or post-Bell Beaker populations.[65]

The archaeological material from pit no. 107 is outstanding both in its quality and quantity compared to the rest of the settlement features *(fig. 5)*. The clay fabric of these vessels were rich in sand, mica and/or small quartzite pebbles, while their exteriors were burnished originally (this in most cases had eroded away) and were fired dark grey. Fragments of jugs *(fig. 6. 7)* and their larger variants, the amphorae *(fig. 6. 4–6, 9–11; fig. 7. 1)* represented the consumption vessels. They were often decorated with a plastic rib either at the root of the neck or running along the shoulder;[66] a choice of decoration that also occurs on ceramics from Rusovce.[67] Furthermore the emphasis of the upper segment of the belly by an incised line or lines appears frequently on the vessels both from the Nagycenk occupation site *(fig. 6. 7, 11)* and the cemetery, and on fragments of jugs and amphorae known from sites in Austria.[68] The most complete amphora from pit no. 107 *(fig. 6. 11)* shows close similarities with the amphora documented in burial (no. 66) at Nagycenk-Lapos-rét.[69] Bowl fragments collected from pit no. 107 in most cases have inwards turning rims *(fig. 6. 1–3),* which occur only in a couple of cases in Gáta–Wieselburg assemblages.[70] The analogues of truncated-cone shaped bowls with inwards turning and profiled rims can also be found among the material of the Makó–Kosihy–Čaka culture complex, more precisely at its sites in Northwestern Transdanubia,[71] and among the assemblages of the Bell Beaker groups in Moravia.[72] The truncuted-cone shaped bowl with inwards turning rim is also a characteristic vessel type of the Leithaprodersdorf group.[73] The absence of this bowl type in Gáta–Wieselburg assemblages could be explained by the small amount of published archaeological material and,

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60 From the assemblages of the cemetery of Nagycenk-Lapos-rét and the settlement site of Nagycenk-Kövesmező, altogether 54 ceramic fragments were selected and sampled to undergo petrographic analyses. The examinations were carried out in the Laboratory for Applied Sciences at the Hungarian National Museum by Attila Kreiter and Péter Skoda. We would like to express our thanks here for their contribution. The outcome of this research will be published in detail in a separate study.

61 *Ilon 2004* 46–47, Tab. XXV. 3.

62 Abda-Hármasok: *Figler 1996* Pl. I. 5; Táp-Borbapuszta: *Figler 1994* Abb. 5. 1–2; Üllő site 5: *Kővári – Patay 2005* fig. 27. 2, fig. 30. 8; *Kulcsár 2009* 152–154, fig. 34. XIII/3.

63 *Šebela 1999* Pl. 5. 6, Pl. 7. 6, Pl. 10. 3, 4, Pl. 26. 3, 6, Pl. 34. 3, Pl. 35. 3, Pl. 37. 5, Pl. 70. 2, Pl. 105. 5; *Peška 2013* fig. 65. 15, fig. 87. 11.

64 *Kalicz-Schreiber 1976* Abb. 15. 4; *Kulcsár 2009* 152.

65 *Károlyi 1975* fig. 11b–c, fig. 12, fig. 14.

66 *Gömöri – Melis – Kiss 2018* fig. 38. 4, 5, 7, 12, 13, 14, 16, 20, 21.

67 *Mellnerová Šuteková et al. 2015* fig. 5. 5, 7; *Bartík et al. 2016* Tab. 1, 2, 3, 18.

68 *Hicke 1987* 102, TA 1, TA 4, 103, THG 2, THG 3; *Leeb 1987* Abb. 3. A2, A3, B3, C1, C3, D3; *Gömöri – Melis – Kiss 2018* fig. 38. 8, 9, 10, 13, 17–24.

69 *Gömöri – Melis – Kiss 2018* fig. 38. 16.

70 A variant with a plastic rib decoration: *Leeb 1987* Abb. 4. E1; and a rim with applied knobs: *Neugebauer 1994* Abb. 30. 12; bowl with a handle: *Krenn-Leeb 2011* Abb. 19.

71 Abda-Hármasok: *Figler 1996* Pl. II. 7; Táp-Borbapuszta: *Figler 1994* Abb. 6. 18.

72 Česká I.-1/83 (Czech Republic): *Ondráček – Dvorák – Matějíčková 2005* Taf. 37. 2.

73 *Hicke 1987* 99, L SCH 1, Inv. no. 23.185, 100, L SCH 2, Inv. no. 9266.

considering the chronological classification of these analogues, it is probable that style continued on from the previous period (Early Bronze Age 2) into the subsequent Gáta–Wieselburg culture.

Cooking pots and their variants were also represented in relatively large numbers in the fill of pit no. 107. Vessels similar to small jars with plastic knobs applied onto their necks and shoulders *(fig. 7. 3–4)* occur in the cemetery of Nagycenk-Lapos-rét, but in slightly better quality.[74] This particular type can be identified as variant 'J' according to the published Gáta–Wieselburg vessel typology.[75] A single analogous vessel to the large, biconical cooking pot *(fig. 8. 1)* is known from a Gáta–Wieselburg burial at Iván,[76] however, a further two similar pieces came to light from Rusovce with plastic knobs applied onto the shoulder.[77] The exterior of the cooking pots is often rusticated *(fig. 7. 5–8, fig. 8. 1);* a surface treatment that also occurs on small cooking pots and deep bowls documented in the Nagycenk-Lapos-rét cemetery,[78] and on vessels at the settlement of Rusovce.[79] A fragment of a wide rimmed, good quality cooking pot *(fig. 6. 8),* is almost identical to a piece discovered in burial no. 65 at Nagycenk-Lapos-rét.[80]

The material represented by the 'find concentrations' of nos. 97, 109, 111 and 114 is directly corresponding with the contents of pit no. 107 and the grave goods of Nagycenk- Lapos-rét. The assemblages recovered from the 'find concentrations' were poorly preserved, and lacked larger, diagnostic pieces. 'Find concentration' nos. 97 and 111 yielded fragments of deep bowls[81] with outcurving rims *(fig. 4. 10, fig. 8. 7).* The shoulder profile of a sherd identified from no. 97 is analogous to a bowl from burial no. 51 at Nagycenk-Lapos-rét,[82] while a more eroded piece from no. 111 is similar to a vessel documented in burial no. 78.[83] A biconical jug identified in 'find concentration' no. 109 *(fig. 8. 12)* is analogous to the jug decorated with ribs from burial no. 79 at Nagycenk-Lapos-rét.[84] The jug with short handles and with its centre of gravity close to the base can be correlated with variant 'C3' of the Gáta–Wieselburg ceramic typology.[85] The fragment of an amphora from 'find concentration' no. 114 *(fig. 8. 11)* could belong to a characteristic Gáta–Wieselburg type: an amphora with short or assymetrical handles, with an applied horizontal rib on the upper half of the belly.[86]

Less diagnostic sherds came to light from pits nos. 93, 95, 117 and 119, furthermore from posthole no. 94. The clay fabric of these pieces was rich in sand and small quartzite pebbles, similar to the material collected from pit no. 107. Fragments of small grey cups or jugs, rusticated body sherds of cooking pots and pieces of amphorae with unevenly smoothed exteriors were also identified. The outcurving rim fragment recorded from pit no. 119 *(fig. 8. 13)* is similar to the cup found in burial no. 74 at Nagycenk-Lapos-rét and a piece documented from one of the two burials at Iván.[87] Fragment of a round ceramic spoon was discovered nearby pit no. 95 *(fig. 4. 13)* which could be dated to the Copper Age given the occupation of the Lengyel culture present at the

[74] *Gömöri – Melis – Kiss 2018* fig. 39. 15, 18, 19.
[75] *Leeb 1987* Abb. 4. J1–J2.
[76] *Melis 2019* 151, fig. 9. 7.
[77] *Mellnerová Šuteková et al. 2015* fig. 3. 2; *Bartík et al. 2016* Tab. 2. 7.
[78] *Gömöri – Melis – Kiss 2018* fig. 39. 13, 14, 15, 23, 26.
[79] *Bartík et al. 2016* fig. 8. 1–4, Tab. 2. 1–3.
[80] *Gömöri – Melis – Kiss 2018* fig. 16. 3.
[81] *Leeb 1987* Abb. 4. G1–2.
[82] *Gömöri – Melis – Kiss 2018* fig. 5, Grave 51, 2.
[83] *Gömöri – Melis – Kiss 2018* fig. 23, Grave 78, 2/A.
[84] *Gömöri – Melis – Kiss 2018* fig. 24. 3.
[85] *Leeb 1987* Abb. 3. C3.
[86] *Leeb 1987* Abb. 3. D1–D3.
[87] *Melis 2019* 150–151, fig. 9. 5; *Gömöri – Melis – Kiss 2018* fig. 20, Grave 74, 2.

site. Ceramic spoons are well-known from both the Bell Beaker complex,[88] and from the Makó–Kosihy–Čaka culture from the Early Bronze Age – although the spoons associated with the latter tend to be more oval in shape. Round ceramic spoons can be found among the assemblages of the Kisapostag culture from Ménfőcsanak-Széles-földek,[89] and from the Únětice burials of Bernhardsthal (Austria),[90] which correspond chronologically with the Gáta–Wieselburg culture, therefore it is possible that the piece from Nagycenk can also be dated to the later period of the Early Bronze Age or to the early Middle Bronze Age.

The material recovered from 'find concentrations' situated between postholes (feature nos. 115, 116, and 113) was even more fragmented. Small vessel rims were documented from feature no. 113, amongst them a thickened, inwards turning rim of a bowl *(fig. 8. 9)*. Analogous vessels are known from Gáta–Wieselburg graves from Szakony-Kavicsbánya (burial no. 3) and from Ménfőcsanak (burial no. 10695).[91] Furthermore, a straight cut rim belonging to a truncated-cone shaped bowl *(fig. 8. 8)* was also documented from 'find concentration' no. 113, with examples among Bell Beaker assemblages[92] and the material of the Oggau–Wipfing–Ragelsdorf group.[93] The truncated-cone shaped neck and the thickened rim of a cooking pot *(fig. 8. 14)* appears to be similar to the ovoid cooking pots of the Leithaprodersdorf group.[94] Comparable pieces occur on settlement sites during the preceding Oggau–Ragelsdorf–Wipfing group, with thickened rims. Jars with narrowing necks from the Gáta–Wieselburg culture have two published analogues from earlier excavations.[95]

In sum, while the ceramic material documented from pits can be directly associated with the Gáta–Wieselburg culture, and in one instance (pit no. 84), with the preceding Makó/Somogyvár–Vinkovci/Bell Beaker horizon, out of the postholes and the 'find concentrations' only the feature nos. 109 and 111 can unequivocally be linked with the period of the Gáta–Wieselburg culture. Although the rest of the postholes and 'find concentrations' also contained ceramics with the characteristic Gáta–Wieselburg clay fabrics – rich in mica, sand or small quartzite pebbles – the formal analogues of quite a few vessels were already being used by the second phase of the Early Bronze Age.

Stone tools

Altogether four pieces of chipped stone tools or their fragments were documented from Bronze Age features. A piece of surface debitage found in 'find concentration' no. 97, two core flakes and a microblade fragment from pit no. 107. The raw material used was in all cases of regional origin; a radiolarite variant from the Transdanubian Hill region. The presence of flakes and debitage suggests that the manufacture of stone tools took place at the site. The microblade fragments came to light from one of the richest burials of the cemetery of Nagycenk-Lapos-rét, from the grave of an adult male (no. 55), were also made of Szentgál radioralite.[96] So far a single knapped

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[88] Szigetszentmiklós-Üdülősor: *Endrődi 1992* fig. 47. 8a–b; Bořitov VII, 1/76 (Czech Republic): *Ondráček – Dvorák – Matějíčková 2005* Taf. 6. 3–17.

[89] *Figler 1996* Pl. III. 10; *Melis in prep.*

[90] *Neugebauer 1994* Abb. 58. 2 (22) 8.

[91] *Melis 2015* Tab. IV. 5; *Melis 2019* 149–150, Abb. 9. 1.

[92] Békásmegyer: *Kalicz-Schreiber 1984* Taf. XXXII. 4; Budakalász: *Czene 2017* fig. 9. 5, 6.

[93] *Neugebauer 1994* Abb. 19. 1, 2; Wildendürnbach-Pottenhofen (Austria): *Pittioni 1954* Abb. 185. 3.

[94] *Hicke 1987* 101 L T 1.

[95] Mosonszentjános (Jánossomorja): *Bóna 1975* Abb. 24. 5; Arbersthal (Göttlesbrunn-Arbesthal, Austria): *Pittioni 1954* Abb. 224. 4.

[96] *Gömöri – Melis – Kiss 2018* 62.

arrowhead variant characteristic to the Bell Beaker complex is known from Szombathely-Reiszig forest from a deposit that could tentatively be linked to the Gáta–Wieselburg culture.[97]

Detailed studies of chipped stone tools from Early and Middle Bronze Age settlement sites are largely limited to the territories of Central Hungary, where the most utilised raw material was the Buda hornstone.[98] In Transdanubia the dominant raw material type in the Middle Bronze Age was radiolarite and flint from Sümeg as the stone tools from Zalaegerszeg-Ságod-Bekeháza and Kaposvár-Toponár testify.[99]

Settlement layout and building structures at Nagycenk-Kövesmező

Features dated to the Middle Bronze Age concentrated in the central segments of the investigated area. Pit no. 84 dating to the second phase of the Early Bronze Age was an exception as it was found 30 m to the southeast (aligned with the Árpádian-period pits, nos. 89A–B) farther away from the rest of the settlement features *(fig. 3).* Pits associated with the Gáta–Wieselburg culture concentrated on an area of 650 m², around 150 metres away from the burials of Nagycenk-Lapos-rét. In the northwestern segment of the trench in a 150 m strip evidence for building structures constructed on the surface were documented, represented by 'find concentrations' and postholes. Therefore, it is feasible to assume that functions of habitation and the containment of domestic refuse was kept separate at the site.

The postholes in most cases situated on the eastern sector of the 22–24 m wide strip, only posthole nos. 109 and 111 were located about 10 metres away from the primary cluster. As the 44 postholes concentrated towards the edge of excavation in an approx. 6 m radius, a range of different building structures could be considered for reconstruction. Based on the observations made during the excavation and similar building structures described in the section below, we would like to present the possible reconstruction of a Bronze Age building found at Nagycenk.

Early and Middle Bronze Age building structures in Transdanubia and the nearby regions

The largest number and the broadest variety of buildings dating to the Hungarian Early Bronze Age is associated with the Bell Beaker complex (2500/2400–2200/2100 BC). The structures linked to the Budapest group of the Bell Beaker population were typically 8–16 m long, and 4–6 m wide, with sides curving to form a characteristic boat shape. These buildings were constructed onto the surface, strengthened by a post-structure and oriented to the southeast *(fig. 9. 1).*[100] Similar boat-shaped domestic buildings occur at the settlement sites of the Oggau–Wipfing–Ragelsdorf group in county Vas in Hungary, and in Lower Austria.[101] Apart from the boat-shaped buildings, other types of building constructions are also known from the Bell Beaker distribution. At Albertfalva, two building structures of a rectangular layout came to light, similar in their sizes to longhouses, furthermore buildings supported by post-structures with square and/or oval layout were also documented.[102] A building structure with a square plan recorded at the site east of Szombathely-Bogáca Stream can be associated with the Bell Beaker culture as well.[103] At the site of Vát-Rátka

[97] *Horváth – Wild 2017* 105, fig. 6. 2.
[98] *Cs. Balogh 1992; Horváth 2004.*
[99] Reports by Tünde Horváth: *Kvassay – Kiss – Bondár 2004* 142; *Kiss – Somogyi 2004* 108–112.
[100] *Endrődi – Reményi 2016* 71–73, fig. 66, fig. 69, fig. 72.
[101] Bucsu: *Ilon 2011* 97–98, figs. 47–48; Vát: *Reményi – Dobozi 2012* fig. 2; Walpersdorf (Austria): *Kern – Pentz– Schmitsberger 2019* 721–725, Abb. 6, Taf. 1–3.
[102] *Endrődi – Reményi 2016* fig. 66.
[103] *Ilon 2004* 46, fig. 35; *Ilon 2011* 96–97.

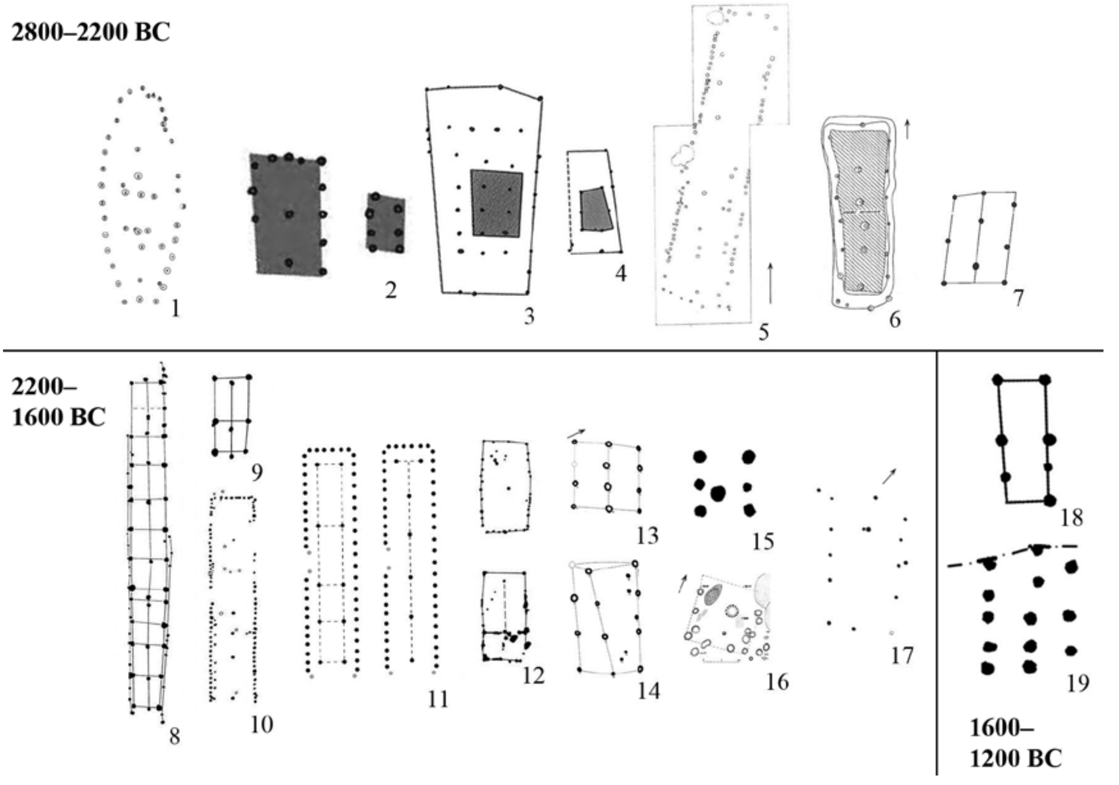

Fig. 9. Early and Middle Bronze Age buildings with post-structures from Central Europe: 1. Szigetszentmiklós-Üdülősor (Bell Beaker complex, *Endrődi 1992* fig. 10); 2. Vát-Rátka-patak keleti oldala (Bell Beaker complex, *Reményi – Dobozi 2009* fig. 2); 3. Wennungen (Corded Ware complex, *Friedrich 2019* Abb. 3. 13); 4. Gimritz (Corded Ware complex, *Friedrich 2019* Abb. 3. 6); 5. Csongrád-Vidresziget (Makó–Kosihy–Čaka complex, *Kalicz 1984* 95, Taf. XXIII. 1); 6. Abda-Hármasok (Makó–Kosihy–Čaka complex, *Figler 1996* fig. 1); 7. Wien-Oberlaa (Makó–Kosihy–Čaka complex, *Kern – Pentz – Schmitsberger 2019* 718–720, Abb. 2); 8. Eching-»BMW Lager« (Straubing culture, *Schefzik 2010* Abb. 9. 1); 9. Eching- »Kleiststraße« (Straubing culture, *Schefzik 2010* Abb. 9. 3); 10. Brežno (Únětice culture, *Schefzik 2010* Abb. 9. 4); 11. The two sub-variants of the Zwenkau type buildings (Únětice culture, *Schunke – Stäuble 2019* Abb. 5); 12. Aschheim (Straubing culture, *Schefzik 2010* Abb. 9. 8–9); 13. Holubice (Únětice culture, *Stuchlík 2000* fig. 4); 14. Velešovice (Únětice culture, *Stuchlík 2000* fig. 7); 15. Győr-Ménfőcsanak-Széles-földek (Únětice/Veteřov transitional phase, *Melis 2014* fig. 3. 1); 16. Nitriansky Hrádok (Mad'arovce culture, *Točík 1978–1981* Plan 46. 1); 17. Jelšovce-Nitriansky kraj (Únětice culture, *Bátora 2019* fig. 30); 18. Ordacsehi-Bugaszeg (Tumulus culture, *Kiss 2011* fig. 3 right); 19. Kóny-Barbacsi-tó (Tumulus culture, *Egry 2002* Map 3)

Stream shore, two 7×10 m rectangular buildings were found along with a number of smaller post structures with a square floor plan – both linked to the Oggau–Wipfing–Ragelsdorf group *(fig. 9. 2)*. Additionally, a sunken featured building was also documented here, which is quite unique in the territory of the Eastern Bell Beaker complex.[104]

More recently, from the distribution of the Corded Ware (2800/2700–2300/2200 BC) in Central Germany, numerous building structures came to light, among them a so far unknown type identified with a trapezoidal layout. The buildings were around 10–20 m long, oriented to the NNW–SSE, and could reach the size of 200 m². Inside the external wall structure was supplemented by a grid network of smaller posts, supporting an approx. 35 m² second floor above *(fig. 9. 3–4)*.[105]

[104] *Reményi – Dobozi 2012* 123–124.
[105] *Friedrich 2019.*

Sunken featured buildings were much more common in the distribution of the Makó–Kosihy–Čaka complex (2600/2500–2300/2200 BC) in Transdanubia, although their interpretation in terms of function is less clear.[106] An example of these came to light from Abda-Hármasok, where a large (15×5 m) sunken featured, rectangular building was excavated, oriented N–S, with three internal post structures *(fig. 9. 6)*.[107] At the same time evidence for buildings constructed on the surface are well-known, the largest of such buildings (37×7 m) was rectangular in plan excavated at Csongrád-Vidre-sziget *(fig. 9. 5)*.[108] Smaller, 4×5–6 m post-structured buildings were documented at Wien-Oberlaa (Austria) as well *(fig. 9. 7)*.[109] Furthermore, a couple of preliminary archaeological reports mention post-structured buildings from Transdanubia, associated with the Makó–Kosihy–Čaka complex.[110]

The number of building structures published from the distribution of the Somogyvár–Vinkovci complex (2500/2400–2200/2100 BC) is much lower, and the construction of these structures indicate sunken featured buildings.[111] At the site of Szombathely-Liget Hotel sunken featured buildings supported by post structures were unearthed dating to the second phase of the Early Bronze Age.[112] The situation is similar within the distribution of the Kisapostag culture (transition from the Early to the Middle Bronze Age: the Earliest Transdanubian Encrusted Pottery culture: 2200/2100–1900/1800 BC) and the Transdanubian Encrusted Pottery culture (1900/1800–1500/1450 BC), the number of currently available published building structures is very limited. In some instances, the intact surfaces situated in between elongated domestic refuse pits could indicate the presence of buildings constructed on beam footings.[113] Evidence for plastered floors was documented at Süttő-Nagysánctető and Mosonszentmiklós-Akasztódomb.[114] Preliminary reports mention a few buildings with post-structures from northwest Transdanubia associated with the Encrusted Pottery culture:[115] from the site of Veszprém-Kádárta a building of a size of 8.4×3.4 m was recorded,[116] from Dör a structure of 7×10 m was documented,[117] while from Bakonytamási only partial building was found.[118] Sunken featured buildings with uneven layout identified by Late Kisapostag and Encrusted Pottery culture sherds were most likely associated not with domestic habitation but with agriculture, animal husbandry or craft production.[119]

From the sites of Gattendorf (Gáta, Lajtakáta, Austria) and Schwarzenbach in Austria building structures linked to the Gáta–Wieselburg culture (2200/2100–1600/1500 BC) have been published. At these sites the narrow foundation trenches of buildings could be documented which imply the existence of buildings of 17.5×7.5 m constructed onto beam footings. Since there was no evidence for daub, the structures can be reconstructed as log-buildings.[120] In contrast, in 1980

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[106] Nyergesújfalu-Józsefpuszta, Budakeszi-Szőlőskert, Kánya: *Kulcsár 2009* 63; Schwechat (Austria): *Kern – Pentz – Schmitsberger 2019* 718.
[107] *Figler 1996* fig. 1.
[108] *Kalicz 1984* 95, Taf. XXIII. 1.
[109] *Kern – Pentz – Schmitsberger 2019* 718–720, Abb. 2.
[110] Tatabánya-Dózsakert: *Cseh – Vékony 2002* 253–254; *Kulcsár 2009* 63; Mosonszentmiklós-Gyepföldek: *Aszt 2001* 214–215, Map 1; *Kulcsár 2009* 63.
[111] Keszthely, Csepreg: *Károlyi 1975* fig. 9; Tamási, Kánya, Pécs: *Kulcsár 2009* 263–268, fig. 45.
[112] *Ilon 2004* 45, fig. 33, Tab. XXIII. 4–5.
[113] Kaposvár-Toponár, Road no. 61/site 1: *Kiss – Somogyi 2004* fig. 2; Győr-Ménfőcsanak, Szeles-dűlő: *Figler 1996* 11.
[114] *Kiss 2012a* 210.
[115] *Bándi 1967; Honti – Kiss 1996; Vadász 2001; Kiss 2012a* 210–211.
[116] *Ilon 2012; Kiss 2012a* 210.
[117] *Egry – Szőnyi – Tomka 1997.*
[118] *Ilon 1995* 74.
[119] *Kiss 2012a* 210–211, fig. 60, fig. 61.
[120] *Krenn-Leeb 2011* 15–16.

at the site of Szombathely-Romkert, a long, rectangular building with wattle-and-daub walls was unearthed.[121] The archaeological report describe sunken featured buildings from the site of Szakony-Kavicsbánya.[122] Although neither the previously described Gáta–Wieselburg buildings nor their material have been published, it can be assumed that both wattle-and-daub structures and log-houses existed simultaneously.

From the distribution of the Unterwölbling (2200/2100–1700/1650 BC) and Únětice (2100/2000–1700/1600 BC) cultures in Austria, there are published examples for longhouses with post structures and/or with foundation trenches, which are similar in their construction to the buildings known from the territories of Moravia and Germany.[123] The so-called Březno-type structure for example was widespread in the Traisen and Morava valleys *(fig. 9. 10)*. These rectangular buildings were generally 20–30 m long, and 7–8 m wide, oriented N–S. Their external walls were constructed of larger posts, supported by a row of smaller stakes on both sides.[124] Long buildings with foundation trenches also occur in Central Germany.[125] However, in this region the so-called Zwenkau-type buildings were more characteristic: these were 20–57 m long and 5.5–7 m wide with one end of the house finishing in a rounded apsis. The houses could have had two or even three aisles with two weight bearing posts to support the hipped roof on the western side *(fig. 9. 11)*.[126] In the territory of southern Germany the so-called Eching/Öberau-type buildings were common during the Central European Early Bronze Age (2100/2000–1600/1500 BC). These could be as long as 75 metres with a double row of postholes supporting the external walls *(fig. 9. 8)*.[127] Another building variant characteristic in the Southern German regions was the so-called Zuchering-type house: a smaller building (15–20 m in length), with foundation trenches and curved external walls *(fig. 9. 12)*. Aside of these, numerous other building variants co-existed at the time.[128] Apart from longhouses, smaller buildings with post-structures also occur on settlements dated to the Early Bronze Age in Germany. The so-called Poing-type building for instance with its length of 10 metres and altogether nine posts arranged into three rows *(fig. 9. 9)* could be considered as the simplified version of the Eching/Öberau-type buildings.[129] Among the long building constructions (12.4–16 m) with post structures there are ones with rounded apsides and ones with curved external walls were in use simultaneously around 2000–1300 BC in the territory of Germany.[130]

In contrast to the examples from Moravia and Germany, smaller buildings (10–15 m long, 6–8 m wide) with post-structures and wattle-and-daub walls were documented from the region of Slovakia, associated with the Únětice culture (2000/1900–1800/1700 BC) *(fig. 9. 17)*.[131] In addition to Únětice culture's longhouses with multiple aisles, evidence for the existence of small huts (4–8 m long, 3.5–5 m wide) was documented from Moravia *(fig. 9. 13–14)*.[132]

From Győr-Ménfőcsanak a small-sized, almost square building (4×4 m) was excavated consisting of seven postholes which could have supported a pyramid roof *(fig. 9. 15)*. The Únětice type cup and loaf-of-bread idol fragments discovered in the fill of the postholes here date the

[121] Remains unpublished, the site mentioned by: *Ilon 2004* 47; *Károlyi 2004* 179, fig. 135; *Nagy 2013* 80.
[122] *Nováki 1965c; Ilon 1996* 27.
[123] *Lauermann 2003* 472–499.
[124] *Neugebauer 1994* Abb. 57; *Schefzik 2010* 339–340, Abb. 7.
[125] *Schefzik 2010* Abb. 2, Abb.7.
[126] *Schunke – Stäuble 2019.*
[127] *Schefzik 2010* 334–335, Abb. 1. A, Abb. 2; *Schefzik 2019* 686–689, Abb. 9, Abb. 10, Abb. 11.
[128] *Schefzik 2010* Abb. 2, Abb. 9; *Schefzik 2019* 689–694, Abb. 13, Abb. 17, Abb. 20.
[129] *Schefzik 2010* 335, Abb. 6, Abb. 9. 3.
[130] *Schefzik 2010* 336, Abb. 3.
[131] *Bátora 2019* 842–844, fig. 31, fig. 34.
[132] *Stuchlík 2000* 249, figs. 5–7.

building to the Late Únětice – Early Věteřov period.[133] The closest analogue of this structure is known from the site of Nitriansky Hrádok/Kisvárad in Slovakia, associated with the Mad'arovce culture (1750/1700–1600/1500 BC) *(fig. 9. 16).*[134] Similarly, smaller buildings (8 m long, 3–7 m wide) with two or three rows of posts are known from the distribution of the subsequent Tumulus culture in Transdanubia towards the end of the Middle Bronze Age (1600/1500–1300/1200 BC) *(fig. 9. 18, 19).*[135] Given the daub-rich debris of the building excavated at Hegyfalu, the wattle-and-daub technique could have continued to be used until the beginning of the Late Bronze Age in the region.[136]

A possible reconstruction of the buildings discovered at Nagycenk-Kövesmező

During the archaeological investigation of the Nagycenk-Kövesmező site in 2005, altogether eight posthole clusters were identified (feature nos. 111, 109, 113, 108, 115, 116, 103, 102). Out of the four postholes arranged in a right angle and identified as to have belonged to the same feature no. 111, posthole nos. 111/2 and 111/3 were aligned according to a NE–SW axis, and were located only 5 metres away from the postholes discovered underneath the 'find concentration' nos. 109/1 and 109. There were two clusters of postholes (feature nos. 109 and 111) which lay farther to the north, seemingly separate from the rest of the postholes, and could have belonged to a single building structure. The eastern side of this structure did not survive, but despite of this a building of a size of 12×5.3 m could be assumed supported by seven posts (their postholes found *in situ*) *(fig. 10).*

In a 100 m long and 20 m wide strip along the eastern edge of the excavation a concentration of altogether 44 postholes was observed, among which 13 belonged to feature no. 113. Around posthole no. 113G even the Bronze Age walking surface could be observed. Postholes 113A, 113H, 113L could represent the remains of the building's western, while postholes 113C, 113E, 113I the eastern external walls. The central axis of the house consisted of postholes 113J, 113F, 113D and possibly 113B. Feature no. 113G could be interpreted as the supporting post for 113I, similarly to feature 113K associated with 113J. Whether posthole 113M belonged to the building is unclear. Based on these, the building structure could be reconstructed as a 16.5 m long and 4.5–5.7 m wide construction consisting of at least 12 postholes arranged in three rows, oriented in a NW–SE direction *(fig. 10).*

Postholes 108A, 108B and 108C were arranged in a line oriented NW–SW. 4 m west of posthole 108A lies posthole 108F, while 2 metres from 108B in each direction postholes 108D and 108E were located in a triangular arrangement. It is possible that along with posthole 113M to the northeast these postholes were part of a trapezoidal structure (7×9 m) with a pyramid roof *(fig. 10).*

Right next to and beneath 'find concentration' no. 115 the postholes of 115B, 115C and 115D came to light forming a triangle of a size 2.5×0.7 m. Nearby 'find concentration' no. 116. the postholes of 116B, 116C and 116D were aligned in a NW–SE direction. Postholes of 116B and 115D were of similar depths (15–20 cm) and arranged parallel with postholes 116C and 115C oriented NE–SW. It is feasible to assume that postholes 115 and 116 were part of the same building, however given their location close to the edge of excavation, multiple possible reconstructions can be considered. One of these might be that the postholes were part of a 6 m long and 6 m wide southwestern end of a rectangular building oriented to the SW–NE *(fig. 10).*

[133] *Melis 2014* 57–59, fig. 3.
[134] *Točik 1978–1981* 70–73, Plan 25. 2, Plan 38. 1, Plan 46. 1, Plan 47.
[135] Kóny-Barbacsi-tó: *Egry 2002* 9–10, no. 4, Map 3; Ordacsehi-Bugaszeg: *Kiss 2011* 101–102, fig. 2. 2, fig. 3 right.
[136] *Károlyi 1984* 133–143.

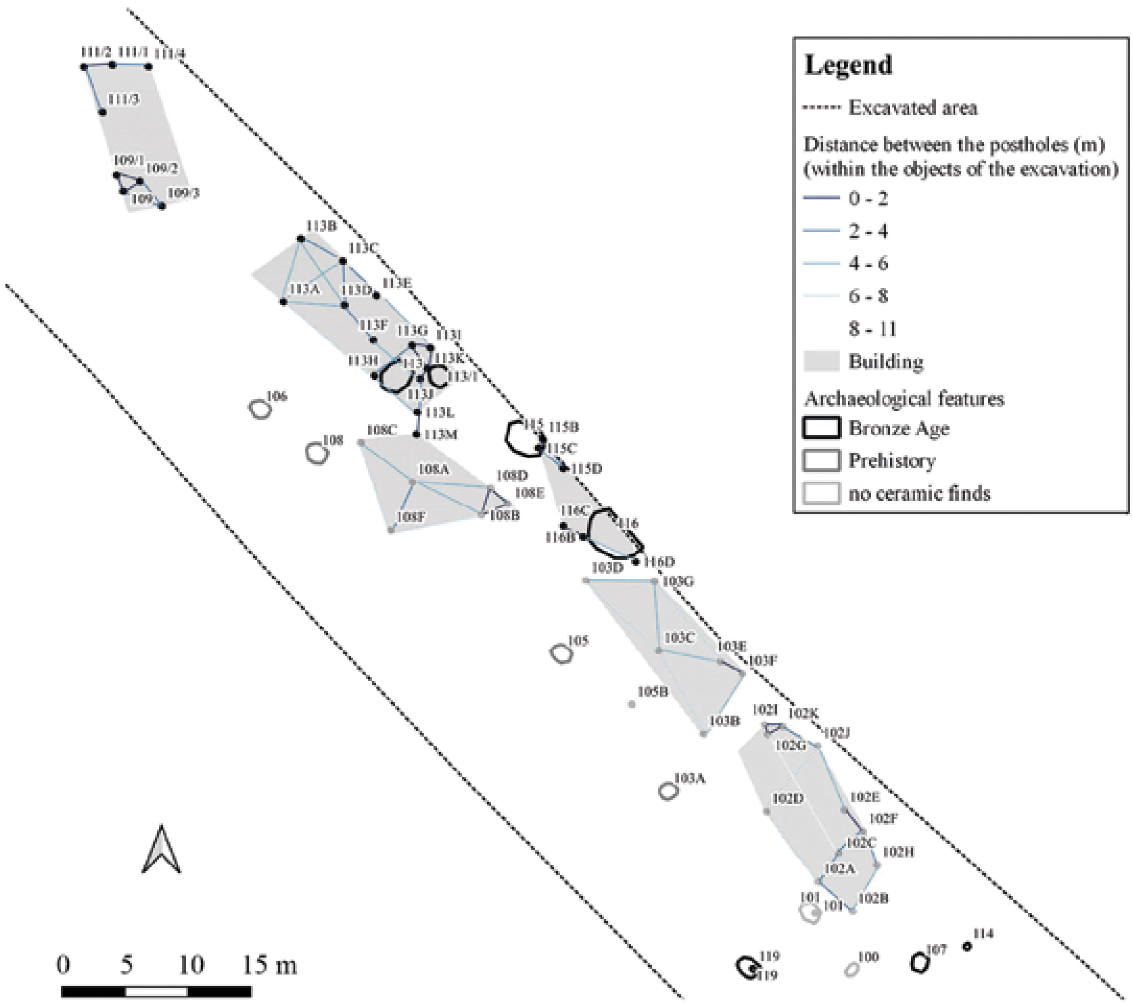

Fig. 10. A possible reconstruction of the post-structures at Nagycenk-Kövesmező

Postholes 103B, 103C, 103D, 103E, 103F and 103G were located on a trapezoidal area of 15×5 m, in between feature nos. 116 and 102. The postholes – with one exception – situated relatively far from each other and formed uneven rows running in a NW–SE direction *(fig. 10)*.

The postholes of 102A, 102F, 102J and 102D associated with feature no. 102 were arranged in a more or less rectangular layout, with posthole 102E on the eastern, and 102C on the southern side. To the southeastern side of the rectangular construction joined postholes 102B and 102H forming a trapezoidal layout. Northeast of these and 3 m to the northwest from posthole 102J there was a cluster of postholes consisting of 102I, 102G and 102K. The postholes associated with feature 102 form a 15 m long and 7 m wide layout structure with a square end on the southeast and with a rounded apsis end on the northwest *(fig. 10)*.

In sum, on average buildings of 11–16 m in length and 5 m in width could be reconstructed, built directly on the Bronze Age surface, supported by a post structure and a row of internal posts bearing the weight of a gable roof. Fragments of daub discovered among the fill of the postholes suggest wattle-and-daub walls. Similar buildings are known from the distributions of the Bell Beaker complex's Budapest and Oggau–Wipfing–Ragelsdorf groups.[137] In the Únětice

[137] *Reményi – Dobozi 2012; Endrődi – Reményi 2016* fig. 66.

complex building structures with two aisles and length less than 20 m represent the medium-sized constructions in the territory of Germany, while buildings of similar dimensions could be considered average in the region of Slovakia.[138] Examples for buildings with a pyramid hipped roof – as it is assumed feature no. 108 might have been – are known from Ménfőcsanak (Hungary) and from Nitriansky Hrádok/Kisvárad (Slovakia).[139] In the case of feature no. 102, a building structure could be reconstructed with one, apsis end, however the exact size and layout of this construction remains unclear.

The relative and absolute chronological classification of the Nagycenk-Kövesmező settlement

The material of pit no. 84 contained ceramics with the characteristics of the Bell Beaker, Somogyvár–Vinkovci and Makó–Kosihy–Čaka complexes, dating to the second phase of the Early Bronze Age. Given the relative proximity of the Bell Beaker culture's Leitha group,[140] and the increasing dominance of local communities during the late Bell Beaker period,[141] the earlier, Bronze Age component of the Nagycenk-Kövesmező settlement can be dated to the late phase of the Bell Beaker culture. Radiocarbon dates from Hungary indicate that sites linked closely with the Bell Beaker complex were established around 2550/2500 cal BC, could have remained in use until around 1950/1900 cal BC in a gradually shifting cultural environment.[142] The most recent radiocarbon dates classify the Makó–Kosihy–Čaka complex's early phase to ca. 2550–2300 BC, while the late phase to ca. 2300–2150 BC.[143] Most recent radiocarbon dates yielded by sites associated with the Somogyvár–Vinkovci complex in Hungary place the span of the culture between 2500/2400 and 2300/2200 BC.[144] The three radiocarbon dates derived from analogous Corded Ware sites from the territories of Moravia and Bohemia range between 2450 and 2200 cal BC.[145] Based on this data, the most probable absolute dating for pit no. 84 can be assumed to fall between 2400/2300 and 2200/2100 cal BC.

The ceramic material documented from the rest of the pits (located more than 30 metres north of pit no. 84) can be identified as the assemblages of the Gáta–Wieselburg culture. The existence of the Gáta–Wieselburg complex spans from the end of the Hungarian Early Bronze Age throughout the entire period of the Middle Bronze Age (which is also parallel with the period of the Central European Early Bronze). In the region of Transdanubia Gáta–Wieselburg communities were contemporaneous with the sites of the Kisapostag (Earliest Encrusted Pottery) and the Encrusted Pottery culture.[146] In the neighbouring territories of Eastern Austria, the complexes of the Unterwölbling and Únětice cultures dominated at this time.[147] The region of southwestern Slovakia was occupied by the communities of the Nitra, Únětice and Věteřov

[138] *Schefzik 2010* 336, Abb. 3; *Bátora 2019* 842–844, fig. 31, fig. 34.
[139] *Točik 1978–1981* 73, Plan 6, 7, 23–24; *Melis 2014* 57–59, fig. 3.
[140] *Neugebauer 1994* 35–48.
[141] *Károlyi 1975* 172; *Károlyi 2004* 176–178; *Reményi – Dobozi 2012.*
[142] *Kulcsár 2011* fig. 5; *Patay 2013* fig. 19; *P. Fischl et al. 2015* 503, 506, fig. 6a–b; *Endrődi – Reményi 2016* 221–227; *Czene 2017* fig. 18; *Kiss et al. 2019* 177–180, fig. 4.
[143] C.f. *Kővári – Patay 2005; Kulcsár – Szeverényi 2013* fig. 3; *Dani et al. 2019* Table 1; *Szabó 2017a* fig. 3, Table 1; *Staniuk 2021.*
[144] E.g. *Kulcsár 2013* Table 1; *Kulcsár – Szeverényi 2013; Gál 2017* Appendix 1; *Szabó 2017a; Szabó 2017b.*
[145] Slaný (Czech Republic): KlA-11798: 3854 ± 39 BP, 2447–2209 cal BC (68.3%), 2460–2203 cal BC (95.4%) (*Furholt 2003* Taf. 107. 1); Hulín-Pravčice (Czech Republic): UGAMS-9500: 3880 ± 20 BP 2453–2301 cal BC (68.3%), 2461–2291 cal BC (95.4%) Oloumuc-Řepčín (Czech Republic): Poz-14919: 3890 ± 35 BP, 2458–2310 cal BC (68.3%), 2469–2211 cal BC (95.4%) (*Peška 2013* fig. 65, fig. 87).
[146] *Kiss 2012b* fig. 3; *P. Fischl et al. 2015* fig. 1b.
[147] *Neugebauer 1994* 69–118.

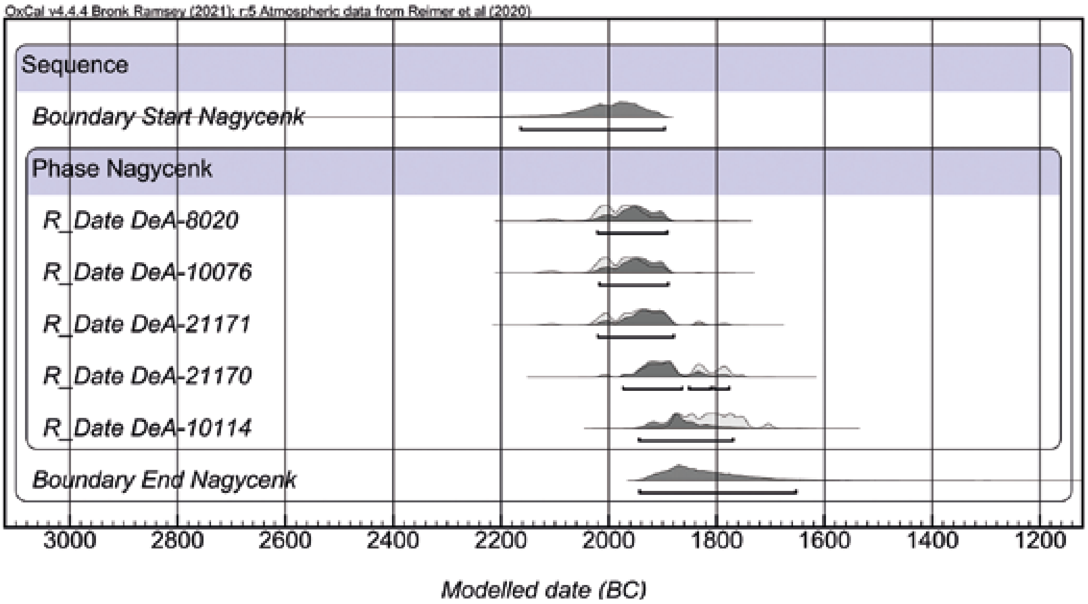

Fig. 11. Bayesian modelling *(Reimer et al. 2020; Bronk Ramsey 2009)* of the ^{14}C dates from Nagycenk-Lapos-rét and Nagycenk-Kövesmező (see *Table 2*)

cultures in the period between 2200 and 1600 BC,[148] showing signs of intermingling with Gáta–Wieselburg materials.[149]

The available radiocarbon data directly associated with the Gáta–Wieselburg culture is worth mentioning here. Altogether ten radiocarbon dates have been published deriving from Gáta–Wieselburg burials in Hungary: four from Zsennye,[150] three from Nagycenk,[151] two from Ménfőcsanak[152] and one from Szakony.[153] The published and calibrated raw dates scatter with and plot between 2110 and 1560 cal BC. The combined value of two radiocarbon dates yielded by a secondary burial from Neusiedl am See (Nezsider) in Austria fall a little later, to 1690–1520 cal BC.[154] By the combination and the visual wiggle-matching of the dates produced by samples from an inhumation burial and a consecutive burial discovered at Weiden am See (Védeny, Austria) place the first burial to 1900 cal BC, and the second to around 1860 cal BC.[155] The radiocarbon dates yielded by burial nos 55 and 51 from Nagycenk-Lapos-rét could therefore be considered as one of the earliest representatives associated with the Gáta–Wieselburg complex *(Table 2)*.[156] The individual data derived from the recently analysed burial no. 1 from Nagycenk ranges too broadly (2034–1782 cal BC [95.4%]), but it is more likely to fall to the earlier period, while the data from burial no. 61 (1894–1697 cal BC [95.4%]) suggests a later dating. A sample taken from animal bone from pit no. 107 further indicates an earlier date (2012–1768 cal BC [95.4%]). If these five dates are considered and modelled within a single typological phase, then the beginning of this period falls to around 2164–1897 (95.4%) cal BC, and ends around 1943–1653 (95.4%) cal BC *(fig. 11).*

[148] *Bátora 2018* fig. 65.
[149] *Leeb 1987* Abb. 1; *Benkovsky-Pivovarová – Chropovský 2015* 126–144, Abb. 90.
[150] *Nagy 2013* 110–114.
[151] *Gömöri – Melis –Kiss 2018* 70–71, fig. 41.
[152] *Melis 2015* fig. 2; *Melis 2017* Table 1.
[153] *Melis 2019* 151.
[154] *Stadler 2002.*
[155] *Aspöck – Banerjea 2016* fig. 10.
[156] *Gömöri – Melis –Kiss 2018* 70–71, fig. 41.

Site	Feature no.	Feature type	Sample type	Laboratory no.	BP date	Cal BC (95.4%)	Cal BC (68.3%)	Reference
Nagycenk-Lapos-rét	1	inhumation burial	human bone	DeA-21171	3589 ± 33	2034–1782	2011–1895	unpubl.
Nagycenk-Lapos-rét	51	inhumation burial	human bone	DeA-10076	3612 ± 27	2111–1889	2023–1934	*Gömöri – Melis – Kiss 2018*
Nagycenk-Lapos-rét	55	inhumation burial	human bone	DeA-8020	3617 ± 25	2112–1893	2025–1940	*Gömöri – Melis – Kiss 2018*
Nagycenk-Lapos-rét	61	inhumation burial	human bone	DeA-10114	3489 ± 31	1894–1697	1879–1751	*Gömöri – Melis – Kiss 2018*
Nagycenk-Kövesmező	107	pit	animal bone	DeA-21170	3545 ± 32	2012–1768	1940–1779	unpubl.

Table 2. ^{14}C dates from Nagycenk-Lapos-rét and Nagycenk-Kövesmező

Larger, characteristically Gáta–Wieselburg ceramic fragments discovered in posthole nos 109 and 111 can be associated with the later phase of the Nagycenk-Kövesmező settlement. In contrast, small sherds coming from the rest of the postholes and 'find concentrations' had less diagnostic potential, although forms associated with the preceding period, the second phase of the Early Bronze Age also occur. The majority of these pieces had a clay fabric rich in mica, sand and small quartzite pebbles – a characteristic trait of Gáta–Wieselburg vessels. The location of postholes and the spatial separation of pit no. 84 from the rest of the settlement features suggests that the building structures constructed on the prehistoric surface represent the Middle Bronze Age Gáta–Wieselburg culture, however an earlier (Early Bronze Age 2) dating of these structures cannot be excluded either. Furthermore, Early and Middle Bronze Age surface ceramics were collected from an area of 40 ha surrounding the settlement of Nagycenk-Kövesmező, on the northern shores of the Arany Stream *(fig. 12. 1, 2).* As a result, the boundaries of the settlement site had been revised as the occupation seems to have extended farther to the east than previously thought. This indicated the presence of a less intensive but more sprawling occupation of the area. The dating of the settlement material implies that the site was established during the second phase of the Early Bronze Age (2400/2300 cal BC) and continued to be utilised until the second or third phase of the Middle Bronze Age (1650/1600 cal BC).

Bronze Age occupation in the Arany Stream Valley

The Bronze Age occupation in the Arany Stream Valley was outlined based on the systematic collection of surface finds in 2018–2019, before plotting them by using a geoinformatics software (QGIS) supplemented by the data acquired through excavations in 2004–2005 and 2017–2019. The Bronze Age ceramics collected in 50×50 m grids partially overlapped with previously known Bronze Age sites, and their presence only indicated certain segments of site-complexes *(fig. 12. 1).* In the vicinity of Nagycenk it was possible to investigate a more extensive area, located on the southern peripheries of the microregion. About half of this area, approx. 1147.25 hectars (assessed in 4589 grids of 50×50 m) was surveyed in 2018 (the rest was either under cultivation or under

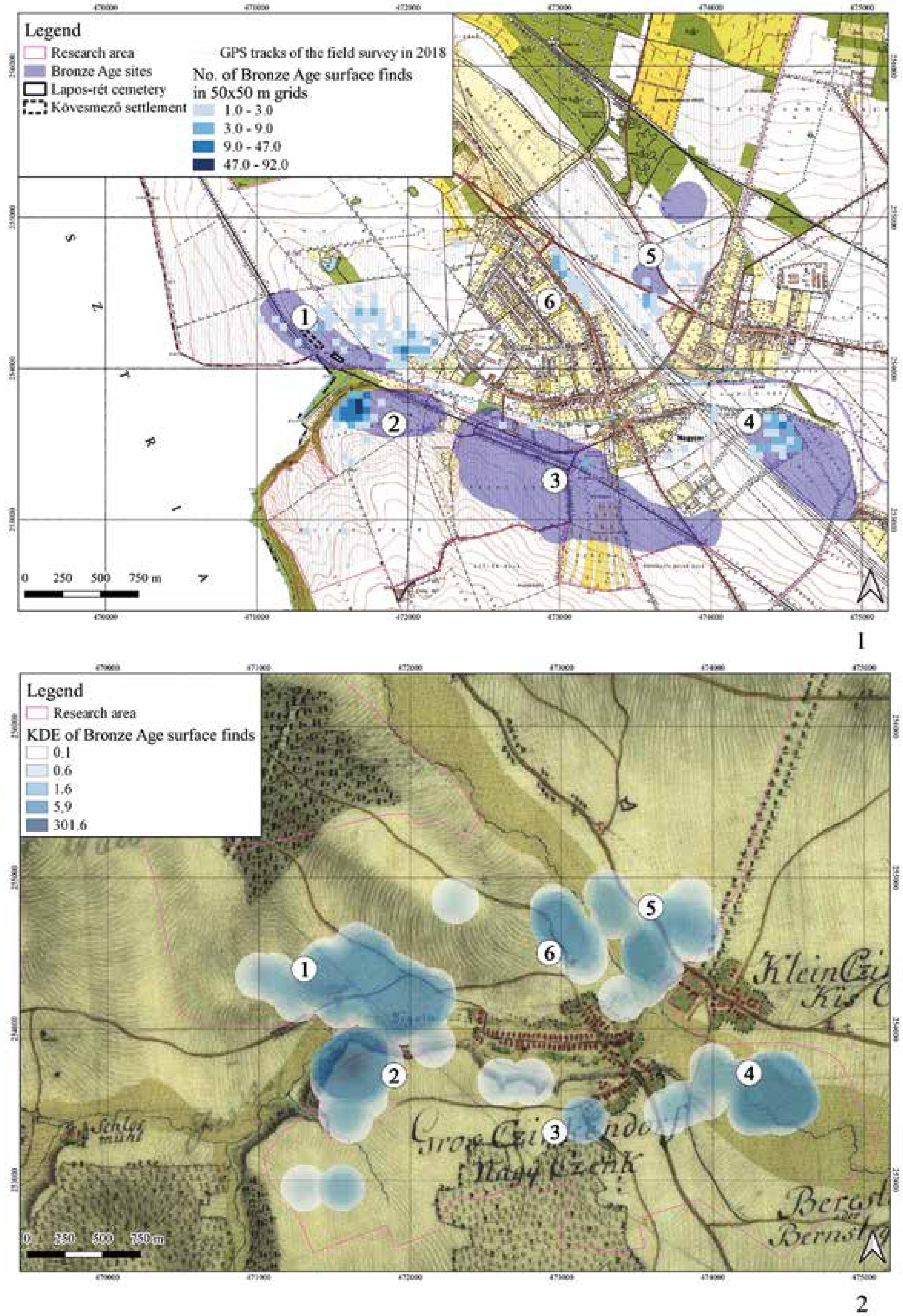

Fig. 12. 1. The assessment of the Bronze Age material collected in 50×50 m grids during the systematic field survey in 2018; 2. Kernel Density Estimation of the Bronze Age finds collected in 2018 on the First Military Survey of the Habsburg Empire (1782–1785). Legend to the numbers of Bronze Age find concentrations: 1. Nagycenk-Kövesmező; 2. Nagycenk-Alsó-domb-dűlő; 3. Nagycenk-Farkasverem; 4. Nagycenk-Belső Vízálló; 5. Nagycenk-Kismező; 6. Nagycenk-Soproni út–Ikva között

modern occupation). In the southern territory of the study area heatmaps were created to estimate the density of Bronze Age surface finds *(fig. 12. 2)* achieved by Kernel Density Estimation (KDE) included in QGIS package. Out of a variety of Kernel estimations, the regular (Gauss) plotting method was selected. To identify the optimal bandwith for the Kernel we applied the $h_{opt}=[2/3n]^{1/4}$ σ formula and arrived at the value of 157 m.[157]

Both the preliminary grid data and the KDE based on Early and Middle Bronze Age surface scatters suggested the presence of an extensive occupation site north of the Arany Stream, which in light of the previously investigated settlement Nagycenk-Kövesmező could be interpreted as one large Bronze Age settlement site *(fig. 12. 1, 2).*

Although east of Nagycenk-Kövesmező around the site of Nagycenk-Farkasverem only a few Bronze Age surface scatters were identified *(fig. 12. 1, 2),* during the excavations carried out prior to the construction of Road M85 a new, outstandingly rich cemetery of the Gáta–Wieselburg culture came to light containing 31 burials.[158] Both Nagycenk burial grounds (Lapos-rét and Farkasverem) were rich in bronze ornaments and were located approx. 1.5 km from each other, implying that the communities utilising these sites possessed exceptional wealth in the context of Middle Bronze Age Transdanubia.

On the eastern shores of the Ikva River, north of Kiscenk, surface ceramics similar to the material (i.e. fabrics rich in mica and sand) of Kövesmező site were collected. The surface scatters were successfully dated by a few diagnostic pieces (such as bowl with decorated interior) to the first and second phase of the Early Bronze Age (2600/2500–2300/2200 BC) (Nagycenk-Kismező site; *fig. 12. 1, 2*). At this site a less intensive Early Bronze Age occupation can be assumed, heavily disturbed by later (Iron Age, Roman- and Árpádian-periods) features. At the site of Nagycenk-Belső Vízálló *(fig. 12. 1, 2)* the presence of multiple archaeological periods were identified, ceramic sherds suggest that the site was occupied by the Late Copper Age Baden culture and by Early Bronze Age populations.

The number of Late Bronze Age ceramics (417 pieces) however, exceeded the amount of sherds collected from earlier periods. This material was gathered from the site of Nagycenk-Alsó-domb-dűlő, south of the Arany Stream dating to the subsequent period of the Gáta–Wieselburg culture, to the transition of the Middle to Late Bronze Age *(fig. 12. 1, 2).* Here, on the flat hilltop flanking the Arany Stream, features associated with the *Litzenkeramik* and the Maďarovce–Tumulus culture, the Early Copper Age and the Early Iron Age were investigated by Bálint Savanyú.[159] During our extensive survey we were able to reassess and extend the boundaries of the site to the south. The steep hillside on the north facing the curve of the stream could have provided adequate protection for past occupants.

Southwest of the Ikva River, on the gentle slopes directly opposite the site of Nagycenk-Kismező Late Bronze Age ceramics were collected along with Roman- and Árpádian-periods fragments. This surface scatter indicates the presence of a so far unknown site (Nagycenk-Soproni út–Ikva között; *fig. 12. 1, 2*). However, its investigation could prove difficult as the area to the west (towards Road 84) is currently being occupied.

There were a few areas in the vicinity of Nagycenk which due to agriculture and vegetation could not been surveyed in 2018 – some of these fields investigated during the course of late 2019, the identification of the material collected from here is in progress. It is also possible that the outcome of these assessments may modify the extent of sites and their interpretation described above.

[157] https://kdepy.readthedocs.io/en/latest/introduction.html [last accessed: 22.06.2022]. *Berta 2022* 99–104.
[158] *Savanyú 2020a.*
[159] *Savanyú 2020b.*

In the near future, we are planning to concentrate our efforts on the northern territories of the microregion; towards the meeting point between the Fertő Basin and the Western Hungarian peripheries. Our key aim is to establish the exact boundaries of the hilltop settlement of Fertőboz-Gradinahegy as in the next phase of our research project we would like to draw up and distinguish different types of occupations and their connections within the microregion; potentially shedding more light on the organisation of Bronze Age societies in Western Transdanubia.[160]

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MIDDLE BRONZE AGE BURIAL AT THE SETTLEMENT OF SÓSKÚT-BARÁTHÁZ, SITE 26/4 (CENTRAL HUNGARY)[1]

Zusammenfassung: In diesem Beitrag wird die Grabstätte der mittelbronzezeitlichen Siedlung von Sóskút-Barátház, Fundort Nr. 26/4, im Tal des Benta-Baches südlich von Budapest vorgestellt. Das Tal am rechten Donauufer bildet eine klar abgegrenzte naturgeographische Einheit, die mit der Tellsiedlung Százhalombatta-Földvár verbunden war. An der Fundstelle Sóskút-Barátház, neben der befestigten Siedlung Sóskút-Kálvária-hegy, wurde im Jahr 2012 auf der äußeren Ebene der befestigten Siedlung ein bronzezeitlicher Laufhorizont ausgegraben, die von mehreren Gruben und Pfostenlöchern umgeben war. Die Bewertung der Funde aus den Gruben und der Radiokohlenstoffproben legt nahe, dass die äußere einschichtige Siedlung während der Vatya-Kultur über einen längeren Zeitraum (1880–1560 v. Chr.) genutzt wurde. In einer der Gruben wurde ein weibliches Skelett in anatomischer Lage gefunden, das einen weiteren Beweis für einen von Brandbestattungen abweichenden Ritus innerhalb der Siedlung liefert und das Spektrum der Bestattungen innerhalb der Siedlung erweitert.

Keywords: pit burial, Vatya culture, Koszider period, Middle Bronze Age, Benta Valley

The Sóskút-Barátház 26/4 site[2] is located in the Benta Valley, halfway between the headwaters of the Benta Stream (at Lake Bia), and its confluence with the Danube just beyond Százhalombatta. The Benta Valley Project emerged as an offshoot of the Százhalombatta Archaeological Expedition

[1] This study presents the preliminary outcomes of the Benta Valley project, while the comprehensive publication of the investigation is ongoing. The paper was supported by the 'Landscapes of Complexity: The Politics of Social, Economic and Ritual Transformations in Bronze Age Hungary' research project, funded by the Wenner-Gren Foundation in 2012–2013. (PI: Timothy K. Earle, Gabriella Kulcsár), and furthermore by the Momentum Mobility Research Project hosted by the Institute of Archaeology, Research Centre for the Humanities, Hungarian Academy of Sciences (PI: Viktória Kiss). The research was supported by the Hungarian Scientific Research Fund (project id.: FK-128013), and by the Bolyai Scholarship of the Hungarian Academy of Sciences; by the New National Excellence Program of the Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund (Tamás Hajdu). We would like to thank Magnus Artursson, Janusz Czebreszuk, Péter Czukor, Erika Gál, Mateusz Jaeger, Carla Klehm, Attila Kreiter, Tamás Polányi, Łukasz Pospieszny, Anna Priskin, Gábor Sánta, Gábor Serlegi, and Csaba Bodnár, Eszter Fejér, Eszter Melis, István Greman, the archaeology students of Pécs University and Péter Lakatos for their help and assistance ont he field and in the post excavation periode. Special thanks are due to Magdolna Vicze (former director of the Matrica Museum, Százhalombatta), members of the Directorate of Pest County Museums and the Sóskút local government for their support. The illustrations of vessels were carried out by László Gucsi, the layout by Zsolt Réti and László Gucsi. We are grateful for the help of László Gucsi and Gábor Sánta on the analyses of pottery.

[2] *MRT 7* Site 26/4, 223.

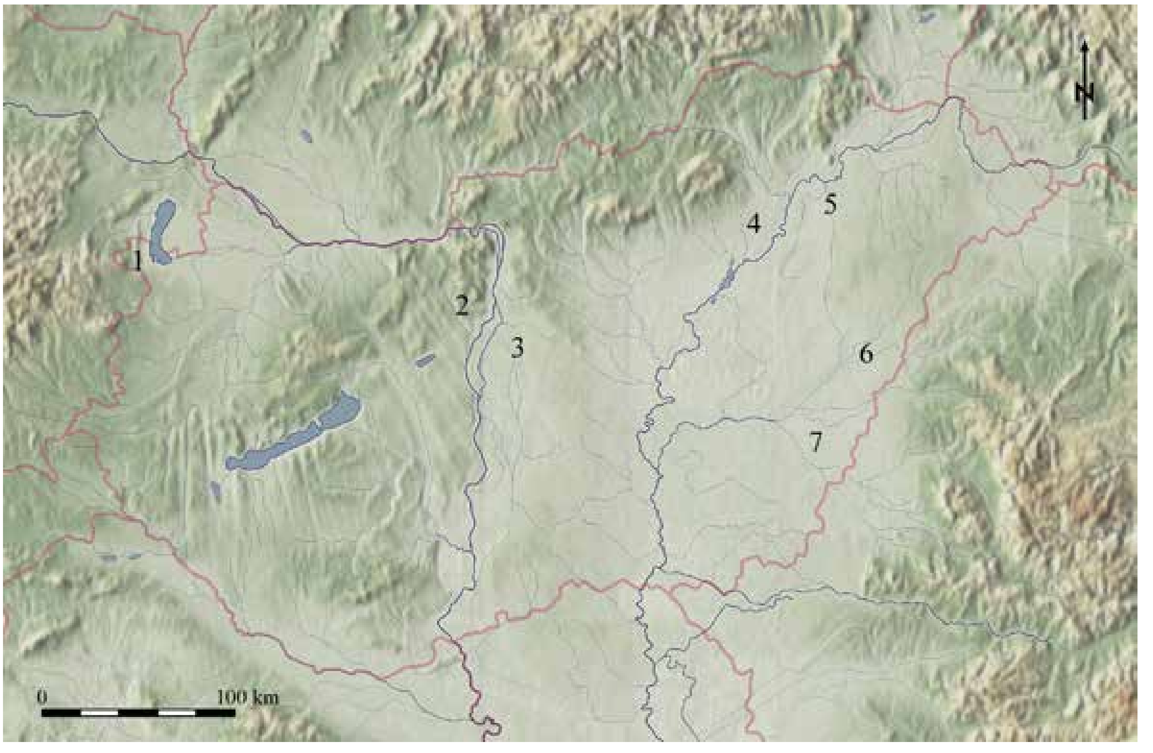

Fig. 1. Ongoing Middle Bronze Age microregional research projects in Hungary.
1. Nagycenk Region; 2. Benta Valley (SAX and Benta Valley Project); 3. Kakucs Region (KEX Project);
4. Borsod Plain (BORBAS Project); 5. Polgár Region; 6. Berettyó Valley;
7. Körös Valley (BAKOTA Project) (after *Dani et al. 2019* fig. 1)

(SAX) launched in 1997 *(figs. 1–2)*.[3] This Hungarian–Swedish–American and, later, Hungarian–Swedish–English collaborative research project focused on the detailed investigation of the tell settlement at Százhalombatta-Földvár, one of the key Bronze Age sites in the Central Danube Valley. The excavation of the tell site had been ongoing when it transpired that it would be equally important to study the Bronze Age settlement network in the surrounding microregion. Thus the Benta Valley Project was set up in order to shed more light on the broader archaeological context of the central tell site: the social, economic and political dimensions of the local Middle Bronze Age, and to identify the patterns of settlement hierarchies, their structure and variety along the Benta Valley.

For this microregional investigation a three-phase research plan was devised, following Charles L. Redman's proposal: 1) field survey – Phase I, 2) determination of site types – Phase II, 3) excavation – Phase III. During the first phase of the investigation, which built upon the results of *Archaeological Topography of Hungary* (initial data collection was carried out in the 1970s) – a total of 32 Bronze Age sites were identified in the Benta Valley by extensive field surveys.

The second phase (between 2003 and 2007) determined the variety of site types and methods of occupation. Each site was shovel-tested on a 50 m grid to establish its extent, before 1×1×0.3 m soundings were opened within the given locality to identify the time period and the type of activities that had been taken place at the site. Based on these shovel tests and the 1×1 m soundings, a tentative reconstruction of the Bronze Age settlement network was drawn up *(fig. 2)*.[4]

[3] *Poroszlai – Vicze 2000; Poroszlai – Vicze 2005; Earle – Kristiansen 2010; Czajlik 2017; Vicze – Sørensen in press.*

[4] *Earle – Kristiansen 2010; Earle et al. 2010; Earle et al. 2011; Earle et al. 2012a.*

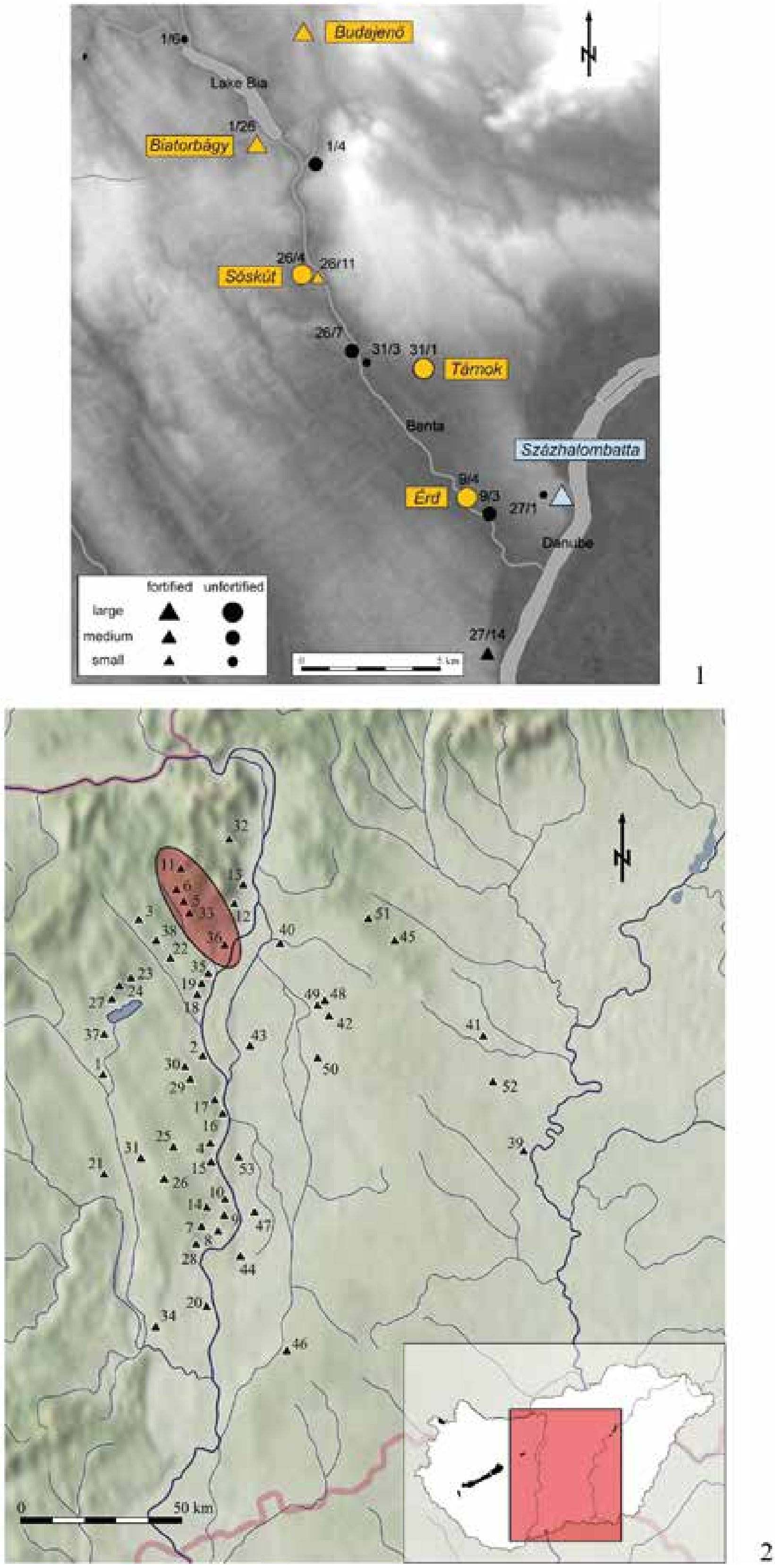

Fig. 2. 1. Middle Bronze Age settlements located in the Benta Valley; 2. Middle Bronze Age tells and fortified settlements in Central Hungary (11. Budajenő-Hegyi szántók, 33. Sóskút-Kálváriahegy/ Baratház, 36. Százhalombatta-Földvár) (after *Earle et al. 2011* fig. 1; *Szeverényi – Kulcsár 2012* fig. 1; *Dani et al.* 2019 fig. 2, fig. 4, with modifications)

The project Phase III, supported by the Wenner-Gren Foundation and the National Cultural Fund of Hungary, took place in 2012–2013.[5] Geophysical (magnetometer) surveys followed by excavations were conducted on the three different settlement types identified during Phase II at Tárnok (Site 31/1, open site), Bia (Site 1/26, a small fortified site), and Sóskút (Site 26/4, an external settlement adjacent to Sóskút-Kálvária-hegy Site 26/11), in order to compare the layout of the building structures at various settlement types and to identify similarities and differences between them.[6] This paper provides the first archaeological assessment of the Sóskút-Barátház excavations, with the detailed publication of a pit burial and its assemblage.

Sóskút-Barátház, Site 26/4 – Excavation results

Sóskút-Barátház, Site 26/4 is situated in the northern or Upper Middle Valley tract of the Benta Stream, characterised by pasture-covered limestone formations.[7] The site itself lies west of the slopes of the Kálvária Hill, on cultivated farmland. The *Archaeological Topography of Hungary* lists the presence of Middle Bronze Age (Vatya) and Late Bronze Age (Urnfield) habitation at the site which was later confirmed by reconnaissance field surveys carried out by the SAX project in 1999, and by the Benta project's Phase II between 2003 and 2007.[8] These recent investigations identified further components of the site (e.g. ceramics dating to the Early Bronze Age, Hallstatt and Roman period) and established that it was most intensively utilised during the Bronze Age as a single-layered settlement.[9]

In the spring of 2012, the remote sensing survey of the site was carried out followed by a systematic field surface collection in a 10×10 m grid (covering roughly 2.5 hectares) *(fig. 3. 1)*.[10] During the systematic collection of surface finds the distribution of daub and pottery was recorded (*fig. 3. 2–3* for MBA). Contrasting this data with the images generated by the geophysical surveys, there was no indication of timber-framed houses and neither were other anomalies present that could have signalled the remains of burnt buildings. Due to the lack of apparent building structures, areas of uniform signal that appeared as 'empty' spaces on the magnetometry images, but where the field survey documented larger find concentrations, were selected for closer examination by excavation (Benta Phase III). Four areas were targeted, out of which two were investigated in trenches (Trench 2 and 3) measuring 4×4 m *(fig. 3. 4)*. The trenches revealed Late Bronze Age assemblages, as well as deposits from the Middle Bronze Age occupation.

In Trench 2 a Bronze Age occupation layer, three domestic refuse pits and a number of post-holes were discovered *(fig. 3. 4, fig. 4)*. Although this occupation deposit may in fact represent the remains of a house, there is so far no conclusive evidence to support this, as the building was not destroyed by fire and thus its floor and upright walls had not been exposed to high temperatures that tend to preserve such features.

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[5] Landscapes of Complexity: The Politics of Social, Economic and Ritual Transformations in Bronze Age Hungary project.

[6] *Earle et al. 2012a; Earle et al. 2014*. The initial assessment of the finds from Tárnok were completed by Nóra Szabó in her BA thesis *(Szabó 2015)*.

[7] *Earle et al. 2011; Klehm – Nyíri 2016*.

[8] *MRT 7* Site 26/4, 223; *Vicze – Earle – Artursson 2005*.

[9] *Klehm – Nyíri 2016*.

[10] *Earle et al. 2012b; Earle et al. 2014*.

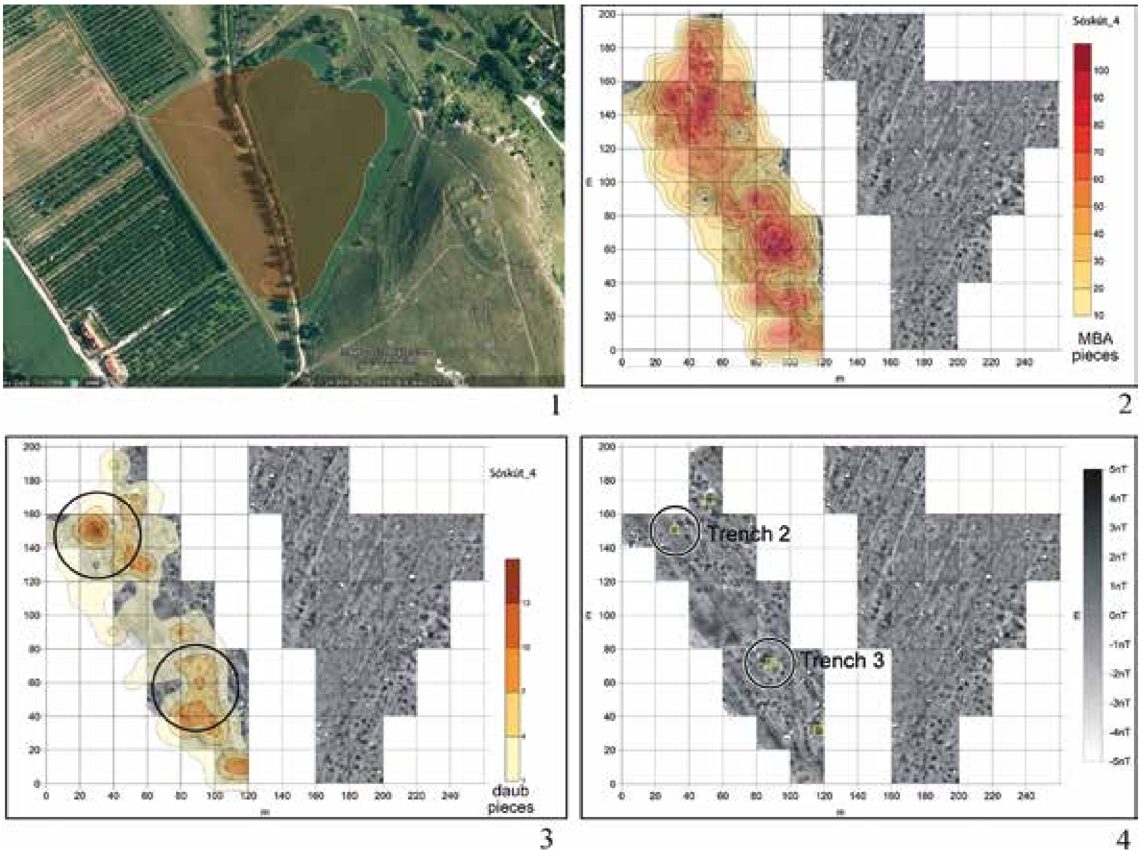

Fig. 3. Sóskút-Baráthház (Site 26/4) archaeological investigation. 1. Study area marked in red on a Google Earth image. Magnetometer and field survey of the site; 2. The scatter of Middle Bronze Age sherds; 3. The scatter of daub finds; 4. Location of Trench 2 and 3 (©analysis by Péter Czukor and the authors)

The Middle Bronze Age occupation layer is associated with the Vatya culture, whose relative chronology was first outlined in the 1970s by István Bóna based primarily on cemetery data.[11] According to this periodisation the emergence of the Vatya culture (Vatya I) is linked to the onset of the MBA 1 in Hungary, Vatya II roughly corresponds to the MBA 2, while MBA 3 can be equated with the culture's later periods (Vatya–Koszider, Alpár, Rákospalota phase). The archaeological assemblages found in three domestic refuse pits and the radiocarbon dates from Trench 2 considered together suggest the presence of a single-layer settlement at Sóskút-Barátház 26/4, inhabited for an extended period of time.[12] The three refuse pits and their assemblages appear to be dating to three different phases of the Vatya chronology.[13] The typochronological and stratigraphic evidence indicates that the Sóskút horizontal settlement was occupied continuously, characterised by Vatya type material (1880–1560 BC), from the Late Nagyrév/Early Vatya transition to the Late Vatya (Vatya III and Vatya–Koszider) phase, from the Middle Bronze Age 1 until the Middle Bronze Age 3 period in the relative chronological framework.

[11] *Bóna 1975; Bóna 1992*. Further analyses *Vicze 2011; Reményi 2012; Szeverényi – Kulcsár 2012; Jaeger – Kulcsár 2013; Jaeger et al. 2018; Staniuk 2020; Staniuk 2021.*

[12] *Earle et al. 2012b; Earle et al. 2014.*

[13] For the associated radiocarbon dates, see *Jaeger – Kulcsár 2013; Kiss et al. 2019; Szeverényi et al. 2020.*

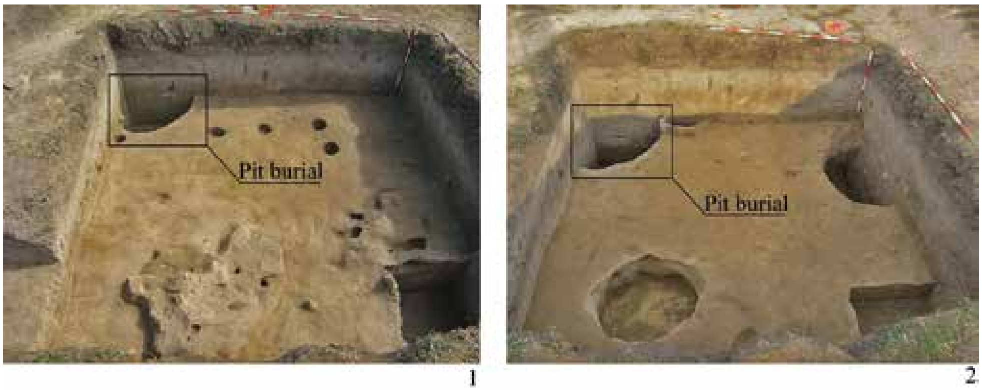

Fig. 4. Sóskút-Barátház (Site 26/4), Trench 2, the level of appearance of pit no. 261/314.
1. The Middle Bronze Age occupation layer and pit burial surrounded by post-holes;
2. The lowermost occupation with cuts of earlier pits present
(©Gabriella Kulcsár and the authors)

Fig. 5. Sóskút-Barátház (Site 26/4), Trench 2, the different stratigraphic units (contexts) of pit no. 261/314. 1–2. S314; 3. S317; 4. S318 (©Gabriella Kulcsár and the authors)

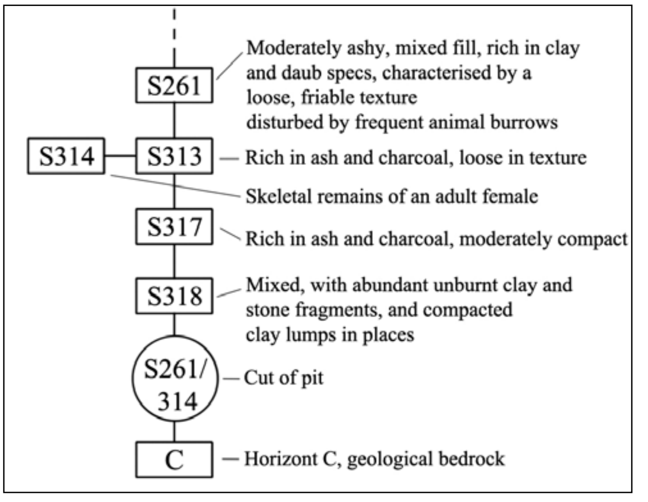

Fig. 6. Sóskút-Barátház (Site 26/4), Trench 2. The model of the stratigraphic units (contexts) of pit no. 261/314 (©László Gucsi)

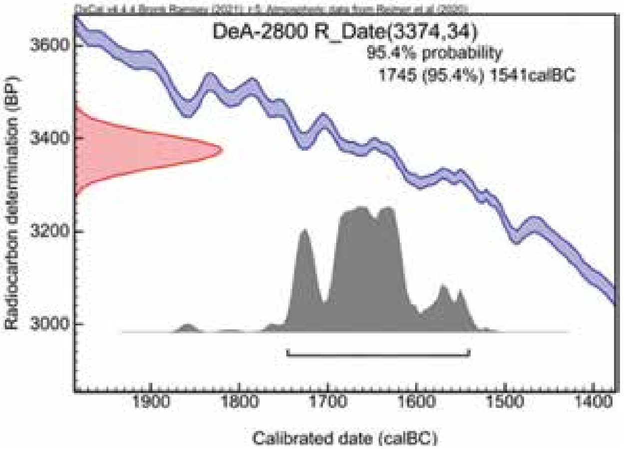

Fig. 7. Sóskút-Barátház (Site 26/4), Trench 2, pit no. 261/314. AMS radiocarbon dating of the inhumation burial (S314). The radiocarbon date was calibrated using OxCal v4.4 *Bronk Ramsey 2021* r:5; Atmospheric data from *Reimer et al. 2020*

Pit burial from the Late Vatya period

Pit no. 261/314 (S261/S313–314/S317–318), an approximately quarter section of a beehive-shaped pit (measuring ca. 140×130 cm) could only be partly excavated, due to its position in the NE corner of Trench 2 *(figs. 4–6).* The top of the pit was observed 60 cm below the present surface and its bottom was reached at the depth of 180 cm. The feature contained five deposits (five layers: S261, S313, S314, S317, S318) and the skeletal remains of an adult female (S314) *(figs. 5–6).* The top deposit (S261) was a moderately ashy, mixed fill, rich in clay and daub specs, characterised by a loose, friable texture disturbed by frequent animal burrows. The layer below (S313) was loose in texture, rich in ash and charcoal, as the deposit beneath (S314), in which the skeleton was discovered. The next fill in the sequence was slightly more compact, but still rich in ash and charcoal (S317). The bottom layer (S318) was mixed, with abundant unburnt clay and stone fragments, and compacted clay lumps in places. The feature dates to the Late Vatya–Koszider period (MBA 3).[14]

An inhumation burial of a female individual came to light from the stratigraphic unit S314, laid to rest in a crouched position on her left side, oriented SE–NW. Perforated beads of mollusc shells were found along one edge of the pit in an animal burrow, which is likely to have belonged to the burial. The radiocarbon date of the human remains was established to 1745 (95.4%) 1541 calBC (DeA-2800, 3374±34 BP) *(fig. 7).*

[14] *Vicze 2011; Jaeger – Kulcsár 2013; Kiss et al. 2019.*

Fig. 8. Sóskút-Baratház (Site 26/4), Trench 2, pit no. 261/314.
The cranium of the buried adult female (©Tamás Hajdu)

Fig. 9. Sóskút-Barátház (Site 26/4), Trench 2, pit no. 261/314.
The mandible of the buried adult female (©Tamás Hajdu)

Physical anthropological analysis of the pit burial

The pit contained the body of a mature adult female individual between 35 and 39 years of age. The anthropological analyses carried out on the remains established that the skull and post-cranial remains were relatively well-preserved but partially incomplete. The sex of the buried individual was determined on the basis of 16 features indexing sexual dimorphism.[15] The sexualisation ratio (-1.27) indicated feminine characteristics. The age at death estimation was carried out based on the degree of fusion (ossification) on the external and internal faces of the cranial sutures, the morphology of the *facies symphysialis ossis pubis* on the pelvis, and the age-related changes documented on the rib *extremitas sternalis*.[16] The skull is short and moderately wide based on

[15] *Éry – Kralovánszky – Nemeskéri 1963.*

[16] *Nemeskéri – Harsányi – Acsádi 1960; İşcan – Loth – Wright 1984; İşcan – Loth – Wright 1985; Brooks – Suchey 1990.*

Martin no.		Size (mm)
1.	Maximum cranial length	167
5.	Basion-Prosthion length	–
8.	Maximum cranial breadth	134
9.	Minimal frontal breadth	90
10.	Maximal frontal breadth	113
11.	Auricular breadth	–
12.	Occipital breadth	99
17.	Basion-bregma height	–
20.	Porion-bregma height	–
23.	Cranial circumference	–
40.	Nasion-Prosthion height	–
43.	Upper facial breadth	–
45.	Bizygomatic breadth	–
46.	Bimaxillary breadth	–
47.	Maxiumum frontal height	–
48.	Upper facial height	54
51.	Orbital breadth	40
52.	Orbital height	33
54.	Nasal breadth	24
55.	Nasal height	–
62.	Maxillo-Alveolar length	–
63.	Maxillo-Alveolar breadth	–
65.	Bicondylar breadth	–
66.	Bigonial breadth	–
69.	Chin height	–
70.	Height of ramus	–
71.	Minimum breadth of ramus	–
Index		
8:1	Cranial index	80.24
17:1	Height-length index	–
17:8	Cranial breadth index	–
20:1	Cranial length-height index	–
20:8	Cranial breadth-height index	–
9:8	Frontoparietal index	67.16
47:45	Facial index	–
48:45	Upper facial index	–
52:51	Orbital index	82.50
54:55	Nasal index	52.17
63:62	Maxillo-alveolar index	–

Table 1. Sóskút-Baráthház (Site 26/4), Trench 2, S314. Metric dimensions and indexes of the cranium (©Kitti Köhler)

	Left	Right
Clavicula M1	–	–
Humerus M1	–	–
Ulna M1	(230) mm	230 mm
Radius M1	211 mm	213 mm
Femur M1	417 mm	–
Tibia M1	–	330 mm
Fibula M1	–	319 mm
after *Bernert 2005*	164.3 cm	
after *Sjøvold 1990*	152.9 cm	

Table 2. Sóskút-Baratház (Site 26/4), Trench 2, S314.
Dimensions of the long bones and the calculated stature (©Kitti Köhler)

the metric dimensions *(figs. 8–9; Table 1)*. The forehead is narrow. The upper facial structure is narrow.[17] The circumference of the eye socket is moderately wide. The upper cranium classifies as moderately broad *(mesocran)* according to the length-breadth index. The frontal bone is also moderately broad *(metriometop)*. The orbits are moderately high relative to other facial features *(mesoconch)*. The nose can also be reconstructed as broad *(chamaerrhin)*.[18]

Morphologically, the skull is ovoid in superior view. The forehead and occipital are both curved in lateral view. No flattening of the lambdoid present. The orbits are round. The *apertura piriformis* is anthropoid, the *spina nasalis anterior* is of degree 5. The *fossa canina* is moderately deep.[19] The stature calculated by the size of the long bones classifies as medium according to Zsolt Bernert and small by Torstein Sjøvold *(Table 2)*.[20]

An anatomical variation of an independent suture bone *(ossa suturae lambdoidea)* is present on the right side of the skull.[21]

Pathological lesions include mild (grade 1) enthesopathy on the left patella and the heel bones. Such lesions, characterised by bone spikes, occur most commonly as result of overuse or repeated microtrauma. A sign of physical trauma (fracture) is present in the upper third of the diaphysis of the left humerus *(fig. 10. 1–2)*. The woman survived the fracture indicated by the partial regeneration of the bone, but the fracture ends remained unfused at the time of her death. This is known as a non-union fracture, which occurs when the fractured bone ends have not been stabilised (i.e. by a cast or brace), or when the blood supply of the bone is insufficient, or when the limb becomes infected. In the present case, the remodelling of the bone had begun, closing the fracture ends, accompanied by inflammation, indicated by the deformation of the lower diaphysis and the significant bone loss. The woman did not die as the result of the fracture: she survived the trauma for at least 2-3 months (or more). However, her upper arm would have not regained its pre-fracture strength and load-bearing capacity in that time. Unfortunately, the *humerus* on the other side is fragmentary, so it is not possible to determine the extent of any shortening (if occurred) of the injured bone.

17 *Martin – Saller 1957.*
18 *Aleksejev – Debec 1964.*
19 *Martin – Saller 1957; Aleksejev – Debec 1964.*
20 *Sjøvold 1990; Bernert 2005.*
21 *Hauser – De Stefano 1989.*

Fig. 10. Sóskút-Baratház (Site 26/4), Trench 2, pit no. 261/314.
1–2. Non-union fracture on the diaphysis of the left *humerus* of the female skeleton;
3. Porosity of the hard palate on the maxilla (©Tamás Hajdu)

Furthermore, prior to the woman's death, all the teeth in both the maxilla and the mandible had fallen out *(fig. 9)*. The *antemortem* tooth loss resulted in a complete loss of the teeth sockets and atrophy of the bone tissue. In addition, the porosity on the hard palate of the maxilla indicates the presence of inflammation probably due to an infection *(fig. 10. 3)*.[22]

Analyses of the ceramics associated with the pit burial

Methodology

The methodology used for the assessment of ceramics followed standard typological description practices employed by most Hungarian museums for accessioning, cataloguing archaeological material. In each feature, sherds were counted (referred to as Number of Sherds or *NoS* or simply as 'pieces' throughout the text and in charts) and grouped into 'vessel types', some of which were quite broad or overlapped with other types due to the ambiguity of diagnostic features and the considerable degree of fragmentation. These 'vessel types' formed the bases for ceramic units (referred to as 'Minimum Number of Items' or MNI – a standard statistical formula). Sherds lacking diagnostic features were clustered into three (proxy) groups: large, medium and small vessels; an assessment based on ceramic wall-thickness. This 'lumping' method is routinely employed by Hungarian archaeologists when dealing with large numbers of unassociated fragments recovered during excavation. During Phase II of Benta Valley Project, Carla Klehm and Borbála Nyíri extended the application of this method to material deriving from fieldwalk collections, shovel-scrapes and cubic soundings.[23] While the number of sherds is used to identify the location, extent and density archaeological sites (standard Cultural Resource Management [CRM] practice in Europe and North America), its application in tandem with the quick typological examination of the kinds of sherds, had the potential to reveal certain socio-economic activities taking place at the Benta sites during different time periods. The quick typological examination included the categories of 'cups' (wall-thickness: <3 mm, a category of vessels – including small bowls – used for serving drinks and small portions of food, or used for storing non-food related items), 'small pots' (wall-thickness: 3–6 mm, vessels used for serving, cooking, and possibly for short-term, temporary storage), and 'pots' (wall-thickness: >6 mm, vessels used for storage or cooking). During the establishment of the above categories – since the assemblage derived from surface-scrapes or cubics – the erosion of ceramic surfaces and the generic degradation of fragments were taken into account; a factor which featured less prominently during the present analysis given the material was excavated from deeper layers. Thus, small vessels' wall-thickness was set to be <5 mm, for medium vessels it generally ranged between 6 mm and 1 cm, and the wall-thickness for large vessels was over 1 cm.

The recorded typological features included interior and exterior colour, surface treatment and some aspects of the firing, temper and matrix, decoration, use, and respective measurements of the particular vessel part/fragment. Technological details, along with signs of manipulation before, during and after breakage/discard were also documented. During both the processes of pre-sorting and cataloguing the context of each sherd was noted, even in the case of vessels consisting of multiple fragments (sometimes recovered from different fills), highlighting the 'mixing' between layers; taphonomic or deliberate human activities which could not be observed while the feature was being excavated.

22 *Steinbock 1976; Ortner – Putshar 1981; Ortner 2003.*

23 *Earle et al. 2011; Klehm – Nyíri 2016.*

Pottery

Altogether 1138 pieces of sherds were counted from the fills which were distributed between 28 different ceramic types (NoS 269, MNI: 112 – *fig. 11; figs. 19–22*). Cups clearly dominate the assemblage (MNI 18, NoS 38) followed by pots or urns (MNI 10, NoS 33), and to a lesser degree bowls (MNI 9, NoS 12), pots (MNI 9, NoS 23) and cups or bowls (MNI 5, NoS 26). The highest sherd-count is attributed to urns (NoS 40) representing 8 ceramic units.

In terms of the ceramic content of the five deposits, the sherd-count in the top layer (S261) was the highest (NoS 551 – 120 identified, 431 undiagnostic). S313 contained 96 pieces (41 identified, 55 undiagnostic), while S314 below was the poorest in ceramic fragments, only 29 sherds (13 identified, 16 undiagnostic) were found here (along with the skeleton). In the fill beneath, in S317 the number of fragments is relatively high again in comparison to the previous deposit (NoS 312 – 62 identified, 260 undiagnostic), while in S318, the bottom layer, the sherd-count drops down to 150 pieces (33 identified, 117 undiagnostic). The distribution of ceramic types within each layer seems to reflect the overall trend outlined above; cups or small bowls being the leading vessel types, followed by urns, pots and bowls. The only exception is S314 within which only a pot or a pot or bowl was documented *(fig. 12)*. Mixing between the five layers was substantial, and although the majority of these were limited to ceramic units with fragments between 2–5 pieces (MNI 12), 25 fragments of an urn were recovered from 4 different contexts (*fig. 13;* especially see *fig. 22. 11*). This could suggest that the deposits were repeatedly disturbed, either by deliberate re-opening or re-use of the pit, or by higher than average animal activity.

Unidentified fragments formed the bulk of the ceramic material (869 pieces – 76%), with the highest number of unknown medium-sized vessels (476 pieces – 41.8%) followed by – interestingly – known vessel types (269 pieces – 24%) and unknown small-sized vessels (212 pieces – 18%, *fig. 14*). The ratio of unknown large- and large/medium-sized vessels was surprisingly low (7% – 80 pieces, 4% – 45 pieces), although this is balanced out by the high number of identified large vessels such as urns or large bowls.

The diagnostic vessel parts distributed according to expectations. The dominance of body sherds could be observed, followed by body and rim and rim, body and base – the latter attributed to the high number of cups (which had the tendency to remain fairly intact) especially visible in S317 *(fig. 15)*. The number of household ceramics appears to dominate the entire assemblage, primarily due to sherds from S261 (287 pieces), although from the other four contexts the number of household ceramics remain low (between 9–65 pieces). Tablewares reflect a slightly different picture: the ratio of tablewares in S261 is less than half of the household ceramics (126 pieces), whereas it is slightly higher in the case of S317 (101 pieces). The ambiguous household/tableware category was also led by sherds from S317 (179 pieces), followed by S261 (136 pieces), while in the case of the other three contexts the number of sherds belonging to this group was a little higher compared to the household ceramics *(fig. 16).*

The number of decorated and undecorated sherds was fairly equal (562 pieces – 576 pieces), and a similarly balanced picture is outlined by the treatment of interior and exterior surfaces (both ranging at 85–88%). This could be attributed to smaller, delicate vessels with wider orifice (cups and bowls) equalling the number of vessel with more restricted openings *(fig. 17),* but also perhaps indicating a trend during the Late Vatya–Koszider period whereby the interior surfaces (at least in the upper quarter) were burnished or lightly burnished even in the case of large storage vessels.

A small number of fragments exhibited a clay body structure involving a sandwich of dark grey core followed by a layer of bright red lamina sandwiched between a dark grey or black crust on the in/exterior. The structure could be the result of a particular firing technique: reduction firing at the beginning of the process, followed by the brief introduction of oxygen, before finishing the

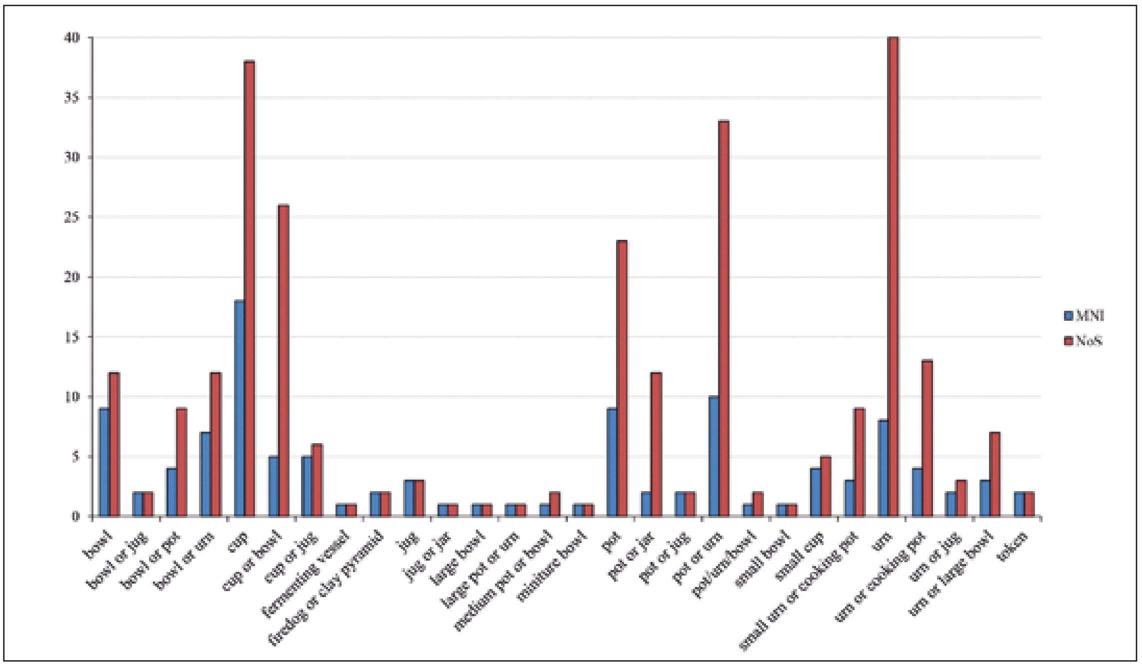

Fig. 11. Sóskút-Barátház (Site 26/4), Trench 2, pit no. 261/314.
Distribution of the 28 ceramic types (©Borbála Nyíri)

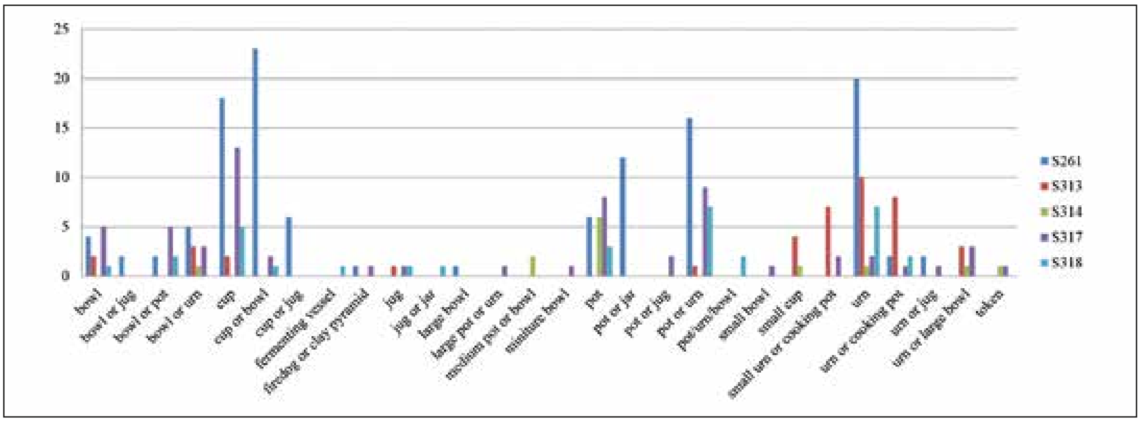

Fig. 12. Sóskút-Barátház (Site 26/4), Trench 2, pit no. 261/314.
Distribution of ceramic types within the five deposits in pit no. 261/314 (pieces) (©Borbála Nyíri)

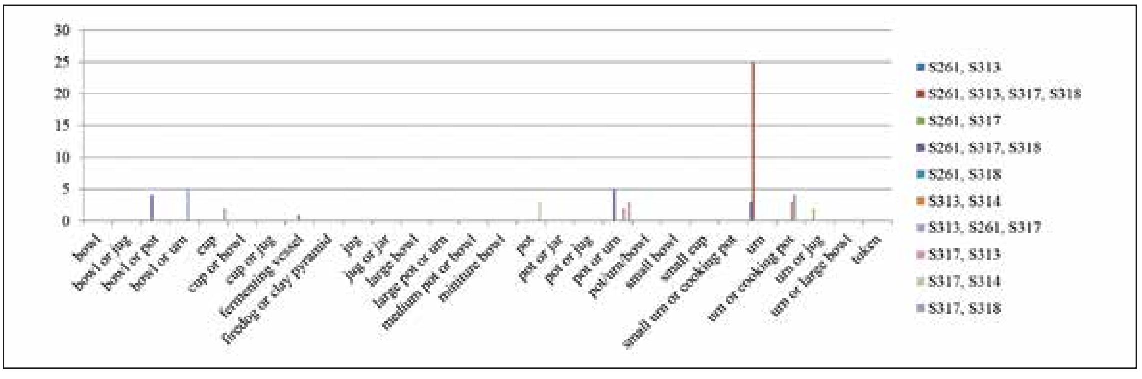

Fig. 13. Sóskút-Barátház (Site 26/4), Trench 2, pit no. 261/314.
Mixing' between the five deposits in pit no. 261/314 (pieces) (©Borbála Nyíri)

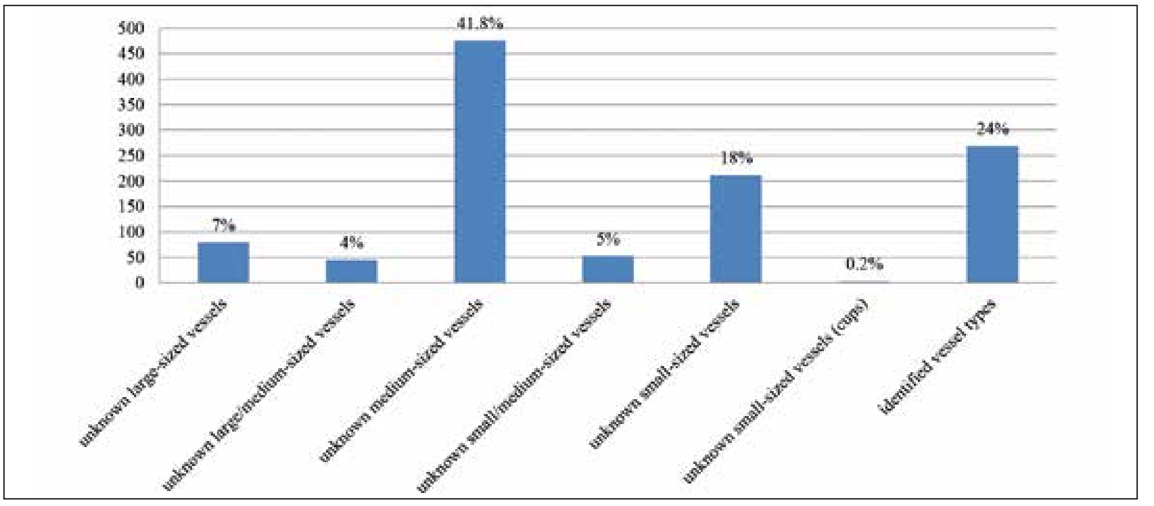

Fig. 14. Sóskút-Baráthház (Site 26/4), Trench 2, pit no. 261/314.
Percentage of unknown and identified vessel types (%) (©Borbála Nyíri)

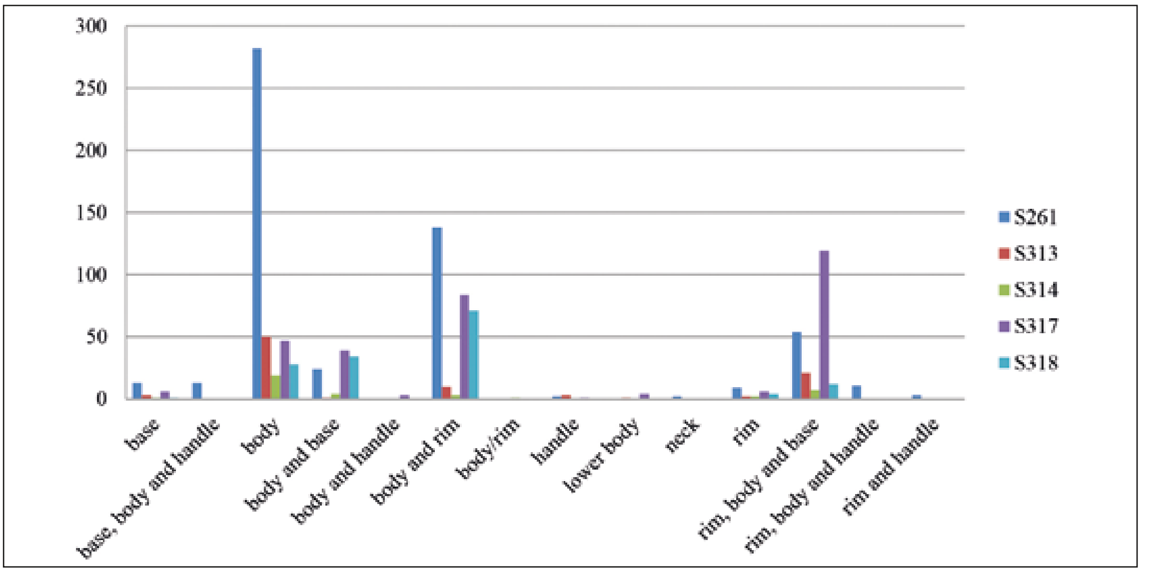

Fig. 15. Sóskút-Baráthház (Site 26/4), Trench 2, pit no. 261/314.
Distribution of diagnostic vessel parts (pieces) (©Borbála Nyíri)

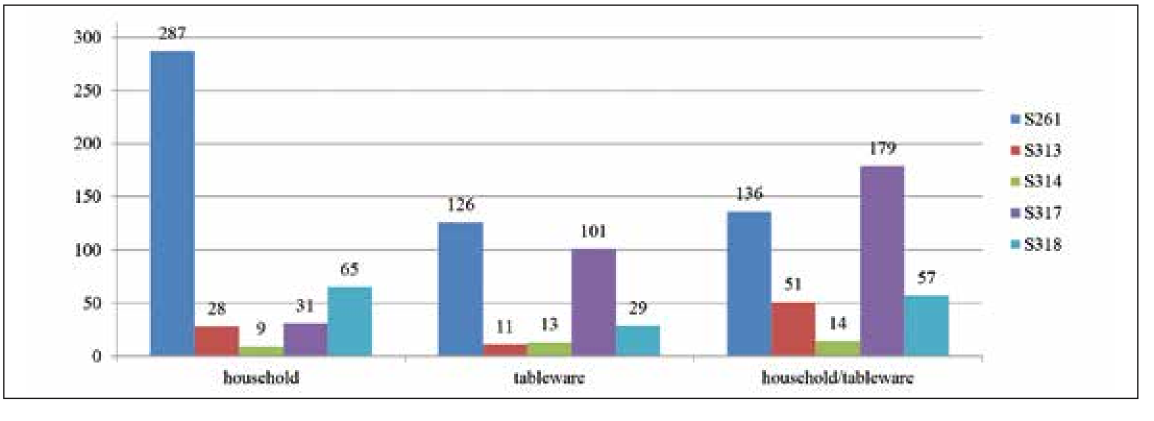

Fig. 16. Sóskút-Baráthház (Site 26/4), Trench 2, pit no. 261/314.
Distribution of household and tablewares in pit no. 261/314 (pieces) (©Borbála Nyíri)

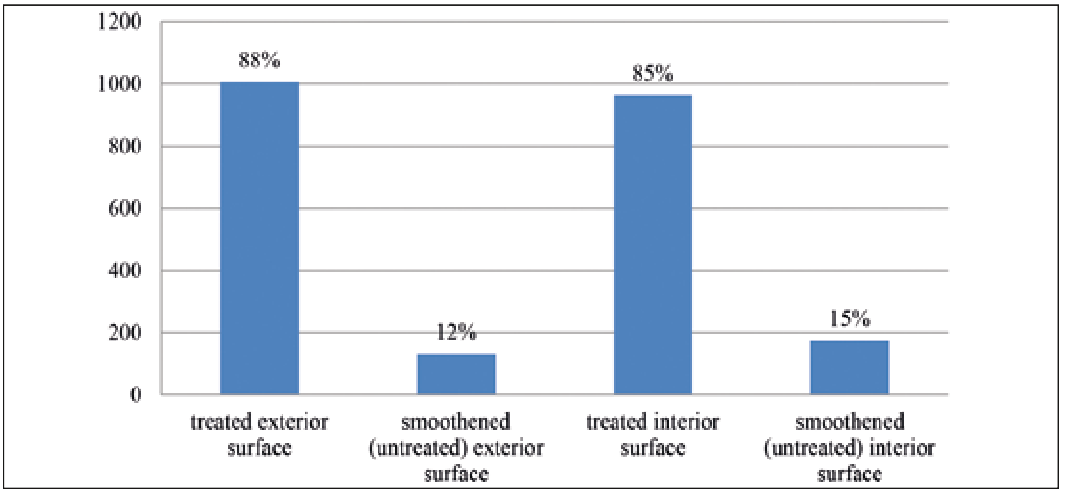

Fig. 17. Sóskút-Barátház (Site 26/4), Trench 2, pit no. 261/314.
Surface treatment of fragments (%) (©Borbála Nyíri)

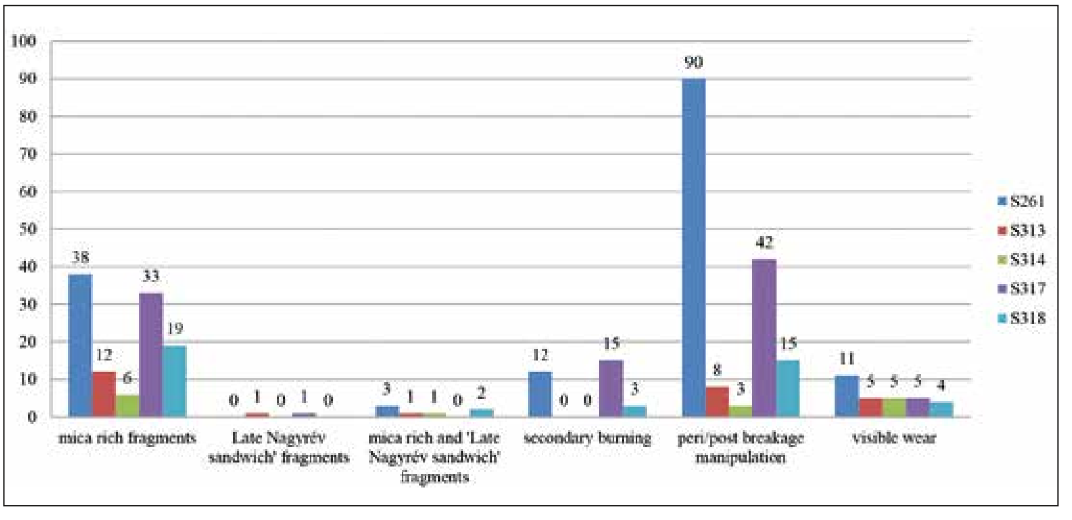

Fig. 18. Sóskút-Barátház (Site 26/4), Trench 2, pit no. 261/314.
Particular technological features and signs of manipulation (pieces) (©Borbála Nyíri)

pots again in a reduction atmosphere – however, there is more research necessary to reconstruct the exact procedure. This clay structure is most characteristic on Late Nagyrév sherds (therefore it is referred to as 'Late Nagyrév sandwich' in the text and figures) often accompanied by a mica rich clay body.[24] The amount of 'Late Nagyrév sandwich' fragments recovered from the pit is negligible (S313 – 1 piece, S317 – 1 piece) and the number of such sherds accompanied by mica rich clay body was also minimal (S261 – 3 pieces, S313 – 1 piece, S314 – 1 piece, S318 – 2 pieces) – a similar trend observed in the other two excavated pits. The number of secondarily burnt sherds, 25 fragments with visible signs of wear and manipulated sherds were also slightly higher than in the other two pits (given the higher overall sherd-count), but the ratio seems to correspond with values recorded there *(fig. 18).*

[24] This feature is particularly characteristic in Late Nagyrév assemblages further south along the Danube, e.g. at Dunaújváros-Duna-dűlő *(Vicze 2011)* and Rácdomb *(Nyíri 2013).*

[25] *Gucsi 2020.*

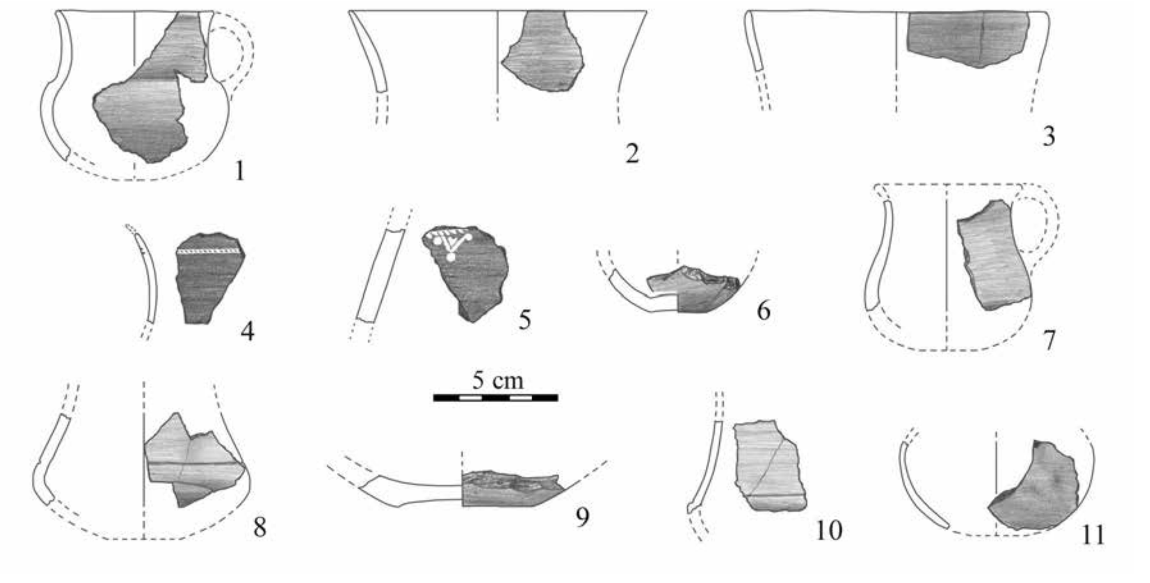

Fig. 19. Sóskút-Baráthát (Site 26/4), Trench 2, ceramic fragments from pit no. 261/314; cups.
1–5. S261; 6. S313; 7–9. S317; 10. S317 and S318; 11. S318 (©László Gucsi, ©Zsolt Réti)

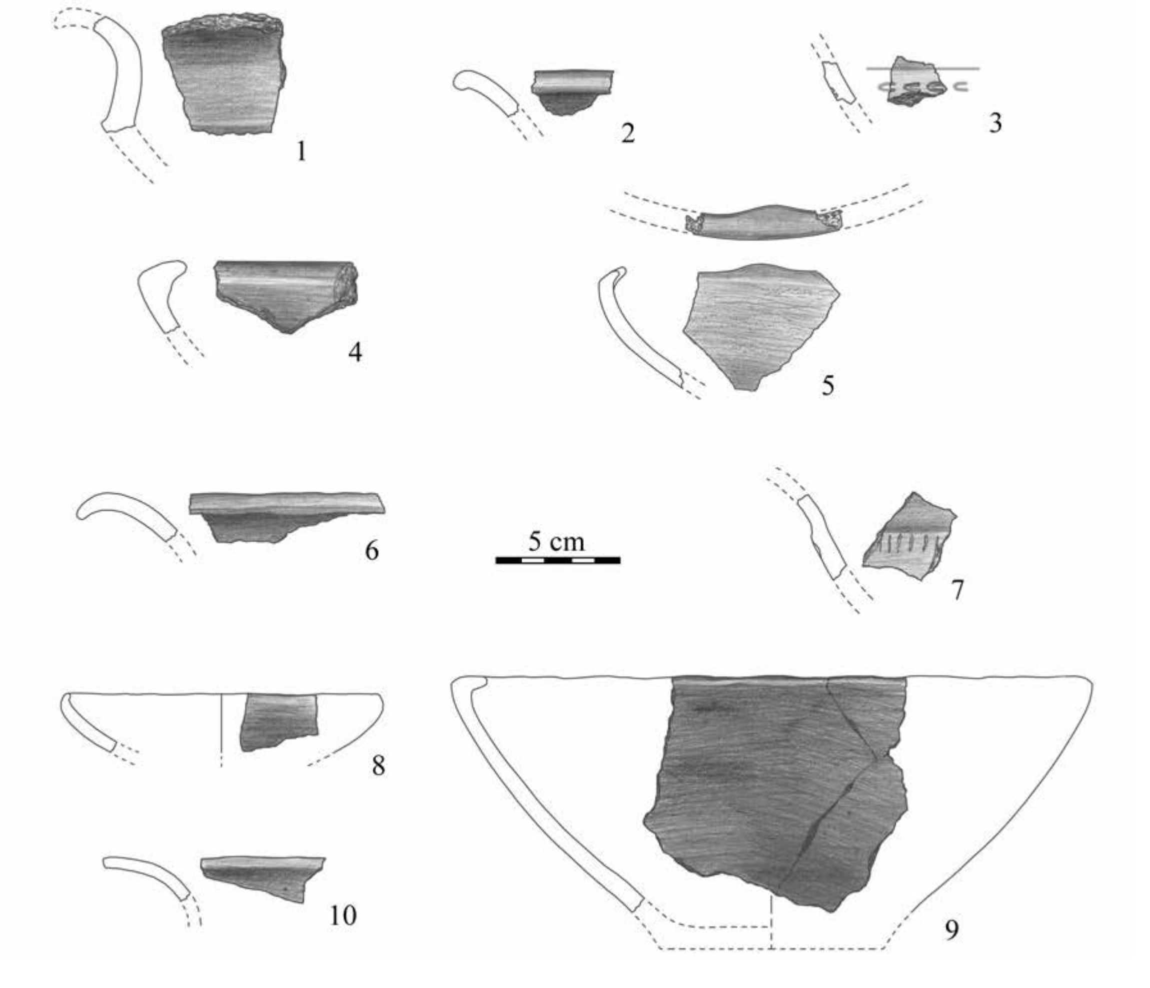

Fig. 20. Sóskút-Barátház (Site 26/4), Trench 2, ceramic fragments from pit no. 261/314; bowls.
1–5. S261; 6–9. S317 (©László Gucsi, ©Zsolt Réti)

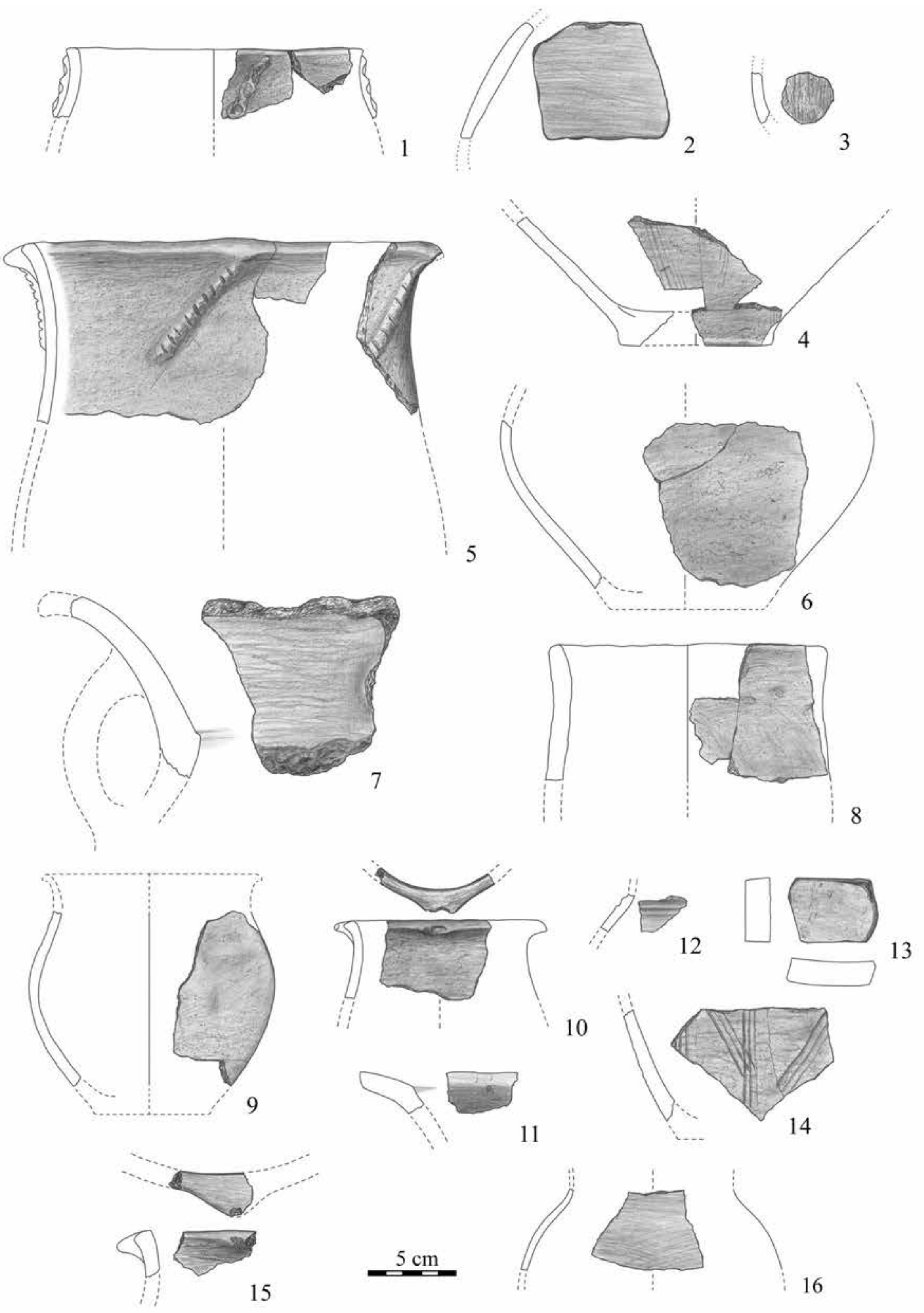

Fig. 21. Sóskút-Barátház (Site 26/4), Trench 2, ceramic fragments from pit no. 261/314; pots and urns. 1–3. S261; 4. S261 and S313; 5–6. S313 and S317; 7. S314; 8. S314 and S317; 9–14. S317; 15–16. S318 (©László Gucsi, ©Zsolt Réti)

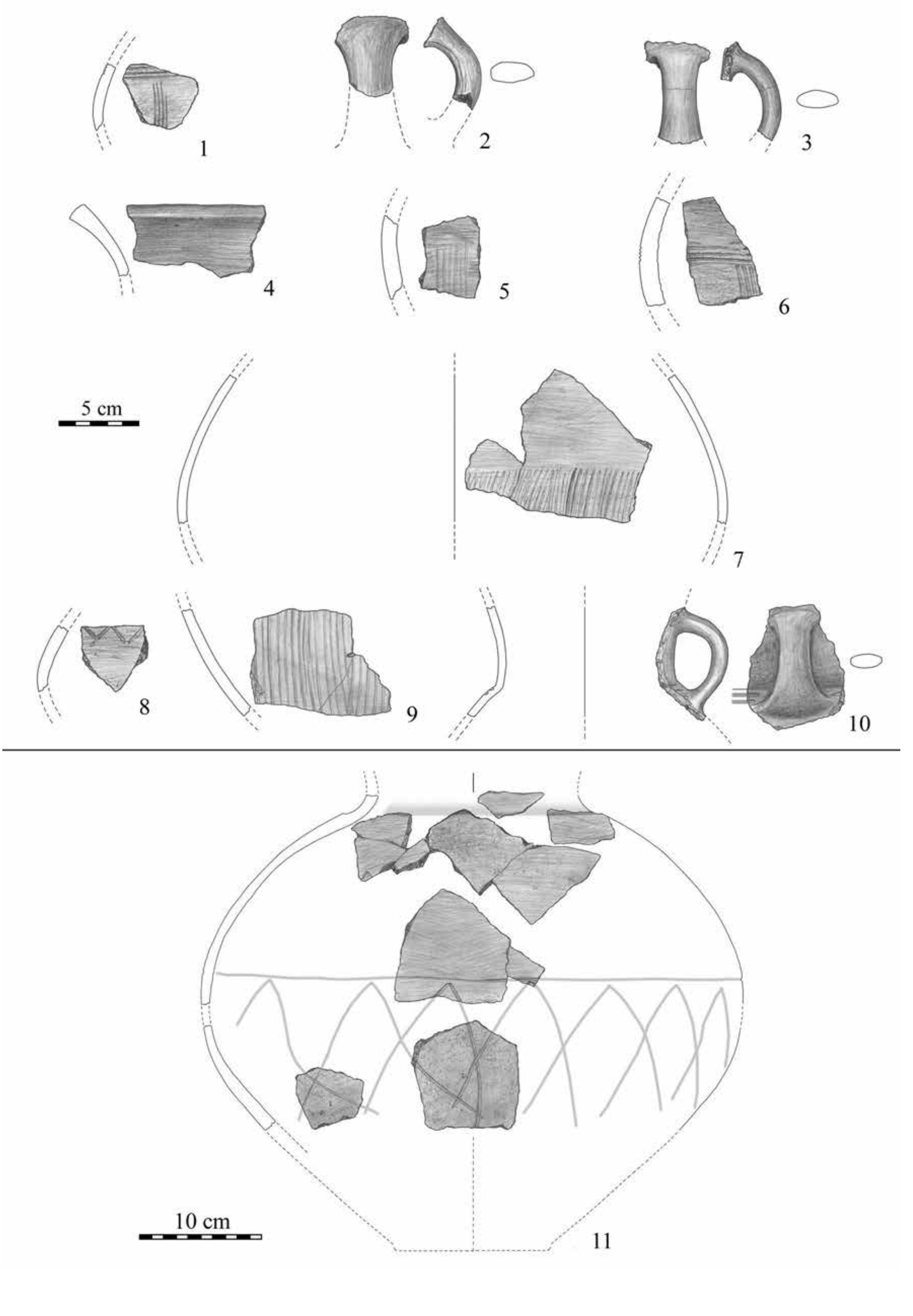

Fig. 22. Sóskút-Baráthház (Site 26/4), Trench 2, ceramic fragments from pit no. 261/314; pots and urns.
1–2. S261; 3. S261 and S317; 4–6. S313; 7. S155 and S314; 8–9. S317; 10. S318; 11. S261, S313, S317 and S318
(©László Gucsi, ©Zsolt Réti)

Conclusions

Although the feature of a domestic refuse pit (no. 261/314) was only partially excavated due its position in the trench, it had the largest sherd-count (1138 pieces) out of the three pits, and contained the highest amount of deposits (5 layers: S261, S313, S314, S317, S318), including a human skeleton. Cups or small bowls were represented by the highest number of fragments *(fig. 19)* followed closely by urns, pots *(figs. 21–22)* and bowls *(fig. 20)*, a trend which is reflected in each layer to a certain degree, but also by the overall distribution of ceramic types. The majority of imports in the ceramic assemblage could have originated from the neighbouring Transdanubian Encrusted Pottery complex or were the local imitations of these (e.g. *fig. 19. 4–5*). Out of the three archaeological features the degree of mixing between deposits was the most substantial in the pit containing the burial which could imply that the fills were once (or multiple times?) disturbed, either by the deliberate re-opening (with the aim to manipulate the human remains perhaps?), or simply by the practical re-use of the pit. The intentional re-opening of the pit is supported by the fact that the skeleton was found incomplete and that particular bones were fragmented by both *post mortem* and post-depositional events. This aspect is particularly intriguing, since the skeletal remains were recovered from context S314; the deposit situated in the middle of the fill sequence, accompanied by ceramic material that shows a significant rate of fragmentation and wear, 12–15% of the sherds had evidence of secondary burning present. Therefore, it is likely that these ceramic pieces had longer and varied 'object biographies' as opposed to vessels made specifically for funerary purposes. The composition (i.e. the variety of household wares) and overall character (i.e. domestic refuse) of the assemblage further implies that the pit burial and its 'domestic' context could be understood as a non-normative mortuary deposition.[26] Although similar depositions of human remains are not unusual in the previous Nagyrév period,[27] from the later Vatya, Late Vatya–Koszider phase so far only one similar feature is known from Érd-Hosszúföldek, where scientific analysis showed the repeated interment of human remains throughout a long period of time.[28]

In sum, the archaeological assessment of pit no. 261/314 is challenging. Is the high sherd-count reflective of the intensive use of the settlement or the activities taking place there? Or, since the deposition of human remains, could it be that the pit assumed new roles beyond its domestic function (e.g. sacrificial pit, intramural grave, representation of taboos)? At the moment archaeological information is still too scarce to answer these questions. The generally poor physical condition of this individual must also be taken into account: her remains showed signs of infection, presence of disease, and extreme physical trauma which suggests that she was lacking resources and/or support during the final stages of her life. Examples from other contemporaneous sites (e.g. Érd) also indicate that at least some individuals deposited in pits were probably of low social status.[29]

Earlier archaeological theories proposed that in the so-called Bronze Age chiefdom societies, exclusive access to ritual knowledge may have been an important basis for elite power.[30] It is likely that this segment of the society could have been responsible for the regulation and the maintenance of ritual traditions reflected by the highly prescribed mortuary practice evident in Vatya cemeteries. The pit burials of Sóskút and Érd therefore stand out in the context of normative Vatya burials, and given the physical trauma and condition of the individuals interred in the pits, it

26 *Balogh 1997; Poroszlai 2000; Gucsi – Szabó 2019.*

27 *H. Hanny 1997; Keszi 2020.*

28 *Earle et al. 2014; Szeverényi et al. 2020.* Pit burials also occur in settlements of contemporaneous communities (e.g. Transdanubian Encrusted Pottery and Maros culture; *Kiss et al. 2015; Szeverényi et al. 2020*) and later assemblages of the Tumulus culture *(Ilon 2014).*

29 *Earle et al. 2014; Szeverényi et al. 2020.*

30 *Earle 1987; Johnson – Earle 2000; Dani et al. 2016.*

is feasible to assume that they represent the outliers or low status members of local communities. Their low or peripheral social standing could have derived either from (or was enhanced by) being non-locals, or having had a long-term mental and/or physical illness, disobeying social traditions or committing a crime. It is also possible that they themselves (for similar reasons) became victims of violence and were deposited without the adherence to rules surrounding mortuary rituals. Therefore, this non-normative pit burial at Sóskút can be considered as a significant addition nuancing the hitherto assumed picture of chiefdoms and otherwise uniform burial practices in the Carpathian Basin in the middle of the 2nd millennium BC.

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RÓBERT BOZI – GÉZA SZABÓ

THE BEGINNINGS OF THE USE OF EQUIDS AS WORK ANIMALS IN THE BRONZE AGE CARPATHIAN BASIN[1]

Zusammenfassung: Die wichtigste Frage in Hinsicht auf die Domestikation von Pferden lautet: Wie und wann gerieten Pferde unter menschlichen Einfluss, und welche Beweise gibt es, dass es zu solchen Tätigkeiten wahrhaftig gekommen ist. Archäologische Funde und frühe Abbildungen weisen darauf hin, dass Pferde mithilfe verschiedener Gegenstände aufgezäumt wurden, bevor sich das Konzept der Trense im Maul des Tieres etablierte. Es muss ebenso auf die Domestikation anderer Tierarten, wie zum Beispiel von Rindern (*Bos taurus*, ab 6000 v. Chr.) und von Trampeltieren (*Camelus bactrianus*, ab 3000 v. Chr.) eingegangen werden, die neben der Milchgewinnung auch für Personen- und Lastentransport herhielten, und der Domestikation von Pferden als Beispiel gedient haben können. Die völkerkundlichen Beispiele besagen, dass sich bei Rindern der Nasenring, Nasenriemen und das Zaumzeug und bei Pferden die Trense bewährten, während man bei Kamelen Holz- oder Knochennägel verwendete, um die Scheidewand in der Schnauze zu durchbohren.

Die beiden im Karpatenbecken zutage geförderten archäologischen Funde der jüngeren Vergangenheit, auf die in diesem Bericht eingegangen wird, versuchen zu belegen, welche Erfahrungen bei der Domestikation anderer Tierarten bei Pferden genutzt wurden. Der Pferdeschädel, den man im Rahmen landwirtschaftlicher Arbeiten mit weiteren Knochenbruchstücken (Tompa-3) an einem bronzezeitlichen Fundort, in Tompa (Südregion Mittelungarns) aufgedeckt hatte, verdient besondere Aufmerksamkeit. Der besagte Fund weist eine Veränderung am *Os incisivum* auf, die wahrscheinlich durch menschliche Einwirkung erfolgte (Tompa-1). Aufgrund der ^{14}C-Datierung (1870–1620 BC) und anhand der in nächster Nähe des Pferdeschädels geborgenen Keramikfunde kann der Sammelfund der Vatya-Kultur III zugeordnet werden, als der Kulturkomplex seine Vorherrschaft auch auf das Donau-Theiß-Zwischenstromgebiet ausweitete. Die am Tierkieferfragment Tompa-3 beobachtete Knochenwucherung ist offensichtlich auf die regelmäßig in das Maul des Tiers gelegte Trense zurückzuführen, während im Diastema des Exemplars Tompa-1 keine ähnliche pathologische Veränderung vorzuweisen war. Die mögliche Verwendung von Nasen- und Maultrensen im Falle der Pferdearten Tompa-1 und Tompa-3 könnten darauf hindeuten, dass im Verlauf des langwierigen Domestikationsprozesses von Pferden zahlreiche Versuche erfolgt waren, Pferde für Arbeitszwecke zu nutzen.

Keywords: equids, domestication, horse control, archaeozoology, Bronze Age, Carpathian Basin

Thanks to the advances of archaeological research, our knowledge regarding the domestication of horses has been transformed in the past few years. However, due to a variety of different approaches and research traditions, scientists are yet to reach common ground even in fundamental issues such as the definition of domestication. The primary aim of animal domestication was to

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more efficiently exploit natural resources by changing the behaviour of certain species; both by inhibiting their instinctive responses and by aiding their adaptation to the anthropogenic environment.[2] The process of domestication, which spanned across several millenia, involved many twists and turns. The morphological characteristics of some animal species made them less suitable for domestication, nevertheless, individual animals could still be successfully trained to carry out specific tasks (like present-day circus animals for example). The level of domestication is generally estimated by a set of morphological characteristics (e.g. the size of teeth, horns, and volume of cranium, etc.), although, more recently the genetic modification of certain fenotypes is also being considered as indicators. Both approaches agree that the process of horse domestication took place in different geographical areas involving many – often dissimilar – stages of adaptation over several millenia. The utilisation of horses for work and transport is particularly significant, since it enhances the speed and efficiency of human mobility. Given the lengthy and multi-faceted process of domestication it might not ever be possible to pinpoint the exact location and time the domestication of horses took place. Even in the most fortuitous cases data can only be linked to a particular geographical region while it is entirely possible that similar attempts of domestication might have taken place in different areas at different times targeting other equine species.

Traces of Bronze Age horse use in the Carpathian Basin

In the middle of the 20th century – in part due to the contributions made by the Hungarian research community – it was assumed that the Carpathian Basin represented a centre or hub for horse domestication from the Early Copper Age/Eneolithic (e.g. the sites of Deszk, Kisköre-Szingehát, Kenderes-Telekhalom and Kenderes-Kulis).[3] The backdrop to equine domestication was the historical process associated with the appearance of kurgans and horse equipment north of the River Körös in northeast Hungary; a process that may also be linked to the changes occurring in the biological make-up of Central and Eastern Europe at the time.[4] The significance of horse equipment in these assemblages from Hungary, although cannot unequivocally be associated with the control or utilisation of horses as work animals, has been overrated by research since its apparent linkage to the finds discovered at Dereivka.[5] Scientists today agree that influences originating from the steppe region reached the territories of Central, Eastern and Southeastern Europe in waves from the beginning of the Eneolithic.[6] Population genetic studies link these processes between 3000 and 2500 BC to the movements of the Yamnaya pastoralist population from the direction of the Caspian–Pontic steppe region.[7] Based on these population movements, a direct correlation was assumed between the migrating population connected to the Yamnaya culture and the spread of horse domestication, however, the most recent horse genomic evidence published by the team of Ludovic Orlando outlines a situation where migrating pastoralists would have brought the know-how of horse control and transport but not their horses. According to their view the process of horse domestication carried out by the Yamnaya pastoralists was restricted to the natural habitat of these equids and did not spread into other geographical areas in the period before 2200–2000 BC – similarly to the case of the Botai horses domesticated around 3500 BC.[8] The so-called DOM2 type horses – currently regarded as the ancestors of modern domesticated

2 *Zeder 2015* 3191.
3 *Bökönyi 1959; Bökönyi 1974; Bökönyi 1978; Greenfield 2006* 221–222.
4 *Ecsedy 1979.*
5 *Bökönyi 1959; Bökönyi 1974; Bökönyi 1978; Levine 1990; Benecke 1994; Makkay 2004.*
6 *Gimbutas 1977; Anthony et al. 1986; Anthony 2007; Szabó 2017a.*
7 *Allentoft et al. 2015; Haak et al. 2015; Goldberg et al. 2017.*
8 *Gaunitz et al. 2018.*

horses in Eurasia – are assumed to have been developed in the Volga–Don region in the second half of the 3rd mill. BC and spread towards the west with a population directly preceding the Sintashta culture.[9] These new and somewhat surprising conclusions will no doubt require further investigations as they seem to contradict current archaeological and archaeozoological observations,[10] human genetic studies.[11] It is highly likely, that if the Yamnaya population had kept domesticated horses and used them for transport and/or traction, that these horses were taken along by their owners to the new territories. However, it is entirely possible that horses were not as significant at the time as we assume, – cattle could have played a more prominent role as traction animals (as it is implied by heavy chariots with solid wheels).[12] Nevertheless, it would be unlikely that one of the most mobile and agile group of animals were left behind by the pastoralist communities. At present, compelling evidence for the domestication and utilisation of horses dates to the time when the DOM2 type horses began to distribute widely across the territories of Eurasia.[13] So far neither the archaeological investigations, nor the genetic examinations have been able to provide clear answers whether the processes of domestication and population migration were contemporaneous, and how closely were they intertwined, since the prolonged nature of such developments. Recently, however, a set of methodologies has been developed specifically for the study of horses, by identifying the changes on the metatarsals which could help to shed light on the utilisation of individual animals and could provide further details to the above assumed processes.[14]

There is increasing archaeological information which suggests that the lengthy process of domestication and utilisation of horses only began in the Early Bronze Age.[15] Horse remains and bit types *(fig. 1)* appear in different numbers within the distribution of certain archaeological cultures during the Early and Middle Bronze Age in the Carpathian Basin.

Archaeozoological data implies that in the area of distribution of the Copper Age Baden and Boleraz cultures (at the sites of Szűr, Paks, Kaposvár, Ordacsehi and Kaposújlak) horse remains are lacking. However, in the same region during the subsequent Early Bronze Age Somogyvár–Vinkovci culture (at sites of Paks, Ordacsehi and Dombóvár) and the earliest phase of the Transdanubian Encrusted Pottery culture (Ordacsehi, Kaposvár)[16] until the beginning of the Middle Bronze Age horse bones had been found, although in small numbers (2–11 fragments), producing radiocarbon dates of 2620–1880 cal BC.[17] Beside the Dunaújváros horse so far only the specimen from Kaposújlak (2560–2410 cal BC) has undergone genetic examination which indicates that this horse also belonged to ancient wild horse population of the region which has small scale genetic links pointing towards the east; to the territories of southern Thrace.[18] At the site of Dombóvár-Tesco (2570–2470 cal BC) associated with the Somogyvár–Vinkovci culture (also with links to the eastern steppe region)[19] a loose network of domestic buildings were identified suggestive of a pastoralist lifestyle of its inhabitants.[20] It would be feasible to assume that the advantages of horse domestication were utilised by these communities. However, the

[9] *Librado et al. 2021.*
[10] *Taylor – Barrón-Ortiz 2021.*
[11] *Allentoft et al. 2015; Haak et al. 2015.*
[12] E.g. Novotitarovskaya, Ostannii kurgan 1, chariot burial no. 150; *Gerling 2015* fig. 2. 5.
[13] *Hüttel 1981; Librado et al. 2021* 635–636.
[14] *Bozi – Szabó 2020.*
[15] *Levine 2004.*
[16] *Gál 2017* fig. 86.
[17] *Gál 2017* Appendix 1.
[18] *Librado et al. 2021* 635.
[19] *Szabó 2017b* 381–385.
[20] *Szabó – Gál 2013.*

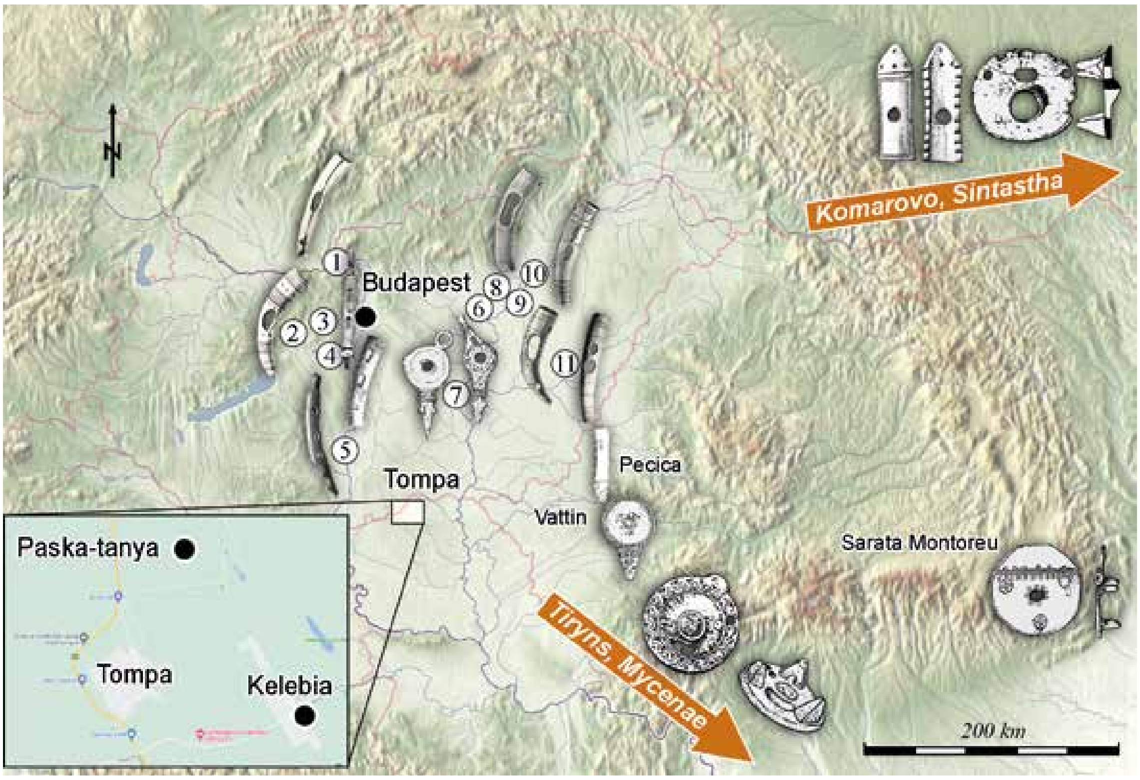

Fig. 1. Significant horse bit finds of the Carpathian Basin and their linkages. 1. Szob-Kálvária; 2. Pákozd-Várhegy; 3. Budapest-Lágymányos; 4. Százhalombatta-Földvár, Téglagyár; 5. Gerjen; 6. Jászdózsa-Kápolnahalom; 7. Tószeg-Laposhalom; 8. Füzesabony-Öregdomb; 9. Tiszafüred-Ásotthalom; 10. Mezőcsát-Pástidomb; 11. Köröstarcsa (©Géza Szabó, ©Zsolt Réti)

only two bone fragments *(radius, pelvis)* found at the site belonging to mature horses imply that horses did not play a significant role either as sources of meat/milk or as spiritual entities in the life of the local community, while the lack of horse equipment further suggests that horses were not widely used as work animals at the site in the Early Bronze Age.[21] Nevertheless, it is not impossible that individual horses were kept as pets or as prestige signifiers, and could have been trained to carry out certain tasks.

As opposed to the more scattered assemblages of Southeast Hungary, the picture is very different at the Bell Beaker sites around Budapest, where ratio of horse remains were unusually high (Bell Beaker–Csepel group: Albertfalva, Budakalász, Budapest-Békásmegyer, Csepel-Háros, Csepel-Hollandi út, Szigetszentmiklós, 2500–2200 BC). Some researchers even considered this area to be the centre of horse domestication/breeding, and assumed that horses could have spread from this original hub to other parts of Europe in the middle of the 3rd millenium.[22] However, the large number of young animals (most likely) kept for their meat seem to contradict this,[23] along with – as data from Southeast Hungary suggest – the very limited number of horse related assemblages from contemporaneous archaeological cultures *(fig. 2)*. The domesticated horse from Dunaújváros-Kosziderpadlás dating to 2139–1981 cal BC (along with the above mentioned specimen from Kaposújlak)[24] suggests that the breeding of horses was evidently taking place

21 *Szabó – Gál 2013* 89–90.
22 *Endrődi – Reményi 2016* 232.
23 *Lyublyanovics 2016* 205; *Kanne 2018* 185.
24 *Gaunitz et al. 2018* 20.

Fig. 2. Small/medium-sized horse from the Bronze Age accompanied by Nagyrév-type ceramic vessels (Soroksár-Site 1, excavated by Géza Szabó in 1999, unpublished; ©Géza Szabó)

from the Early Bronze Age in the Carpathian Basin.[25] Most recently Katherine Stevens Kanne's extensive study provided a detailed overview of horses and horse equipment from the Carpathian Basin, therefore here we shall underscore only the pieces linked directly to transport or traction.[26]

In terms of the utilisation of horses the first major change seem to have occurred during the Middle Bronze Age, when bits appear in the archaeological record, primarily in the eastern regions of the Carpathian Basin *(fig. 1).* This corresponds well with the most recent research, according to which the first securely (both genetically and morphologically) identified domesticated horse remains are known from burials in the territories of Russia and Central Asia dating to around 2000 BC.[27]

The archaeological phenomena observed in the steppe region is particularly interesting since the predecessors of Bronze Age bits occur within the distribution of the Sintashta–Poltavka culture. The first appearance of bits at Bronze Age settlements located along the Danube and the Tisza date to the Middle Bronze Age (2000/1900–1600/1500 BC).[28] However, none of these

[25] It is necessary here to clarify that based on the results of the genetic examinations Gaunitz and her team made the following statement: 'Dunaújváros_Duk2 (Duk2) the earliest and most basal specimen within DOM2, was divergent to all other DOM2 members.' (*Gaunitz et al. 2018* 112). This statement was in a later interpretation (*Kanne 2018* 31) slightly modified: 'The DNA from the bones of a horse excavated from the settlement of Dunaújváros-Kosziderpadlás dating to 2139–1981 cal BC have revealed it to be ancestral to all modern domesticated horses *(Gaunitz et al. 2018).*' Although this statement is undoubtedly flattering to Hungarian archaeology, according to the most recent studies *(Librado et al. 2021)*, it is likely to be incorrect.

[26] *Kanne 2018; Kanne 2022.*

[27] *Orlando 2020; Taylor – Barrón-Ortiz 2021.*

[28] *Mozsolics 1953; Bándi 1963; Jaeger – Kulcsár 2013* fig. 20.

finds have secure radiocarbon dates associated with them. The available dating of the bits can only allow limited interpretation, as the chronological classification of these objects was based on largely outdated excavation methods (i.e. spits).[29] Katherine Stevens Kanne in her work mentions 14 bits dating to the Early Bronze Age and 79 to the Middle Bronze Age, all located in the eastern or northeastern regions of the Carpathian Basin. She suggests that in this area, the utilisation of horses and horse equipment was continuous since the Early Bronze Age. She associates the bridle cheekpieces with riding, the disc-shaped ones with traction/chariotry.[30] Nevertheless, so far there is not clear evidence for the use of bits from the Early Bronze Age, and the first unequivocal trace for the utilisation of horses as work animals was observed on the hereby discussed specimen of the Tompa-1 horse in the Carpathian Basin.

When it comes to the origins of the bone bits discovered in the Carpathian Basin, researchers has been divided. Some argued for their prototypes to be found in Asia Minor,[31] while others suggested links with the eastern steppe region.[32] Following the excavation of the cemetery of Sintashta,[33] it became evident that – as opposed to Asia Minor origins[34] – the disc-, or rectangular cheekpieces were in fact developed by the communities of the Sintashta–Poltavka complex in the Volga–Ural region 2000 BC. Assemblages containing chariots, bits and cheekpieces, along with rock art and other depictions testify that these objects reached territories lying west, east and south of the steppes, travelling long distances.[35] Contrary to previous views, these influences seem to have spread in the opposite direction: from the steppe region to Mycenae via the migration of early Aryan populations, while through another trajectory it reached the Carpathian Basin along with the knowledge of horse control, chariotry and equipment.[36] The insular distribution of the disc and rectangular bits in the above mentioned three regions indicate direct links between the radiocarbon dates derived from the Sintashta assemblages, depictions of Mycenae and Tiryns from the MH II period, and the second half of the Hungarian Middle Bronze Age (RBz A2a).[37] A similar picture is reflected by a map showing the distribution of various bit types.[38] Despite the close links, compared to the other two regions, the development of horse equipment appears to have taken a slightly different direction. There is so far no examples found of the rectangular bits in the territories along the Danube and the Tisza Rivers. The interior of the disc-shaped bit variants' is smooth, without spikes. Even if considered together with the so-called mixed variants, the disc-shaped bits only make up around 10% of all horse equipment in the Carpathian Basin, where the Füzesabony-type cheekpieces dominated during the Middle Bronze Age *(fig. 1).* Therefore, the two horse remains from Hungary discussed below – both with pathologies caused by the equipment – need to be examined against this historical backdrop.

Bronze Age remains of equids from Tompa

The skull of the Tompa-1 *(fig. 3)* along with other bone fragments *(fig. 6)* horse mandible, mt. III., mammal bone were discovered during agricultural works in the Danube–Tisza Interfluve region close to the southern border of Hungary *(fig. 1).* The remains were gifted to the Bozi Ars Med.

29 *Bándi 1963.*
30 *Kanne 2018; Kanne 2022* 297.
31 *Bándi 1963* 55.
32 *Mozsolics 1960; Hüttel 1981.*
33 *Gening – Gening – Zdanovič 1992.*
34 *Smirnov 1961.*
35 *Lichardus – Vladár 1996* 25–27; *Makkay 2000.*
36 *Boroffka 1999; Penner 1998; Makkay 2006.*
37 *Penner 1998* 161–165.
38 *Hüttel 1981* Tab. 26.

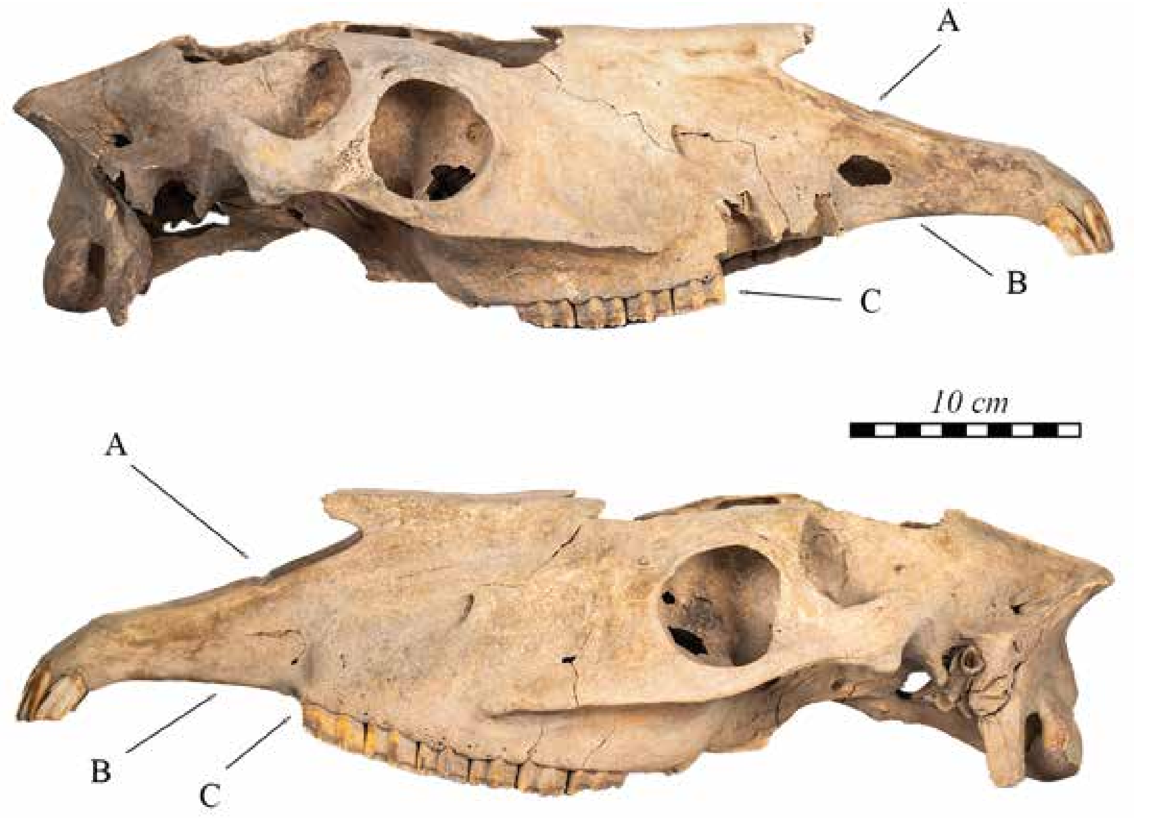

Fig. 3. Lateral view of the Tompa-1 horse cranium. A. Groove on the nasal process of the incisive bone running in a dorsal-dorsomedial direction; B. Intact interdental space *(diastema);* C. No damage visible on the exterior of the second premolar (©Árpád Bozi)

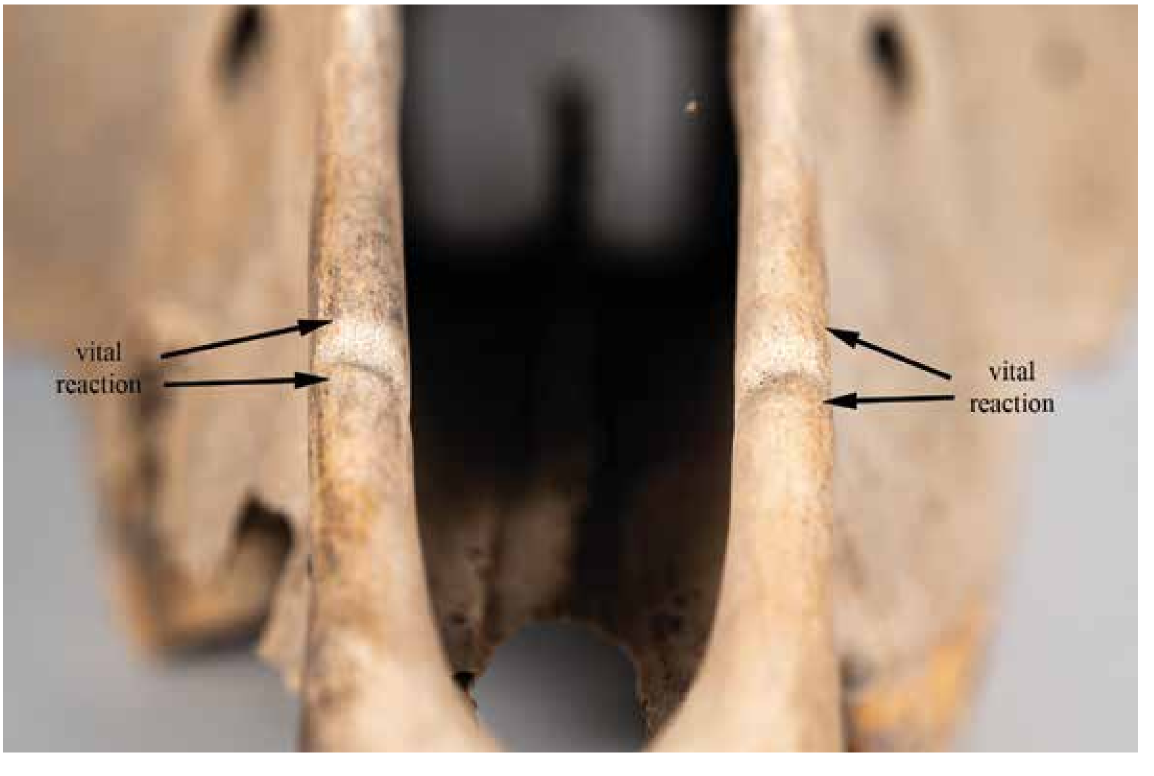

Fig. 4. Evidence for vital reaction on the nasal process of the incisive bone on the Tompa-1 horse skull (©Árpád Bozi)

Vet. Clinic in 2020, and following their examination, they were inventoried into the collection of the Museum of Agriculture, Budapest. According to the collector, the bones and the ceramic fragments accompanying the remains were found in the northern vicinity of Tompa, between the railway track and a farm. Unfortunately, the frontal bone, the larger part of the nasal bone and the mandible of the skull was already missing. Among the ceramic pieces, a bowl of dark grey colour was identified to have belonged to the Middle Bronze Age Vatya culture (see below).

This detail raised the possibility that the skull could have belonged to a Bronze Age *Equus caballus,* which might also indicate that the remodelling observed on the *os incisivus* stands as the earliest example for a horse used for riding or transport in the Carpathian Basin. The pathologies present on the mandible fragment imply the use of a bit, therefore the two bone specimens will be discussed and interpreted together.

Tompa-1 sample (equine cranium)

The cranium is well preserved, the frontal bone, the larger part of the nasal bone and the mandible is missing. The second premolar (hereafter P^2) on the right side was removed and sampled for ^{14}C, and $^{87}Sr/^{86}Sr$ and ^{18}O tests. The piece not used for analysis was later restored into the maxilla. The examination of the incisors has shown that the specimen belonged to a mare about 8 years old, canines were missing. The remains were of light brown colour, code Dac693. The measurable characteristics of the skull and its comparison specimen (a skull fragment of an *Equus ferus* from the Pleistocene)[39] are listed in the *Appendix.* The frontal region of the Tompa-1 horse skull is shorter, the temporal/occipital/parietal area was broader, and the molars significantly smaller than that of the *Equus ferus* living in the Danube–Tisza Interfluve during the Pleistocene. The length measurements taken at the base of the skull suggest a withers height of 131.27 cm according to Ludwig Kiesewalter,[40] and 139.3 cm according to Vladimir Oskarovich Vitt.[41] In the comparative dataset the withers height measured on wild horse specimens fall within the range of 142.26–155.33 cm based on Vitt's study.[42] Therefore the measurements and the calculated withers height suggest that the Tompla-1 skull belonged to a domesticated *Equus caballus*. Out of the 11 indices of morphological measurement criteria 2 (18.18%) is characteristic of western type horses, 8 (72.72%) of eastern types and 1 (9%) index to both types. The morphological examination support the eastern type of the Tompa-1 specimen.[43]

On both sides of the incisive bone's *(os incisivum)* nasal process *(processus nasalis)*[44] a bevelling can be observed in a dorsal or dorsomedial direction *(fig. 4)*. The axis of the bevelling creates an angle of 22 degrees on the left and 21 degrees on the right side in an oral direction with the labial plane of the central incisors. The largest dorsal breadth of the bevelling on the left is 11.43 mm, on the right is 11.54 mm. The length of the bevelling is 12.41 mm on the left, and 12.18 mm on the right. The largest depth of the bevelling is 3.31 mm on the left, and 3.2 mm on the right. In both cases on the front and back edge of the bevelling flame-shaped bone spur formed, a so-called vital reaction. The width of the bone spur on the left side is 9.02 mm, its length is 8.55 mm, while the width of the bone spur on the right measures 8.08 mm, its length is 8.63 mm. The X-ray has shown evidence for osteoporosis within the area of the bevelling *(fig. 5. 1)*. The remodelling detected on the incisive bone was likely due to physical stress (e.g. pressure or pull caused by a harness). There is no trace of a bevelling or remodelling of the nasal

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39 *Driesch 1976.*

40 *Kiesewalter 1888.*

41 *Vitt 1952.*

42 *Bozi – Szabó 2020.*

43 *Besskó 1906.* The DNA analysis of the remains was carried out by the Institute of Archaeogenomics at the Research Centre for the Humanities.

44 *Kovács 1967.*

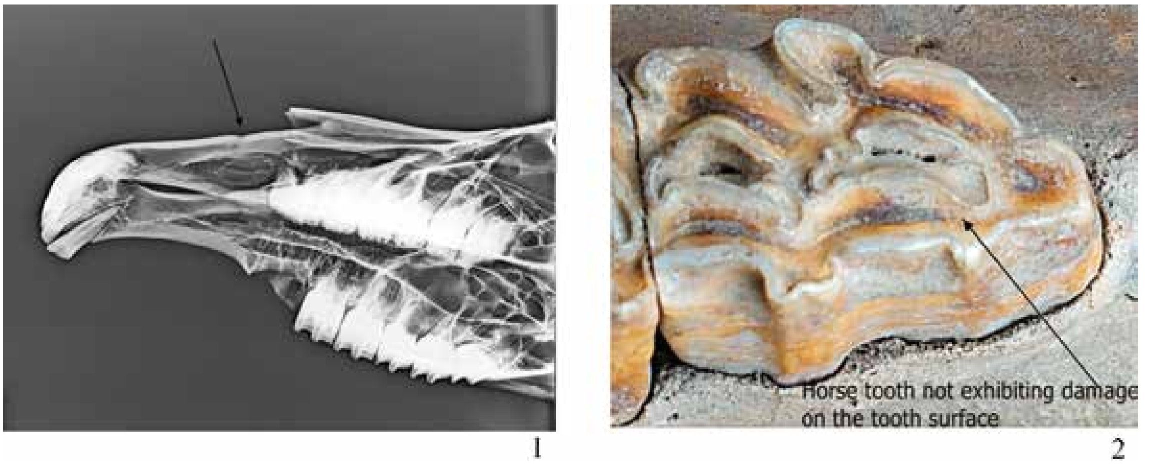

Fig. 5. 1. X-ray image of the Tompa-1 cranium; 2. P^2 premolar (©Róbert Bozi)

bone or on the nasal process. Furthermore, there is no evidence for wear caused by chewing on a bit on the anterior edge and the crown of P^2 *(fig. 5. 2).* The bone surface in the interdental space *(diastema)* is intact. There was no ossification detected at the point of attachment of the large median ligament *(ligamentum nuchae)* on the occipital bone. Exterosis present at the attachment point of the large median ligament and on the occipital bone is a sign of the horse being used for traction but can also signify abnormal neck posture (bent posture, overbent neck, broken neck).[45]

Similar pathologies on the nasal process of the incisive bone have been described before and explained by various reasons: endogenous and exogenous causes. Fundamental endogenous cause for example is a prolonged O_2 deficit. The lateral muscle in the nose *(musculus nasi lateralis)* attaches to an S-shaped cartilage, which helps to lift the muscle and open up the airways when breathing in. In the case of prolonged O_2 deficiency the muscle is continuously strained, it becomes hypertrophic and presses on the nasal process of the incisive bone from a dorsomedial direction and also on the infraorbital nerve *(nervus infraorbitalis)* creating a bevelling or groove in the bone material dorsomedially and laterally.[46] A number of health conditions can result in permanent O_2 deficit. RAO (Recurrent Airway Obstruction) develops as an effect of stabling, caused by airborne particles, such as stable dust, fodder dust, fungi spores or polluting gases which induce an allergic reaction resulting in the inflammation of the airways. A disease of slow progression, does not improve.[47] IAD (Inflammatory Airway Disease) is brought on by bacteria, viruses, airborne particles, or polluting gases. It can be cured by providing a clean environment and suitable medication. Often traditional medicines can also improve the condition. Improves quickly.[48] *Laryngeal hemiplegia* is the paralysis of the recurrent laryngeal nerve *(nervus recurrens)*. Dystrophy of the left recurrent nerve occurs more commonly than the right. The left vocal fold and the *arytenoid cartilege* partially obstruct the airways. It causes some level of exercise intolerance but no shortness of breath. Occurs mainly in large racehorses and English thoroughbreds, does not affect mares.[49] A tumour in the nasal passage is a rare pathology and in most cases affects one side only.

In the case of the Tompa-1 horse, endogenous causes can most likely be excluded. RAO: archaeological evidence for the sabling of horses during the Bronze Age in the region is lacking,

45 *Higgins 2009.*
46 *Pérez – Martin 2001.*
47 *Rush 1955.*
48 *Rush 1955.*
49 *Karsai – Vörös 1993.*

and the analysis of another mt. III. bone fragment found along with the skull has shown that the horse was pastured.[50] IAD: Stabling also plays a role in the development of the disease, but the condition improves quickly. *Laryngeal hemiplegia:* Occurs among large English thoroughbreds especially among stallions and geldings. The estimated withers height based on the base length measurement of the Tompa-1 skull implies that the specimen belonged to a horse of small-medium build. The lack of canines in the skull indicates a mare. *Tumour in the nasal passage:* most tumours can be identified as sarcomas originating from the bone membrane. Such pathologies were not detected on the Tompa-1 cranium.

Exogenous causes are always linked to contraptions placed on the head restricting the animal's movements and to facilitate its control during transport or traction. In order to achieve this reins, bridles and bits were used. The use and, consequently, the chewing of the bit results in a characteristic wear on the oral edge of the P^2, thus a diagonal wear greater than 3 mm indicates the usage of such contraption. In the diastema a bone spur can sometimes develop due to irritation by the bit. Bits made of metal and organic material can leave a distinguishable trace on the bone.[51]

The usage of the bit could have been preceded by the employment of a simple rein. During prolonged exertion the pressure caused by a tight noseband can result in a groove or bevelling on the incisive bone.[52] The sideways pressure induced by the noseband can put stress on the *nervus infraorbitalis,* which in turn could lead to the development of a lateral bone spur on the nasal process *(processus nasalis),* but still providing enough room for the nerve to branch off. Prolonged forceful breathing can also result in the development of a medial groove on the nasal process, its depth is dependent on the horse's age. The correction coefficient is 0.028 mm/year.[53] Along with these pathologies, ossification of the nuchal ligament can also occur due to exertion. The comparison between recent, domesticated horses used for traction, wild horses kept in zoos, and archaeological specimens suggest that if this pathology is present, the animal was likely to be utilised in some way, however, it is not yet possible to identify what exactly this task involved.[54] The type of work these horses were used for could be ascertained by a newly published method,[55] looking at bone cortex modification and bone tissue hyperthophy identified on the mt. III.

Tompa-3 sample (equid mandible)

The mandible fragment of the Tompa-3 horse belonged to a domesticated equid *(fig. 6).* The size of its P_2 premolars are characteristically different from the *Equus ferus,* while the presence of canines indicate a stallion or a gelding. Based on the wear detected on the incisors, its age could

Fig. 6. Lateral view of the Tompa-3 mandible (©Árpád Bozi)

[50] *Bozi – Szabó 2020.*
[51] *Bendrey 2007.*
[52] *Taylor – Tuvshinjargal – Bayarsaikhan 2016* figs. 3–4.
[53] *Taylor – Jamsranjav – Tuvshinjargal 2015* 863.
[54] *Taylor – Jamsranjav – Tuvshinjargal 2015.*
[55] *Bozi – Szabó 2020.*

Fig. 7. Tompa-3 P_2 diastema. 1. Frontal view; 2. Plan view (©Róbert Bozi)

Fig. 8. 1. Plan view of the Tompa-3 P_2; 2. Occlusal surface of the Tompa-3 lower incisors (©Árpád Bozi)

Fig. 9. X-ray image of the Tompa-3 mandible. 1. Plan view; 2. Lateral view. The toothless part of the mandible with clearly visible the bone proliferation, caused by the bits (arrow in the image; ©Róbert Bozi)

be estimated to 14-15 years.[56] Comparing the available morphological characteristics of the Tompa-1 and 3 samples, it is evident that the two equids represent markedly different fenotypes. The interdental space *(diastema)* of the Tompa-3 equid is slightly – but not significantly – longer than in the case of the Tompa-1 specimen. In terms of teeth, *pli caballinid* cannot be detected on the P_2 (which could be due to wear on the enamel), the premolar is considerably shorter than of the Tompa-1 specimen's. This difference cannot be explained by one being a lower premolar, while the other an upper. Consequently, the row of premolars of the Tompa-3 specimen is shorter, and the animal had a somewhat longer but narrower maxillary nasal structure than the Tompa-1 horse's. This could have been the result of local selection, breeding activities or that the Tompa-3 specimen belonged to a different genetic pool or even species (e.g. donkey or hybrid species: mule) altogether. The currently ongoing archaeogenetic examinations will hopefully be able to shed more light on this aspect.

There are characteristic pathologies present on the Tompa-3 mandible caused by the use of bits and attached cheekpieces. In the diastema the bone membrane is showing signs of irritation; a dorsolateral proliferation, most likely due to pulling or yanking on the harness and the bit. The greatest length of the proliferation is 12.45 mm, extending in the middle section of the *diastema,* its greatest width measures 4.76 mm, which could be a correlated with the diameter of the mouthpiece. The back edge of the bone spur developed close to the corner of the oral cavity. Erosion of the enamel can be observed on the anterior edge of the P_2 (depth: 1.4 mm, height: 11.7 mm), most possibly due to wear. On the occlusal surface of P_2 on the protocone,

[56] *Kovácsy – Monostori 1892* 219.

and on the anterior of the hypocone the enamel had been eroded away. These pathologies do not suggest the permanent use of an elaborate mouthpiece *(figs. 7–9)*.[57] The animal was most probably utilised for work, but since the metatarsals are missing, it is impossible to say what this task or tasks entailed.[58]

Absolute and relative chronology, and the natural environment of the Tompa-1 and Tompa-3 horses

In order to identify the age and habitat of the Tompa-1 horse, ^{14}C, $^{87}Sr/^{86}Sr$, $\delta^{18}O$ (phosphate) examinations have been carried out. To estimate the horse's age the root of the right P^2 premolar was sampled and analysed. The isotopic tests were carried out in the Institute for Nuclear Research, ICER Centre in Debrecen,[59] along with ^{14}C dating of the remains. The skull produced AMS dates of 3412 ± 29 BP, the 2σ calibrated range spans between 1870 and 1620 cal BC (95.4% probability), dating to the 19th–17th century BC *(fig. 10)*.[60] The ^{14}C dates and the ceramic fragments found along the horse bones all indicate that the specimen date to the Vatya III period, when the cultural complex expanded its occupation to the Danube–Tisza Interfluve.[61] This era represents the second phase of the Middle Bronze Age in the Carpathian Basin, contemporaneous with the transition of the Reinecke BA2–BB periods according to the Central-European chronology,[62] with the disintegration of the Sintashta-Petrovka complex in the southern Ural region and with the period directly preceding the Mycenaean shaft graves (MH II).

The Tompa-3 mandible has been also sampled for ^{14}C, $^{87}Sr/^{86}Sr$, and $\delta^{18}O$ (phosphate) analyses in order to establish the age and habitat of the specimen. The AMS dates (DeA-31495) the Tompa-3 remains date to 3412 ± 29 BP, the 2σ calibrated range spans 1610–1450 cal BC (95.4% probability), to the 17th and 15th century BC *(fig. 10)*. This complement the dating of the Tompa-1 specimen, and correspond with the late Vatya culture's Koszider phase, with the Reinecke BB1 period according to Central-European chronology, and correlate with the assemblages of the Mycenaean shaft graves exhibiting strong steppe influences.[63]

In order to establish the similarities and differences in the strontium isotope ($^{87}Sr/^{86}Sr$) signatures associated with the habitat and the place of deposition of the horse, samples were taken from the enamel of its P^2 premolar and analysed in the ICER laboratory at Debrecen as well. Tooth enamel, in contrast to bones, has been shown to be less susceptible to diagenesis and contamination from the soil than bioapatite, and does not remodel during the individual's lifetime. For this reason tooth enamel is the most common tissue targeted for $^{87}Sr/^{86}Sr$ analyses of human and animal remains. Archaeological and isotope studies of the last decades indicate that most of the food consumed by later prehistoric communities was produced on land surrounding settlements.[64] Comparative samples to establish a reference dataset of background signatures (samples of soil, grass and mollusc shells) were collected from the northern vicinities of Tompa. The isotopic rate of 0.709335 $^{87}Sr/^{86}Sr$ measured on the Tompa-1 horse is so close to rate produced by the background soil sample (0.709256) that it would strongly suggest the congruence of the

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57 *Bendrey 2008.*

58 *Bozi – Szabó 2020.*

59 *Major et al. 2019.*

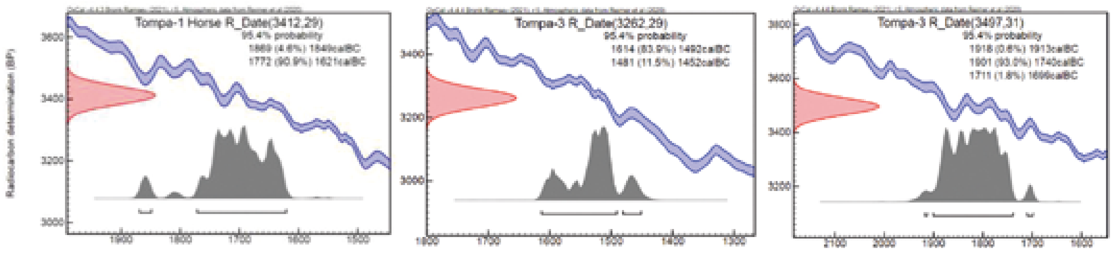
60 The dates were calibrated with the 'OxCal' v4.3 software *(Bronk Ramsey 2009)* using the IntCal20 Northern Hemisphere radiocarbon calibration curve *(Reimer et al. 2020).*

61 *Bóna 1975* 52.

62 *Szabó 2017b* fig. 5; *Stockhammer et al. 2015* fig. 7.

63 *Szabó 2017b* fig. 5; *Stockhammer et al. 2015* fig. 7.

64 For more details of the method see *Cavazzuti et al. 2019.*



AMS ^{14}C No	HEKAL No	Sample	Type	(BP) (±1σ)	cal BC (2σ) (OxCal v4.4.3)
DeA-27707	1/2553/1	Tompa-1	Horse P^2 premolar	3412 ± 29	1869–1621
DeA-31495	1/2735/2	Tompa-3	Bone	3262 ± 29	1614–1452
DeA-31496	1/2735/3	Tompa-4 R_Date	Mammal bone	3497 ± 31	1918–1699

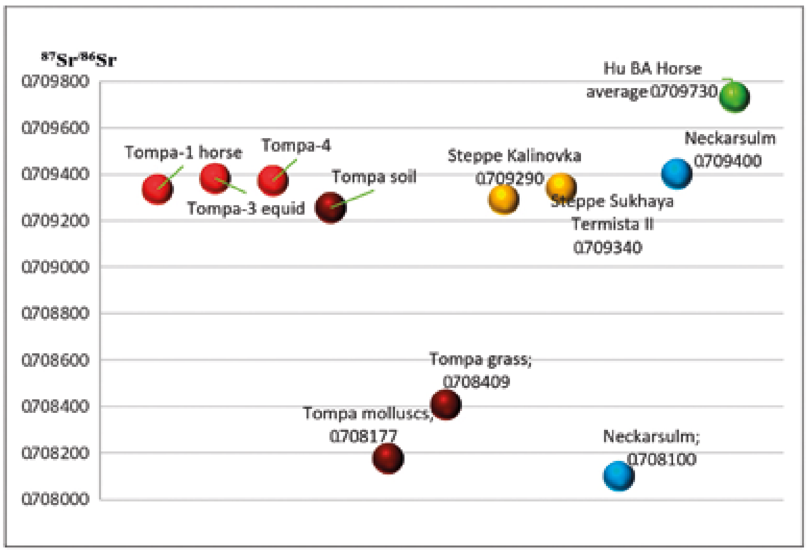
Fig. 10. ^{14}C dating of the Tompa-1, 3. samples (Institute for Nuclear Research, ICER Centre, Debrecen)

habitat and the place of deposition. Recently published archaeological fauna data from the Kelebia cemetery (2 km southeast from Tompa) with Sr ratio between 0.7091 and 0.7100 are coherent with the Tompa-1 horse and soil samples.[65] However, the $^{87}Sr/^{86}Sr$ isotopic signature of a recent soil sample corresponded more with a signature produced by the ancient bone than with the other two background reference samples which calls for some caution when interpreting the results.[66] The strontium isotopic signatures produced by the Tompa-1 horse barely reach the lowest values of other samples analysed from Hungary previously.[67] The situation is similar in the case of sampled Bronze Age horse teeth.[68] The closest comparable signature to the Tompa-1 horse's $^{87}Sr/^{86}Sr$ isotopic rates derived from samples from a Yamnaya burial at Kétegyháza-Kétegyházi tanyák site (Kurgan 3, burial 1: 0.70936) – located on the Great Hungarian Plain, characterised by largely homogenous geology.[69] When the Tompa-1 samples are compared with signatures produced by samples from regions farther west or east, it transpires that they all fall into the range measured at Neckarsulm (0.7081–0.7094: Baden-Württemberg, Germany), but the signatures measured on samples from Bulgaria and the steppe area are also close.[70] Moreover, the $^{87}Sr/^{86}Sr$ isotopic signatures[71] measured at several sites in the Eastern steppes fall closer to the rates measured on the Tompa-1 horse, than to the signatures produced by the background reference samples of grass or molluscs. It is particularly interesting that the $^{87}Sr/^{86}Sr$ isotopic signature of 0.70934 measured on a sample from the Sukhaya Termista II site associated with the Catacombe culture, and also the signature of 0.70929 produced by a bone sample (from burial no. 5)[72] from the site of Kalinovka I linked to the Poltavka culture (partially preceeding the Bronze Age Sintashta culture along the Volga) falls closer to the measurements of the Tompa-1 horse than to signatures produced by the background reference samples. Therefore, the isotopic signature of 0.709335 $^{87}Sr/^{86}Sr$ produced by the Tompa-1 sample would suggest a high likelyhood of the horse being of local origin, but given the archaeological context it could also have originated from territories of the present-

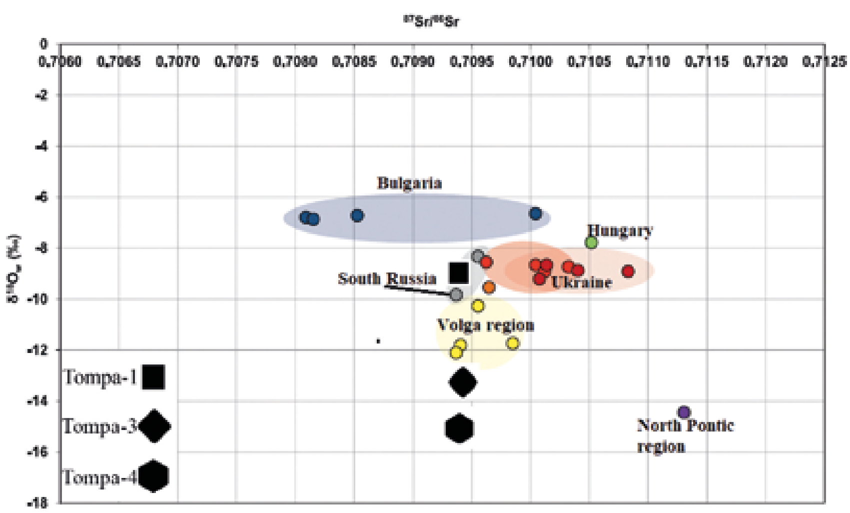
[65] *Cavazzuti et al. 2021.*
[66] For the possible contamination of the grass and molluscs Sr data see *Thomsen – Andreasen 2019.*
[67] *Giblin et al. 2013* Tab. 1; *Gerling 2015* fig. 4. 8; *Sjögren – Price – Kristiansen 2016* 19.
[68] *Kanne 2018* Tab. 5. 9.
[69] *Gerling 2015* 344. See also *Depaermentier et al. 2021* fig. 5.
[70] *Gerling 2014* figs. 1–2; *Sjögren – Price – Kristiansen 2016* fig. 9.
[71] *Gerling 2015* 65–66, fig. 4. 21–22.
[72] *Gerling 2015* 347.

HEKAL Sample No.	Sample	$^{87}Sr/^{86}Sr$	± 1σ	$\delta^{18}O$ (phosphate) vs VSMOW (‰) (±0.4‰)	On carbonates	$\delta^{18}O_w$ (‰)
I/2553/1	Tompa-1 horse	0.709335	0.000028	15.4	24.46	-9.7426
I/2553/2	Tompa grass background	0.708409	0.000029			
I/2553/3	Tompa soil background	0.709256	0.000031			
I/2553/4	Tompa molluscs background	0.708177	0.000030			
I/2735/2	Tompa-3 equid	0.709381	0.000034	11.6		-15.8
I/2735/3	Tompa-4 mammal bone	0.709372	0.000033	14.0		-13.1

A



B



Tompa-1 after converting: -9.4 and -10.6‰; Tompa-3 after converting: -16.4 and -15.2‰

C

Fig. 11. A. The $^{87}Sr/^{86}Sr$ isotopic signatures and $\delta^{18}O$w average of the Tompa specimens and background reference samples; B. The averages of $^{87}Sr/^{86}Sr$ isotopic signatures from Tompa compared to the averages of Bronze Age horses in Hungary (*Kanne 2018* 192) and similar values from other regions (after the chart by *Gerling 2014* figs. 1–2; *Sjögren – Price – Kristiansen 2016* fig. 9); C. The $^{87}Sr/^{86}Sr$ isotopic signatures and $\delta^{18}O$w averages of the Tompa specimens compared to the values derived from the Eneolithic and Bronze Age in the close region (after *Gerling 2015* fig. 4. 103; ©Géza Szabó)

day southern Germany or the eastern steppe region. In order to get a more detailed picture, the strontium isotope analyses were supplemented by $\delta^{18}O$ (phosphate) vs VSMOW examinations carried out on the same P^2 premolar at Debrecen. The measured rate of 15.4‰ (±0.4‰) produced by the Tompa sample shall be converted[73] to get the drinking water value: which is between -16.6 and -9.4‰ (considering the std. dev.), and slightly higher than the 'local range' of $\delta^{18}Ow$ -9.15 and -7.15‰ characteristic of Hungary according to the study by Claudia Gerling.[74] These results may suggest a possible non-local origin for the Tompa-1 horse (for more details see below).

The isotopic signatures of 0.709381 $^{87}Sr/^{86}Sr$ measured on the Tompa-3 sample show a slightly higher value than the isotope ratio produced by the Tompa-1 sample, but it still falls below the average rate of $^{87}Sr/^{86}Sr$ 0.70973 characteristic to the Bronze Age horses from Hungary.[75] These signatures indicate that a local origin for the Tompa-3 horse cannot be ruled out, while if the archaeological context is being taken into account, the steppe region can also be considered as a possible place of origin. The $\delta^{18}O$ (phosphate) vs VSMOW analyses found values of 11.6‰ (±0.4‰). After conversion into drinking water values these range between -16.4 and -15.2‰, which are lower than what is considered to be a 'local range' characteristic to the Great Hungarian Plain ($\delta^{18}Ow$ -9.15 and -7.15‰) *(fig. 11. A–B)*.[76] The signatures produced by the Tompa-1 specimen appear to correlate more with the values measured along the Volga ($\delta^{18}Ow$ -12.74 and -9.56‰),[77] and southern Russia (foothills of the Caucasus) ($\delta^{18}Ow$ -10.4 and -8.4‰).[78] The average of the 'local range' in the latter region is slightly broader, the values fall between $^{87}Sr/^{86}Sr$ 0.7087 and 0,7095.[79] When the combination of the mentioned $\delta^{18}Ow$ and $^{87}Sr/^{86}Sr$ values are plotted on a chart, the Tompa-1 fall close to the Volga region, while the Tompa-3 isotopic signatures fall in the lower segment of the Hungarian dataset *(fig. 11. C)*.[80]

Tompa equid remains and their broader archaeological context

Among the ceramic fragments discovered nearby the Tompa-1 horse skull there was a fragmentary, dark grey ceramic vessel, a so-called 'Swedish helmet' type bowl *(fig. 12),* with a broad, out-curving rim and bulging lower section. Similar types of large bowls were used in the third phase of the Vatya culture as covers for burial urns. The strap handle of the bowl attaches to the rim and sits on the angled shoulder. Despite the strongly eroded exterior, the lower section of each of the bowl was decorated with four horizontal channels. Below the handle and the additional knobs sitting on the shoulder three impressed dots can be observed from which a bundle of lines (made of three strands) run towards the middle forming a cross on the lower exterior of the bowl. The centre point of the hemispherical base was emphasised by an *omphalos* surrounded by two concentrical channels. A similar type of large bowl covered the urn of burial no. 34 in the cemetery of Kelebia associated with the Vatya culture.[81] The sherds found along the horse bones can be linked to the third phase of the Vatya culture which at this time occupied parts of the Danube–Tisza Interfluve.[82]

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[73] Conversion was based on *Daux et al. 2008*. WSMOW: Vienna standard mean ocean water.
[74] *Gerling 2015* 161.
[75] *Kanne 2018* 192, Tab. 5. 9.
[76] *Gerling 2015* 161.
[77] *Gerling 2015* 163.
[78] *Gerling 2015* 169.
[79] *Gerling 2015* 163.
[80] *Gerling 2015* fig. 4. 103–104.
[81] *Zalotay 1957* 21; *Bóna 1975* Tab. 67. 10.
[82] *Bóna 1975* 52.

At the location specified by the collector of the finds – in the northern vicinity of Tompa village, between the western side of the Budapest–Belgrade railway track and a nearby farmyard (referred to as Tompa-Paska farm) – there had been reports of late Medieval settlement remains and traces of inhumation burials of unknown date, according to the journal of Elemér Zalotay. More recent finds brought to light by agricultural works imply that at least some of the human remains belonged to a Bronze Age burial ground. These observations are further supported by a feature clearly distinguishable on the aerial photograph taken of the site: a dark circular patch of 50 m in diameter surrounded by a band of lighter geography which strongly indicate the presence of an eroded kurgan. Within the radius of a few kilometres from the kurgan, there are several inventoried sites associated with the Vatya culture. The most significant among these is the biritual cemetery of Kelebia only 2 km south of Tompa, with 99 urn burials along with – unusually – 23 inhumations. The collagen samples taken for ^{14}C dating from the skeletal remains of this cemetery place the burials to the Vatya III and to the Koszider period (burial no. 90: 1610–1460 cal BC).[83] During the excavation of the inhumations, the leading archaeologist noted specifically that the deceased were not placed flexed on their sides but were buried upright, in a squatting position.[84] The observations made at Kelebia were further supported by a burial from Csanytelek, placed in a similar upright position also dating to the Vatya III–Vatya-Koszider period (Csanytelek-Palé burial no. 27).[85] The 'Swedish helmet' type bowl found in burial no. 79. at Kelebia proves a link with the Vatya urn and inhumation burials, but also suggest a relationship with a non-normative burial practice further afield.

Fig. 12. A so-called Swedish-helmet type bowl from Tompa (©Géza Szabó, ©Zsolt Réti)

Traces of the horse's control on the Tompa equids remains

The bone proliferation observed on the Tompa-3 mandible is evidently the effect of a bit placed in the mouth regularly, while there was no similar pathology detected in the diastema on the Tompa-1 specimen. On the anterior edge of the P_2 premolar and on the occlusal surface of the teeth there was no trace suggesting the use of a bit of either organic or inorganic material in case of the Tompa-1 equid. The development of the bit as a device of control has been experiential, its technology is still being refined even today. In the case of the Tompa-1 horse, it is possible that

83 *Kiss et al.* 2019 Tab. 4.

84 *Zalotay 1957* 62–64, fig. 10.

85 *Lőrinczy – Trogmayer 1995* Abb. 4. 4. This cemetery also contains characteristic Swedish helmet' type bowls.

instead of a more sophisticated equipment, a simple halter was used.[86] However, on the incisive bone of the Tompa-1 horse, there is no sign of lateral remodelling, and the bevelling on the nasal bone is also lacking. The absence of these two pathologies suggest that the horse was not made to wear a tight halter regularly. The only pathology indicating that this particular horse was utilised for work is the groove on the incisive bone's nasal process in a dorsal or dorsomedial direction. This is a proper groove, not a shallow bevelling. Similar grooves were described by William Taylor and his colleagues from Mongolia. However, the depth of the Tompa-1 specimen (after age corrections) is 60% greater than of the Mongolian specimens.[87] There is another key difference: In the case of the Tompa-1 horse the groove is symmetrical on both sides of the nasal process, and the bone material underneath is showing signs of osteoporosis, along with a development of a bone spur on the edges. The development of osteoporosis was due pressure applied to the bone surface, while the bone spur evolved as a result of tissue irritation. Similar pathologies can be observed around bone implants. In this case, the implant was most likely a thin, cylindrical, rod-like implement, which was placed in the animal's nasal septum. The integration of the implement was dependent on a number of factors. It was important that the device had a flexibility similar to bone, was smooth and rounded in shape; antiseptic properties were further an advantage. In the Bronze Age certain plant species, such as willow fitted these criteria.[88]

There is no proliferation of the occipital bone which would suggest lengthy periods of the neck being bent downwards, and there is no sign of stress around the site of attachment of the nuchal ligament indicating that the horse's head was not restricted in its movement. Effects of a pulling force associated with traction is not present on the cranium.[89]

Early control of animals

The key questions of equine domestication is how and when horses were brought under human control, and what kind of evidence is there to support that such activities had indeed taken place.[90] The archaeological record and early depictions indicate that a variety of implements were used for the harnessing of horses before bits placed in the animal's mouth became the dominant method. It is important to draw attention here to other domesticated species such as cattle (*Bos taurus* – from 6000 BC) and camel (*Camelus bactrianus* – from 3000 BC)[91] which, beside providing milk, were also exploited for transport and traction and could have served as examples for the domestication of horses. In most cases these large animals respond well to vocal commands, hand gestures or to a crop or cane, but in order to carry out tasks precisely sometimes a device was necessarily that would directly counteract some of the animals' instinctive reflexes. The construction of this device or implement depended on the cultural context, the abilities and character of the animal, and the task at hand. Ethnographic examples show that a nose rings, nosebands and halters worked well for cattle, bits were used for horses, whereas wooden or bone pegs piercing the membrane of the nasal passage of camels were employed. Therefore, the horse cranium exhibiting remodelling of the *os incisivum* most likely due to human interference deserves special attention *(fig. 3)*.

Some early depictions portray yoked onagers with nose rings *(fig. 13. 4, B),* while other reliefs show yoked horses without nose rings and halters, but a rein attached to the left side of their heads

[86] *Taylor – Tuvshinjargal – Bayarsaikhan 2016* figs. 3–4.
[87] *Taylor – Jamsranjav – Tuvshinjargal 2015* fig. 3.
[88] *Birtalan 2008* figs. 262–266.
[89] *Bendrey 2008.*
[90] *Levine 1999; Outram et al. 2009; Taylor – Barrón-Ortiz 2021.*
[91] *Heide 2011* 360.

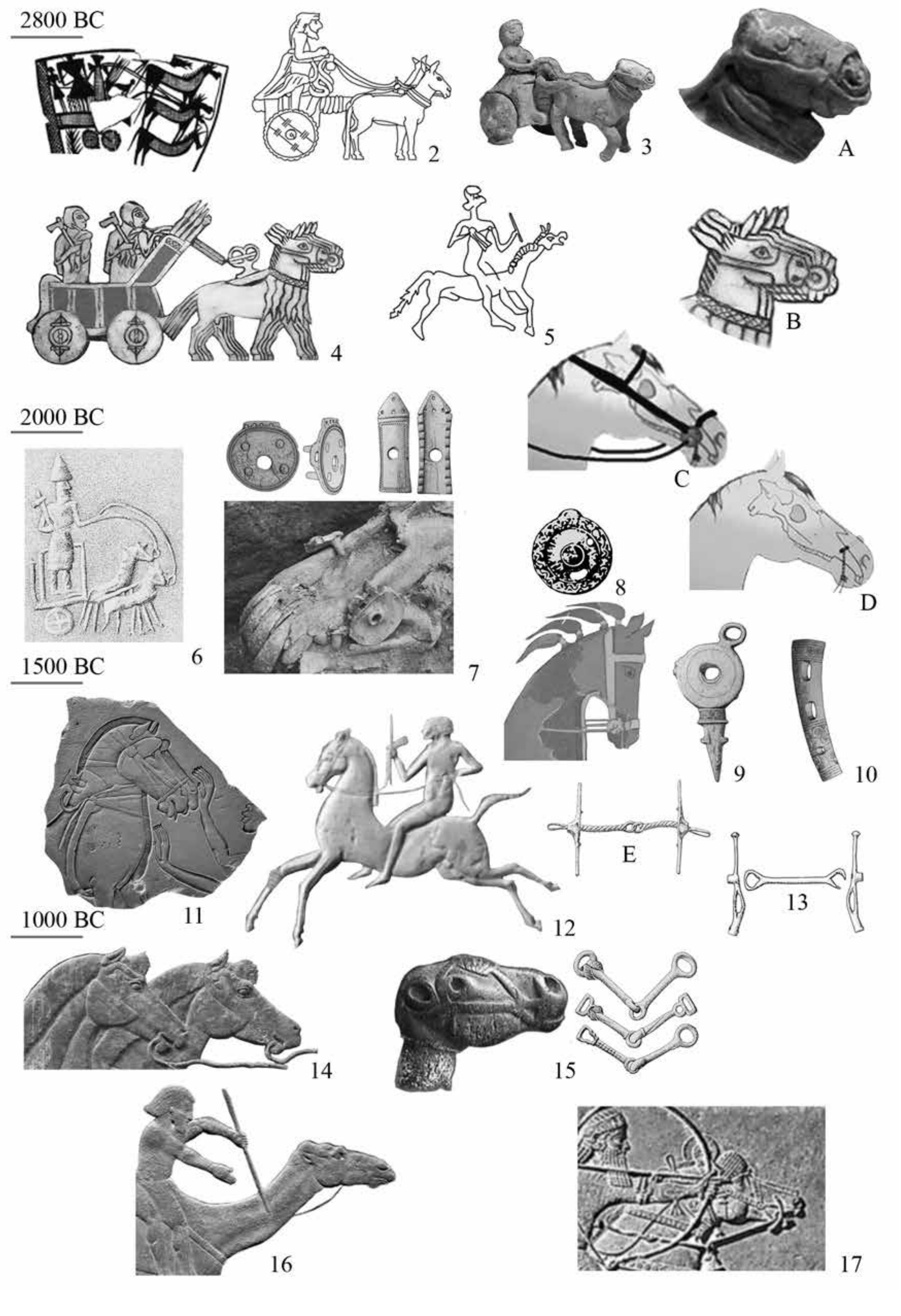

Fig. 13. Methods of control. A. Reins; B. Nose rings; C. Bits; D. Nose bit; E. Metal bits. Examples for different methods listed by species, chronological periods and geographical regions (27th–7th century BC) (©Géza Szabó, ©László Gucsi; see also note 92)

(fig. 13. 1–3, A).[92] On these depictions, the animals travel from left to right, thus the method of attachment remains unknown, but it is possible that the reins were fixed to an implement placed in the nose. Nose rings are still being used on Bovins, and in the case of camels a nose rod made of wood is widely employed even today. Wood only preserves in exceptional circumstances which could explain the absence of these artifacts in the archaeological record, and it is also possible that similar, rod-shaped bone implements from previously excavated assemblages were identified erroneously. The bits discovered in the territories of modern-day Hungary imply that horses were began to be utilised during the second half of the Middle Bronze Age in the Carpathian Basin. According to the radiocarbon dates, the Tompa-1 horse represents, so far, the earliest of horses that were utilised either for travel or traction. Of the bit cheekpieces documented from the Danube–Tisza Interfluve by Amália Mozsolics[93] and Hans-Georg Hüttel[94] neither the bridle type, nor the disc, rectangular nor the mixed type horse bits could have caused the pathology identified on the Tompa-1 horse cranium. In the case of the Tompa-1 horse this excludes all the methods of control associated with the above bits and cheekpieces, however these implements are still linked chronologically and culturally since the horse remains were found along with Vatya III ceramics. Therefore on the one hand, it is worth to provide a brief overview of methods of control here which could have resulted in the pathologies detected on the Tompa-1 skull. On the other hand, the $^{87}Sr/^{86}Sr$ isotope rates and ^{14}C dates along with the burials of the Bronze Age cemetery of Kelebia and the analogues of horse bits and cheekpieces found in the Carpathian Basin with links to the steppe and particularly towards the Volga–Ural region[95] make it reasonable to consider the wider context of the contemporaneous Sintashta culture.

The variants of nose bands, nose rings, reins and – in the case of camels – nose pegs are still in use worldwide, which testifies for the efficacy of such methods of control. Equipment made of organic materials like ropes or leather straps disintegrate with time, as opposed to the antler or bone cheekpieces and strap dividers known from the territories of the Bronze Age Sintashta–Arkaim culture (2050–1750 cal BC) from the southern Urals,[96] which– so far – are the first representatives of their kind. On the chariot model from Tell Agrab (Iraq) (*fig. 13. 2;* Early Dynastic period II, 2700–2500 BC), the rein is attached to the nose rings of the four abreast harnessed onagers through a single strap that runs along the chariot's shaft.[97] This method of chariotry is also depicted on the side of a jug from Khafajeh (Iraq) *(fig. 13. 1)* curated by the British

[92] Fig. 13 based on images from *Anthony 2007; Kanne 2018; Gening – Gening – Zdanovič 1992:* 1. Khafajeh, 2800–2600 BC, British Museum; 2. Tell Agrab, 2700 BC; 3. Sumer, 3rd–2nd millenium BC; 4. Ur, 26th–25th century BC, British Museum; 5. The earliest depiction of a horse riding, Ur, Age of Si-sin (2037–2029 BC); 6. Karum Kanesh 20th–19th century BC; 7. Disc and rectangular cheekpieces, Sintasta culture, 20th–19th century BC; 8. Reconstruction of a harness with a buckled mouthpiece and disc-shaped cheekpieces, Tyrins, Mycenae (1600–1200 BC); 9. Composite cheekpiece, Tószeg-Laposhalom, Koszider period (17th–15th century BC); 10. Bridle type cheekpiece, Százhalombatta, Koszider period (17th–15th century BC); 11. Draught horses being controlled by reins without bits, Saqqara 18th Dynasty (1545–1291 BC), British Museum; 12. Riding horse controlled by a bit in the military camp of Horemheb (around 1292 BC) Archaeological Museum of Bologna, photo made by the authors; 13. Bronze bit mouthpiece, Mengen, Early Urnfield period, 13th century BC; 14. Horses controlled by simple mouthpieces while swimming, Ashurnasirpal II. (865–860 BC), Nimrud; 15. Depiction of a bronze bit and harness, Arsan kurgan no. 2. (9th–8th century BC); 16. Combat camel controlled by a nose peg and a single rein, Ashurbanipal (645–635 BC), British Museum; 17. Mounted royal hunt, Ashurbanipal (645–635 BC), Ninive.

[93] *Mozsolics 1953; Bökönyi 1953.*

[94] *Hüttel 1981.*

[95] *Hüttel 1981* 56–65.

[96] *Gening – Gening – Zdanovič 1992; Koryakova – Epimamakhov 2007; Čečuskov 2013; Chechushkov – Epimakhov – Bersenev 2018.*

[97] *Raulwing 2000* fig. 7. 2.

Museum.[98] There is a similar image on the standard found in burial PG 779, in the necropolis of Ur (Iraq) (*fig. 13. 4, B;* Early Dynastic period III, c. 2600 BC), however on this illustration the halter and the nose ring is clearly visible.[99] Likewise on the seals of the Assyrian merchant colony of Kültepe Kārum (Turkey); Kanesh II, 1974–1836 BC, animals are seen harnessed to a chariot with a single rein attached to their nose rings.[100] By using this method of chariotry, only one animal was being turned when changing directions which then pulls or pushes the rest of them along *(fig. 13).*

In contrast to the widespread use of chariots and carts, the first depiction of a single horse rider dates to much later, but nose rings were commonly used for riding as well, as it can be seen on the terracotta plaque found at Kis (Iraq) in Mesopotamia dating to around 2000 BC *(fig. 13. 6).* On this depiction the rider sits on the horse without a mount, holding a rein which is attached to the nose ring on both sides of the head indicating that it was possible to ride a horse this way, without the use of a bridle.[101] The nose ring as a method of horse control was given up fairly soon after this period, while more sophisticated headgear such as bridles and reins began to play a larger role. As it is shown on a Sumerian clay model of a chariot (the turn of 3000–2000 BC) a bridle with a nose- and brow-band, and a rein that ran along both sides of the head was apparently sufficient enough to control a horse *(fig. 13. 3, A).* A later and quite specific version of this bridling is depicted on a relief fragment from Saqqara (Egypt) (*fig. 13. 11;* New Kingdom, 18th Dynasty, 1550–1292 BC), where the headgear was not attached either to a nose ring or a bit.[102] It might be surprising, but there are reliefs showing chariot drivers manoeuvring horses by reins tied to their waists. As opposed to the Mesopotamian tradition, in this case both reins ran on the outer side of the harness through loops or terrets attached only to the horses on each end, thus the animals tied abreast pulled each other into the desired direction making the use of bits redundant. Such method of horse control was quite common according to the depictions of Urartu.[103] A similar method was widely utilised by native Americans in the US where a version of this type of horse control is protected by US regulation no. 6.591589 B2.[104] These methods of horse control achieved through the physical manipulation of soft tissue very seldomly leave a mark on the underlying bone structure. However, more recently William Taylor and his colleagues described pathologies connected to methods like tight harnesses.[105] The usage of bits, leaving visible marks on the horse's teeth can be linked directly to a known person: King Menua (810–786 BC) from Karmir Blur (ancient Urartu, today Armenia), where two bronze bits with curved cheek pieces were found with his inscription.[106] Metal bits began to appear in the archaeological record around the 9th–8th centuries BC south of the Caucasus, while the intricate bronze bits of Luristan become widespread in the 8th–7th centuries BC. However, given their dating, these pieces cannot be considered in relation to the pathologies detected on the Tompa-1 horse.

Methods of control developed specifically for equids were used throughout the steppe region relatively early on. Control was achieved by bits placed directly into the animal's mouth. It is so far unclear what played a more crucial role in this decision: the absence of processes similar to the Near East preceding domestication or the use of an implement that was more efficient and anatomically better suited for the horse. Several earlier assumptions about the usage of organic

98 *Delougaz 1952* Pl. 62.
99 *Fields 2006* 6.
100 *Becker 1994* Abb. 4c; *Anthony 2007* fig. 15, 15b.
101 *Becker 1994* Abb. 4b.
102 *Fields 2006* 7.
103 *Schachner 2007* Abb. 74–79.
104 *Kanne 2018* 245.
105 *Taylor – Jamsranjav – Tuvshinjargal 2015; Taylor – Tuvshinjargal – Bayarsaikhan 2016.*
106 *Van Loon 1966* 113–114.

Fig. 14. The distribution of disc-shaped cheekpieces of the Sintastha culture and its relations (©Géza Szabó, ©Árpád Bozi)

bits in relation to Derevka and the sites of the Botai culture (3700–3100 BC) in Kazakhstan for instance,[107] turned out to be erroneous.[108] The earliest evidence for horse domestication and the use of horses for travel and/or traction is known from the territories of the Sintashta-Petrovka culture (2050–1750 cal BC) in the Southwestern Urals.[109] These included rectangular, disc and bridle cheekpieces made of antler.[110] Numerous artifacts, along with furnaces excavated in domestic structures indicated that copper mining and smelting played an important role here, something that is not generally characteristic among steppe communities. The large portion of these products were found in Central Asia in the territories of the BMAC (Bactria–Margiana Archaeological Complex), and distributed as far as Mesopotamia in the south, bringing the steppe and the Ancient Near East in closer reach. It is important to note that the domestication of the camel took place in exactly this region.

The most spectacular elements of the Sintashta culture; the horse-drawn chariot and the related equipment appear in the furthest regions of the Ancient Near East. Similar chariots are depicted on steles and seals found in Mycenaean B shaft burials (dating to around 1650 BC), while the on murals of shaft burial IV. of Mycenaea and Tiryns even the disc-shaped cheekpieces can be recognised,[111] just like in the horse burial excavated at the fortress of Buhen in Nubia dating to around 1675 BC.[112] The above mentioned artefacts draw together and contextualise these interactions between far away regions within a single timeframe testifying for the intensity and durability of these links between remote territories; marked by the Hyksos rule in Ancient Egypt, the appearance of Indo-European warriors in Mycenaean shaft burials and the exploitation of the Tompa-1 horse in the Carpathian Basin *(fig. 14)*. The latest genetic research has shown that the

[107] *Bökönyi 1968; Anthony – Brown 1991; Anthony – Brown 2011.*
[108] *Levine 1999; Taylor – Barrón-Ortiz 2021.*
[109] *Chechushkov – Usmanova – Kosintsev 2020.*
[110] *Gening – Gening – Zdanovič 1992; Chechushkov – Ovsyannikov – Usmanova 2020* 55.
[111] *Hüttel 1981* 40–48, Tab. 43. B; *Penner 1998* 30–41, Tab. 1–2.
[112] *Makkay 2004* 61; *Decker 1994* 260.

distribution of the Sintashta culture's craft products, which were the outcomes of innovations associated with the riding, chariotry and weapons, is closely linked with the migration of Indo-European populations both in Europe and in Asia.[113] It is important to mention here that the matrilinear genomic data of a woman excavated at the site of Érd of the Vatya culture (2000–1500 BC) have shown the presence of the H2a1 haplogroup,[114] similarly to the contemporaneous female burial from Kameni Ambar 5 (Russia) of the Sintashta–Arkaim culture (2050–1650 BC, female MtDNA H2a1a), and at Muradym 8 (Russia) of the Srubnaya Alakulskaya culture (female MtDNA H2a1, 1890–1750 BC), indicating a genetic link with the steppe.[115] However, beyond this link there is very little information about the contexts of these relationships.

Interpretation of the Tompa-1 and Tompa-3 finds

Nonetheless, there is one possible explanation for the pathologies present on the Tompa-1 horse cranium that would fit with contemporaneous practices of horse control; a long, thin, cylindrical nose peg was (and still is) often used on camels which could have resulted in similar pathologies detected on the Tompa-1 horse *(fig. 15).* The domestication of camels took place around the 3rd millenium BC in the Baktria–Margiana Basin,[116] therefore through the intermediary of the Sintashta culture there could have been links between the Steppe and the Carpathian Basin in the time of the Middle Bronze Age. Although such implements are insofar unknown in the archaeological record in Hungary, camels are depicted on reliefs of the Ancient Near East both as pack and combat animals. On the wall relief of the palace of Nimrud (Kalhu, Iraq) (728 BC), Assyrian riders chase a man escaping on a camel holding a rein attached to the left side of the animal's head. On the right side of the camel's head, at the level of the incisive bone there is a small, peg-like implement visible on the relief. This method of control is still being used on camels today. In Mongolia, camels are led by a peg pierced through the nasal septum *(buil)* to which a rein *(burantag)* is attached. In most cases the nose peg is made of wood, usually of willow *(burgas),* beech *(xus),* peashrub *(xargana),* or larch *(xar mod)*. Until the beginning of the 20th century wealthy camel owners were even able to afford the use of sandalwood, silver or gold nose pegs.[117] The lenght of the nose peg is around four plus one inch (4 *xurū* + 1 *yamx*, approx. 18–20 cm), depending on the camel's age and behaviour. For a camel less easy to keep in check, and which has a tendency to yank its head, a longer piece is used for more efficient control and to prevent injuries.

Fig. 15. Camel controlled by a nose peg (Persepolis 2014, ©Géza Szabó)

Nose pegs exist in various forms: with forked ends *(acan buil)*, with circular (or hemispherical) ends *(mȫgön buil),* with a movable crescent-shaped end on one side *(tagil buil),* or with a buckle end (with a hammer-like finial on the right side – *čagtan buil*). It is apparent that the material

[113] *Penner 1998; Makkay 2000; Allentoft et al. 2015* 168–169; *Librado et al. 2021.*
[114] *Allentoft et al. 2015* ERD4, RISE483.SG/ Skel. ID 106/159 Q2.
[115] *Rondu 2021* fig. 1.
[116] *Heide 2011.*
[117] *Birtalan 2008* figs. 262–266.

used for the pegs – either organic or metal – should not irritate the skin or soft tissue, or even possess some antiseptic properties. The implement is often boiled in fat before insertion in order to sanitise it and reduce the chance of infection. The camel's nasal septum is pierced by a sharp, awl-like instrument, then the peg is inserted from the right hand side, before the ends *(šowx)* are secured by a piece of sheep or goat's hoof horn *(tūrai),* or a scrap of leather *(towx).*[118] The approx. 2.5–3 m *(2 ald)* long rein *(burantag)* is usually made of a combination of camel hair, mane hair *(jogdor),* and wool *(em nōs)* plaited twice, attached to the left side of the peg as it can be seen on the Kalhu relief. The reason for this could be that in this way the rider was able to control the camel with his left hand and could hold a weapon in the right. The length, size and placement of these nose pegs and the pathologies caused by their perpetual employment implies the use of a similar implement in the case of the Tompa-1 horse. Thus, henceforth this implement will be referred to as a nose bit. The pathologies detected on the skull of the Tompa-1 horse would strongly suggest the usage of a rod-like implement which was inserted through the nasal septum, then was used to control the horse similarly to a bit placed in the mouth. The examples currently being used on camels are often made of wood which would also explain why this artefact type is missing from the archaeological record. It is also possible that such objects made of non-perishable materials have so far not been recognised in assemblages.

The proliferation of the bone matter observed in the mandibular diastema of the Tompa-3 equid, the wearing away of the enamel on the anterior edge of the P_2 premolar, and the erosion of the enamel on the occlusal surface of the same tooth (both on the protocone and on the hypocone) indicate the prolonged use of rough bit mouthpiece. This draws further attention to the fact that despite the numerous disc-shaped and bridle cheekpieces known from the Middle Bronze Age, mouthpieces seem to appear in the archaeological record only from the Late Bronze Age. The absence of mouthpieces in the Middle Bronze Age can be explained by the use of organic materials, such as leather, rope or wood. Even in the case of Sintashta burials, only the disc-shaped cheekpieces could be found *in situ* on the horse crania which further suggest that elements of the harness and bits were constructed of organic components. The bone proliferation and the pathologies detected on the P_2 premolar of the Tompa-3 equid suggest the use of a material that could caused erosion in the oral cavity (even in a moist environment), not so much by pressure but by slipping around and creating friction in the horse's mouth. It is most likely that the mouthpiece was constructed of ropes or leather straps which when moist – especially if soiled with sand – could have caused the erosion of the enamel and the irritation of soft tissue. Therefore, based on the pathologies observed on the Tompa-3 equid, it is feasible to assume the use of a bit mouthpiece fashioned of ropes and leather straps, which could have been combined with bone and antler cheekpieces until the appearance of metal bit mouthpieces.

Summary

The potential use of the nose bit and the bit placed in the mouth in the case of the Tompa-1 and Tompa-3 equids *(fig. 16)* could further indicate that throughout the lengthy process of domestication there had been numerous attempts to utilise horses for work, and for this, experiences gained through the domestication of other animal species were actively employed. The camel is perhaps the best example for this, as in this case all possible methods of control (harness, bridle, nose ring, nose band etc.) – apart from the bit – are still being used today. As the outcome of the lengthy and diverse process of equine domestication the bit placed in the horse's mouth proved the most effective method of control, although it is certainly not the only one.

[118] *Birtalan 2008* figs. 262–266.

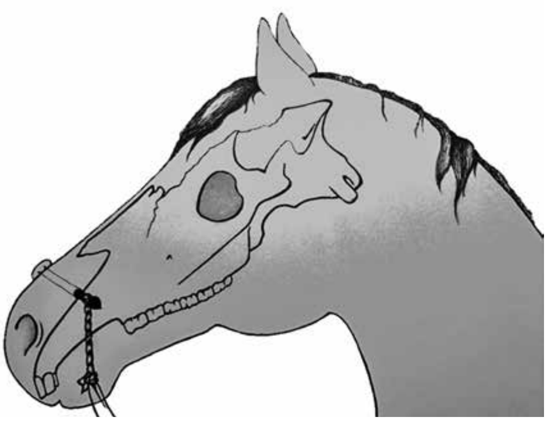

Fig. 16. Reconstruction of a nose bit based on the pathologies present on the Tompa-1 horse cranium (©Géza Szabó, ©Anna Tápai)

The over a hundred year difference between the Tompa-1 and Tompa-3 specimens and their equipment perhaps reflects technological steps in the advancing process of horse control, however it does not exclude the possibility that there had been an overlap between the use of the two bit types.

The appearance of the nose bit in the Carpathian Basin on its own around 1700 BC is difficult to interpret, however, in the broader context of the late Sintashta culture and its exchange network that span across large swathes of the steppe and the Near East,[119] it is perhaps feasible to consider that this method of horse control could have reached the Carpathian Basin from all the way of the BMC regions, where the domestication of camels took place initially. This is further supported by the hereby discussed Tompa-1 and Tompa-3 specimens and their isotopic signatures pointing towards the Volga–Ural region. Future genetic studies could reveal more about the exact location of this and the roles the Sintashta culture played in transmitting these objects and ideas further afield. However, assemblages linked to Indo-European populations during the period prior to the Mycenaean shaft burials (MH II) suggest that there is a change taking place from across the Altai region to the Danube and from Scandinavia to the Aegean at this time.[120] The Tompa-1 horse controlled by a nose bit – along with the seated burials of Kelebia – can therefore be considered as part of this process, and could be understood as evidence for steppe influences reaching the Carpathian Basin in repeated waves from the time of the Eneolithic.

The specimens presented here, as far as we are aware, represent the earliest evidence for equids utilised for work, and therefore they usher in a new era in the Bronze Age Carpathian Basin around 1700 BC. This new type of exploitation of equids increases the speed of mobility substantially, the efficacy of various human enterprises and their radius; it can be considered as a kind of ‘motorization’ which was only surpassed by the process of industrialisation in the 20th century. The different ^{14}C dating of the two specimens, their isotopic signatures, and the Tompa-3 cranium with probable evidence for the use of a bit mouthpiece, all indicate that these equids represent distinct stages of a lengthy process which was inextricably linked to the steppe region even during the 16th century BC. The picture will be no doubt detailed further by the increase of data, particularly the publication of the cemetery of Kelebia,[121] and by the outcomes of the currently ongoing genetic examinations of the Tompa-1 and Tompa-3 crania.[122]

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[119] *Makkay 2000.*

[120] *Gerling 2015; Allentoft et al. 2015; Szabó 2017a; Librado et al. 2021.*

[121] The isotopic examination of the Bronze Age burials from Kelebia has been conducted by Claudio Cavazzutti.

[122] The manuscript was closed on 28 May 2021.

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Appendix A.

Skull dimensions according to *Driesch 1976*
Tompa-1, *Equus ferus*

Location of the recorded size	**Tompa-1 mare (mm)**	***Equus ferus* stallion (mm)**
Profile length: A-P	528	
Condylobasal length	510	
Basal length	487	
Basilar length	483	
Short scull length: B-P	355	
Basicranial axis: B-H	229	
Basifacial axis: H-P	356	
Neurocranium length : B-N	-	
Viscerocranium length: N-P	324	
Upper neurocranium length: A-S	187.50	
Facial length: S-P	352	
Basion-most oral point of the facial crest on one side	278	
Most oral point of the facial creston one side-Prosthion	228	
Short lateral facial length: En-P	308	
Length of braincase: O-Ec	193	
Lateral facial length: Ec-P	368	
Greatest length of the nasals	-	
Basion-Staphylon	224	
Median palatal length: S-P	260	
Palatal length	253	
Dental length: Postdentale-Prosthion	293	
Lateral length of the premaxilla: N-P	171	174.73

Location of the recorded size	Tompa-1 mare (mm)	*Equus ferus* stallion (mm)
Length of the diastema (P^2-I^3)	102.60	
Length of the cheek tooth row (measured along the alveoli	159.30	
Length of the cheek tooth row (measured near the biting surface)	155.30	
Length of the molar row (measured along the alveoli on buccal side)	76.00	
Length of the molar row (measured near of biting surface)	74.24	
Length of the premolar row (measured along the alveoli on buccal side)	85.77	
Length of the premolar row (measured near the biting surface)	84.30	
Length and breadth P^2	L: 33.86, B: 22.16	
Length and breadth P^3	L: 26.08, B: 23.89	
Length and breadth P^4	L: 25.40, B: 25.11	L: 29.11, B: 29.96
Length and breadth M^1	L: 21.91, B: 24.63	L: 26.42, B: 29.04
Length and breadth M^2	L: 23.96, B: 24.38	L: 26.74, B: 29.12
Length and breadth M^3	L: 28.46, B: 23.65	
Greatest inner length of the orbita Ec.-En.	62.65	
Greatest inner height of the orbita	56.90	
Greatest mastoid breadth: Otion-Otion	114.07	
Greatest breadth of the occipital condyles	82.50	
Greatest breadth at the bases of the paroccipital -processes	102.68	
Greatest breadth of the foramen magnum	35.20	
Height of the foramen magnum: Basion-Opisthion	37.60	
Greatest neurocranium breadth: Euryon-Euryon	121.00	123.00
Least frontal breadth	90.50	79.00
Least breadth between the supraorbital foramina	143.30	136.81
Greatest breadth of skull = greatest breadth across the orbits	211.00	205.36
Least breadth between the orbits: Entorbitale-Entorbitale	148.91	
Facial breadth between the outermost points of the facial crest at the point of intersection of the maxillo-jugal suture with the facial ridge	Old horse, not measurable	
Facial breadth between the infraorbital foramina (least distance)	73.30	
Greatest breadth of snout: measured across the outer borders of alveoli of I^3	52.72	
Greatest breadth on the curvature of the premaxilla	71.72	
Least breadth in the region of the diastema	58.88	
Greatest palatal breadth: measured across the outer borders of the alveoli	125.66	
Greatest skull height	Not measurable	
Basion height	Not measurable	
Width above jaw joint (by *Besskó 1906*)	201.50	
Occipital width (by *Besskó 1906, Hutyra – Marek 1923–1924*)	65.07	

Appendix B.

Tompa-1, skull indexes according to *Besskó 1906* and *Hutyra – Marek 1923–1924*

Tompa-1 index a/b*100	**West horse type**	**East horse type**	**Can belong to both type**
Face width/forehead width		80.33	
Width above the jaw joint/forehead width		95.50	
Nuch width/forehead width	30.84		
Facial breadth between the infraorbital foramina/forehead width		27.91	
Forehead width/basal length		43.69	
Basal length/total length			91.45
Forehead width/total length			39.96
Entorbitale-Entorbitale/forehead width		70.57	
Greatest breadth of snout/forehead width	35.40		
Greatest breadth of snout/basal length		10.93	
Greatest inner height of the orbit/greatest inner length of the orbit		90.82	
Eurion-Eurion/basal length		25.00	

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GÁBOR ILON

CASTING MOULDS IN THE BRONZE AGE OF THE CARPATHIAN BASIN A CATALOGUE OF SITES AND FINDS

In memoriam Tibor Kovács (1940–2013)

Zusammenfassung: Die aus Stein oder Ton gefertigten Gussformen sind wichtige Beweise lokaler Metallurgie und entsprechender Fachleute. Vorliegende Studie lokalisiert die verschiedenartigen bronzezeitlichen Zentren der Metallverarbeitung im Karpatenbecken anhand der Verbreitung dieser Formen. Ergebnisse hinsichtlich der frühen, mittleren und späten Bronzezeit werden mithilfe von Landkarten und Tabellen erläutert. Ziel des Verfassers ist, unter Anwendung einheitlicher Prüfkriterien eine angemessene Grundlage für weitere internationale archäometrische Forschungen zu schaffen.

Keywords: casting moulds, metalworking, metalsmiths, workshops, Bronze Age, Carpathian Basin

Research today differs between independent specialists in each phase of metal processing, from mining to metalsmithing.[1] Casting moulds were most probably made by metalsmiths themselves, that is, the same craftspeople who used them. Single-use casting moulds made from sand or clay and reusable ones made from stone, a special kind of ceramic material resembling stone, or, rarely, bronze, are crucial evidence of the presence of local metalworking (and the related specialists), thus providing substantial information for Bronze Age archaeology.[2]

Bronze Age casting moulds from Hungary – a personal view

I started to attend the excavations at Velem-Szent Vid back in the 1970s, still a high school student. It was the first time for me there to have a casting mould in my hands, and, later on, on a second occasion during a visit to the Miske Collection of the Savaria Museum. The significance of these finds became revealed to me through field stories by the archaeologists who led the excavation, Gábor Bándi and Mária Fekete, and their guests: István Bóna, Géza Komoróczy, and Gábor Vékony. The first stone mould I ever found came to light in 1985 from Grave 6 in an Árpádian-period cemetery at Mezőlak-Szentpéteri-domb *(Table 3. 55),* one of my own excavations.[3] This specimen was made in the Late Bronze Age to cast a single socketed bronze axe; it later became transformed into a core piece and, finally, used perhaps as a whetstone during the Árpádian period. I also found, during the summer of 1986, a (maybe dolomite-tempered) clay mould for casting perhaps loops

[1] *Jockenhövel 1986* 215, Abb. 3; *Jockenhövel 2018* 314; *Sperling 2019* 162, 165, Abb. 3–4, 9, Table 1–2; *Molloy – Mödlinger 2020* 176.

[2] *Gazdapusztai 1959; Bóna 1960; Bóna 1975; Ecsedy 1982; Ecsedy 1995; Kovács 1995; Nessel 2019* 163–165; *Molnár et al. 2021* 14.

[3] *Ilon 1989* 21, fig. 7. 2.

in 'Grave 2' in Tumulus no. III/4 at Németbánya *(Table 3. 60).* According to the anthropological analysis, the disturbed burial mound (Grave 3) was the final resting place of an adult woman – however, this result never got into international circulation.[4] In my opinion, the four separate 'grave' remains unearthed at different points of the tumulus belonged to a single burial – a phenomenon not without analogies, observed on field and confirmed by anthropological evaluation several times before. In 1988, I found three casting moulds with a Keftiu or oxhide ingot mould among them, admixed with human remains, in Section K-6, Pit A at Gór-Kápolnadomb *(Table 3. 38).* These finds were published shortly after their discovery,[5] and the identification of the ingot mould as a 'Keftiu' type has become accepted by international research.[6] Besides their publication, one of the casting moulds found at Gór-Kápolnadomb was subjected to scanning electric microscope analysis with considerable results: its raw material was identified as rhyolite from Sárszentmiklós (county Fejér) at a distance of approximately 150 km.[7] The object's inner surface contained tin (Sn) and lead (Pb) remains, indicating its one-time use in casting processes. The thin section samples taken for petrographic analysis from most casting moulds from Gór became lost around the end of the 1990s, during the integration of the Central Museum Directorate into the Hungarian National Museum. As a consequence, Bálint Péterdi had to carry out such analyses on other Middle Bronze Age moulds in the collection of the Hungarian National Museum, of mostly unidentified origin but sometimes with their findspot known Füzesabony-Öregdomb *(Table 2. 20),* Sarkad area *(Table 2. 55),* Százhalombatta-Földvár *(Table 2. 65A),* Százhalombatta-Téglagyár *(Table 2. 65B),* Szelevény-Demeter-part *(Table 2. 66),* Tiszakeszi *(Table 2. 72).*[8] In the meantime, I have published a short study about the find material of a metal workshop discovered at Gór.[9] Furthermore, the petrographic analysis of the Urnfield-period moulds from Sármellék *(Table 3. 79, fig. 5)* was completed in 2022; the publication of the results is scheduled for the following year.

Next, I started to collect casting moulds and finds related to bronzeworking from sites all over the Carpathian Basin. My goal was to prepare a manuscript, together with Tibor Kovács, for a single volume for the series *Prähistorische Bronzefunde*. He started a similar investigation earlier, focusing on finds from Transdanubia, and already had several drawings and descriptions prepared for a monographic publication (see the back of *Inventaria Praehistorica Hungariae* 6, where the volume *Neuere bronzezeitliche Hortfunde Transdanubiens* is marked as upcoming – regrettably, it was never completed in the end). Tibor Kovács was obtained from scientific work by his tasks as General Director of the Hungarian National Museum and later by his lasting illness and death in 2013. Finally, as it had already been announced, *Prähistorische Bronzefunde* became discontinued (manuscripts were not accepted after 2010), and the founding editor, Hermann Müller-Karpe, died in 2013. These circumstances forced me to rethink my publishing goals.

Several observations were presented in a study during the first collecting phase.[10] These can be summarised as the followings:

1. The number of casting moulds and objects related to bronzeworking and the number of related sites is constantly growing with time throughout the Bronze Age (Early Bronze Age: 22 sites, Middle Bronze Age: 52 sites, Late Bronze Age: 65 sites);

2. The metalsmiths' burials were usually associated with high prestige in all periods, as indicated by 11 grave finds from 9 sites;[11]

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4 *Ilon 1989* 18, fig. 6; *Ilon 1996* 108; *Jockenhövel 2018* 239, Table 1, Abb. 10. c.
5 *Ilon 1992.*
6 *Primas 2005; Jones 2007; Ciugudean 2010; Popa 2015.*
7 *T. Biró 1995.*
8 *Péterdi 2004.*
9 *Ilon 2003.*
10 *Ilon 2006.*
11 See also *Jockenhövel 2018* especially Abb. 2, Table 1.

3. High-volume, quasi-industrial production of bronze objects can only be hypothesised in the Late Bronze Age Urnfield cultural complex.[12] During the Urnfield period, the settling of specialists working with metal was undoubtedly way more concentrated and, in many cases, centralized than during the preceding centuries, as marked by the great abundance of moulds and other accessories of metalworking in the archaeological record of these places (e.g. Romania: Ciumeşti; Slovakia: Radzovce, Výsný Kubín; Hungary: Gór-Kápolnadomb, Polgár, Celldömölk-Ság-hegy, Várvölgy-Nagyláz-hegy, Velem-Szent Vid; Croatia: Sveti Petar). I attempted to reveal the connection between the centralization of bronzeworking and settlement network in a complex analysis of Urnfield-period sites in Northwest Transdanubia;[13]

4. I presumed (with some caution) a geographical division of tasks related to bronzeworking, meaning that mining could have been a priority in copper ore resource areas, while other territories probably dealt mainly with processing (melting and casting). In other words, the communities of the archaeological cultures concerned probably maintained an active connection network.[14] This chain of hypotheses seemed to have been confirmed by the known distribution of related finds: considerably fewer casting moulds (or none) were registered in copper ore resource areas in the Slovakian and Transylvanian Ore Mountains compared to their peripheral regions and territories poor in, or devoid of ore resources. I considered this theory correct even knowing that the copper ore surface outcrops in the Mátra Hill Range were still known and exploited as late as the 18th century BC.

Materials and new database

Most data in my former database was sourced from publications. To complete that, in 2008, I sent a circular to my Hungarian archaeologist colleagues, while in 2017, another opportunity opened for me due to a Momentum project of the Hungarian Academy of Sciences. As a result, a new, more extensive, and more detailed database was created and, as a concluding act and spectacular addition to this work, a former student of mine, Gyula Isztin, created graphic renderings of the collected data to visualize their distribution on separate survey maps for each period *(figs. 1–3).*

The history of castings is closely bound up since its very beginnings, i.e. the Copper Age, with the storage and distribution structures and patterns of the related societies. Oval ingots appeared in several areas around the turn of the 5th and 4th millennia BC, contemporaneous roughly to the Middle Copper Age in the Carpathian Basin: in Central Europe (e.g. Handlová [Nyitrabánya, SK], Szeged-Szilér) and the territories of Iran, Georgia, Armenia, Jordania and Lower Egypt. Besides, axe-shaped ingots also appeared at that time. Those were cast in clay moulds that perhaps also served as cupels.[15]

Among single-use mould types, clay moulds (e.g. Hidegség-Templom-domb: *Table 1. 8, fig. 4*) had a much better chance of persisting than those in sand. Most mould finds, however, are in stone.[16] The identification of their materials is not unproblematic, though: without scientific material analysis, one cannot be sure whether a piece made seemingly from stone is indeed stone or a special kind of fired-through clayey admixture ('artificial stone') resembling that. As I did not have the chance to examine most finds enrolled in the catalog part *(Tables 1–3)*, the identification of their materials was sourced from related publications.

12 *Ilon 2006* List 3, Abb. 5–6.

13 *Ilon 2007.*

14 See also in more recent summaries of the topic: *Krenn-Leeb 2010; Radovijević et al. 2019* 161.

15 *Czajlik 2012* 67; *Apakidze – Hansen 2020* 49–50, fig. 10.

16 *Nessel 2019* 163–165, Abb. 186.

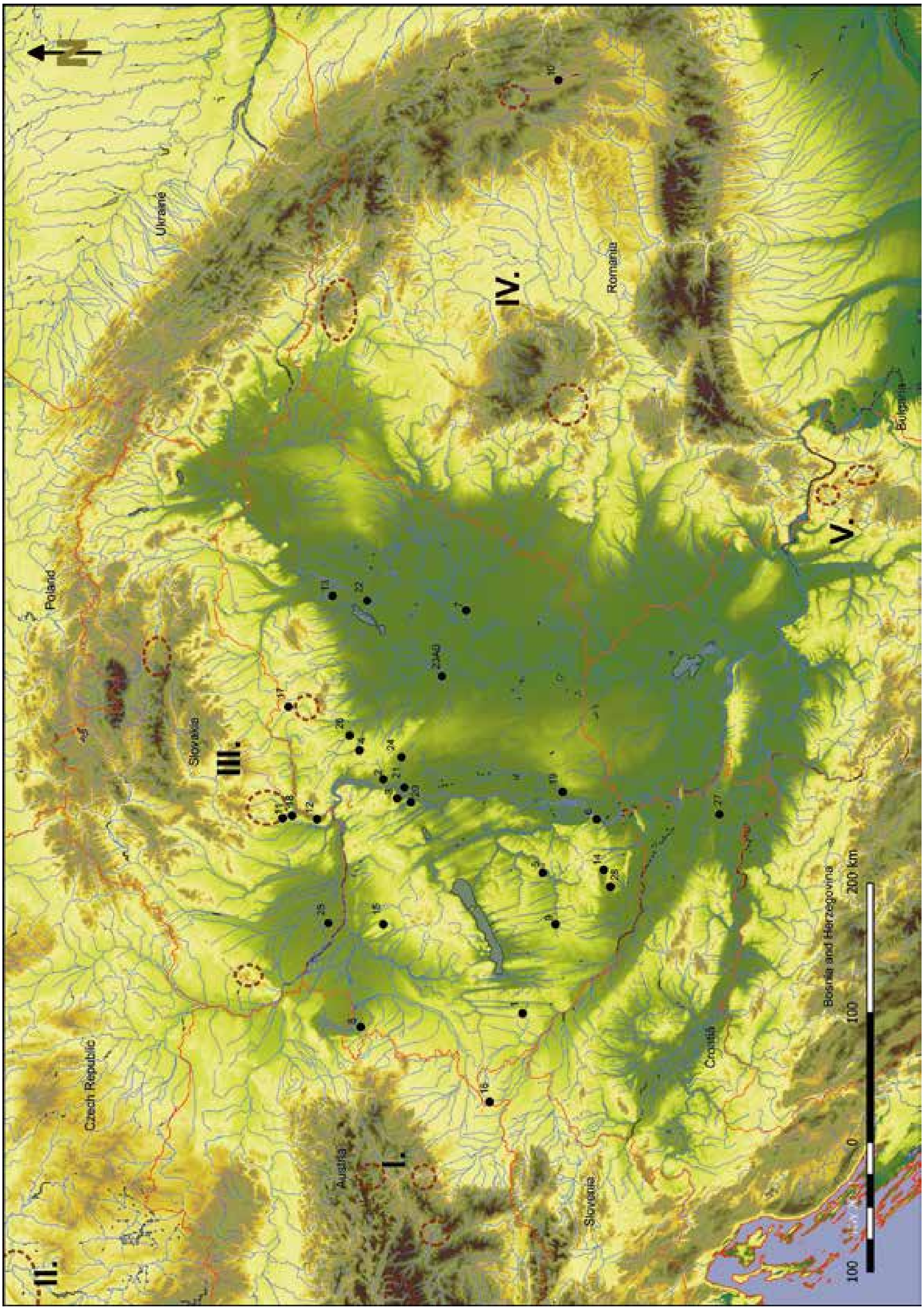

Fig. 1. Sites with casting moulds from the Early Bronze Age of the Carpathian Basin. Distribution map of the sites in *Table 1* (©Gábor Ilon, ©Gyula Isztin)

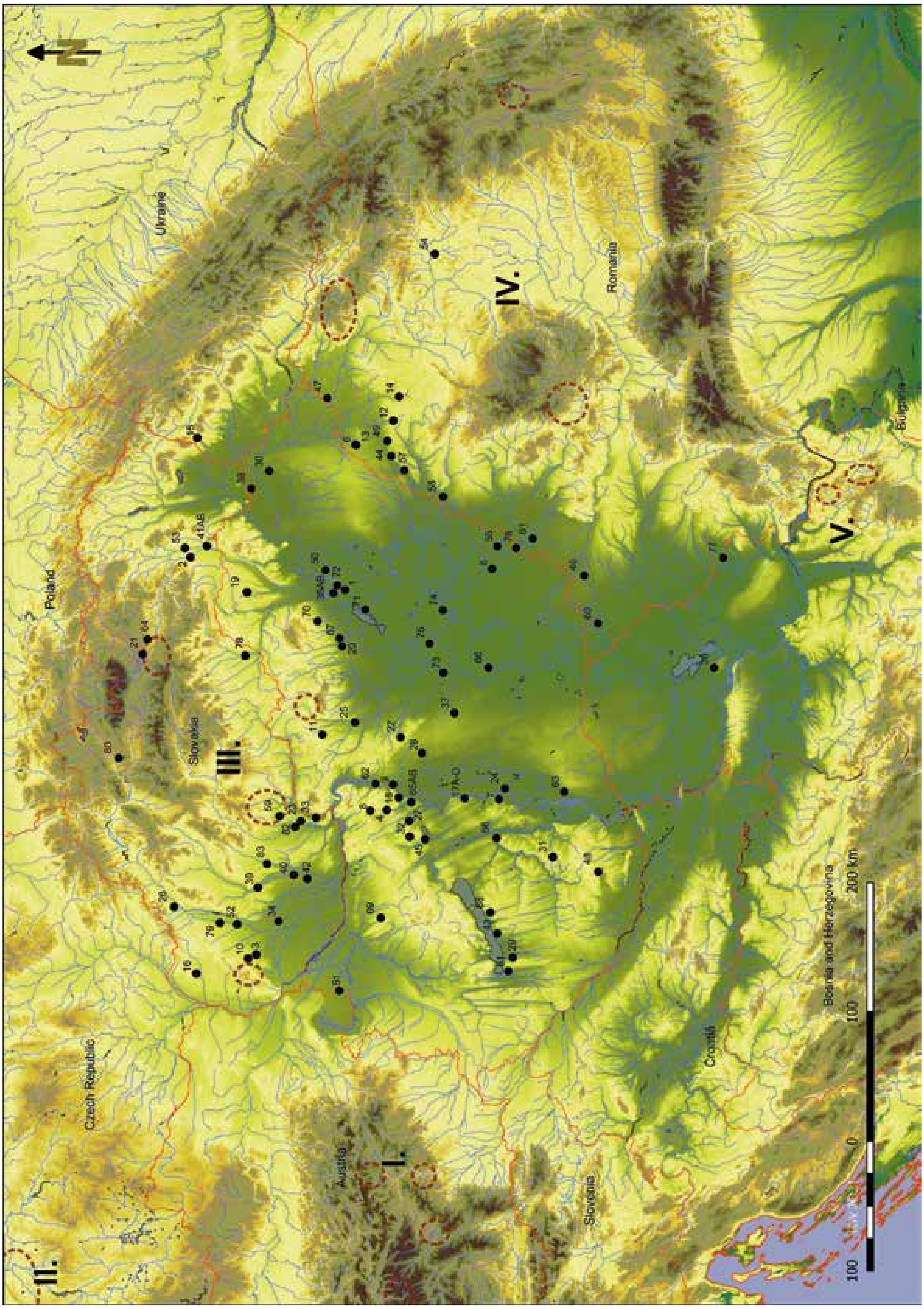

Fig. 2. Sites with casting moulds from the Middle Bronze Age of the Carpathian Basin. Distribution map of the sites in *Table 2* (©Gábor Ilon, ©Gyula Isztin)

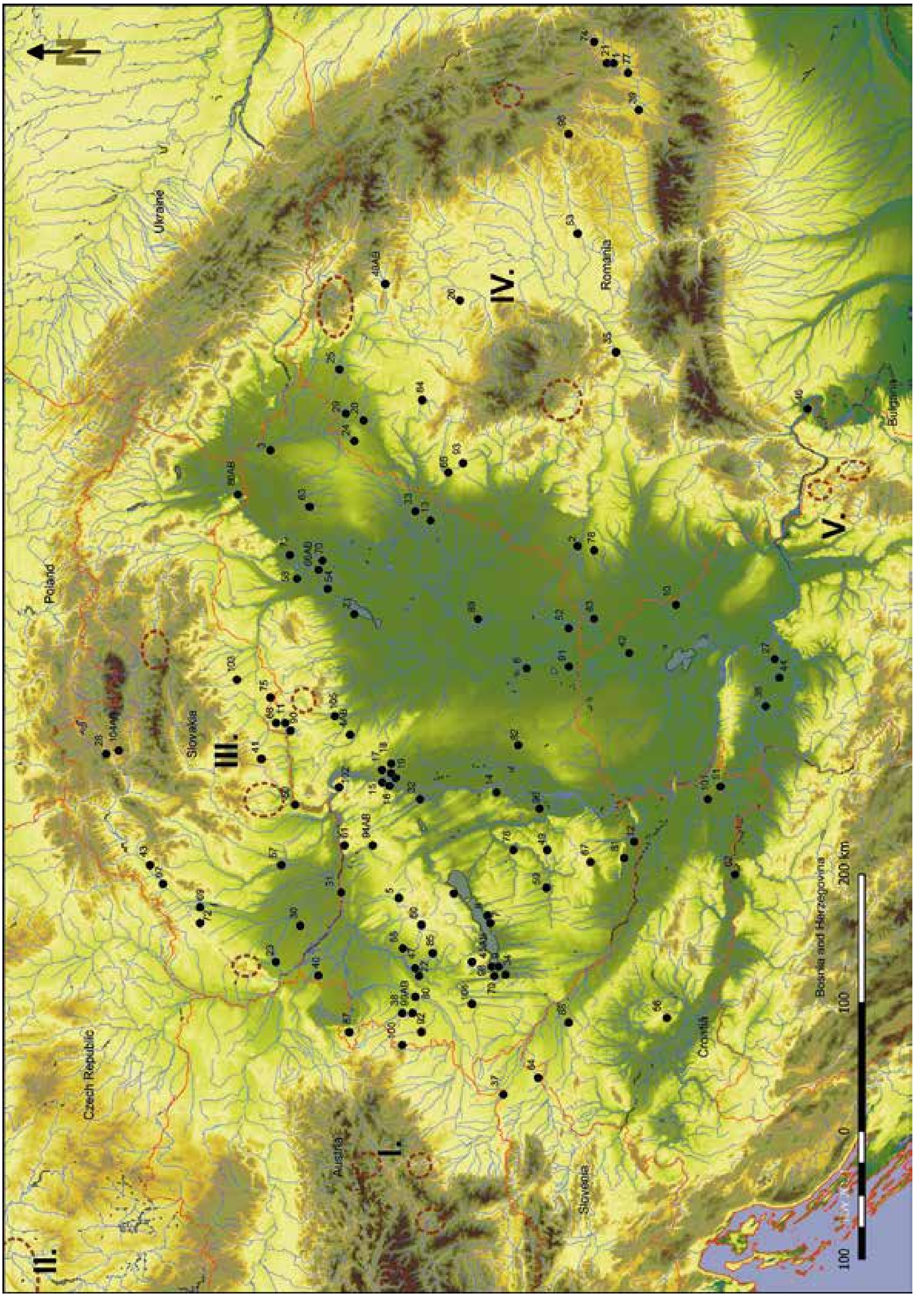

Fig. 3. Sites with casting moulds from the Late Bronze Age of the Carpathian Basin. Distribution map of the sites in *Table 3* (©Gábor Ilon, ©Gyula Isztin)

The results of my collection, according to the current Bronze Age chronology[17] in Hungary, are the following:[18]

Early Bronze Age (Mozsolics BI, absolute dates: 2600–1900 BC)
Casting moulds are registered from altogether 28 sites: 23 of these were found in settlement context, in four cases there was probably a workshop in the settlement, i.e. more than three moulds were discovered in a closed context (H: No. 19. Sükösd-Szúnyogosi- dűlő, No. 20. Százhalombatta-Földvár, No. 24. Üllő-Site No. 5, No. 28. Zók-Várhegy) *(Table 1, fig. 1)*. The quantity and spatial distribution of the sites only allow one for drawing perhaps some consequences regarding the processed copper ores in the Slovakian Ore Mountains.[19]

One mould was found in a grave (H: Hidegség-Templom-domb *[Table 1. 8, fig. 4]*) in four cases, the precise find context is unknown. With these, we can count six new sites compared to those published in 2006.

Middle Bronze Age (Mozsolics BII to BIIIb/BIV, 1900–1650/1500 BC)
Casting moulds are registered from altogether 83 sites: 69 were found in settlement context, while two in depots inside settlements (SK: No. 83. Želiezovce, 3 pcs.) *(Table 2, fig 2)*. In 31 cases there was probably a workshop in the settlement, SK: No. 2. Barca (Košice), No. 3. Báhoň, No. 10. Budmerice, No. 40. Nitriansky Hrádok-Zámeček, No. 41B. Nižná Myšľa-Várhegy, No. 59. Santovka (Malinovec)-Nad Búrom, No. 79. Veselé-Hradisko, No. 83. Želizovce; RO: No. 6. Berea-Zsidó-tag, No. 12. Cehălut-Kismező, No. 44. Otomani-Cetatea de pământ, No. 46. Pecica-Nagysánc, No. 58. Sântion-Dealul Mănăstirii; H: No. 1. Ároktő-Dongó-halom, No. 7. Bölcske-Vörösgyír, No. 17B. Dunaújváros-Kosziderpadlás, No. 19. Felsővadász-Várdomb, No. 20. Füzesabony-Öregdomb, No. 25. Hatvan-Strázsa-hegy, No. 28. Kakucs-Balladomb, No. 32. Lovasberény-Mihályvár, No. 37. Nagykőrös-Földvár, No. 38. Nagyrozvágy-Pap-domb, No. 65A–B. Százhalombatta-Földvár and Téglagyár, No. 67. Szihalom-Árpádvár, No. 71. Tiszafüred-Ásotthalom, No. 72. Tiszakeszi, No. 73. Tószeg-Laposhalom; SRB: No. 36. Mošorin-Feudvar *(Table 2, fig. 2)*. One casting mould was found in the Danube by Dunaújváros in the 19th century; it may got there as a result of erosion of layers of a Bronze Age settlement by the river bank.

Based on geographical vicinity, the communities of No. 1. Ároktő-Dongó-halom, No. 71. Tiszafüred-Ásotthalom, and No. 73. Tószeg-Laposhalom *(Table 2, fig. 2)* utilised the copper obtained from the Recsk-Lahócza mine area in the Mátra Mountain Range.[20]

The bronze production of several sites in today's Slovakia and Hungary, SK: No. 2. Barca (Košice), No. 3. Báhoň, No. 10. Budmerice, No. 40. Nitriansky Hrádok-Zámeček, No. 41A–B. Nižná Myšľa-Várhegy, No. 79. Veselé-Hradisko, No. 83. Želizovce; H: No. 17B. Dunaújváros-Kosziderpadlás, No. 38. Nagyrozvágy-Pap-domb, No. 65A–B. Százhalombatta-Földvár and Téglagyár *(Table 2, fig. 2),* was probably based on the mines of the Slovakian Ore Mountain Range.[21]

Sites in Romania today (RO: No. 6. Berea-Zsidó-tag, No. 12. Cehălut-Kismező, No. 44. Otomani-Cetatea de pământ, No. 46. Pecica-Nagysánc, No. 58. Sântion-Dealul Mănăstirii) *(Table 2, fig. 2)* probably relied on copper ore resources identified as region IV.[22]

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[17] As defined by *Bóna 1975* 23–26; *Mozsolics 1984* Table 1; *Kiss et al. 2015* figs. 3, 5, 11–12; *Ilon 2015b* Taf. 20–22; *Szabó 2017; Ilon 2019* Abb. 3–4.

[18] In the following section, the countries are abbreviated, Croatia: HR, Hungary: H, Romania: RO, Serbia: SRB, Slovakia: SK, Slovenia: SLO, Ukraine: UA.

[19] *Czajlik 2012* fig. 2, region III.

[20] *Czajlik 2012* fig. 2, Hungarian part of region III.

[21] *Czajlik 2012* fig. 2, Slovakian part of region III; *Garner – Stöllner 2021.*

[22] *Czajlik 2012* fig. 2, region IV.

The workshops of SRB: No. 36. Mošorin-Feudvar and H: No. 7. Bölcske-Vörösgyír *(Table 2, fig. 2)* perhaps used ore from Rudna Glava.[23]

Seven specimens were discovered in graves within the boundaries of six sites (H: No. 9. Budapest, XXI-Csepel-sziget, No. 17A. Dunaújváros-Dunadűlő, No. 51. Pusztasomorja/Jánossomorja-Tímárdomb; SK: No. 34. Matúškovo, in a symbolic burial, No. 41A. Nižná Myšľa, in two burials, No. 80. Vyšný Kubín) *(Table 2, fig. 2).* The precise find context is unknown in nine cases. That means 31 more sites compared to 2006.

Late Bronze Age (end of Mozsolics BIIIb to BIV, BB1 to Ha B2/3, Tumulus and Urnfield cultures, 1650/1500–800/750 BC)

Casting moulds are registered from altogether 106 sites. The finds were discovered in settlement context in 77 cases, of which 22 indicate the presence of a workshop *(Table 3, fig. 3).* Based on the concentration patterns of moulds (four or more moulds per site), workshops with supralocal significance, producing for smaller or larger areas, were defined.

These are, connected with copper ore mines[24] in the Eastern Alpine region (H: No. 22. Celldömölk-Ság-hegy, No. 98. Várvölgy-Nagyláz-hegy, No. 100. Velem-Szent Vid; SLO: No. 37. Gornja Radgona), in the Slovakian Ore Mountains (H: No. 3. Aranyosapáti-Temető, No. 102. Visegrád-Diós; SLO: No. 69. Pobedim, No. 75. Radzovce, No. 104A. Vyšný Kubín) and with the Recsk-Lahócza mine at Mátra Hill (H: No. 66A–B. Oszlár-Nyárfaszög) *(Table 3, fig. 3).*

The topographical position of the settlement at H: No. 68. Piliny-Borsoshegy *(Table 3, fig 3)* perhaps allowed it to access either or both copper resources in the Slovakian Ore Mountain Range and at Recsk.

Transylvanian copper resources could have been utilised by metalsmiths in present-day R: No. 24. Ciumesti, No. 39. Hălchiu (Brasso), No. 48A–C. Lăpuş, No. 78. Şagu, No. 95. Teleac, and in H: No. 52. Makó-Innenső Jángor 3, No. 91. Szeged-Szőreg C-Szív utca *(Table 3, fig. 3).*

The bronze production in the territory of H: No. 14. Bölcske-Sziget, No. 67. Pécs-Makártető, No. 82. Soltvadkert-Büdöstó, and HR: No. 88. Sveti Petar-Ludbreški *(Table 3, fig 3)* was probably based on copper obtained from mines at Rudna Glava.

Casting moulds were found in settlement depots in nine sites: H: No. 3. Aranyosapáti-Temető, No. 12. Beremend, No. 82. Soltvadkert-Büdöstó, No. 91. Szeged-Szőreg-Szív utca, a pit in cemetery C; RO: No. 24. Ciumeşti, No. 29. Domaneşti; No. 39. Hălchiu (Brasso), No. 95. Teleac; HR: No. 88. Sveti Petar Ludbreški *(Table 3, fig 3).* One mould was discovered in a cave (RO: No. 35. Geoagiu-Kőalja hegy) *(Table 3, fig. 3),* while from four sites mould were found in graves (SK: No. 43. Ilava, No. 104A. Vyšný Kubín; RO: No. 48A–C. Lăpuş, Tumulus No. 11, 13, 16; H: No. 60. Németbánya-Felsőerdei dűlő) *(Table 3, fig. 3).* Furthermore, unpublished moulds are presented in this study from Western Transdanubia (H: No. 31. Danube's bed [Almásneszmély–Győr], No. 79. Sármellék-Száraz-eleje, No. 100. Velem-Szent Vid) *(Table 3, fig. 3, fig. 5).* In 23 cases, the precise find context is unknown. That means 41 sites more compared to 2006.

Results

The distribution of the sites on the survey maps *(figs. 1–3)* suggests that almost all copper ore resource areas[25] were already known since the beginning of the Bronze Age. Metal industry of the Tumulus and Urnfield cultures in Western Transdanubia probably relied on mines in the

[23] *Czajlik 2012* fig. 2, region V.
[24] *Czajlik 2012.*
[25] *Krause 2003* Abb. 7, 11, 15; *Czajlik 2012* fig. 2; *Pernicka – Lutz – Stöllner 2016* fig. 14; *Radivojević et al. 2019* fig. 1.

Eisenerz Alps in Styria and at Trieben in Upper Styria and especially on mines and settlements specialised in pre-processing of ores in Lower Austria (Prigglitz-Gasteil, Rax-Goggnitz). While the mentioned Styrian mines were active around ca. 1200–900 BC, the Lower Austrian ones emerged only around 1500–600 BC when the large early mines (e.g. Mitterberg, used from the 19/18–17th centuries) gradually became exhausted and abandoned.[26] During the Bronze Age, water transport was important in supplying the workshops with copper ore. In the case of Middle Bronze Age Western Transdanubia, the Rába and Zala rivers, both originating in the Eastern Alps, must have played a crucial role in transportation. The third main body of water was the Danube, in the case of which one must assume upstream transportation of copper from the Rudna Glava area. It must be taken into account, however, that the rivers were probably significantly slower at the time as their beds were unregulated and their floodplains much more extended. The transportation of raw materials from the Slovakian Ore Mountain Range[27] *(fig. 3)* to the territory of Northeast Transdanubia and the broader area of Budapest must certainly have been realised using the Danube and its subsidiaries (Garam and Ipoly). The almost complete lack of moulds in Northwest Transdanubia during the Middle Bronze Age is conspicuous (the two known examples are No. 51. Pusztasomorja-Jánossomorja-Tímárdomb and No. 69. Tarjánpuszta-Vasasföld II *[Table 2, fig. 2]*), even though the mines near Mitterberg and in Slovakia were active during this period.[28] Currently, there is no satisfying explanation for the lack of casting moulds in the inner territories of Transylvania; one rather suspects methodological issues in the background, like selective access to publications or significant quantities of unpublished finds.

A statistical comparison of the data sets published in 2006 and the present paper clearly shows a significant increase in Middle Bronze Age data points (due primarily to Tünde Horváth's, Alexandra Găvan's and Bianka Nessel's studies).[29] A concentration of metal production points (31 workshops) as early as the Middle Bronze Age also seems unquestionable. The loci of centralization seem to have changed to new places during the Late Bronze Age, while the production profile also shifted towards larger series as marked by both the increased number of casting moulds per centre as well as by the higher total amount of such finds.

In the case of settlements, a feature was only interpreted as 'workshop' when it contained more than one casting mould and, perhaps, also other relics and accessories of metalworking (bronze slag, ingots, tuyeres) referring to local production. It must also be noted that 1. every casting mould found on a settlement is interpreted as a relic of metalworking; 2. where other relics and accessories of metalworking were found together with the moulds one might speak about local production; and 3. casting moulds in depots unanimously refer to nearby workshops, i.e. to production of metal objects in large series. Features are interpreted as 'central workshop' which may have been producing for more than a single settlement if more than three casting moulds and preferably other relics, by-products, and accessories of metalworking are known from the related find material.

The current possibilities of interpretation allow one to drawing a much more refined picture than before. During the Bronze Age, or at least in its late phase, metalworking and ~production must have been concentrated in hill areas, plainlands (not necessarily near to an exploited resource area), and highlands *(fig. 3).* Earlier, during the Middle Bronze Age the active mines in the Slovakian Ore Mountain Range (Czajlik's region III, including the Mátra Hill Range) and the suspected processing

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26 *Czajlik 1993* 341; *Czajlik – Molnár – Solymos 1999* 43; *Czajlik 2012* 20, 41, 43, fig. 2; *Kiss 2009* fig. 3; *Stöllner 2005* Abb. 1; *Stöllner 2015* Abb. 1, Abb. 9; *Trebsche – Pucher 2013* 118–199, Abb. 3; *Falkenstein 2017* 9.

27 *Czajlik 2012* fig. 2, region III; *Stöllner 2021* 3–6, Abb. 1.

28 *Pernicka – Nessel – Mehofer 2016* 23–25, figs. 4–5; *Radivojević et al. 2019* 161–162, fig. 1.

29 *Horváth 2004; Găvan 2015; Nessel 2019.*

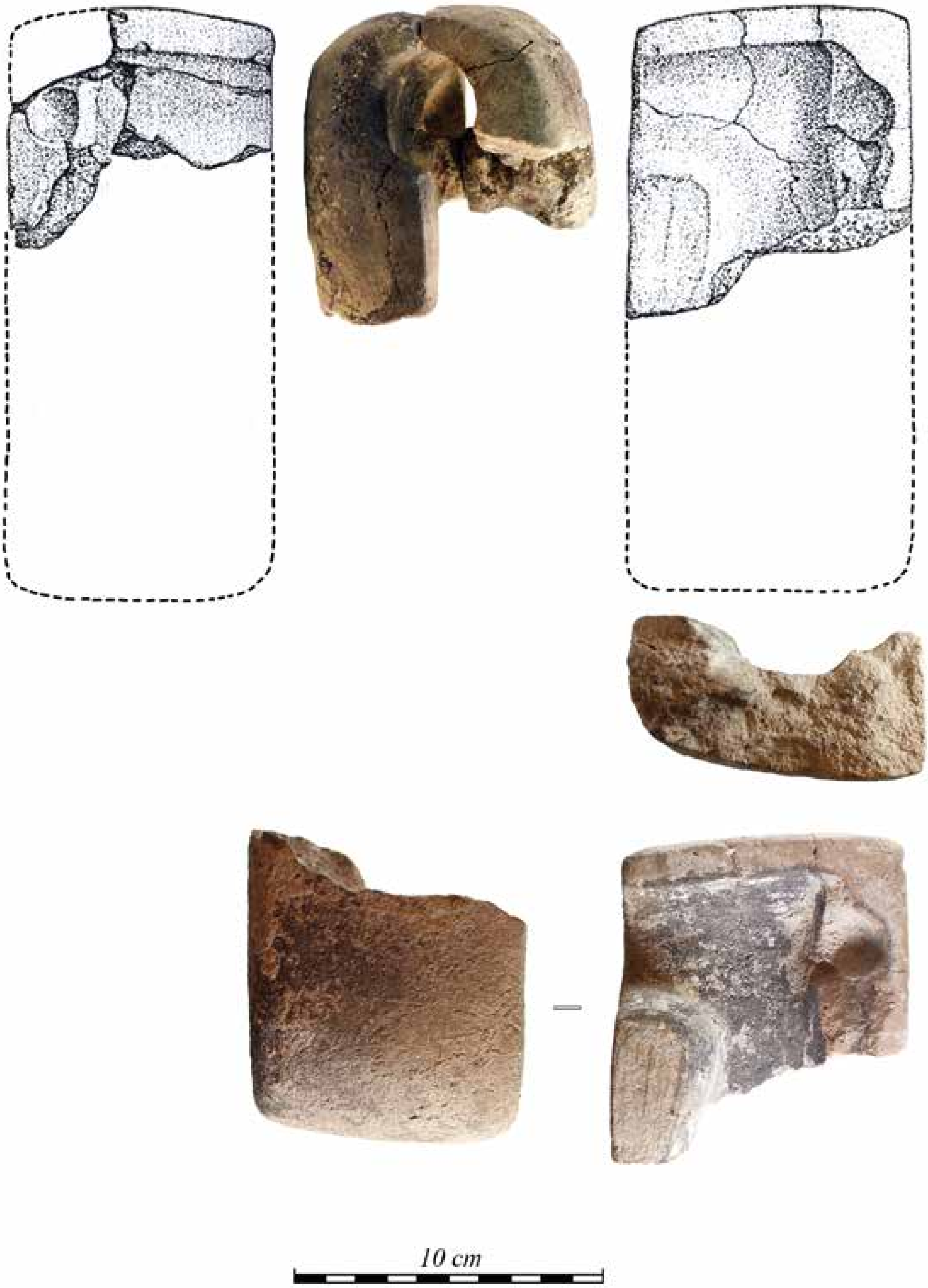

Fig. 4. Casting mould of an axe. Hidegség-Templom-domb

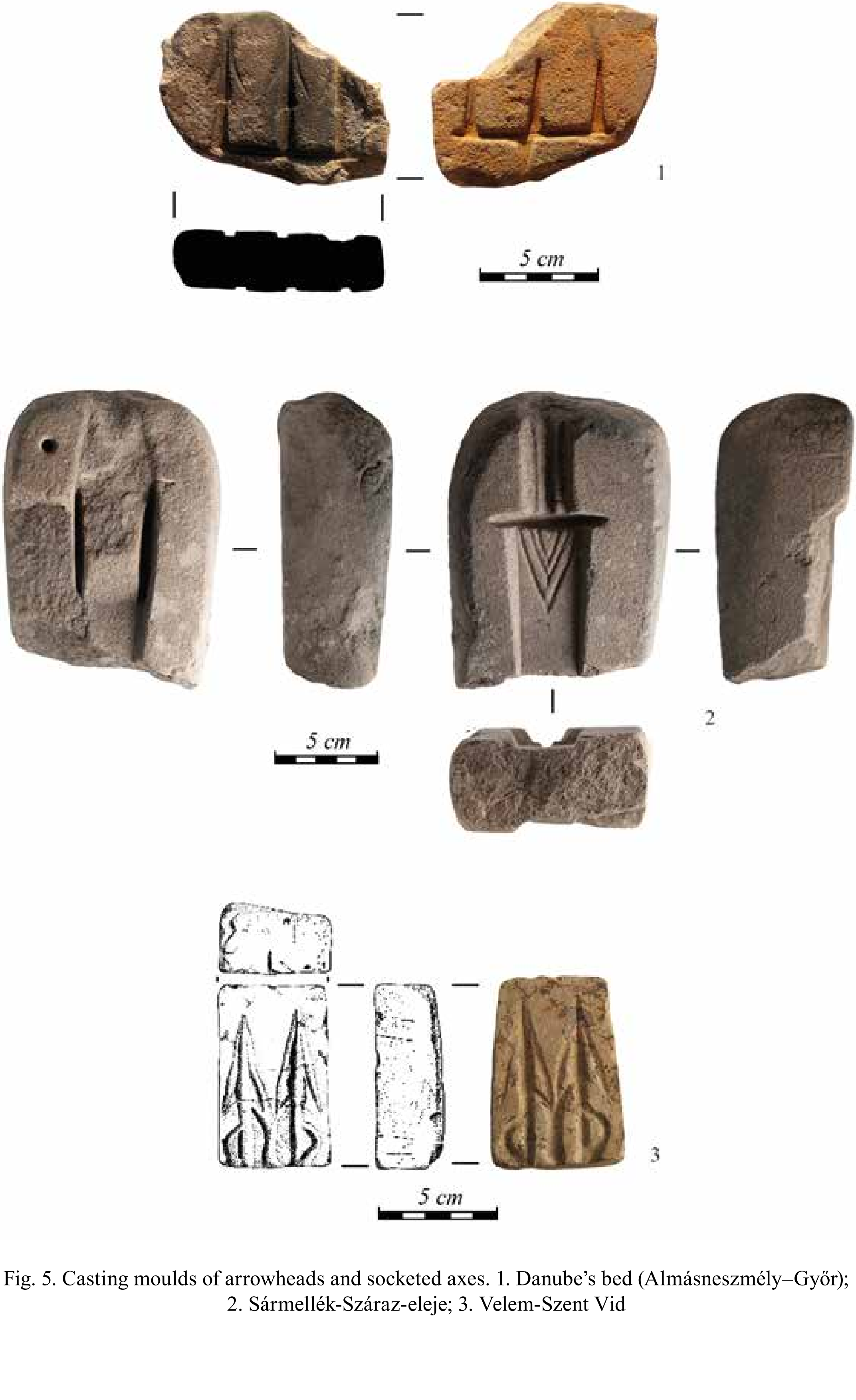

Fig. 5. Casting moulds of arrowheads and socketed axes. 1. Danube's bed (Almásneszmély–Győr); 2. Sármellék-Száraz-eleje; 3. Velem-Szent Vid

sites containing casting moulds were much closer. As for the Early Bronze Age, the scarcity and scattering of related sites deprived one of the possibilities to draw valuable conclusions.

New questions and tasks

The current state of research delineates future tasks. Further scientific research would be best aided by a public database containing all published casting moulds, with descriptions and pictures for the finds, made freely accessible for interested researchers. Creating such a database could be the goal of a joint international research project, under which every side of every casting mould becomes photographed and measured, and as many objects as possible undergo a petrographic analysis.[30] This analysis could enable a distinction between clay and 'artificial stone' moulds and also include a raw material resource location for stone moulds which might give away further information on connections between, and work distribution patterns inside cultural units. In the following phase, this database would be worth completing with related finds dated to the Copper[31] and Iron Ages, as well as making it public. Also, a composition analysis project should be conducted, characterising the copper ores of various mines and describing the by-products (slags and ingots) of bronze production.

An evaluation system comprising unambiguous criteria should be developed to distinguish between higher-level central workshops (characterised by almost 'industrial' production) and lesser ones engaged primarily in repair and domestic production, serving only a household or a single settlement at best.

One of the most urgent tasks is a complex petrographic analysis of large series of casting moulds (preferably all) according to an elaborate protocol, realised preferably in international cooperation. Research has no fair chance to leap forward without exploiting these pieces of information from the currently available finds.[32]

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30 *Koós 2016.*

31 *Bondár 2019.*

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No.	Current name	Former name	Lands/ parcel	Country, county, district	Site/find context	Object to cast	Material of the casting mould	State of the casting mould	Dating (period/culture)	Other metal-working finds	Literature	Notes
1.	**Börzönce**		Temetői dűlő	H, Zala	settlement	pin	clay	fragmented	Somogyvár–Vinkovci culture		*Bondár 1995* 214–216, Taf. 181. 432; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
2.	**Budapest, I.**		Várhegy, Szt. György tér, Sándor palota	H	settlement, sacrificial pit	spearhead	sandstone	fragmented	Nagyrév culture		*Hanny 1997.*	
3.	**Diósd**		Szidónia/ Szádvári-hegy	H, Pest	settlement pit	axe, pendant	sandstone	intact (?)	Nagyrév culture		*Patay 1965* Abb. 5, *Bóna 1992* 49; *Péterdi 2004* 508, 515, Table VIII. 1, VIII. 4; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
4.	**Domony**			H, Pest	unknown	shaft-hole axe	unknown		Makó–Kosihý–Čaka culture		*Kalicz 1968* Taf. X. 1, *Bóna 1992* 49; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
5.	**Döbrököz**		Tűzköves	H, Tolna	fortified settlement, stray find from fieldwalking	shaft-tube axe	unknown	fragmented	Somogyvár–Vinkovci culture		*Miklós 2002* 197; *Kulcsár 2009* Cat. no. 49; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
6.	**Dunaszekcső**		Várhegy	H, Baranya	unknown	axe	unknown		Vučedol culture		*Ecsedy 1990* 227–228, fig. 9; *Bóna 1992* 49; *Ecsedy 1995* 33; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
7.	**Endrőd**		Paraj-hegy dűlő	H, Békés	settlement	axe	sandstone	fragmented	Makó–Kosihý–Čaka culture		*MRT 8* 147–148.	Unclear drawing.
8.	**Hidegség**		Templom-domb	H, Győr-Moson-Sopron	settlement	two-piece mould of a Kozarac-type axe	clay	intact (?)	Somogyvár–Vinkovci culture		*Gömöri 1992* 14; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
9.	**Kaposújlak**		Várdomb-dűlő	H, Somogy	settlement, features 144, 191 and 702.	3 axes with a Kozarac-type among them	clay	fragmented	Somogyvár–Vinkovci culture		*Somogyi 2004* 167, Abb. 14–16; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
10.	**Leliceni**	Csíkszentlélek		RO, jud. Harghita	settlement	two-piece mould of a shaft hole axe	unknown	fragmented	Jigodin culture		*Roman – Dodd-Oprițescu – János 1992* Taf. 78. 1a, 2a; *Dénes – V. Szabó 1998* 95–97, Abb. 7; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
11.	**Santovka (Malinovec)**	Magyarád/ Hévmagyarád	Santovka (Malinovec)	SK, okr. Levice	fortified settlement	Tószeg-type axe	tuffite	fragmented	Early Hatvan culture		*Bátora 2009* 199.	
12.	**Malé Kosihy**	Ipolykiskeszi	Törökdomb	SK, okr. Nové Zámky	fortified settlement		unknown		Hatvan culture	tuyeres (2 pcs.)	*Bátora 2009* 201, fig.7.	
13.	**Mezőcsát**		Pástidomb	H, Borsod-Abaúj-Zemplén	settlement	dagger	unknown		Hatvan culture		*Bóna 1992* 50; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
14.	**Nagyárpád (Pécs)**		Dióstető	H, Baranya	settlement pit	shaft-hole axe	unknown		Somogyvár–Vinkovci culture		*Ecsedy 1982* 79, 83, 90, Abb. 45, Taf. 9. 5; *Bóna 1992* 49; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
15.	**Ravazd**		Villibald domb	H, Győr-Moson-Sopron	settlement pit	Kozarac-type shaft-hole axe	unknown		Somogyvár–Vinkovci culture		*Bóna 1992* 49; Ecsedy 1995 35; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	

16.	**Rogašovci**	Szarvaslak		SLO, Prekmurje	unknown	daggers	unknown		Vučedol culture		*Ecsedy 1995* 35; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
17.	**Salgótarján**		Pécskő	H, Nógrád	unknown	shaft-hole axe	unknown		Makó–Kosihý–Čaka culture		*Korek 1968* 19; *Bóna 1992* 49; *Kovács 1996* 116, Abb 1; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
18.	**Sazdice**	Százd		SK, okr. Levice	fortified settlement	pin	clay	fragmented	Hatvan culture		*Bátora 2009* 201.	
19.	**Sükösd**		Szúnyogosi-dűlő	H, Bács-Kiskun	settlement, pit 32	Approx. 20 moulds. Two-piece mould of a Kozarac type shaft-loch axe (1 intact, 1 half missing, fragments), flat axe	clay	partially reassembled, fragmented	Early Nagyrév culture		Poster at the ΜΩΜΟΣ conference at Százhalombatta in 2017; *Somogyvári 2020* 443–444, fig. 4.	From the M9 motorway excavations in 2009–2010. From Á. Somogyvári.
20.	**Százhalombatta**		Földvár	H, Pest	tell settlement, a workshop in layer Vb	moulds	unknown	fragmented	Nagyrév culture		*Poroszlai 1993* 14; *Poroszlai 2000a* 103, 105; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
21.	**Sziget-szentmiklós**		Üdülősor	H, Pest	settlement	shaft-hole axe(?)	sandstone	fragmented	Bell Beaker culture		*Endrődi 1992* 96, Abb. 77. 7; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
22.	**Tiszafüred**		Ásotthalom	H, Jász-Nagykun-Szolnok	tell settlement	axe	unknown	fragmented	Hatvan culture		*Bóna 1975* 156, Taf. 196. 8, *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
23.	**Tószeg A**		Laposhalom	H, Jász-Nagykun-Szolnok	settlement	adze and rod	clay	no data	Nagyrév culture		*Bóna 1992* 50; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
23.	**Tószeg B**		Laposhalom	H, Jász-Nagykun-Szolnok	settlement, level IX.	shaft-hole axe, two pice mould of a battleaxe (1909/e and 1927/XII.)	stone	fragmented	Hatvan culture		*Márton 1931* Abb. 13–14; *Mozsolics 1952;* *Mozsolics 1967* Abb. 2; *Kalicz 1968* Taf. 101. 1a–b; *Bóna 1992* 48, 50, Abb. 20; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
24.	**Üllő**		Site No. 5	H, Pest	settlement, feature 5605.	two-piece mould of a sockedet adze, Kozarac-type shaft-hole axe, etc.	unknown	intact	Makó–Kosihý–Čaka culture		*Horváth 2004* 27; *Kővári – Patay 2005* 113–123, *Ilon 2006* 276–277, Liste 1. Abb. 1–2.	
25.	**Veľký Meder**	Nagymegyer		SK, okr. Dunajska Streda	settlement	Kozarac-type shaft-hole axe	clay	fragmented	Makó–Kosihý–Čaka culture		*Bátora 2003* 22, Abb. 17. 7; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	
26.	**Verseg**		Makkos	H, Pest	settlement, 1984. section I, level 2, -20/23-40/43 cm	two-piece moulds for pins	sandstone	intact	Hatvan culture		Description from the cardboard register.	By K. Kővári. Petőfi Sándor Museum (Aszód) Inv. no. 93.1.a.b
27.	**Vinkovci/ Vinkovce**		Tržnica	HR, Vukovarsko	settlement	6 Kozarac-type shaft-hole axes, rod	unknown	intact	Classical Vučedol culture		*Bátora 2003* 16.	
28.	**Zók**		Várhegy	H, Baranya	settlement, pit 1977/36	flat axes, arrowhead or miniature socketed adze, Fajsz and Kozarac-type axes	clay	may be reconstructed, fragmented	Vučedol culture		*Bóna 1992* 49; *Ecsedy 1982;* *Ecsedy 1990* 227, fig. 8. 1–3; *Ecsedy 1995* Abb. 16; *Ilon 2006* 276–277, Liste 1, Abb. 1–2.	

Table 1. Early Bronze Age casting moulds of the Carpathian Basin (Croatia: HR; Hungary: H; Romania: RO; Slovakia: SK; Slovenia: SLO)

No.	Current name	Former name	Lands/ parcel	Country, county, district	Site/find context	Object to cast	Material of the casting mould	State of the casting mould	Dating (period/culture)	Other metal-working finds	Literature	Notes
1.	**Ároktő**		Dongó-halom	H, Borsod-Abaúj-Zemplén	tell settlement	pin or rod, tutulus, shaft-tube axe, two heart-shaped pendants (unfinished)	sandstone (?)	parts missing	Classical and Late Füzesabony/ Otomani culture		*Kalicz 1968* Taf. LXX. 9–10; *P. Fischl 2006* 137. The axe and the pendants are unpublished.	Excavation of T. Kemenczei in 1966.
2.	**Barca (Košice)**	Bárca		SK, Košice	fortified settlement	B type ringbutt axe(?), armspiral, pin, lunula, disc	sandstone (?)	parts missing	Füzesabony/ Otomani culture		*Furmánek 1980a* Taf. 6. 116; *Novotná 1980* 184, Taf. 53. 1506–1508; *Bóna 1992* 62; *Găvan 2015* 197–198, Pl. 24. 1–7.	
3.	**Báhoň**	Báhony		SK, Pezinok district	settlement	daggers, tweezers, two palstave axes	sandstone (?)	fragmented	Late Maďarovce culture		*Bartík 1999* 187, Abb. 3.	
4.	**Bia (Biatorbágy)**		Öreghegy	H, Pest	settlement	adze(?)	sandstone	fragmented	Late Vatya culture		*Horváth 2004* 17, Abb. 5. 1.	
5.	**Békés**		Várdomb	H, Békés	tell settlement	pins	stone	fragmented	Gyulavarsánd/ Otomani culture		*Banner – Bóna 1974* 64–65, Taf. 28. 10.	
6.	**Berea**	Bere	Zsidó-tag	RO, kr. Satu Mare	settlement	3 Hajdúsámson type battle-axes, two adzes	stone	intact, parts missing	Ottomani I.		*Bader 1978* 120, LXIII. 4–6, 10–11; *Soroceanu 2012* 22, Taf. 7–8; *Molnár 2014* Pl. 167. 5, 7, Pl. 169. 3–4, 8.	From the collection of I. Kovács.
7.	**Bölcske**		Vörösgyír	H, Tolna	tell, workshop	pin (?), ring, flat adze	sandstone	fragmented	Vatya I–III.	tuyere fragment, anvil, combined anvil and workbench	*Bóna 1975* 272; *Horváth – Kozák – Pető 2000a* 198, Taf. 5. 5, 7; *Horváth 2004* Abb. 5. 2–3.	
8.	**Budajenő**		Hegyi-szántók	H, Pest	fortified settlement, pits 689 and 696	several objects, e.g. spearhead	sandstone	no data	Vatya III– Koszider period	slag	*Repiszky 2004a,* *Repiszky 2004b;* *Szabó 2018 76;* *Szabó in print.*	I only have a photo of one of the moulds as a courtesy of N. Szabó.
9.	**Budapest, XXI.**		Csepel-sziget	H	urn grave in cemetery	flat axe, pin, dagger(?)	sandstone (?)	fragmented	Vatya II.		*Nagy 1973* 60, Abb. 13; *Bóna 1975* 272; *Bóna 1992* 52; *Horváth 2004* 41–42, Abb. 17. 6.	
10.	**Budmerice**	Gidrafa		SK, okr. Pezinok	fortified settlement	rod or ingot, three pins, axe	unknown	intact (rod), fragmented	Maďarovce culture	tuyeres (3 pcs.), slag	*Vavák et al. 2015* figs. 1–2.	
11.	**Buják**		Tarisznya-part	H, Nógrád	settlement	bet buckle(?), sickle	sandstone (?)	no data	Hatvan culture, Koszider period		*Tárnoki 2010* 55–56, Taf. 5. 1–2.	
12.	**Cehăluţ**	Magyar-csaholy	Kismező	RO, kr. Satu Mare	settlement	C type shaft hole axe, 3 pcs	sandstone (?)	intact	Gyulavarsand/ Otomani culture, Hajdúsámson horizon		*Bóna 1992* 52; *Soroceanu 2012* 27, Taf. 9–10; *Molnár 2014* Pl. 169. 5–7.	
13.	**Ciumesti**	Csomaköz		RO, kr. Satu Mare	settlement	pin	unknown	intact	Gyulavarsánd/ Otomani		*Molnár 2014* Pl. 171. 8.	
14.	**Derşida**	Kisderzsida	Dealul lui Balotă	RO, jud. Sălaj	tell	adze, flat rhomboid object	sandstone	intact (adze), unknown	Wietenberg II.	tuyere, ingot	*Găvan 2013* 148, 156, 161; *Găvan 2015* 188–189, Pl. 4. 3–5.	
15.	**Djakove**	Nevetlenfalu	Kiserdő - Mondicstag	UA, Zakarpatska oblast	settlement	unknown pin (?), armring	stone	fragmented	Early Felsőszőcs/ Suciu de Sus/ Stanovo culture		*Balaguri 1974* 44, fig. 9. 20, 23, 24; *Balaguri 2001* 263, fig. 70a. 20, 23, 24.	
16.	**Dojč**	Dócs		SK, okr. Senica	settlement (?) stray find, gift	belt buckle	sandstone	intact	Maďarovce		*Bača – Bartík 2012.*	
17A.	**Dunaújváros A**		Dunadűlő	H, Fejér	grave 1029/960	two-piece cast of a lunula	redsandstone	intact	Vatya I (II.?) – B A2		*Mozsolics 1967* 137, Taf 19. 2; *Bóna 1975* 55, Taf. 46. 9; *Mozsolics 1984* 54; *Bóna 1992* 52; *Horváth 2004* 41, Abb. 8. 2; *Jockenhövel 2018* 233; *Jankovits 2017* Taf. 45. 1492.	

17B.	**Dunaújváros B**		Koszider-padlás	H, Fejér	settlement	socketed adze, disc pendant, Koszider type pendant, pin, dagger, unknown	mica, striped sandstone	intact (socketed adze), fragmented	Vatya II–III. and Koszider period		*Horváth 2004* 20, 33; *Gǎvan 2015* 189. Pl. 5. 6, 6. 1–2, 4; *Jankovits 2017* 1940.	
17C.	**Dunaújváros C**		Duna/ Danube	H, Fejér	riverbed	Křtenov type axe-adze	mica	fragmented	Vatya culture		*Horváth 2004* 17, 20, fig. 6. 1–2; *Gǎvan 2015* 189. Pl. 6. 3.	
17D.	**Dunaújváros D**		Rácdomb	H, Fejér	settlement (?)	flat axe	sandstone	intact, fragmented	Middle Bronze Age		Unpublished.	Excavation of J. B. Horváth in 1993; the description and a photograph are a courtesy of T. Keszi.
18.	**Érdliget (Érd)**			H, Pest	unknown	dagger	sandstone	fragmented	Vatya II–III.		*Horváth 2004* 20.	
19.	**Felsővadász**		Várdomb	H, Borsod-Abaúj-Zemplén	settlement	two rods(?), miniature knife	sandstone	fragmented	Hatvan and Early Füzesabony cultures		*Koós 1991* 13–15, fig. 4. 2–3; *Gǎvan 2015* 191. Pl. 13. 1–3.	Stray finds from a ploughed layer.
20.	**Füzesabony**		Öregdomb	H, Heves	tell settlement	Füzesabony type shaft-hole axe, pins	sandstone	fragmented	Füzesabony culture		*Szathmári 1994* Cat. nos. 344–345.	
21.	**Gánovce**	Gánóc		SK, okr. Poprad	settlement	dagger, unknown, pin	stone	fragmented	Middle Bronze Age		*Gǎvan 2015* 237; *Hudák et al.* 2020 219, 224, fig. 23–24.	
22.	**Gomba**		Várhegy	H, Pest	settlement	unknown, pin(?)	local sandstone	fragmented	Vatya culture	ladle	*Kubinyi 1861; Horváth 2004* 13; *Gǎvan 2015* 193, Pl. 15. 5.	Excavation of G. Kulcsár and E. Bolega in 1997, unpublished.
23.	**Grantal-Ipeltal**	Garam-Ipoly vidéke/völgye		SK	unknown	5 pcs.	unknown	no data	Late Maďarovce culture		*Bartík 1999* 187, 190.	
24.	**Harta**		Weierhivli	H, Bács-Kiskun	settlement, pit 107	axe(?)	sandstone	fragmented	Middle Bronze Age		Unpublished.	Excavation of R. Kustár in 2003.
25.	**Hatvan**		Strázsa-hegy	H, Heves	tell settlement	two rods, dagger hilt unfinished?) two-piece mould of dagger (2 pcs.)	stone, sandstone	fragmented, parts missing, intact	Late Hatvan and Early Füzesabony cultures	tuyeres (2 pcs.)	*Gǎvan 2015* 193, Pl. 15. 6–8; *Tarbay 2019* 8–11, 15, 17, 31, 33–34, fig. 2, 4, 7, 12. 4.	
26.	**Ivanovce**	Ivánháza	Bašta	SK, okr. Trenčín	settlement (?)	two armrings	stone	fragmented	Maďarovce		*Bátora 2009* 207, fig. 14.	
27.	**Kajászó**		Várdomb	H, Fejér	settlement, section II, level 7	socketed axe-adze, pendant, rippled rods	local red and yellow sandstone	intact (axe and rods), fragmented	Vatya II. and Koszider period, Early Tumulus culture		*Horváth 2004* 17, 20.	
28.	**Kakucs**		Balladomb	H, Pest	tell settlement	unknown, pin fragment (), 2 pinheads	sandstone	fragmented	Vatya III.	tuyere, slag	*Horváth 2004* 13, 24.	
29.	**Kéthely**		Baglyas hegytől Ny-ra	H, Somogy	unknown	four spoke wheel pendant, lunula	unknown	fragmented	Transdanubian Encrusted Pottery culture		*Kuzsinszky 1920* 30–31, fig. 37. 16.	
30.	**Kisvárda**			H, Szabolcs-Szatmár-Bereg	unknown	C type shaft hole axe	unknown	no data	Gyulavarsand/ Otomani culture		*Bóna 1992* 52.	
31.	**Lengyel (Mucsi)**		Sánc	H, Tolna	settlement	comb pendant, adze or ingot(?), ring	stone	intact, fragmented	Transdanubian Encrusted Pottery culture		*Horváth 2004* 17; *Patek 1968* 59, Taf. 78. 13–14; *Bóna 1975* 215, Taf. 269. 10–12; *Kovács 1986* 100, Abb 1; *Jankovits 2017* Taf. 47. 1493.	
32.	**Lovasberény**		Mihályvár	H, Fejér	settlement, workshop	mushroom head pins, belt buckle, mushroom head pin	sandstone, metamorph	intact (belt buckle), fragmented	Vatya culture Koszider period	barren moulds in clay	*F. Petres – Bándi 1969* 174–175; *Horváth 2004* 11, 24; *Gǎvan 2015* 238.	

No.	Current name	Former name	Lands/ parcel	Country, county, district	Site/find context	Object to cast	Material of the casting mould	State of the casting mould	Dating (period/culture)	Other metal-working finds	Literature	Notes
33.	**Malé Kosihy**	Ipolykiskeszi	Törökdomb	SK, Nové Zámky	settlement	dagger	unknown	parts missing	Maďarovce culture		*Bartík 1999* 190; *Bátora 2009* fig. 7.	
34.	**Matúškovo**	Taksonyfalva		SK, okr. Galanta	grave 50, a symbolic burial	dagger	sandstone	fragmented	Aunjetitz culture	2 stones for crushing ore, tuyeres (4 pcs.)	*Bátora 2002* 193, fig. 14; *Ilon 2006* 276–277, Liste 1, Abb. 1–2; *Jockenhövel 2018* 232, Table 1, Abb. 5. C	
35A.	**Mezőcsát**		Oroszdomb	H, Borsod-Abaúj-Zemplén	settlement	crutched pendant, open pendant	sandstone	fragmented	Hatvan culture with Füzesabony pottery finds		*Koós 1991* 5, 9–10, fig. 4. 1; *Jankovits 2017* 126, Taf. 47. 1494A–B.	Excavation of N. Kalicz in 1960.
35B.	**Mezőcsát**		Oroszdomb	H, Borsod-Abaúj-Zemplén	settlement	lunula	sandstone	intact	Füzesabony culture, Koszider period		*Koós 1991* 9–13, fig. 4. 1.	
36.	**Mošorin**	Mozsor	Feudvar/ Földvár	SRB, Vojvodina	tell settlement, workshop in a house corner in section E	armring, spearhead, flanged axe, dagger, knife, adze	clay	fragmented	classical Vattina, RB A2, Hänsel FD III.	polishing stone, corepieces	*Hänsel – Medović 1991* 71–72, 82–83, Taf. 11–12, Abb. 3–4; *Găvan 2015* 201–202, Pl. 28–35.	
37.	**Nagykőrös**		Földvár	H, Pest	settlement, layer 3, house or workshop and other places	unknown, pin	sandstone	fragmented	Vatya III.		*Horváth 2004* 24, 27.	
38.	**Nagyrozvágy**		Pap-domb	H, Borsod-Abaúj-Zemplén	settlement	toggled pendant, two lunulae with an axe mould on the backside of one of them, conical headed pin, pin with arrowhead on the backside, pin with concentrical rings on the backside	sandstone		Füzesabony culture		*Koós 2008;* *Koós 2016.*	Excavation of J. Koós between 2005–2007 preceding the building of a water reservoir at Cigánd.
39.	**Nitra**		Mostná ulica	SK, okr. Nitra	settlement	winged axe, butt-ring fragment of an axe	sandstone	broken into pieces, reconstructable	Late Maďarovce culture		*Bartík 1999* 187, Abb. 4; *Bátorá 2009* 209, fig. 18. 1–2.	
40.	**Nitriansky Hrádok**	Kisvárad	Zámeček	SK, okr. Nové Zámky	fortified settlement, sector B/14 pit 306, D/15 pit 300	rings, pin, rippled armring, small spheres	unknown	fragmented	Maďarovce culture	tuyeres (14 pcs.)	*Točík 1978* Taf. 80. 12, *Bartík 1999* 187; *Găvan 2015* 204, Pl. 42. 1–5.	
41A.	**Nižná Myšľa**	Alsómislye		SK, okr. Kosice	grave 133	two-piece mould of a rod or pin	sandstone	intact	Early Füzesabony culture (1965–1754 BC)		*Olexa 1987* Abb. 1, Abb. 2. 11; *Bátora 2002* 193, fig. 16; *Găvan 2015* 206; *Jaeger – Olexa 2015* 154, 156, fig. 3, 6.	
41A.	**Nižná Myšľa**	Alsómislye		SK, okr. Kosice	grave 280	two-piece mould of a rod or pin	sandstone	intact	Early Füzesabony culture (1965–1754 BC)	hammer for crushing ore, tuyere	*Olexa 1987* 262, Abb. 3, Abb. 4. 2, 6; *Olexa 2003* Abb. 23; *Kovács 1995* 40, Abb. 19. 2; *David 2002* Taf. 246. 8, 5; *Bátora 2002* 193, fig. 15; *Găvan 2015* 206; *Jaeger – Olexa 2015* 156, fig. 4–6; *Jockenhövel 2018* 232.	
41B.	**Nižná Myšľa**	Alsómislye	Várhegy	SK, okr. Kosice	settlement	two daggers, tutulus, rod	sandstone, one tuffet (for gold?)	fragmented	Füzesabony culture	tuyere	*Olexa 2003* Table VII, XI, XIII, Taf. XV. 17.	

42.	**Nové Zámky**	Érsekújvár	Zofijska osada	SK, okr. Nové Zámky	stray find from settlement (?)	belt buckle	unknown	fragmented	Maďarovce/ Tumulus culture		*Liszka 1984* 148, fig. 77. 3.	
43.	**Ordacsehi**		Kis-töltés	H, Somogy	settlement	pin (?)	stone	fragmented	Transdanubian Encrusted Pottery culture		*Kulcsár 2002* 26.	
44.	**Otomani**	Ottomány	Cetatea de pământ	RO, jud. Bihor	tell settlement	tutulus, sickle, B1 type ring-butted axe	sandstone	intact	Middle Bronze Age III.		*Ordentlich – Lie – Ghemiş 2014* 141, Pl. V. 9; *Molnár 2014* Pl. 167. 12, Pl. 172. 10; *Găvan 2013* 147, Pl. IV. 3; *Găvan 2015* 207–208.	The find material perhaps got admixed with the moulds from Otomani Cetăţuie(a) = Dealul Cetăţii
45.	**Pákozd**		Várhegy	H, Fejér	settlement	pin, 2 pcs.	clay	fragmented	Vatya culture, Koszider period	tuyere	*Horváth – Kozák – Pető 2001* 14; *Horváth 2004* 13; *Farkas-Pető – Horváth – Kozák 2004* 120–121.	
46.	**Pecica**	Ópécska/ Pécska	Nagysánc	RO, jud. Arad	tell settlement	belt buckle, pin or rod, daggers, spearheads, flat axes, socketed adzes, Hajdúsámson type battle-axes	clay, sand-stone	intact, fragmented	layers X to XVI. Maros/Perjámos–Vattina culture	tuyere, corepieces	*Dömötör 1902* 271–4, 273–10, 272–3, 273–6, fig. 7–8; *Roska 1912* 17, 31–32, 36–37, Abb. 25, 55. 1, 56. 1–2, 57, 67; *Kovács 1975* 26, fig. 4. 2; *Bóna 1992* 50; *David 2002* 84, 89, Abb 2. 6–7; *Horváth 2004* 24, 27; *Gâvan – Gogâltan 2014* Abb. 4; *Găvan 2015* 210–212.	
47.	**Petea**	Pete	Határátkelő	RO, jud. Satu Mare	settlement, feature 1014.	pins(?)	stone	fragmented	Early Felsőszőcs/ Suciu de Sus culture		*Găvan 2015* 239.	
48.	**Pécs**		(Mecsek) Szabolcs	H, Baranya	settlement	shafthole axe (Bóna: Aegean-Anatolian type; Horváth: Křtenov-type)	unknown	fragmented	Transdanubian Encrusted Pottery culture		*Bándi – F. Petres – Maráz 1979* 103–104; *Kovács 1994a* 121; *Bóna 1992* 53–54; *Horváth 2004* Table 3.	
49.	**Pir**	Szilágypér	Cetate	RO, jud. Satu Mare	settlement	C type shafthole axe, Hajdúsámson type battle-axe	sandstone	intact, parts missing	Otomani culture		*Bóna 1975* 133; *Bóna 1992* 52; *Găvan 2013* 166–167; *Molnár 2014* Pl. 171. 5.	
50.	**Polgár**		Kender-földek	H, Hajdú-Bihar	tell settlement	Tószeg B type shafthole axe	unknown	fragmented	Late Hatvan/ Early Füzesabony culture		*Bóna 1992* 52; *Găvan 2013* 214.	
51.	**Pusztasomorja/ Jánossomorja**		Tímárdomb	H, Győr-Moson-Sopron	grave A	flat axe, ingot(?)	sandstone	fragmented, reassembled	Gáta–Wieselburg culture	tuyeres	*Melis 2019* 232–233, fig. 3. 1–2.	
52.	**Ratkovce**	Ratkóc		SK, okr. Hlohovec	settlement	reversed heart-shaped open pendant	unknown	intact	Middle Bronze Age		*Furmánek 1980a* 21, Taf. 10. 182.	
53.	**Rozhanovce**	Rozgony	Plebanské II.	SK, okr. Kosice	settlement	dagger	sandstone	fragmented	Otomani culture		*Bátora 2009* 210; Găvan 2015 215.	
54.	**Rusu de Jos**	Alsóoroszfalu		RO, jud. Bistriţa-Năsăud	settlement	C type shafthole axe	unknown	intact	Wietenberg culture		*Kőszegi 1957* 48, Taf. VIII. 1, 3; *Bóna 1992* 52; *Soroceanu 2012* 82–83, Taf. 24.	
55.	**Sarkad area**			H, Békés	unknown	lunula, disc	sandstone	no data	Middle Bronze Age		*Péterdi 2004* 503, Table VIII/1.	HNM Inv. no. 4/1900.93.
56.	**Simontornya**		Malom u.	H, Tolna	unknown	corepiece for socketed objects	unknown	no data	Vatya culture		*Horváth 2004* 27.	
57.	**Săcuieni**	Székelyhíd	Ökörvár	RO, jud. Bihor	settlement (?)	axe	unknown	fragmented	Gyulavarsánd/ Otomani culture		*Molnár 2014*.	

No.	Current name	Former name	Lands/ parcel	Country, county, district	Site/find context	Object to cast	Material of the casting mould	State of the casting mould	Dating (period/culture)	Other metal-working finds	Literature	Notes
58.	**Sântion**	Bihar-szentjános	Dealul Mănăstirii	RO, jud. Bihor	tell settlement	three axes on two moulds, two flat axes, socketed adze	sandstone	parts missing	Gyulavarsánd/ Otomani culture		*Bóna 1975* 133; *Bóna 1992* 52; *Găvan 2013* 147–148, 167; *Găvan 2015* 215–216.	
59.	**Santovka (Malinovec)**	Szántó	Nad Búrom	SK, Levice	settlement	Tószeg type shafthole axe, dagger, pin, undescribed objects	sandstone	fragmented	Maďarovce - Northern Transdanubian Ecrusted Pottery culture	tuyeres (2 pcs.)	*Bátora 2009* 203, fig. 9. 1–2; *Găvan 2015* 216, Pl. 59. 1–2.	
60.	**Sânnicolau Mare**	Nagy-szentmiklós		RO, jud. Timiş	unknown	two wires or rods	unknown	fragmented	Bronze Age		*Gogâltan 1999* 108, fig. 12. 3.	
61.	**Socodor**	Székudvar	Căvăjdia	RO, jud. Arad	settlement	socketed chisel	stone	fragmented	Middle Bronze Age		*Găvan 2015* 216–217.	
62.	**Soroksár (Budapest, XXIII.)**		Várhegy	H	settlement	dagger and pin	local sandstone from the Buda hills	fragmented	Vatya culture, Koszider period		*Endrődi – Gyulai 1999* fig. 18. 6a–b; *Horváth 2004* 27.	
63.	**Sükösd**		Tallér	H, Bács-Kiskun	settlement	Koszider type pendant	sandstone	no data	Szeremle culture		*Bándi – Kovács 1969* 106–107, Taf. X. 14; *Horváth 2004* 20; *Jankovits 2017* Taf. 61. 2244.	
64.	**Spišsky Štvrtok**	Csütörtökhely	Myšia Horka	SK, okr. Levoča	fortified settlement	Mycene type dagger/rapiere, flat or flanged axe	sandstone, clay	fragmented	Otomani culture, B A2		*Vladár 1974* 227, Abb. 13; *Bouzek 2004* 281, Abb. 2. 1; *Găvan 2015* 218, fig. 60. 1.	
65A.	**Százhalombatta**		Földvár	H, Pest	tell settlement	socketed adzes, two daggers, rings, Koszider type pendant, conical pendant, socketed axe later transformed into miniature axe or arrowhead, pin, razor	sandstone, clay (socketed adze, miniature tutulus, ring)	fragmented	Nagyrév culture (one adze), Vatya I. and III, Koszider period	tuyeres (2 pcs.)	*Poroszlai 2000b* 16, 19, 23–24, fig. 17a–b; *Horváth 2004* 12–13, 20, 27, 29, fig. 13. 2, fig. 14. 2; *Horváth – Kozák – Pető 2000b* 113, Pl. IV. 1–2; *Găvan 2015* 220, Pl. 65. 1–3, 66. 1–2.	
65B.	**Százhalombatta**		Téglagyár	H, Pest	unknown	dagger with lengthwise rippled blade (2 pcs.), conical headed pin and a dagger with lengthwise rippled blade	sandstone	no data	Middle Bronze Age		*Péterdi 2004* 507, Table VIII. 1.	HNM Inv. no. 66.17.1401.
66.	**Szelevény**		Demeter-/ Menyasszony-part	H, Jász-Nagykun-Szolnok	tell settlement	pin with biconical, pierced head	unknown	fragmented	Middle Bronze Age		*Péterdi 2004* 503, Table VIII. 1.	HNM Inv. no. 138/1883.525.
67.	**Szihalom**		Árpádvár/ Földvár	H, Heves	tell settlement	two flat adzes (Horváth: Cófalva type axe), Tószeg type shafthole axe, tutulus(?), pin(?), beads	clay, sandstone	intact	Hatvan culture	tuyeres (4 pcs.)	*Hampel 1886* Taf. 3. 1, 3, 5–6; *Mozsolics 1973* 85; *Bóna 1992* 50; *Horváth 2004* Table 3.	
68.	**Szólád**			H, Somogy	settlement (?)	two-piece mould of a spearhead	stone	intact	Transdanubian Encrusted Pottery culture		*Kuzsinszky 1920* 16–19, Abb. 21; *Bóna 1975* 217, Taf. 270. 25; *Kovács 1975* 34, Abb. 4. 6; *Kiss 2012* 139, fig. 37. 3.	
69.	**Tarjánpuszta**		Vasasföld II.	H, Győr-Moson-Sopron	settlement	axe	unknown	no data	Transdanubian Encrusted Pottery culture		*Gömöri 1980; Gömöri 1982.*	No photo or drawing available.
70.	**Tibolddaróc**		Bércút	H, Borsod-Abaúj-Zemplén	settlement	flat axe, flat, rod-shaped ingot	sandstone, stone	fragmented	B II, Late Hatvan culture	tuyeres (3 pcs.)	*Mozsolics 1967* 99; *Găvan 2015* 222–223, Pl. 68. 6–7.	

71.	**Tiszafüred**		Ásotthalom	H, Jász-Nagykun-Szolnok	tell settlement, uppermost layer	8 moulds: 3 lunulae, disc (tutulus), belt hook, pin fragments or rods	sandstone	intact, fragmented	Vatya culture, Koszider period RB2 (?)	tuyere	*Bóna 1960;* *Bóna 1992* 58–62; *Kovács 1994b* fig. 89, Cat. no. 332–340; *Horváth 2004* 20, 24; *Găvan 2015* 223–224; *Jankovits 2017* Taf. 40. 1253–1256, Taf. 48. 1498–1499, Taf. 66. 2399.	
72.	**Tiszakeszi**			H, Borsod-Abaúj-Zemplén	unknown	axe, pin or rod, two pendants, conical headed pin	unknown	fragmented	B III		*Péterdi 2004* 507, Table VIII. 1.	HNM Inv. no. 62.3.34-36.
73.	**Tószeg**		Laposhalom	H, Jász-Nagykun-Szolnok	tell settlement	undescribed mould from layer o (Nagyrév culture); small socketed adzes (layer B 1903, layer C 1909/c, Early and Classical Middle Bronze Age), adze, lunula, ring headed pin (phase B 1948/I and 1974/IX), another moulds (phase C: 1908/3-5, 1909/c-d, 1911/A3, 1974/B and level IX.) two Tószeg type axes	clay, sandstone	fragmented	Tószeg C = RB2 = B III = Vatya culture	tuyeres (9 pcs.)	Nagyrévi c.: *Mozsolics 1952* 47, Taf. XVIII. 5; *Banner – Bóna – Márton 1957* 116, Abb. 19. 17–19, Taf. 9. 1, Taf. 19. 17–19; *Mozsolics 1967* 19, Abb. 2; *Bóna 1992* 48, 50, Cat. no. 342–343; *Găvan 2015* 225–227.	
74.	**Túrkeve**		Terehalom	H, Jász-Nagykun-Szolnok	tell settlement	axe	sandstone	fragmented	Gyulavarsánd, Koszider period	tuyere	*Csányi – Tárnoki 1994* 165, Cat. no. 346–347.	
75.	**Török-szentmiklós**		Terehalom	H, Jász-Nagykun-Szolnok	settlement	shafthole axe	unknown	fragmented	Classical and Late Hatvan culture		*Bóna 1992* 50.	
76.	**Vărşand**	Gyulavarsánd		RO, jud. Arad	tell settlement	flat axe	unknown	fragmented	Gyulavarsánd/ Otománi	tuyere	*Bóna 1975* 133, Taf. 150. 14; *Bóna 1992* 52; Găvan 2015 228.	
77.	**Vatin**	Vattina/ Versecvát		SRB, Vojvodina	tell settlement	Hajdúsámson type axe on both sides	stone	no data	Maros/Perjámos – Vattina		*Milleker 1905* 12–13, Taf. III. 1a–b; *Bóna 1992* 50.	
78.	**Včelince**	Méhi		SK, okr. Rimavská Sobota	fortified settlement	pendant, unidentifiable objects	unknown	fragmented	Hatvan culture		*Bátora 2009* 201, fig. 6; *Găvan 2015* 229–231.	
79.	**Veselé**	Vígvár	Hradisko	SK, okr. Piešťany	settlement, pendant from pit 91	palstave axe, flat axe, adze, sickle, pin, pendants	stone, sandstone, unknown	fragmented	Maďarovce (after *Bartík 1996, Bartík 1998, Novotná 1970, Furmánek 1980a* 22), Maďarovce/ Tumulus culture *(Bóna 1992)*	tuyeres (6 pcs.)	*Bóna 1992* 62; *Bartík 1996* 250, Taf. 3. 4; *Bartík 1998* 27, Abb. 1. 5; *Bartík 1999* 187, Abb. 2; *Novotná 1970* 101, Taf. 45. 846; *Găvan 2015* 231–232.	
80.	**Vyšný Kubín**	Felsőkubin		SK, okr. Dolný Kubín	cemetery	reversed heart-shaped open pendant	sandstone	intact	Middle Bronze Age (?)		*Kubinyi 1883;* *Furmánek 1980a* 28, Taf. 15. 403.	
81.	**Vörs**	Battyáni disznólegelő		H, Somogy	settlement	socketed adze	clay	intact	Late Kisapostag culture		*Honti 1996* 49, 54; *Honti – Kiss* 2000 93; *Găvan 2015* 240.	
82.	**Vráble**	Verebély	Fidvár/ Földvár	SK, okr. Nitra	fortified settlement	pin	clay	fragmented	Aunjetitz culture	tuyeres (5 pcs.)	*Bátora 2009* 199, 201, fig. 8. 7.	
83.	**Želiezovce**	Zselíz		SK, okr. Levice	settlement depot	miniature palstave axe, flanged axe, dagger	unknown	unknown	LateMaďarovce/ Late Tumulus culture, B IV		*Mozsolics 1973* 81; *Bóna 1992* 62; *Novotná 1970* 101, Taf. 45. 847–849.	

Table 2. Middle Bronze Age casting moulds of the Carpathian Basin (Croatia: HR; Hungary: H; Romania: RO; Serbia: SRB; Slovakia: SK; Slovenia: SLO; Ukraine: UA)

No.	Current name	Former name	Lands/ parcel	Country, county, district	Site/find context	Object to cast	Material of the casting mould	State of the casting mould	Dating (period/culture)	Other metal-working finds	Literature	Notes
1.	**Albis**	Kézdialbis	Márton-kert	RO, jud. Covasna	settlement	socketed axe with handle	sandstone	parts missing	Gáva culture, Ha B1–2		*Puskás 2015* 8, Pl. 4. 1.	
2.	**Arad**	Arad		RO, jud, Arad	stray find	socketed axe with handle	stone	fragmented	Late Urnfield period		*Wanzek 1989* 200, Taf. 49. 6.	
3.	**Aranyosapáti**		Temető	H, Szabolcs-Szatmár-Bereg	settlement (?) depot	socketed axe with handle (2 pcs.), dagger(?), small rods	sandstone	intact, parts missing	Mozsolics B VIa, Hajdúböszörmény horizon, Ha B1, Gáva	corepiece	*Mozsolics 2000* 33, Taf. 120–121.	
4A.	**Aszód**			H, Pest	stray find	needle (2 pcs.), with a mould for a spearhead on the backside of one	sandstone	intact	Urnfield period	corepiece	*Hampel 1886* Taf. 5. 1–3; *Mozsolics 1973* 81; *Mozsolics 1984* 49, Taf. 12; *Kovács 1986* Abb. 3. 3.	
4B.	**Aszód**		Cukorgyár/ Fiúnevelő-Intézet	H, Pest	stray find	several moulds	unknown	no data	Piliny culture	bronze nuggets and slags	*Kővári 1976* 3; *Kővári 1980.*	
5.	**Bakony-szentkirály**		Zöröghegy II.	H, Veszprém	fortified settlement	no data	sandstone	fragmented	Late Urnfield period		*Nováki 1979* 103, Abb. 39. 4; *Wanzek 1989* 202–203.	
6.	**Baks**		Temetőpart	H, Csongrád	settlement	sickle	unknown	no data	Gáva culture, Ha B1–3	bronze nuggets and ingots	Excavation of G. V. Szabó in 2007. From his presentation on 29.10.2008 in Tata; *V. Szabó 2011* Taf. 1.	
7.	**Balatonboglár**		Borkombinát	H, Somogy	settlement	socketed axe and ring	sandstone	fragmented	Urnfield culture		*Honti et al.* 2004 8, Taf. II. 6.	
8.	**Balatonlelle**		Rádpuszta-Romtemplom mellett	H, Somogy	settlement	no data	unknown	fragmented	Urnfield culture		*Honti et al.* 2007 52.	
9.	**Balaton-magyaród**		Hídvégpuszta	H, Zala	settlement, feature 269.	spearheadhead's end (2 pcs.), ring	sandstone	fragmented	Tumulus culture, B C		Without drawing or photo *Horváth 1996* 60, 72, fig. 26.	Description by L. Horváth in 2008. Inv. no. 96.106.1. Thúry György Museum, Nagykanizsa.
10.	**Banatska Palanka**			SRB, opš. Bela Crkva	stray find	blade part of an axe	stone	fragmented	Late Bronze Age		*Wanzek 1989* 196–197, Taf. 37. 7.	
11.	**Benczúrfalva (Szécsény)**		Majorhegy	H, Nógrád	fortified settlement	axe	sandstone	fragmented	Mozsolics B IV, Piliny culture	tuyere, ladle	*Mozsolics 1973* 81, Taf. 111. 7–9, *Kemenczei 1984* 107.	
12.	**Beremend**			H, Baranya	settlement depot	axe	unknown		Mozsolics B Vc, Gyermely horizon, Urnfield culture		*Mozsolics 1984* 50–51, *Bándi – F. Petres – Maráz 1979* 123.	
13.	**Berettyó-szentmárton (Berettyóújfalu)**			H, Hajdú-Bihar	stray find/ settlement(?)	socketed axe	stone	fragmented	Gáva (?), Urnfield period		*B. Kutzián – Kalicz 1956* 96; *Wanzek 1989* 203, Taf. 49. 12.	
14.	**Bölcske**		Sziget	H, Tolna	settlement	socketed axe (3 pcs.), knife, poppyhead pins, rods/wire (?)	sandstone (?)	fragmented	Urnfield culture	forge's grille	*Szabó 1996* 270, Abb. 5–6; *Szabó 2013* 133, Taf. 127–129.	
15.	**Budapest, III.**		Békásmegyer, Szentendrei u. 781.	H	stray find	socketed adze, pin	sandstone (?)	no data	end of tell cultures, B IV (Mozsolics)		*Schreiber 1968* 4; *Mozsolics 1973* 82; *Bóna 1992* 50.	

16.	**Budapest, XI.**		Skála lehajtó	H	settlement	pendant	unknown	parts missing	Tumulus culture		Unpublished.	
17.	**Budapest, XIV.**		Zugló, Vízakna u. 41/b.	H	settlement	two-piece mould of a palstave axe	sandstone (?)	intact	Tumulus culture, Mozsolics B IV, Rein. B B2		*Kőszegi 1968* 5; *Mozsolics 1973* 82, Taf. 112. 4a–c.	
18.	**Budapest, XVII.**		Rákoscsaba, Majorhegy	H	settlement, feature 99.	no data	unknown	no data	Tumulus or Urnfield culture		*Reményi et al.* 2006 175.	
19.	**Budapest, XXI.**		Csepel-Újfalu	H	stray find	two rings	unknown	intact	B IV (Mozsolics)		*Mozsolics 1973* 85, Taf. 111. 5.	
20.	**Căuaş**	Érkávás		RO, jud. Satu Mare	settlement	ring	unknown	intact	Uriu/Ópályi horizon, RB D, with Gáva pottery		*Bader 1996* 265, 278, Abb. 4. 7.	
21.	**Cernat**	Csernáton		RO, jud. Covasna	settlement	axe, blade part of axe	stone	intact, fragmented	Late Bronze Age		*Székely 1970* fig. 1. 1; *Wanzek 1989* 200, Taf. 49. 4–5.	
22.	**Celldömölk**		Ság-hegy	H, Vas	highland settlement	socketed axes with handle, adze, spearheadhead, arrow, pins, openwork pendant, rings	sandstone	parts missing, fragmented	Urnfield culture	tuyeres, corepieces, ladles	*Lázár 1943;* *Wanzek 1989* 204, Taf. 49. 8–9; *Mozsolics 2000* 37–39; *Jankovits 2017* 180–181, 193–194, Taf. 68. 2458, Taf. 71. 2504.	
23.	**Chorvátsky Grob**	Horvátgurab	Čerešňový sad	SK, okr. Senec	settlement, pit 9/07.	two-piece mould of a winged axe, edge fragments of a similar mould (2 pcs.)	andesite	intact, fragmented	Tumulus culture	ingots, rod	*Bartík 2011* fig. 4–5, 9–11.	
24.	**Ciumeşti**	Csomaköz		RO, jud. Satu Mare	settlement depot	moulds, 19 pcs.: socketed axes with handle, adze, razor, rings, pendants etc.	sandstone	intact, parts missing, fragmented	Early Urnfield period, Ha A1		*Bader 1978* 123, Taf. 64; *Wanzek 1989* 200–201, Taf. 19. 4–6, Taf. 48. 2–4.	
25.	**Culciu Mic**	Kiskolcs		RO, jud. Satu Mare	settlement	heart- or man-shaped pendant	unknown	parts missing	Felsőszőcs horizon		*Bader 1978* 124, Taf. 46. 1.	
26.	**Dăbâca**	Doboka		RO, jud. Cluj	settlement	axe, 3 pcs.	unknown	fragmented, parts missing	B B2 – D	tuyeres (3 pcs.)	*Gogâltan 2017* 18–21, fig. 4–7.	
27.	**Dobanovci**			SRB, opš. Zumen	stray find	socketed axe	stone	intact (?)	Early Urnfield period, Ha A1		*Wanzek 1989* 197.	
28.	**Dolnỳ Kubín**	Alsókubin		SK, okr. Dolnỳ Kubín	settlement	socketed axe with handle	unknown	intact	Lausitz culture		*Čaplovič 1978* fig. 37. 6.	
29.	**Domăneşti**	Domahida		RO, jud. Satu Mare	depot I.	socketed axe	sandstone (?)	intact	Ópályi horizon, B IVb, Otomani III culture		*Mozsolics 1973* 81, 128–129, Taf. 27. 14a–b, Taf. 111. 6.	
30.	**Dunajská Streda**	Dunaszerdahely		SK, okr. Dunajská Streda	stray find	beads	unknown	no data	Urnfield culture		*Pichlerová – Tomčiková 2001* 118, 134, Abb. 4. 1.	
31.	**Danube's bed (Almásneszmély–Győr)**			H, Győr-Moson-Sopron/ Komárom-Esztergom m.	stray find	arrowheads	sandstone	parts missing	Tumulus/ Urnfield culture		Unpublished.	
32.	**Ercsi**			H, Fejér	settlement	openwork pendant, winged and socketed axe with handle	unknown	fragmented, intact (2)	Late Urnfield culture		*Hampel 1880* 211–212, fig. 42–44.	
33.	**Gáborján**		Földvár	H, Hajdú-Bihar	ditch of a fortified highland settlement	dagger (2 pcs.)	sandstone, Parád/ Hárshegy type	parts missing	Gáva culture, B D–Ha A1		*Dani 1999* 37–39.	

No.	Current name	Former name	Lands/ parcel	Country, county, district	Site/find context	Object to cast	Material of the casting mould	State of the casting mould	Dating (period/culture)	Other metal-working finds	Literature	Notes
34.	**Gelsesziget**		Újudvari-Határ-dűlő	H, Zala	settlement, feature 4/a.	ring and armring	sandstone (?)	fragmented	Tumulus (B C2) or Urnfield culture (B D – Ha A)		Unpublished. *Ilon 2015b* Taf. 18. 1.	Description by L. Horváth in 2008. From the permanent exhibition of the Thúry György Museum, Nagykanizsa.
35.	**Geoagiu**	Algyógy	Kőalja hegy	RO, jud. Hunedoara	Kun Kocsárd-cave	Plattenfibel mit gegossesen Endplatten Sebes type torque	stone	parts missing	Urnfield culture, Ha A2–B2–3		*Bader 1983* 39–41, Taf. 4. 23; *Roska 1942* 15; *Mozsolics 1973* 82.	
36.	**Gomolova bei Hrtkovci**		Gomolova	SRB, opš. Ruma	settlement, layer VII.	socketed axe	stone	parts missing	Early Urnfield culture		*Wanzek 1989* 197.	
37.	**Gornja Radgona**			SLO, obč. Gornja Radgona	settlement	socketed axes with handle, adze, spearheadhead, arrow, pins, openwork pendant, rings	unknown	fragmented	Late Urnfield culture		*Wanzek 1989* 197.	
38.	**Gór**		Kápolna-domb	H, Vas	settlement pits	axe, hammer, rings, spearhead, arrowhead, Keftiu ingot etc.	sandstone	intact, fragmented	Urnfield culture, Ha B1	ladles, ingot, slag	*Ilon 1992;* *Ilon 1996;* *Ilon 2003;* *Ilon 2015b* Taf. 18. 7.	The results of the Keftiu ingot's analysis are published in T. Biró 1995.
39.	**Hălchiu (Brasso)**	Höltövény/ Heldsdorf		RO, jud. Sf. Gheorghe	settlement depot	6 moulds for 8–9 objects: hammer-axe, dagger, knife, fourfold-bulge necked pin, roundhead pin with stop-ridge, pin, lunula, 3 buttons, tongue-shaped rod	sandstone and slate/ limestone (?)	fragmented	Noua/Wietenberg culture, SD I (= Beilage 14) = B C-D		*Hänsel 1968* 92, Taf. 56. 22–27, Beilage 14; *Rezi 2015* 18, 26, 32, 43, 104, 139, 174, 332, 341, 374–375, Taf. 24; *Soroceanu 2012* 44–45, Taf. 14.	Lost. *Rezi 2015* 138, 164.
40.	**Hegyeshalom**		Országúti-dűlő 1.	H, Győr-Moson-Sopron	settlement, 2007/93. hous	axe	sandstone	fragmented	Early Tumulus culture		*Aszt 2008.*	Modified dating of the finds during processing of the Bronze Age settlement by E. Melis.
41.	**Horné Plachtince**	Felsőpalojta		SK, okr. Veľký Krtíš	settlement	arrowheads	unknown	intact	Late Piliny culture		*Furmánek 1977* 257, Taf. XX. 2.	
42.	**Idoš**	Tiszahegyes		SRB, opš. Kikinda	stray find	socketed axe with handle	stone	fragmented	Late Urnfield culture		*Wanzek 1989* 197–198.	
43.	**Ilava**	Ilava		SK, okr. Ilava	burial	knife	stone	parts missing	Lausitz culture, Ha B1		*Chebenová 2012* 9. Taf. VII. 4; *Jockenhövel 2018* Table 1.	
44.	**Karlovčić**			SRB, opš. Pecinci	stray find	axe	unknown	fragmented	Early Urnfield culture		*Wanzek 1989.* 198.	
45A.	**Keszthely**		Apátdomb	H, Zala	settlement	axe, pins	unknown	fragmented	Urnfield culture		*Sági 1909* 342–354, fig. 5. 3; *Kőszegi 1988* 150.	
45B.	**Keszthely**		Elkerülő út	H, Zala	settlement pit	dagger	sandstone	fragmented	Tumulus culture, B C		*Ilon 2015b* Taf. 18. 10.	Excavation of R. Müller in 1994. Recorded based on a letter by J. P. Barna in 2008.
46.	**Kladovo**		Duna és Jakomirpatak torkolata	SRB, opš. Kladovo	stray find	axe	stone	no data	Early Urnfield culture, Zuto-Brdo		*Wanzek 1989* 198.	
47.	**Külsővat**		Egressy-dűlő	H, Veszprém	settlement (?)	rings	stone	intact	Tumulus/ Urnfield culture		*Ilon 1995* 92, Taf. VIII. 7.	

48A.	**Lăpuş**	Magyarlápos		RO, jud. Maramures	Tumulus 11	axe	unknown	parts missing	SB 2, Felsőszőcs–Gáva, Lăpuş group		*Kacsó 2001* 239, Abb. 27. H11.	
48B.	**Lăpuş**	Magyarlápos		RO, jud. Maramures	Tumulus 13	rod	stone	parts missing			*Kacsó 2001* 239, Abb. 27. H13.	
48C.	**Lăpuş**	Magyarlápos		RO, jud. Maramures	Tumulus 16	socketed axe with handle (2 pcs.)	stone	fragmented			*Kacsó 2001* 239, Abb. 28. H16. 1–2; *Jockenhövel 2018* 268.	
49.	**Lengyel**		Sánc	H, Tolna	settlement	sickle, knife	unknown	parts missing	Tumulus/ Urnfield culture		*Patek 1968*. Taf. 78. 15; *Kőszegi 1988*. 156, Taf. 8. G34.	
50.	**Lontov**	Lontó	U Litaša	SK, okr. Levice	highland, fortified settlement	two sickles	sandstone	parts missing	Early Urnfield culture		*Chebenová – Cheben 2019* 2–4, 7–9, fig. 5, Pl. VIII. 1–2.	Analysed.
51.	**Lovas**	Lovas		HR, opš. Vukovar	stray find	socketed axe with handle	stone	parts missing	Early Urnfield culture		*Wanzek 1989* 198, Taf. 37. 4.	
52.	**Makó**		Innenső Jángor 3.	H, Békés	settlement, pit	socketed axe with handle	stone (?)	parts missing	Gáva culture		*Hargitai – Sóskuti 2012* 93.	The handle is broken. Recorded based on a sketch by K. Sóskuti.
53.	**Mediaş (and area)**	Medgyes		RO, jud. Sibiu	stray find	socketed axe with handle (2 + 1 pcs.)	stone	intact	Early Urnfield culture		*Wanzek 1989* 201–202, Taf. 47. 1–3.	
54.	**Mezőcsát**		Hörcsögös	H, Borsod-Abaúj-Zemplén	settlement, pit 9.	socketed axe with handle	sandstone	parts missing	Gáva/Kyjatice culture, Ha A		*Patek 1982.*	
55.	**Mezőlak**		Szentpéteri-domb	H, Veszprém	from a grave from the Árpádian period	cased tool converted into a casting core	sandstone	parts missing	Urnfield culture		*Ilon 1989* 21, Abb. 7. 2.	
56.	**Mikleuška**			SRB, opš. Kutina	settlement	socketed axe with handle	clay	parts missing	Late Urnfield culture		*Wanzek 1989* 198, Taf. 39. 4.	
57.	**Mojzesovo**	Özdöge		SK, okr. Nové Zámky	stray find	willowleaf-shaped pendant	sandstone	fragmented	Urnfield culture		*Furmánek 1980b* 68, fig. 34. 1.	
58.	**Muhi**		Kavicsbánya	H, Borsod-Abaúj-Zemplén	settlement	sickle, socketed axe, spearhead	sandstone	fragmented, intact	Gáva culture, Ha A1		*Koós 2015* 141–143, 148, 154, Pl. 16. 1–2, Pl. 17. 1, 3, Pl. 18–20.	
59.	**Nagyberki**		Szalacska	H, Somogy	settlement	socketed hammer	mica	no data	Urnfield culture		*Darnay 1908* 138–139, 142, Abb. 1.	
60.	**Németbánya**		Felsőerdei dűlő	H, Veszprém	mound III/4, grave 2	ring set	burnt clay, dolomite-tempered (?)	fragmented	Late Tumulus/ early Urnfield culture, B D		*Ilon 1989* 18, 25, Abb. 6. 6; *Ilon 2014* Taf. 8. 9.	There was only one grave in the mound. The burial was carried out in several phases and robbed.
61.	**Neszmély**		Felsősziget	H, Komárom-Esztergom	settlement, section I, pit 2	socketed axe with handle	unknown	fragmented	Urnfield culture, Ha A2		*Patek 1961* 57, Taf. 28. 8.	
62.	**Novigrad na Savi**			SRB, opš. Slavonski Brod	settlement	socketed axe with handle, rings	stone	intact	Late Urnfield culture		*Wanzek 1989* 198, Taf. 38. 3.	
63.	**Nyíregyháza**		Oros Úr-Csere	H, Szabolcs-Szatmár-Bereg	settlement, features 120 and 220.	shaft-tube axe, blade part of axe(?), socketed adze	unknown	parts missing	Berkesz horizon, B D		*Bejinariu – Székely – Sana 2009* 58, 67, Pl. XII. 2, XIV. 8.	
64.	**Ormož**	Ormosd		SLO, obč. Ormož	highland settlement	socketed axe	stone	no data	Urnfield culture		*Wanzek 1989* 198–199.	
65.	**Oşorhei**	Fugyi-vásárhely		RO, jud. Bihor	stray find	spearhead, dagger, knobbed end sickle	sandstone	intact	Igriţa group – Urnfield culture		*Hampel 1886* Taf. 2. 4–6; *Darnay 1900* 59; *Mozsolics 1973* 81.	

No.	Current name	Former name	Lands/ parcel	Country, county, district	Site/find context	Object to cast	Material of the casting mould	State of the casting mould	Dating (period/culture)	Other metal-working finds	Literature	Notes
66A.	**Oszlár**		Nyárfaszög	H, Borsod-Abaúj-Zemplén	settlement, feature 652.	pin	stone	fragmented	Egyek-Berkesz horizon, B C2–D		*Kalicz – Koós 1997* 68, 180, 26–31, Abb. 61–62; *Koós 2001* 222–223, Taf. 3. 1a–b, Taf. 3. 3, Taf. 3. 4, Taf. 3. 5 a–b.	
66B.	**Oszlár**		Nyárfaszög	H, Borsod-Abaúj-Zemplén	settlement, feature 477.	spearhead, with rods, lunula and beads or nits on the backside	sandstone	intact	Egyek–Berkesz horizon, B C2–D – Ha A1	feature 219: crucible; feature 477: whetstone	*Kalicz – Koós 1997* 68, 180, 26–31, Abb. 61–62; *Koós 2001* 222–223, Taf. 3. 1a–b, Taf. 3. 3, Taf. 3. 4, Taf. 3. 5 a–b; *Koós 2013.*	
67.	**Pécs**		Makártető/ Makár-hegy	H, Baranya	settlement	knife, axe, socketed axe with handle, pendant	sandstone, clay	intact	Urnfield culture	crucible	*Bándi – F. Petres – Maráz 1979* 121, 157; *Jankovits 2017* 249, Taf. 83. 3052.	
68.	**Piliny**		Borsoshegy	H, Nógrád	settlement	axe, miniature axe, dagger, razor, rods(?)	unknown	intact, fragmented	Piliny culture, B IV		*Hampel 1886* Taf. 3. 2, Taf. 4. 2; *Mozsolics 1973* 81, Taf. 110, Taf. 111. 1–4; *Kemenczei 1984* 106; *Kovács 1986* Abb. 3. 1.	
69.	**Pobedim**	Pobedény		SK, okr. Nové Mesto nad Váhom	settlement	sickle, pins (3 pcs.), knife	sandstone	intact, fragmented	Lausitz culture		*Novotná 1980* 184, Taf. 53. 1511–1513; *Furmánek – Veliačik – Vladár 1991* 226, fig. 38. 9; *Furmánek – Novotná 2006* 47, Taf. 12. 285–286; *Chebenová 2012* Taf. VI. 2.	
70.	**Polgár**		M3/Site 1	H, Hajdú-Bihar	settlement	socketed axe with handle, spearhead, swordblade part, buttons, rings	sandstone	intact, parts missing, fragmented	Classical Gáva culture, Kurd horizon		*V. Szabó 2004* 148, Abb. 8. 2–4.	
71.	**Poroszló**		Aponhát	H, Heves	settlement	pin, socketed axe with handle, hilt fragment of sword or dagger	unknown	fragmented	Gáva culture, Ha A2	two ladles	*Patay 1976* 200–201, Abb. 4. 2, 7.	
72.	**Prašník**	Prasnik-irtvány		SK, okr. Piešťany	highland settlement	knife	unknown	intact	Late Bronze Age		*Chebenová 2012* 9. Taf. VI. 3.	
73.	**Prügy**		Tökföld	H, Borsod-Abaúj-Zemplén	settlement	socketed axe	unknown	no data	Gáva culture		*Kemenczei 1984* 161; *Wanzek 1989* 203.	
74.	**Poian**	Kézdi-szentkereszt		RO, jud. Covasna	stray find	axe	stone	intact	Late Bronze Age		*Wanzek 1989* 202, Taf. 49. 3.	
75.	**Radzovce**	Ragyolc		SK, okr. Lučenec	settlement	sword, daggers, funnel pendants, rod, hammer(?), sickle	sandstone	intact (tutuli), fragmented	Piliny culture		*Furmánek 1977* 257; *Furmánek – Veliačik – Vladár 1991* fig. 38; *Furmánek – Novotná 2006* 47. Taf. 12. 287.	
76.	**Regöly**		Földvár	H, Tolna	settlement, pit 3/B	socketed axe with handle	unknown	intact	Urnfield culture		*Patek 1968* Taf. 81. 12; *Kőszegi 1988* 175, Taf. 8. F33.	
77.	**Reci**	Réty	Telek	RO, jud. Covasna	settlement	edge fragment of an axe	stone	parts missing	Late Bronze Age (?)		*Székely 1959* 197, fig. 6. 6; *Wanzek 1989* 202.	
78.	**Şagu**	Németság		RO, jud. Timis	site A1.1, settlement, features 25, 66, 182, 184, 193, 194, 198.	axes, rods or armrings(?)	clay, sandstone	intact, parts missing, fragmented	B D – Ha A1, Kurd horizon	slags	*Sava – Hurezan – Mărginean 2011* 52–55, fig. 92–95, fig. 104.	
79.	**Sármellék**		Száraz-eleje	H, Zala	settlement, pit: 10, 23, 93, 104	socketed- and winged axe, pendant, armring (?)	sandstone	fragmented	Late Tumulus/ Early Urnfield culture, B D/Ha A1	slags	Unpublished.	Excavation of I. Eke in 2021.
80.	**Sárvár**		Faképi dűlő	H, Vas	settlement	socket fragment of a tool with a ring on the backside	sandstone	fragmented	Late Tumulus/ Early Urnfield culture, B D/Ha A1		*Ilon 2015b* Taf. 18. 11.	Excavation of P. Kiss in 2004.

81.	**Siklós**			H, Baranya	settlement	arrowhead	unknown	no data	Early Tumulus culture		*Mozsolics 1973* 81, note 8.	
82.	**Soltvadkert**		Büdöstó	H, Bács-Kiskun	settlement depot in a pit	41 pcs.: pins, pendants, socketed axe, socketed hammer, flat axes, arrowhead, rings, beads	sandstone, rhyolite tuff	intact, some broken in two	Early Tumulus culture, Koszider horizon or Classic and Late Tumulus – Early Urnfield culture (B C/D – Ha A1)		*Gazdapusztai 1959* 268–276, Taf. II–IX; *Mozsolics 1973* 80–81, Taf. 108–109; *Péterdi 2004* 504, 513, fig. VIII. 1, VIII. 4; *Hänsel 2011;* *Nessel 2019* 809.	
83.	**Sânnicolau Mare area**	Nagy-szentmiklós		RO, jud. Timis	stray find	socketed axe with handle	stone	fragmented	Late Bronze Age		*Wanzek 1989* 202, Taf. 49. 7.	
84.	**Simleu Silvaniei**	Szilágy-somlyó		RO, jud. Sălaj	gifting	pendant	steatite/ soapstone	intact	Urnfield culture		*Jankovits 2017* 240, Taf. 80. 3022.	
85.	**Somlyó/ Somló-hegy**			H, Veszprém	settlement (?)	rod (?)	unknown	no data	Urnfield culture (?)		*Darnay 1900* 31.	
86A.	**Somotor**	Szomotor		SK, okr. Trebišov	stray find	socketed axe	stone	intact	Late Urnfield culture		*Wanzek 1989* 196.	
86B.	**Somotor**	Szomotor			settlement	socketed hammer	unknown	no data	Gáva culture		*Hansen 1994* II. 594/504.	
87.	**Sopron**		Potzmann-dűlő	H, Győr-Moson-Sopron	settlement	socketed hammer	stone	no data	Urnfield culture, Ha A – B1	clay spoon	*Polgár 2013* 74–75, Abb. 2, Abb. 4.	
88.	**Sveti-Petar**		Ludbreški	SRB, opš. Ludbreg	settlement depot	socketed axe with handle (5 pcs.), socketed axe, adze (2 pcs.), rod (2 pcs., on the backside), spearhead, knife (2 pcs.), small head set	clay	intact, parts missing	Late Urnfield culture	tuyere, corepiece	*Wanzek 1989* 199–200, Taf. 35–36, 37. 1–2.	
89.	**Szarvas**		Szarvas-8/ XXV.	H, Békés	settlement (?)	sperhead/adze (?)	unknown	parts missing	Gáva culture, Ha B1	bronze nugget fragment	*MRT 8* 476, Taf. 27. 4.	
90.	**Szécsény**		Benczúrfalva (Dolány)	H, Nógrád	stray find	pendant	unknown	no data	Piliny culture, B D – Ha A1, Kurd horizon		*Jankovits 2010* 50; *Jankovits 2017* 252, Taf. 87. 3098A–B	HNM Inv. no. 58.19.1.
91.	**Szeged-Szőreg C**		Szív utca	H, Csongrád	depot in cemetery C, pit 2	16 moulds: willowleaf-shaped pendant, rippled armring, cauldron handle, spear-head, socketed hammer, nits etc.	sandstone, soapstone	parts missing, fragmented	Gáva culture, Ha B1		*Mozsolics 1985* 196–197, Taf. 273–274; *P. Fischl 2000* Abb. 20–21; *V. Szabó 2004* 148, Abb. 5. 1–7; *Jankovits 2017* Taf. 78. 2974.	
92.	**Szombathely**		Kámon	H, Vas	settlement	rod (?)	sandstone (?)	fragmented	Tumulus/ Urnfield culture transition(?)		Unpublished. Excavation of Mária Károlyi, Gábor Bándi, Mária Fekete. 1981.	The object was recorded from the former permanent exhibition of the Savaria Museum, closed in 2015. Without inv. no.
93.	**Tăşad**	Tasádfő		RO, jud. Bihor	settlement	socketed axe with handle	unknown	fragmented	Gáva culture		*Wanzek 1989* 202, Taf. 49. 2.	
94.	**Tatabánya**		Dózsakert	H, Komárom-Esztergom	settlement, feature 8. working/ waste pit)	socketed adze, pin	sandstone	intact	Urnfield culture, Ha A1. 4 urn bur-ials with bronze objects and pottery	slag and melt (approx. 15 kgs.), stones, grindstones	*Vékony – Cseh 2001* 167; *Mészáros 2012* 7, 28–29, 38, 70, 76–77.	
94.	**Tatabánya**		Dózsakert	H, Komárom-Esztergom	feature 14, workshop	socketed axe	sandstone (?)		Urnfield culture, Ha A1	slag and melt, grindstones	*Mészáros 2012* 31, 34, 37–40.	Tatabánya Museum Inv. no. 2010.1.42.2. In the description only one mould is mentioned from feature 8.

No.	Current name	Former name	Lands/ parcel	Country, county, district	Site/find context	Object to cast	Material of the casting mould	State of the casting mould	Dating (period/culture)	Other metal-working finds	Literature	Notes
95.	**Teleac**	Telek/Telek-falva/Új-csongvaitelek		RO, jud. Alba	settlement depot	4 pcs.: socketed axe, socketed axe with small ring set and pendant(?), rippled armring, 'plant-shaped object'	sandstone (?)	parts missing, fragmented	Ha B1 - C	tuyere, raw material (ascutite)	*Ciugudean – Luca – Georgescu 2008* 43–44, Pl. XXIII. 1, 4; *Ciugudean 2015* 14, fig. 2. 1–2, 5; *Nessel 2017.*	
96.	**Tolna-Mözs**		Sági rétek (S-9 út/ III. lh.)	H, Tolna	settlement, feature 718.	large ring or pendant (2 pcs.)	unknown	no data	Urnfield culture			Recorded from a temporary exhibition in 1999.
97.	**Trenčín**	Trencsén	Istebnik	SK, okr. Trenčín	settlement	rod (?), pins	clay, sandstone	fragmented	Early Lausitz culture	tuyere	*Kujovský 2004* 370, Abb. 2. 6, 9.	
98.	**Várvölgy**		Nagyláz-hegy, Bazaltbánya	H, Zala	settlement	swordblade, spearheads (2 pcs.), axe, pin, ring	clay, sandstone	fragmented	Urnfield culture	crucibles, raw materials	*Mozsolics 2000* 88–89; Müller 2007 13; *Müller 2018* 85, fig. 2. 16a; *Ilon 2015b* Taf. 18. 3–5.	
99A.	**Vát**		Bodon tábla	H, Vas	settlement, pit 199.	ingot	graphite green slate	intact	Urnfield culture		*Ilon 2015a* 60, fig. 33. 3–4; *Ilon 2015b* Taf. 18. 8.	
99B.	**Vát**		Telekes-dűlő	H, Vas	settlement, pit 39.	pins (?)	sandstone	fragmented	Tumulus culture		Unpublished.	
100.	**Velem**		Szent Vid	H, Vas	settlement/ stray find on excavation	socketed axes with handle, adze, rings, pins, sickle, rods, beads	sandstone	intact, fragmented	Urnfield culture	crucibles, corepieces, raw materials	*Miske 1908* Taf. XXII–XXVII; *Bándi – Fekete 1984* 106, fig. 9; *Fekete 2013* Taf. II. 1; *Ilon 2015b* Taf. 18. 2, 6, 9, 12; *Ilon 2018a; Ilon 2018.*	
101.	**Vinkovci/ Vinkovce**		Tržnica	HR, Vukovarsko	tell settlement	battle-axe (Mozsolics 1967 Ac-B1a type), heart-shaped pendant, scale	clay	fragmented	Belegiš I., MD II/III., B B2–C1		*Ložnjak Dizdar 2013* 65–66, Pl. 1, Pl. 3.	
102.	**Visegrád**		Diós	H, Pest	settlement, sections I–III.	unknown	clay	fragmented	Tumulus culture, B C		*Mali 2018* 59, Pl. 2. 7.	
103.	**Vyšná Pokoradz**	Felső-pokorágy		SK, okr. Rimavská Sobota	settlement	razer	stone	intact	Piliny culture, Ha A1		*Furmánek 1977* 257, 297–298, Taf. XXXVII. 5–6.	
104A.	**Vyšný Kubín**	Felsőkubin		SK, okr. Dolný Kubín	cemetery	more than 13 pcs.; published: knives, needles, hammer, two-piece mould of a socketed axe with handle, sickles	sandstone	intact, fragmented	Lausitz culture	core	*Kubinyi 1883* 279–284; *Novotná 1980* 184, 186, Taf. 53. 1514–1515; *Furmánek – Novotná 2006* 47–48, Taf. 13. 290–291; *Jockenhövel 2018* Table 1.	
104B.	**Vyšný Kubín**	Felsőkubin	Tupá-Skala	SK, okr. Dolný Kubín	stray find, fortified Ha-period settlement	knife	sandstone	parts missing	Lausitz culture		*Chebenová 2012* 9, Taf. VI. 1.	
105.	**Zagyvaszántó**		Sósdomb	H, Heves	settlement	miniature dagger	stone	intact	Piliny culture		*Kemenczei 1984* 108, Taf. 13. 28; *Kovács 1986* Abb. 3. 2.	
106.	**Zalaszentiván**		Kisfaludi-hegy	H, Zala	settlement	spearhead, socketed axe/hangers (?)	unknown	intact	Urnfield culture		*Bóna 1958* 236, 241; *Mozsolics 1967* 101; *Száraz 2017* 3, fig. 4; *Száraz 2020* 390, Taf. 1. 6–8.	Excavation of Cs. Száraz in the Zalaegerszeg-Csács-Pethőhenye reservoir project. Recorded based on her letter in 2008.

Table 3. Late Bronze Age casting moulds of the Carpathian Basin (Croatia: HR; Hungary: H; Romania: RO; Serbia: SRB; Slovakia: SK; Slovenia: SLO)

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GÉZA SZABÓ

THE BRONZE HOARD OF MUCSI
DRESS ORNAMENTS OF A HIGH-STATUS WOMAN

Zusammenfassung: Die Studie beinhaltet weiterführende Informationen zur Veröffentlichung des Hortfundes von Mucsi (Komitat Tolna, Südwest-Ungarn), die dem besseren Verständnis jener Bronzeschätze dienen, die mit dem Volk der inkrustierten Gefäße in Verbindung gebracht werden. Die Fundansammlungen des Schatzhorizonts von Tolnanémedi aus der mittleren Bronzezeit beinhalten Schmuckstücke, die zur Tracht der zeitgenössischen Elite gehörten. Der Verfasser kommt auf Einzelheiten von Herstellungs- und Trachtenart der Gegenstände zu sprechen und schlägt einen Zusammenhang zwischen den im Sinne der früheren Forschung schwalbenschwanzförmig genannten und als Teil des Horts zutage geförderten Anhängern und den Omega-Symbolen auf Abbildungen mesopotamischer, bzw. ägyptischer Fruchtbarkeitskulte vor.

Keywords: Tolnanémedi hoard horizon, bronze hoard, fertility cult, Transdanubian Encrusted Pottery culture, Middle Bronze Age, Western Hungary

In the autumn of 1989, András Hohmann a local enthusiast came across three bronze artefacts in a ploughed field in the vicinity of Mucsi which he promptly brought to the Wosinsky Mór Museum at Szekszárd.[1] Given the artefacts' characteristics, it was feasible to assume that they belonged to a larger assemblage associated with the Transdanubian Encrusted Pottery culture disturbed by agricultural activity, therefore an archaeological investigation of the surrounding area was arranged.

Mucsi is a small *cul-de-sac* village situated on a the Tolna Hills in southern Transdanubia, at the headwaters of the Donát Stream *(fig. 1).* Separated only by a chain of hills from the main waterways of the Kapos River, this valley represents a direct link with the Sió river basin. The Mucsi-Hidas Stream, the other waterway of the village also served as a route down to the Sió (via the Völgység Stream) and from there to the Danube. This is particularly significant as the Sió River represented a boundary between the distribution areas of the Transdanubian Encrusted Pottery and the Vatya culture during the Middle Bronze Age. The hoard was found northeast of the village Mucsi on the left bank of the Donát Stream at the foot of a hill. On the hilltop above, ceramic fragments and metal artefacts were collected indicating the presence of a burial ground associated with the Encrusted Pottery culture.[2]

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2 *Kiss 2012a* catalogue site nos. 219–220.

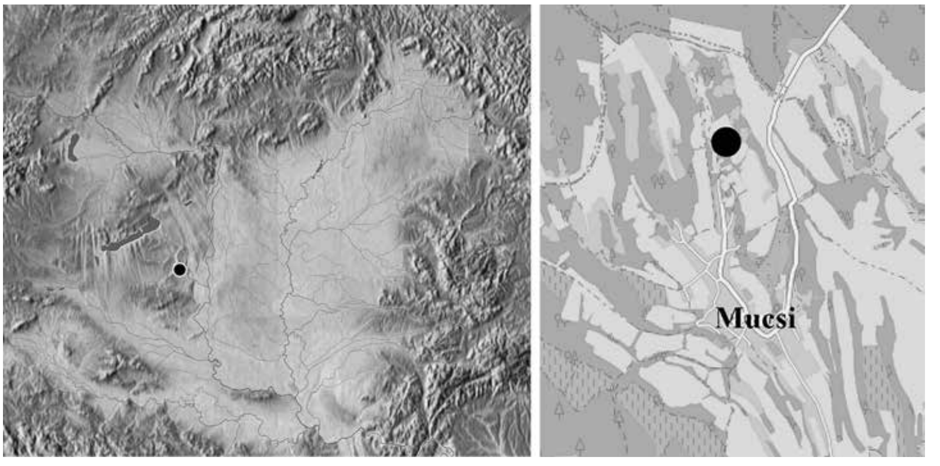

Fig. 1. The location of the Mucsi hoard (©Géza Szabó, ©Csaba Peterdi, ©Zsolt Réti)

András Hohmann showed us the exact location of the hoard in freezing weather conditions in late autumn. The close surrounding area was then investigated by the museum's own metal detector; a device developed by Hungarian engineers. Unfortunately, this did not result in a breakthrough as the grain sown in the field was treated with a chemical of high copper content distorting the signal. However, several bronze artefacts were collected from the ploughsoil evidencing past occupations. The site could only be investigated by a small evaluation trench (1 m × 5 m) at the time targeting a small scatter of ceramics found in the plough soil. The investigation yielded further bronze and ceramic fragments from the ploughed levels, but archaeological features could not be identified. Altogether 60 pieces of bronze ornaments (weighing 480.34 g) – part of an attire of a high-ranking woman – of the Encrusted Pottery culture were documented from the site.[3] Given the finding circumstances of the hoard, it is possible that the assemblage initially contained even more objects. Several artefacts came to light distorted or broken from the plough soil *(fig. 2)*. The photographs published in this paper depict these objects as they were found, while on the drawings we have tried to show their possible reconstructions *(figs. 3–4)*.

The description of the assemblage

Disc-shaped pendant with a cross rib. The object was cast in a mould with two holes added later to aid its attachment. Diameter: 5.6 cm, weight: 38.60 g (Inv. no.: WMM Ö.90.51.1; *fig. 3. 1*). There is a circular rib running parallel with the round edge, and there are additional two ribs crossing in the centre on the frontal plate of the pendant. A burr is visible at the joint where the ribs cross in the middle which was later flattened (probably by hammering) resulting in uneven edges *(fig. 5. 1)*. Furthermore, it is likely that this feature represents the truncated base of the casting sprue (or *engus* – the entry point where molten bronze was poured into the mould) since its central location. Therefore, the circular ribs along the edge of the pendant and the ones meeting in the middle were not only decorative details but could have also served as casting channels aiding the even distribution of the molten bronze. It is feasible to assume that the object was cast in a mould placed in a horizontal position with a casting sprue positioned at the centre, for best access to the casting channels. The remnants of the casting sprue were hammered down indicated by the burrs still present around its edges. The otherwise flat

[3] Wosinsky Mór Museum, Archaeological Collections, Szekszárd, Inv. nos.: WMM Ö.90.51.1–60.

Fig. 2. The Mucsi hoard following conservation (©Géza Szabó)

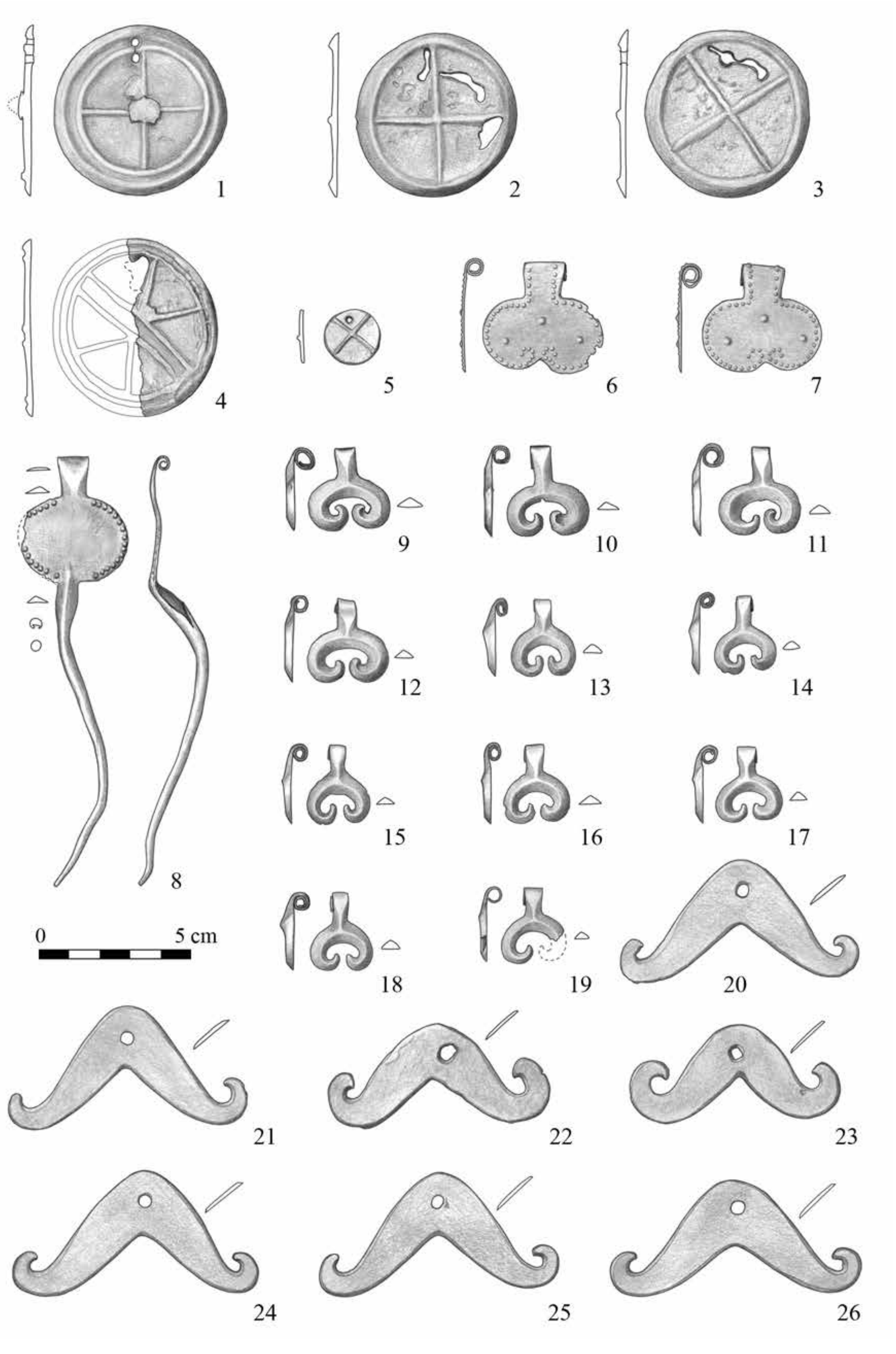

Fig. 3. The hoard of Mucsi (Inv. nos. WMM Ö.90.51.1–26) (©László Gucsi)

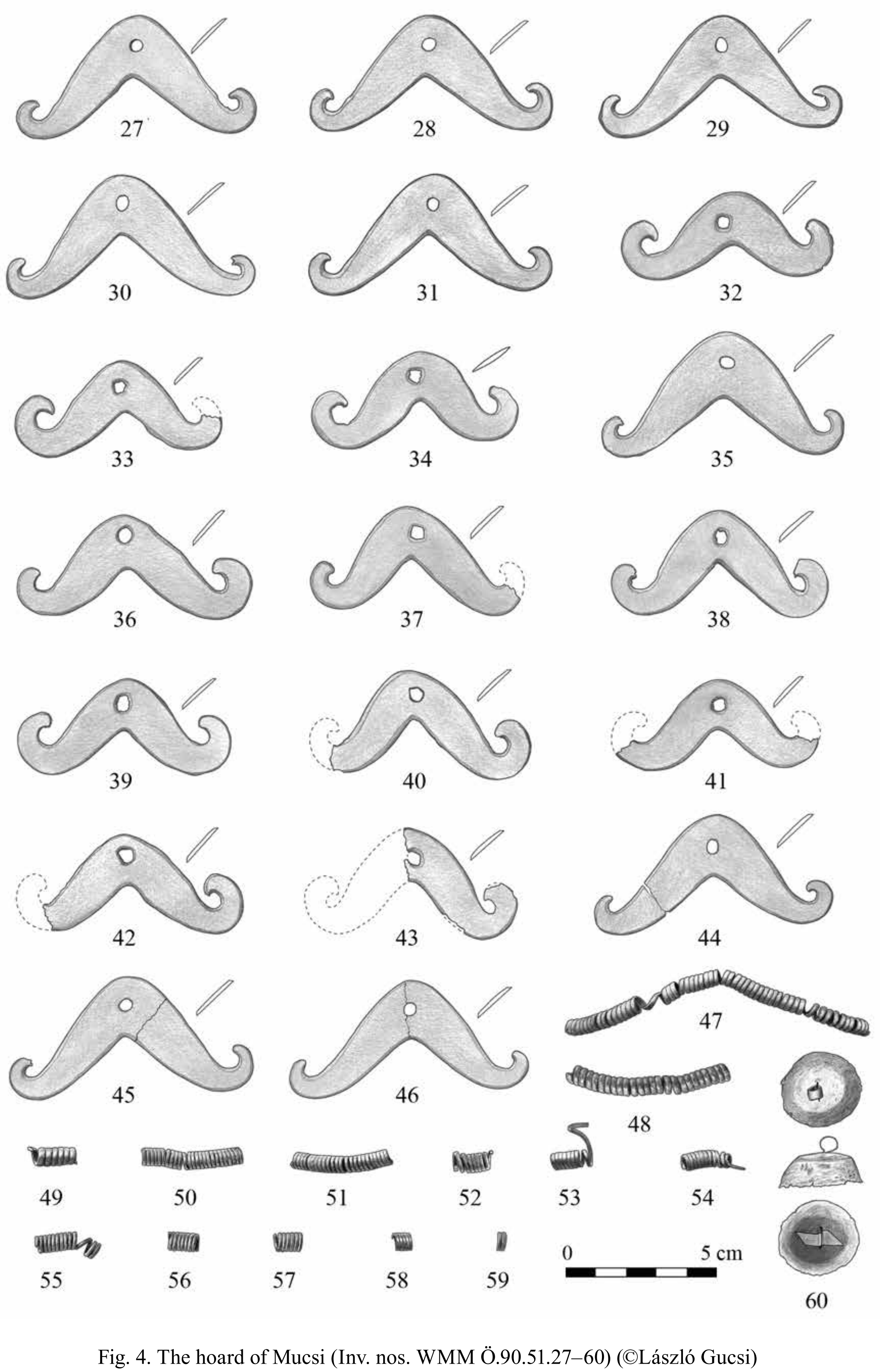

Fig. 4. The hoard of Mucsi (Inv. nos. WMM Ö.90.51.27–60) (©László Gucsi)

Fig. 5. 1. A flattened base of the casting sprue in the centre of the pendant with a burr still present around the edges (Inv. no. WMM Ö.90.51.1); 2. Additional finishing around the pierced holes on the back of the pendant (Inv. no. WMM Ö.90.51.1); 3. The 'U'-shaped indentation left by the casting sprue on the top edge of the pendant (Inv. no. WMM Ö.90.51.2); 4. Irregular clefts present in the material of the pendant (Inv. no. WMM Ö.90.51.2); 5. The 'U'-shaped indentation left by the casting sprue on the pendant's edge (Inv. no. WMM Ö.90.51.3); 6. Signs of deliberate fracture on the pendant (Inv. no. WMM Ö.90.51.4); 7. Evidence of cold-working on the shaft of the disc-headed pin below the head (Inv. no. WMM Ö.90.51.8) (©Géza Szabó)

surface of the disc is disrupted only by two pierced holes placed right next to the straight rib in the upper section of the object implying that these perforations were added later (from the front to the back). The action of perforation resulted in the creasing of the material on the back *(fig. 5. 2).*

Disc-shaped pendant with a cross rib. The placement of the ribs is slightly off centre, the casting is faulty with three irregular clefts left in the material. Diameter: 5.4 cm, weight: 22.60 g (Inv. no.: WMM Ö.90.51.2; *fig. 3. 2).* The artefact was cast in a mould positioned vertically, the molten bronze was poured in through the casting sprue *(engus).* The 'U'-shaped indentation left by the casting sprue is visible on the pendant's edge *(fig. 5. 3)*, in close proximity to the ribs running along the edge and crossing in the centre indicating that beyond their decorative function the ribs may also have served as channels to receive and spread the molten metal. In three out of the four quarter segments of the pendant the bronze did not distribute evenly and solidified forming irregular clefts, which made it possible for the object to be worn without drilling additional holes *(fig. 5. 4).* The casting fault was probably due to the incorrect sizing of the casting channels, or to the composition of the alloy or the incorrect temperature of the molten metal and/or the mould, however to establish the exact cause further scientific investigations would be required.

Disc-shaped pendant with a cross rib. The placement of the ribs is off centre, with a casting fault leaving a long, irregular cleft in the material. Diameter: 5.2 cm, weight: 24 g (Inv. no.: WMM Ö.90.51.3; *fig. 3. 3*). The artefact was cast in a mould positioned vertically, molten bronze was poured in through the casting sprue *(engus).* The 'U'-shaped indentation left by the casting sprue is visible on the pendant's edge *(fig. 5. 5),* in close proximity to the ribs running along the edge and crossing in the centre indicating that beyond their decorative and function the ribs may have also served as channels to receive and spread the molten metal. In one out of the four quarter segments of the object the material did not distribute evenly and solidified forming an irregular cleft. However, the cleft on its own was not large enough for a cord to pass through, therefore it was widened by drilling from both the front and the back. The size, decoration and slightly off-centre ribs indicate that it was cast in the same mould as pendant WMM Ö.90.51.2, further supported by only the fractional difference in the pendants' weight.

Disc-shaped pendant with a cross rib, broken into half. Two parallel ribs run along the pendant's round edge and across its centre. Four additional ribs (two in each half) divide the frontal plate into six segments. A fault in the casting left at least one irregular cleft in the material. Diameter: 5.7 cm, weight: 10.55 g (Inv. no.: WMM Ö.90.51.4; *fig. 3. 4*). The artefact was cast in a mould positioned vertically, the ribs running along the pendant's edge and crossing in the centre could have also served as casting channels to receive and spread the molten metal evenly. However, in at least one segment of the pendant the material did not spread evenly and solidified forming an irregular cleft *(fig. 5. 6).* A sharp edge left by the fracture on both sides indicates that the object was folded and then broken deliberately.

Small, disc-shaped pendant with a cross rib. The cross ribs on the frontal plate divide the pendant into four segments. There is a small hole pierced in one of the sections. Cast piece. Diameter: 1.75 cm, weight: 1.9 g (Inv. no.: WMM Ö.90.51.5; *fig. 3. 5*).

Heart-shaped pendant. Small, impressed dots running along the pendant's edge, including the hanger part which was folded twice. The impressed dots stop at the bottom between the two semi-circular lobes, and curve backwards forming a spiral. There are three larger impressed dots (impressions were made from the back) visible on the frontal plate of the object. Height: 3.6 cm, width: 3.9 cm, weight: 5.4 g (Inv. no.: WMM Ö.90.51.6; *fig. 3. 6*).

Heart-shaped pendant. Small, impressed dots running along the pendant's edge, including the hanger part which was folded twice. The impressed dots stop at the bottom between the two semi-circular lobes, and curve backwards forming a spiral. There are three larger impressed dots (impressions were made from the back) visible on the frontal plate of the object. Height: 3.5 cm, width: 3.8 cm, weight: 5.69 g (Inv. no.: WMM Ö.90.51.7; *fig. 3. 7*). It could have been cast using the same mould as the previously described pendant (WMM Ö.90.51.6).

Disc-headed pin. A line of small, impressed dots run along the edges of the round disc-head that continue on the folded hanger part too. Length: 14 cm, width of the disc-head: 3.7 cm, weight: 16.16 g (Inv. no.: WMM Ö.90.51.8; *fig. 3. 8*). The pin was shaped by hammering and cold-working following the casting process, traces of which are clearly visible on the pin's shaft. The disc-head was probably cast into a round shape initially and hammered into a disc later *(fig. 5. 7)*. It is likely that the hanger part may have served as a casting sprue, and was later worked into a flat sheet then folded up. The use of a single-sided mould, covered by a flat lid for the casing caused the shaft of the pin to be flat on one side, which was then hammered into a cylindrical shape. This is clearly evidenced on the shaft below the disc-head where the material creased and the cracked lengthways.

Crescent-shaped pendant. The object consists of two segments, the two arms bend inwards, towards the centre forming three quarters of a circle. It was cast, the casting sprue had been hammered into a hanger which was folded twice. Height: 2.7 cm, width: 2.6 cm, weight: 6.11 g (Inv. no.: WMM Ö.90.51.9; *fig. 3. 9*).

Crescent-shaped pendant. The artefact consists of two segments, the two arms bend inwards, towards the centre forming two thirds of a circle. It was cast, the casting sprue had been hammered into a hanger which was folded twice. Height: 2.9 cm, width: 2.7 cm, weight: 6.1 g (Inv. no.: WMM Ö.90.51.10; *fig. 3. 10*).

Crescent-shaped pendant. The two arms of the object bend inwards, towards the centre forming two thirds of a circle. The pendant was cast, and the casting sprue hammered into a hanger then folded twice. Height: 2.9 cm, width: 2.7 cm, weight: 5.63 g (Inv. no.: WMM Ö.90.51.11; *fig. 3. 11*). Since its weight and the slight asymmetry in shape is almost identical to pendant WMM Ö.90.51.10, it is likely that the same mould was used for casting this object as well.

Crescent-shaped pendant. The two arms of the object bend inwards, towards the centre forming two thirds of a circle. The pendant was cast, and the casting sprue hammered into a hanger then folded twice. Height: 2.7 cm, width: 2.7 cm, weight: 5 g (Inv. no.: WMM Ö.90.51.12; *fig. 3. 12*). Since its weight and the slight asymmetry in shape is almost identical to pendant WMM Ö.90.51.9, it is likely that the same mould was used for casting this object as well.

Crescent-shaped pendant. The two arms of the object bend inwards, towards the centre forming two thirds of a circle. The pendant was cast, and the casting sprue hammered into a hanger then folded once and a half. Height: 2.5 cm, width: 2.2 cm, weight: 4.36 g (Inv. no.: WMM Ö.90.51.13; *fig. 3. 13*).

Crescent-shaped pendant. The two arms of the object bend inwards, towards the centre forming two thirds of a circle. The pendant was cast, and the casting sprue hammered into a hanger then folded twice. Height: 2.8 cm, width: 2.9 cm, weight: 4.63 g (Inv. no.: WMM Ö.90.51.14; *fig. 3. 14*).

Crescent-shaped pendant. The two arms of the object bend inwards, towards the centre forming two thirds of a circle. The pendant was cast, and the casting sprue hammered into a hanger. Height: 2.1 cm, width: 2.6 cm, weight: 3.7 g (Inv. no.: WMM Ö.90.51.15; *fig. 3. 15*).

Crescent-shaped pendant. The two arms of the object bend inwards, towards the centre forming two thirds of a circle. The pendant was cast, and the casting sprue hammered into a hanger then folded once and a half. Height: 2.5 cm, width: 2.2 cm, weight: 4.09 g (Inv. no.: WMM Ö.90.51.16; *fig. 3. 16*). Since its weight and the slight asymmetry in shape is almost identical to pendants WMM Ö.90.51.17–18, it is likely that the same mould was used for casting this object as well. The weight is similar to pendants WMM Ö.90.51.13–15. too.

Crescent-shaped pendant. The two arms of the object bend inwards, towards the centre forming two thirds of a circle. The pendant was cast, and the casting sprue hammered into a hanger then folded once and a half. Height: 2.5 cm, width: 2.2 cm, weight: 3.97 g (Inv. no.: WMM Ö.90.51.17; *fig. 3. 17).*

Crescent-shaped pendant. The two arms of the object bend inwards, towards the centre forming two thirds of a circle. The pendant was cast, and the casting sprue hammered into a hanger then folded once and a half. Height: 2.5 cm, width: 2.1 cm, weight: 4.8 g (Inv. no.: WMM Ö.90.51.18; *fig. 3. 18*).

Crescent-shaped pendant. The two arms of the object bend inwards, towards the centre forming two thirds of a circle. The pendant was cast, and the casting sprue hammered into a hanger then folded once and a half. Height: 2.5 cm, width: 2.7 cm, weight: 3.34 g (Inv. no.: WMM Ö.90.51.19; *fig. 3. 19*).

Omega-shaped pendant.[4] Thin, cast metal sheet, intact. Height: 3.8 cm, width: 7.9 cm, weight: 12.11 g (Inv. no.: WMM Ö.90.51.20; *fig. 3. 20*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later. It is very similar in shape to pendants WMM Ö.90.51.21–31, thus it is likely that it was cast using the same mould as for pendants WMM Ö.90.51.24–27, and WMM Ö.90.51.29–31. Pendants WMM Ö.90.51.22–23. were cast in different moulds given the curvature of their stems. Furthermore, there is a difference in weight as well, pendant WMM Ö.90.51.28. is heavier than the rest, while pendants WMM Ö.90.51.22– 23. are much lighter.

Omega-shaped pendant. Thin, cast metal sheet, bent. Height: 3.8 cm, width: 7.9 cm, weight: 12.00 g (Inv. no.: WMM Ö.90.51.21; *fig. 3. 21*). There is an irregular shaped hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, bent. Height: 3 cm, width: 7.4 cm, weight: 9.07 g (Inv. no.: WMM Ö.90.51.22; *fig. 3. 22*). There is a slightly squarish shaped hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, bent. Height: 3 cm, width: 6.9 cm, weight: 8.73 g (Inv. no.: WMM Ö.90.51.23; *fig. 3. 23*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, bent. Height: 3.5 cm, width: 6.8 cm, weight: 11.89 g (Inv. no.: WMM Ö.90.51.24; *fig. 3. 24*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, intact. Height: 3.8 cm, width: 7.9 cm, weight: 12.03 g (Inv. no.: WMM Ö.90.51.25; *fig. 3. 25*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, bent. Height: 3.4 cm, width: 7.9 cm, weight: 12.19 g (Inv. no.: WMM Ö.90.51.26; *fig. 3. 26*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

[4] This object type is referred to as swallowtail-shaped pendant *(Schwalbenschwanzförmige Anhänger)* in the archaeological literature (cf. *Kiss 2012a; Honti – Kiss 2013).*

Omega-shaped pendant. Thin, cast metal sheet, bent. Height: 3.6 cm, width: 7.9 cm, weight: 12.59 g (Inv. no.: WMM Ö.90.51.27; *fig. 4. 27*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, slightly bent. Height: 3.6 cm, width: 7.9 cm, weight: 13.00 g (Inv. no.: WMM Ö.90.51.28; *fig. 4. 28*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, slightly bent. Height: 3.6 cm, width: 7.9 cm, weight: 11.61 g (Inv. no.: WMM Ö.90.51.29; *fig. 4. 29*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, slightly bent on the right-hand side. Height: 3.6 cm, width: 6.8 cm, weight: 12.05 g (Inv. no.: WMM Ö.90.51.30; *fig. 4. 30*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, slightly bent on the left-hand side. Height: 3.5 cm, width: 7.2 cm, weight: 12.72 g (Inv. no.: WMM Ö.90.51.31; *fig. 4. 31*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, folded. Height: 2.7 cm, width: 5.9 cm, weight: 8.32 g (Inv. no.: WMM Ö.90.51.32; *fig. 4. 32*). There is a round hole that shifted slightly to the right of the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later. Pendants WMM Ö.90.51.32–46. are clearly different from the ones described above since their smaller size. Unfortunately, the majority of these objects are broken, bent or incomplete, therefore the characteristics of their casting and the mould used to produce them cannot be studied closely (however, given their weight around 8 grams, it is possible that pendants WMM Ö.90.51.31–34., and WMM Ö.90.51.36–41. were cast using the same mould – *fig. 6*). Especially, that in certain cases the difference in size can be as large as 50% (such as in the instance of pendant WMM Ö.90.51.35).

Omega-shaped pendant. Thin, cast metal sheet, the stem on the right-hand side is missing. Height: 2.7 cm, width: 7 cm, weight: 8.12 g (Inv. no.: WMM Ö.90.51.33; *fig. 4. 33*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, bent. Height: 3 cm, width: 6.5 cm, weight: 7.89 g (Inv. no.: WMM Ö.90.51.34; *fig. 4. 34*). There is a irregular shaped hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, folded multiple times. Height: 2.7 cm, width: 5.5 cm, weight: 12.44 g (Inv. no.: WMM Ö.90.51.35; *fig. 4. 35*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, folded once. Height: 4 cm, width: 2.4 cm, weight: 9.15 g (Inv. no.: WMM Ö.90.51.36; *fig. 4. 36*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, bent. Height: 4 cm, width: 2.8 cm, weight: 8.04 g (Inv. no.: WMM Ö.90.51.37; *fig. 4. 37*). There is a round hole that shifted slightly to the right of

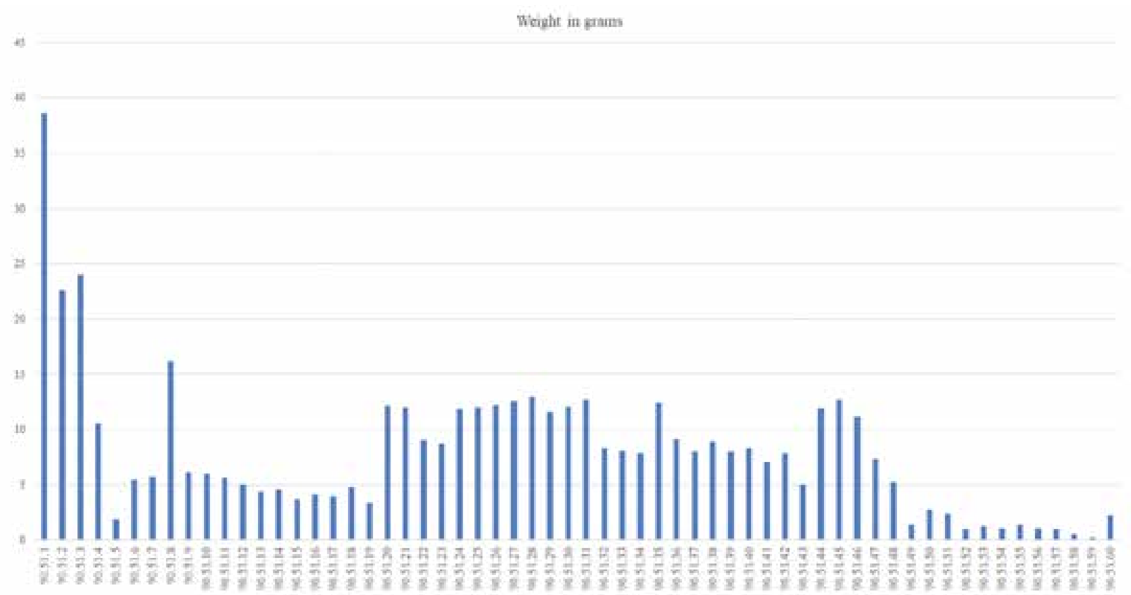

Fig. 6. The weight of each artefact contained by the Mucsi hoard
(data by Viktória Kiss, diagram ©Géza Szabó)

the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, bent. Height: 3 cm, width: 6.8 cm, weight: 8.93 g (Inv. no.: WMM Ö.90.51.38; *fig. 4. 38*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, folded multiple times. Height: 3 cm, width: 5.5 cm, weight: 8.03 g (Inv. no.: WMM Ö.90.51.39; *fig. 4. 39*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, bent, its stem on the left-hand side is missing. Height: 3 cm, width: 5.5 cm, weight: 8.32 g (Inv. no.: WMM Ö.90.51.40; *fig. 4. 40*). There is a round hole that shifted slightly to the right of the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, bent, the ends of both stems are missing. Height: 3.1 cm, width: 3.7 cm, weight: 7.07 g (Inv. no.: WMM Ö.90.51.41; *fig. 4. 41*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, bent, the end of the stem on the left-hand side is missing. Height: 3 cm, width: 6.5 cm weight: 7.91 g (Inv. no.: WMM Ö.90.51.42; *fig. 4. 42*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, bent, the stem on the left-hand side is missing. Height: 3.5 cm, width: 4.2 cm, weight: 5.03 g (Inv. no.: WMM Ö.90.51.43; *fig. 4. 43*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, broken into two halves. Height: 3.8 cm, width: 7.9 cm, weight: 11.09 g (Inv. no.: WMM Ö.90.51.44A–B; *fig. 4. 44*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, broken into two halves. Height: 3.8 cm, width: 7.9 cm, weight: 12.69 g (Inv. no.: WMM Ö.90.51.45A–B; *fig. 4. 45*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Omega-shaped pendant. Thin, cast metal sheet, broken into two halves. Height: 3.8 cm, width: 7.9 cm, weight: 11.18 g (Inv. no.: WMM Ö.90.51.46A–B; *fig. 4. 46*). There is a round hole placed along the central axis on the upper part of the pendant, which seems to have been part of the casting process, its rough edges filed down later.

Fragment of a tubular spiral bead. Made of a flat strip of bronze wire coiled into a cylindrical spiral. Diameter: 6 mm, length: 8.1 cm, weight: 7.32 g (Inv. no.: WMM Ö.90.51.47; *fig. 4. 47*).

Fragment of a tubular spiral bead. Made of a flat strip of bronze wire coiled into a cylindrical spiral. Diameter: 6 mm, length: 5.1 cm, weight: 5.22 g (Inv. no.: WMM Ö.90.51.48; *fig. 4. 48*).

Fragment of a tubular spiral bead. Made of a flat strip of bronze wire coiled into a cylindrical spiral. Diameter: 6 mm, length: 1.3 cm, weight: 1.38 g (Inv. no.: WMM Ö.90.51.49; *fig. 4. 49*).[5]

Fragment of a tubular spiral bead. Made of a flat strip of bronze wire coiled into a cylindrical spiral. Diameter: 5.5 mm, length: 3.4 cm, weight: 2.81, g (Inv. no.: WMM Ö.90.51.50; *fig. 4. 50*).

Fragment of a tubular spiral bead. Made of a flat strip of bronze wire coiled into a cylindrical spiral. Diameter: 5.5 mm, length: 3.4 cm weight: 2.35 g (Inv. no.: WMM Ö.90.51.51; *fig. 4. 51*).[6]

Fragment of a tubular spiral bead. Made of a flat strip of bronze wire coiled into a cylindrical spiral. Diameter: 6 mm, length: 1.65 cm, weight: 1 g (Inv. no.: WMM Ö.90.51.52; *fig. 4. 52*).

Fragment of a tubular spiral bead. Made of a flat strip of bronze wire coiled into a cylindrical spiral. Diameter: 6 mm, length: 1.3 cm, weight: 1.26 g (Inv. no.: WMM Ö.90.51.53; *fig. 4. 53*).

Fragment of a tubular spiral bead. Made of a flat strip of bronze wire coiled into a cylindrical spiral. Diameter: 5.3 mm, length: 2.1 cm, weight: 1.05 g (Inv. no.: WMM Ö.90.51.54; *fig. 4. 54*).

Fragment of a tubular spiral bead. Made of a flat strip of bronze wire coiled into a cylindrical spiral. Diameter: 6 mm, length: 2.1 cm, weight: 1.40 g (Inv. no.: WMM Ö.90.51.55; *fig. 4. 55*).

Fragment of a tubular spiral bead. Made of a flat strip of bronze wire coiled into a cylindrical spiral. Diameter: 6 mm, length: 1 cm, weight: 1.07 g (Inv. no.: WMM Ö.90.51.56; *fig. 4. 56*).

Fragment of a tubular spiral bead. Made of a flat strip of bronze wire coiled into a cylindrical spiral. Diameter: 6 mm, length: 0.8 cm, weight: 1.97 g (Inv. no.: WMM Ö.90.51.57; *fig. 4. 57*).

Fragment of a tubular spiral bead. Made of a flat strip of bronze wire coiled into a cylindrical spiral. Diameter: 5.5 mm, length: 0.6 cm, weight: 0.52 g (Inv. no.: WMM Ö.90.51.58; *fig. 4. 58*).

Fragment of a tubular spiral bead. Made of a flat strip of bronze wire coiled into a cylindrical spiral. Diameter: 5.5 mm, length: 0.25 cm, weight: 0.23 g (Inv. no.: WMM Ö.90.51.59; *fig. 4. 59*).

Bronze stud with a hanger. The stud was made of a bronze sheet hammered into a hemispherical shape. The hanger was shaped from a thin bronze strip and was threaded through the opening on the top of the stud before securing the ends on the interior. It is possible that it could have functioned as a little bell.[7] Diameter: 2.6 cm, weight: 2.23 g (Inv. no.: WMM Ö.90.51.60; *fig. 4. 60).*

[5] The width and the colour of the patina suggests that fragments WMM Ö.90.51.48–49. were originally part of the same artefact.

[6] The width and the colour of the patina suggests that WMM Ö.90.51.51, Ö.90.51.54, Ö.90.51.56–59. belonged to the same object.

[7] Based on its shape and manufacturing technique it is possible that it was not part of the assemblage but belonged to a later chronological horizon.

Technological observations

All 60 items contained by the hoard were made of bronze.[8] In terms of their manufacturing technologies the ornaments can be divided into two groups: 1) hammered objects: tubular spiral beads, studs, disc-headed pin, and 2) cast artefacts: heart-, crescent-, and omega-shaped pendants. Among the disc-shaped pendants with a cross rib there is one which was cast in a horizontally positioned mould (while the rest was cast vertically). The joint of the ribs in the centre of pendant WMM Ö.90.51.1. (frontal page) was hammered down following the casting, indicated by the burrs left behind *(fig. 5. 1)*, which may have also been the spot where the casting spure was fitted. This is further supported by its central location and the lack of evidence for a casting sprue *(engus)* elsewhere on the pendant. However, it is possible that a particular fault which occurred during the casting process was later rectified this way. The pendant is significant since so far all the artifacts linked to this metallurgical horizon were cast in a vertical position. Further archaeometallurgical examinations required to explore the exact stages of casting processes – here, I could only draw attention to this unusual detail.

Typological and chronological interpretation

Several object types contained by the Mucsi assemblage – such as the tubular spiral beads – are generic forms utilised widely across a large geographical area throughout the entire span of the Early Bronze Age.[9] However, there were a number of ornament types typically in use in the regions west of the Danube. Disc-shaped pins[10] for instance can be found in the Vatya culture's territories as well,[11] although their use was more characteristic within the distribution of the Gáta–Wieselburg culture.[12] This overlap in preferences has been observed before by other researchers,[13] a detail that is even more significant in light of the Gáta–Wieselburg community's taste for Dentalium shell necklaces (i.e. molluscs that continue to inhabit the Atlantic and the North Sea, but also occur in Miocene geological strata in Austria)[14] just like the one documented from Bonyhád, the site associated with the Transdanubian Encrusted Pottery culture.[15] Heart-shaped pendants were described by István Bóna as the products of the early Vatya culture's sheet-working metallurgical tradition, a technique which then spread into neighbouring cultural complexes as well.[16] Bóna assumed similar origins and distribution for the cast, crescent-shaped pendants too.[17] Based on this the chronological classification of hoards containing crescent-shaped

[8] Supported by the preliminary XRF examinations carried out by the research group led by Wayne Powell and Arthur Bankoff (City University of New York, Department of Earth and Environmental Science, USA, in July, 2022). The detailed data concerning the composition of the objects will be published after all non-destructive examinations are completed, the data cleaned and evaluated accordingly.

[9] The research history and typological questions of the Encrusted Pottery culture's metallurgy have been discussed in detail by Viktória Kiss in several studies in recent years (*Kiss 2012a* 89–150; *Kiss 2013*), therefore in this paper I focus on the production, utilisation and the potential meaning of the Mucsi ornaments only.

[10] Disc-headed pins were documented in six assemblages of the Encrusted Pottery culture; from burials at Gyirmót-Kölesdomb, Simontornya, and Szekszárd-Vígh telek; and from hoards at Esztergom-Ispita-hegy, Ipoly Valley, and Zalaszabar (*Kiss 2012a* 123).

[11] E.g. Kisapostag, Dunakeszi, Dunaújváros. *(Mozsolics 1942; Bóna 1975* Taf. 55. 5, 13, Taf. 80. 7).

[12] E.g. Gáta, Oroszvár *(Bóna 1975* Taf. 275. 1–2, Taf. 277. 1–3, Taf. 280. 21, Taf. 281. 3).

[13] *Mozsolics 1967* 70–71.

[14] *Nagy – Figler 2009.*

[15] *Szabó 2010* 102, 104, T. 3, inhumation burials nos. 156 and 200.

[16] *Bóna 1975* 54–55, 285–286.

[17] *Bóna 1975* 284–285.

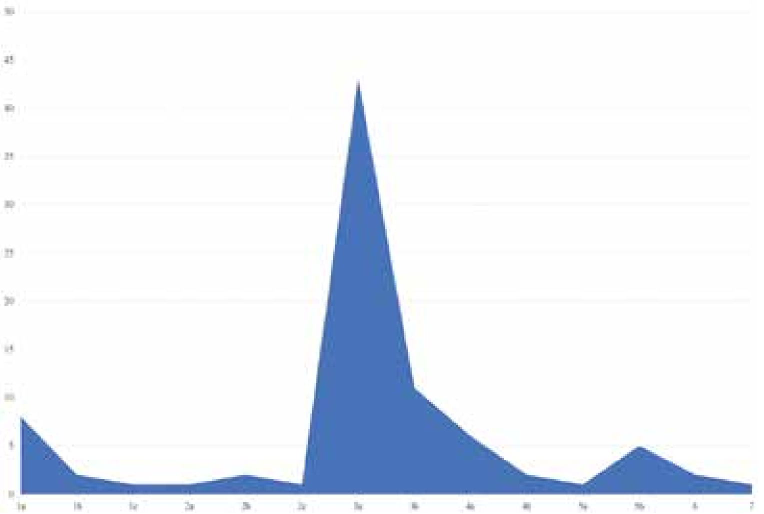

Fig. 7. Types of disc-shaped pendants in various hoards (after *Kiss 2012a* fig. 32, diagram ©Géza Szabó)

pendants and the use of these ornaments can be considered in a broad time frame stretching from the Vatya I period[18] to the Koszider phase in the distribution of the Encrusted Pottery culture.[19]

The minor differences in the shape and decoration of the crescent- and omega-shaped pendants contained by the Mucsi assemblage indicate that at least two moulds were used for casting these ornaments. This is most apparent in the length of the hanger parts and the position of the holes.

Disc-shaped pendants with a cross rib are thought to be the characteristic object types of the Encrusted Pottery culture.[20] Most recently Szilvia Honti and Viktória Kiss distinguished six groups of disc-shaped pendants which were later divided into 13 subtypes based on their shapes and decorations.[21] Two of the Mucsi hoard's disc-shaped pendants (WMM Ö.90.51.2–3) correspond with the Honti–Kiss 3a type, and one (WMM Ö.90.51) with 3b type. On a pendant broken into half the pattern on the frontal plate was divided into six segments (instead of four quarters), which so far stands without an analogue. Therefore, I suggest to add this seventh type to the already existing catalogue.[22] It is apparent from the analyses that pendants over 40 mm diameter occur in various forms, but more than two thirds of them belong to group 3, with cross ribs dividing the frontal plate into four quarters *(figs. 7–8)*. The number of disc-shaped pendants in hoards ranges between three and six on average, only the assemblage of Bonyhád (8 pieces),[23] and Zalaszabar (11 pieces)[24] contained more *(fig. 9)*. However, even in the case of the Zalaszabar hoard, there were four different types of disc-shaped pendants documented. This suggests – as it has been observed in relation to the crescent- and omega-shaped pendants – that the discs were produced in small batches, the same mould was used for producing a small number of ornaments.[25] This indicates several possible scenarios; firstly that within the distribution of the Encrusted Pottery culture, metallurgical production was low-scale and sporadic, generating only small batches of objects. Small, temporary metal workshops could be assumed, perhaps

18 *Vicze 2011* 219, Pl. 75. 11–14.

19 *Bóna 1975* 214–220; *Mozsolics 1967* 124–125; *Kiss 2013; Kiss 2012a* 89.

20 *Bóna 1975* 214–220.

21 *Honti – Kiss 2000* Abb. 4; *Kiss 2012a* 97–101, fig. 32.

22 *Kiss 2012a* fig. 32.

23 *Hänsel – Hänsel 1997* 112–113.

24 *Honti – Kiss 2013.*

25 In the case of the Zalaszabar hoard which contained 11 disc-shaped pendants, only four could have been cast in the same mould. Compositional analyses carried out on the ornaments indicated that the majority of them were produced at different times and assembled as a hoard at a later point (*Kiss 2012b* fig. 2; *Kiss – Barkóczy – Vízer 2013* 79, fig. 3).

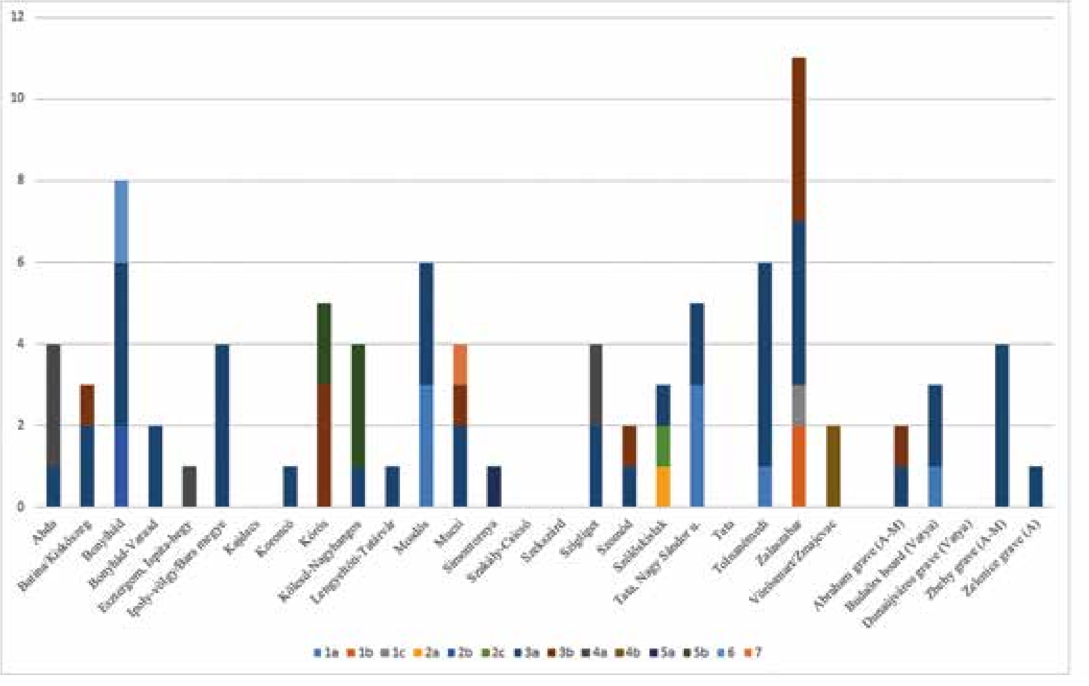

Fig. 8. The typological distribution of disc-shaped pendants
(after *Kiss 2012a* fig. 32, (A): Aunjetitz/Únětice, (A-M): Aunjetitz/Únětice-Maďarovce;
diagram ©Géza Szabó)

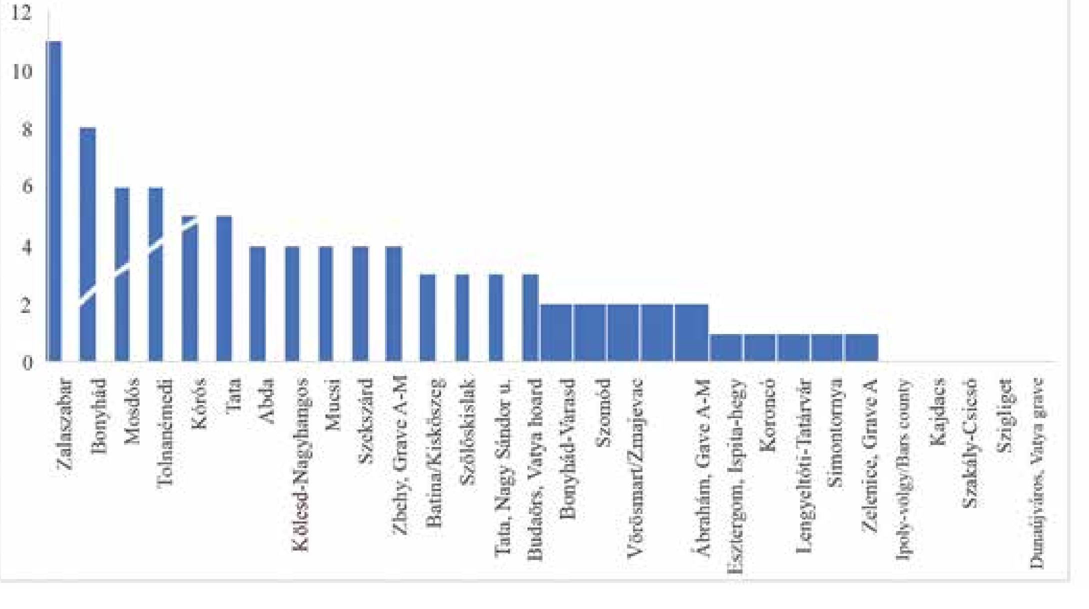

Fig. 9. The number of disc-shaped pendants in various hoards
(after *Kiss 2012a* fig. 32, diagram ©Géza Szabó)

with itinerant craftspeople manufacturing specific artefacts suitable for local tastes,[26] such as disc-, omega-shaped pendants and the so-called anthropomorphic or comb-shaped ornaments occurring in assemblages. Secondly, in the case of the Mucsi hoard, it is very likely that at least two disc-shaped pendants were cast using the same mould (WMM Ö.90.51.2–3); these objects stand without analogues so far. Therefore, it is feasible to assume that within the distribution of the Encrusted Pottery culture disc-shaped pendants – and other artefacts associated with the population – reflect a collective preference, expectation and a system of beliefs manifesting through these ornaments, while the pieces were tailored and manufactured for the rank or personality of a specific individual. This assumption is further supported by the relatively similar composition of hoards directly associated with the Encrusted Pottery culture.

So far about two dozen hoards similar to the Mucsi assemblage are known from the territory of Hungary. The characteristic set of objects repeatedly occurring in these hoards suggests that the items were selected and deposited deliberately, probably linked to a certain event, rather than scampered together and hidden in a haste.[27] Furthermore, the similarity between the ornaments themselves within each hoard across a large geographical area indicates that the artefacts were not only decorative items but were assembled according to a set of rules and conveyed a particular meaning to their owner's social environment.

Archaeometallurgical analyses have shown evidence for secondary heat exposure on certain ornament types, indicating that these pieces were part of the funerary attire or shroud and were placed on the pyre with the deceased,[28] while there were other types where the hardness indicators signalled no evidence for secondary burning.[29] The archaeological examination of hoards and contemporary bronze grave goods have demonstrated that there is only a partial overlap between the composition of hoards and mortuary assemblages. Heart-shaped pendants for instance occurred both in the Zalaszabar hoard[30] and along the cremation burials of Bonyhád (BB114QJ4, BB114QJ17),[31] but despite of belonging to the same typological cluster, there were significant differences in the biographies of these objects: while the heart-shaped pendant in the hoard was exposed to high temperatures due to the manufacturing techniques involved in its production, the piece found along a cremation burial has shown signs for secondary burning. The latter exposure can clearly be linked to the process of the cremation, and it also indicates that the deceased was placed on the funerary pyre wearing his/her ornaments. In the light of this, the following question can be raised: did assemblages such as the Mucsi hoard contain items which were treated separately even during the mortuary process, and if so, what could have been the possible reason for it?

Inhumation burials – which on rare occasions occur in cemeteries of a community that otherwise followed the tradition of cremation as their normative mortuary rite – and anthropomorphic clay figurines have the potential to shed more light on ways these ornaments were worn in the Bronze Age. According to these, the small studs were worn on the head (probably attached to a strap, hat or a scarf), the heart- and crescent-shaped pendants along with the tubular spiral beads ornamented the neck area, while the disc-headed pin could have held the garment together on the shoulders.[32] The disc- and omega-shaped pendants were sewn onto or were hung from the garment indicated

[26] *Bóna 1975* 214–220. The presence of moulds implies a local workshop, e.g. at the site of Mucsi (Lengyel)-Sánc (*Kiss 2012a* fig. 37. 1–2).

[27] The more recently discovered hoards support Viktória Kiss' observation that the Tolnanémedi-type hoards were deposited farther away from settlement sites but still in the surrounding areas of habitation (*Kiss 2012a* 146–147).

[28] *Kovács et al. 2019.*

[29] *Kiss – Barkóczy – Vízer 2013* 80.

[30] *Kiss 2012a* Pl. 62. 2–14, fig. 2.

[31] *Kovács et al. 2019* 187, figs. 8–9.

[32] *Kiss 2012a* 111–112; *Szabó – Hajdu 2011* figs. 6–7.

by their small holes. It is intriguing, however, that the omega-shaped pendants occur very rarely in burials, while other components of hoards (head and neck ornaments: studs, heart- and crescent-shaped pendants, tubular spiral beads, neck rings with spiral ends) are found regularly along with cremations at Bonyhád (BBQ235J2).[33] A similar trend can be outlined for the entire distribution of the Encrusted Pottery culture in Transdanubia: disc-shaped and omega-shaped pendants were scarcely part of the funerary attire or placed in the grave with the deceased.[34]

History of wear and the meaning of ornaments

The examinations which compared the physical anthropological information of the Bonyhád individuals and the decorative motifs on their ceramic grave goods have shown that the depictions on the mortuary vessels corresponded surprisingly well with the age, sex and social standing of their owners. Thus, it may be considered that these decorated vessels depicted the deceased and his/her main social attributes. The consistent use and placement of certain symbols on mortuary vessels could be regarded as a kind of 'script' and was probably widely understood in the community, testified by numerous archaeological assemblages.[35] Some of these depictions are easy to identify (body parts, ornament types: *fig. 10*) while others are more obscure.

Therefore, it seems important to examine the culturally specific ornament types of the Mucsi hoard within the symbolic context of the Encrusted Pottery culture; their possible meaning(s) and the messages these artefacts conveyed. Given their characteristic form, the disc- and omega-shaped pendants are relatively easy to identify on depictions. This also raises the question: is it possible that the role of disc- and omega-shaped pendants stretched beyond being signifiers of economic/social ranks? Could it be that the combinations and different configurations of these ornaments were strictly prescribed by the community reflecting the status and identity of their owners? Given the symbolic framework depicted on the ceramic vessels, could the messages be still comprehensible to us in the 21st century?

The majority of depictions featuring disc- and omega-shaped pendants (*fig. 11:* HI7, MV4i1, MV5n, MV5o, MV5p, MV6i, MV6j, MV7ja, MV7g1, MV7g2, MVII6k, MVX1ab, MXIII8b2, SVI4) – occurring on mortuary ceramic vessels and anthropomorphic figurines – illustrate these ornaments on the waist or attached to a skirt.[36] On closer examination, it becomes clear that the use of these two pendant types were linked to each other and seem to form a symbolic unit. The row of several omega-shaped pendants was hung vertically and usually closed by a single disc-shaped pendant. The number of omega-shaped pendants in a vertical row ranges between two and eight, the number of rows can vary between one and three. Sometimes the rows finish in two discs (MV4i1, MV5n, MV6j, MV7g1, MVII6k). It is apparent however, that the number of components and their combinations only loosely adhered to a pattern, and it is not as consistent as it would be expected, for example, of a calendar.

The interpretation of the Mucsi hoard is further hindered by the nomenclature of the omega-shaped pendants used in the archaeological literature. These pieces – as opposed to ornament types like the crescent-shaped pendants whose form can directly be associated with a universally recognisable phenomenon – are described by a number of different terms such as anchor-, swallowtail- or mustache-shaped pendants, while their function and potential roles remain

[33] *Szabó 2010* Tab. 4. 2; *Kovács et al. 2019* fig. 2.
[34] *Kiss 2012a* 103, Pl. 63. 7–9: Vörs-Papkert, burial „B" CXI.
[35] *Sørensen – Rebay-Salisbury 2008* fig. 6; *Szabó – Hajdu 2011* figs. 6–7; *Hajdu et al. 2016* fig. 7.
[36] *Reich 2006; Hajdu et al. 2016* fig. 7; *Kiss 2019* fig. 4.

Fig. 10. Depiction of a neck ring with spiral ends *(Ösenhalsring)* on the neck of an urn (Bonyhád, Biogáz üzem/Biogas Factory) (©Géza Szabó)

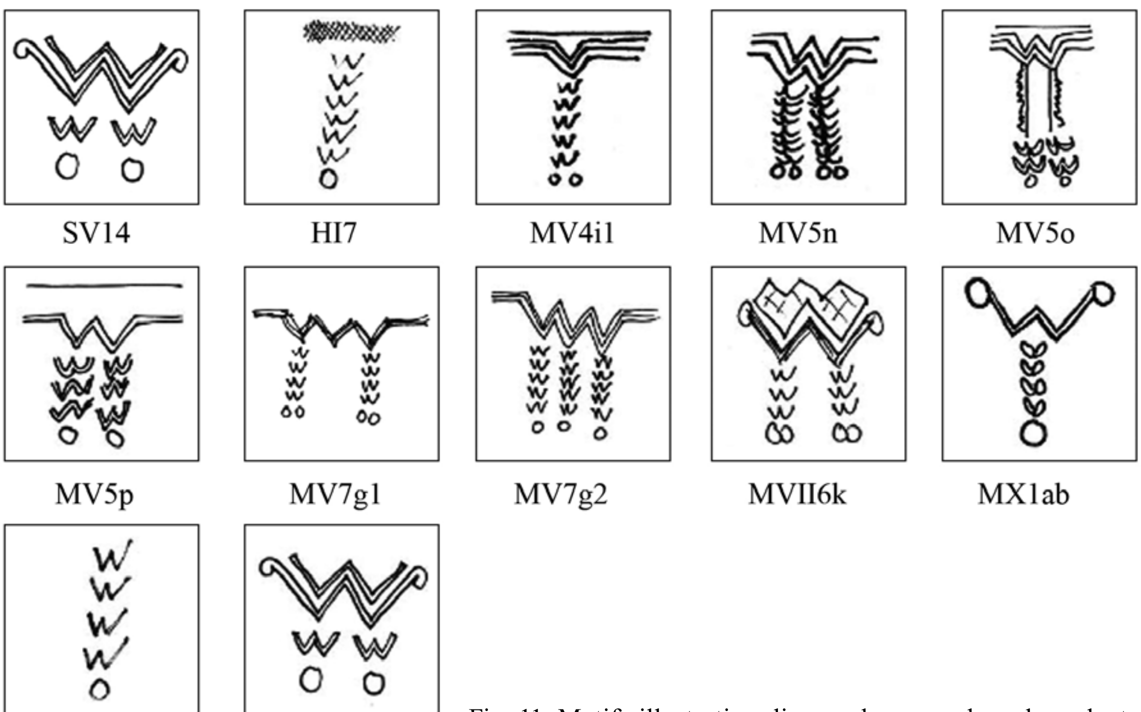

Fig. 11. Motifs illustrating disc- and omega-shaped pendants (©Géza Szabó after *Reich 2006*)

opaque.[37] Nevertheless, it would be important to sketch out the roles of these ornaments could have played in order to better understand the reasons behind hoard depositions, and to interpret the differences between the composition of hoards and burial assemblages. In terms of their shape and structure – symmetrical, thicker in the middle, thinning towards the ends that curve backwards at the terminals – and considering the economic environment of the Encrusted Pottery culture,[38] it may be thought that these pieces resemble a cow's uterus. Such imagery may have symbolised fertility, birth and abundance, as analogues from Mesopotamia imply. From the middle of the 5th millenium BCE following the Ubaid period in Mesopotamia, omega-shaped depictions were associated with the female deity Ninhursag (Ω).[39] On many images the the presence of the goddess is rendered to the symbol of 'Ω', represented on an altar.[40] Therefore, at this point I would suggest the terminology of 'uterus-shaped pendants' as it is referred to by international research to be used in the future or 'omega-shaped pendants' as an alternative in reference to these objects *(fig. 12)*.

Similar symbols of fertility can be seen on the Cybele/Artemis statues adorned with bulls' testicles (previously interpreted as breasts) which are attached to the deity's ceremonial garment. A similar function of the omega-shaped pendants can be assumed in the Encrusted Pottery culture, reflected by their position on the garment: either sewn onto the dress or worn separately on a string perhaps during ceremonies or at other festive events. This further implies that the ornaments were on display for a specific audience and conveyed a distinct meaning to the observers, within the framework of a ritual or ceremony. Therefore, these pendants could be considered not as a property of a certain individual but signifiers of a particular rank, title or office within society. This could provide a possible explanation as to why other dress ornaments (e.g. studs, heart- and crescent-shaped pendants, tubular spiral beads and neckrings with spiral ends) occur regularly in rich burials, while omega- and disc-shaped pendants[41] – if we accept that they served as the material signifiers of prestigious ranks or offices, therefore were not part of the mortuary attire – escaped the process of cremation. It is very possible, as information gleaned from burials and the decorations on clay figurines, that these ornaments were closely linked to the spiritual roles or the social ranks held by women, and were assembled and passed down through many generations.

In this light, the so-called comb-shaped or anthropomorphic pendants – which may also have been part of a festive attire – may be viewed as representations of a cow's uterus placed on an altar as well, and based on the previously mentioned analogues from the Ancient Middle East could symbolise the goddess of fertility. This might also explain why these pieces were depicted on the skirt, hanging from the belt.[42] Furthermore, the anthropomorphic pendants as a group of objects

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37 *Kiss 2012a* 101. István Bóna drew attention to a similar, omega-shaped pendant made of bone from the territory of the Szőreg–Perjámos culture that occupied the southern region of the Great Hungarian Plain (Deszk, burial no. 21). This indicates that the use of such pendants was not exclusive to the communities of the Encrusted Pottery complex, and could be made of different materials other than bronze (*Bóna 1975* 215, Taf. 85. 17). For the bone precursors, see *Szathmári 2000; Kiss 2012a* 137.

38 For an extensive overview, see: *Kiss 2012a* 216–217; *Dani et al. 2019* fig. 16.

39 *Black – Green 1992* 132, fig. 109, 138, 146, fig. 119.

40 *Steinert 2017.* The broader historical context of the 'Ω' symbol is discussed extensively in my forthcoming study focusing on the cemetery of the Encrusted Pottery culture at Bonyhád-Biogáz (Biogas Factory). Neckrings with spiral ends *(Ösenhalsringe)* also resembling an 'Ω' symbol were present and were being used since the Early Bronze Age Koban culture across large swathes of the Middle East, which along their roles as units of measurements/raw materials (ingots), in this new light, have the potential to be acknowledged as objects linked to a fertility cult as well.

41 C.f. *Kiss 2012a* 147, this idea was first proposed by Gábor Vékony. The interpretation of such attire is based on contemporary anthropomorphic depictions, such as the recently published figurine from Izmény (*Kiss 2019* fig. 2. 1).

42 *Kiss 2012a* fig. 33.

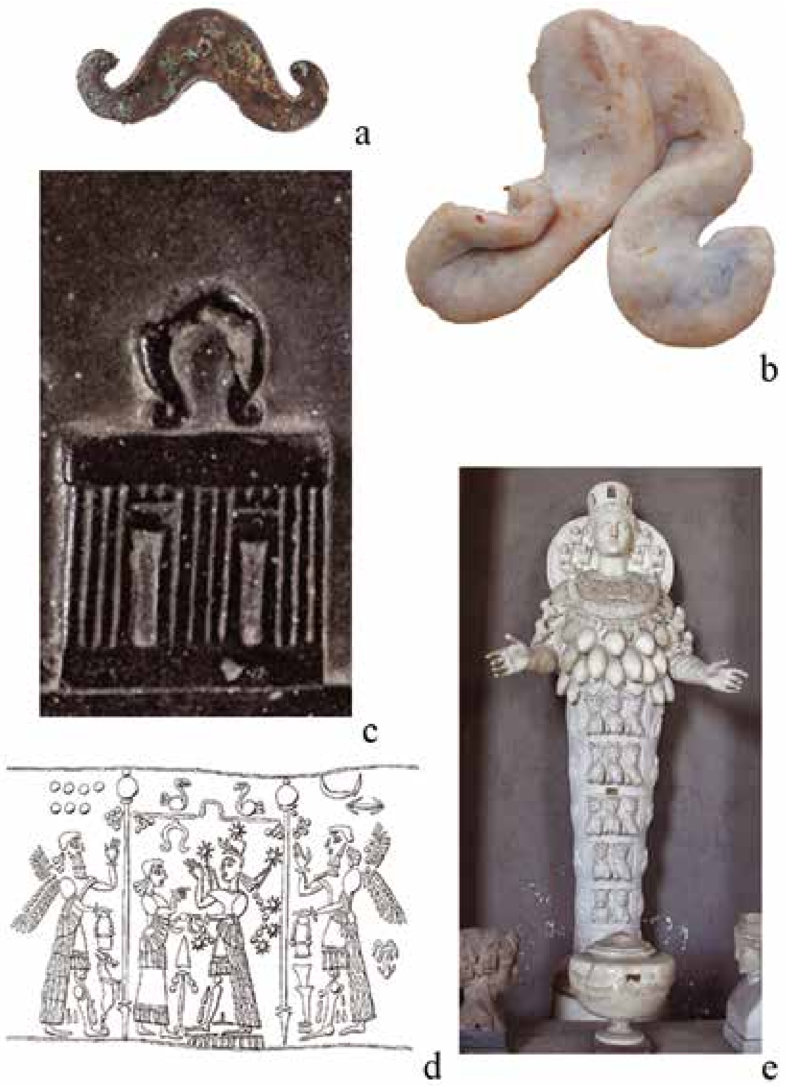

Fig. 12. a. Omega-shaped pendant from the Mucsi hoard; b. Cow's uterus; c–e. Similar depictions on reliefs and statues from the Ancient Middle East (©Géza Szabó)

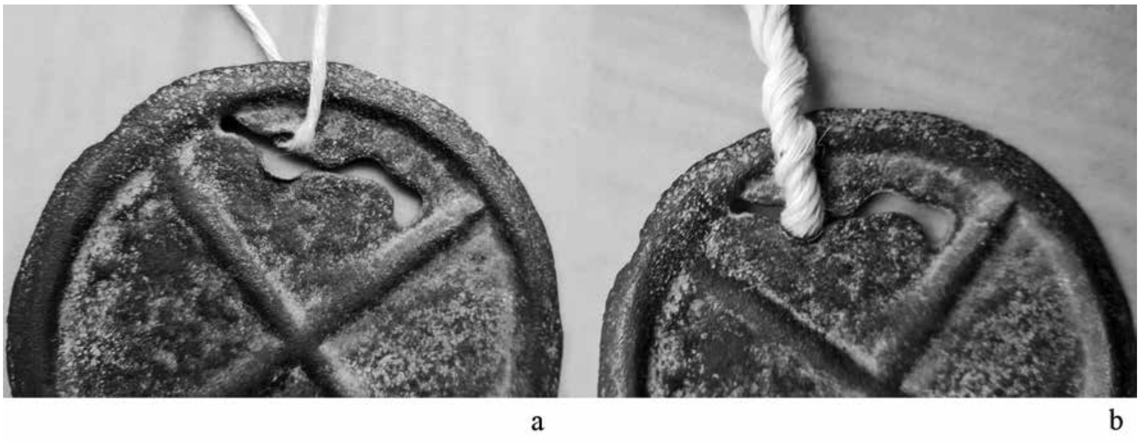

Fig. 13. a. An example for a strong enough cord for the attachment of disc-shaped pendant through a hole (Inv. no. WMM Ö.90.51.3); b. An 8-ply cord fits the hole of disc-shaped pendant perfectly (©Géza Szabó)

may as well be linked to the tradition of bull/cow's head pendants worn around the neck in later periods.

Besides the depictions on ceramic vessels and clay figurines (e.g. Izmény) there is another detail connecting the disc- and omega-shaped pendants: the hole aiding attachment. It is apparent that the craftsperson producing the ornaments aimed to create holes of 4 mm in diameter on all pendants. This is evidenced by disc-shaped pendant WMM Ö.90.51.3, where the cleft left by the insufficient distribution and solidification of the molten bronze should have been enough on its own to serve this purpose, however, the opening was later shaped into a regular hole similar to the ones on the rest of the disc- and omega-shaped pendants *(fig. 9)*. Given the weight of these ornaments (especially when worn in a set) they were likely to have been threaded onto a spun yarn, cord or leather strap *(fig. 13. a–b)*. This also suggests that the pendants were not attached or sewn onto the garment directly but were worn separately as accessories *(fig. 14)*. This set of accessories could have taken the shape of a belt-like item, similar to the ones visible on the previously mentioned Cybele/Artemis statue or to the ones still being used by shamans of certain ethnic groups.[43] Wearing the pendants this way was practical since the skirt or garment is not pulled down by the ornaments (in the case of the Mucsi hoard it is estimated to weigh nearly half a kilo), and it also allowed the easy incorporation of new pieces in the collection. Furthermore, considering the observation according to which the pendants were manufactured at different times supports the idea that the items could have functioned as offerings or votive objects.[44] The ad-hoc number of disc- and omega-shaped pendants in hoards may also reflect that communities associated with each of these assemblages were in different stages of acquiring such objects, and assembled or compiled them in their own unique way.

Fig. 14. Omega- and disc-shaped pendants hanging in a row on an 8-ply cord (Inv. no. WMM Ö.90.51.3) (©Géza Szabó)

As the motifs depicted on vessels and on clay figurines suggest that the elements of the festive attire were consistent across the entire horizon, the number and placement of certain ornaments varied from assemblage to assemblage. The festive female attire, exemplified by the Mucsi hoard, could have been used during special events across the entire distribution of the Encrusted Pottery culture. However, despite of following a certain prescription, such assemblages also attest for

43 *Fodor 2014* fig. 10.

44 Similar, continuous adornment of the goddess' earthly representative has been a well-known practice from the civilisations of Ancient Greece until present-day Christianity. Votive objects could include tools, equipment and dress ornaments related to the cult.

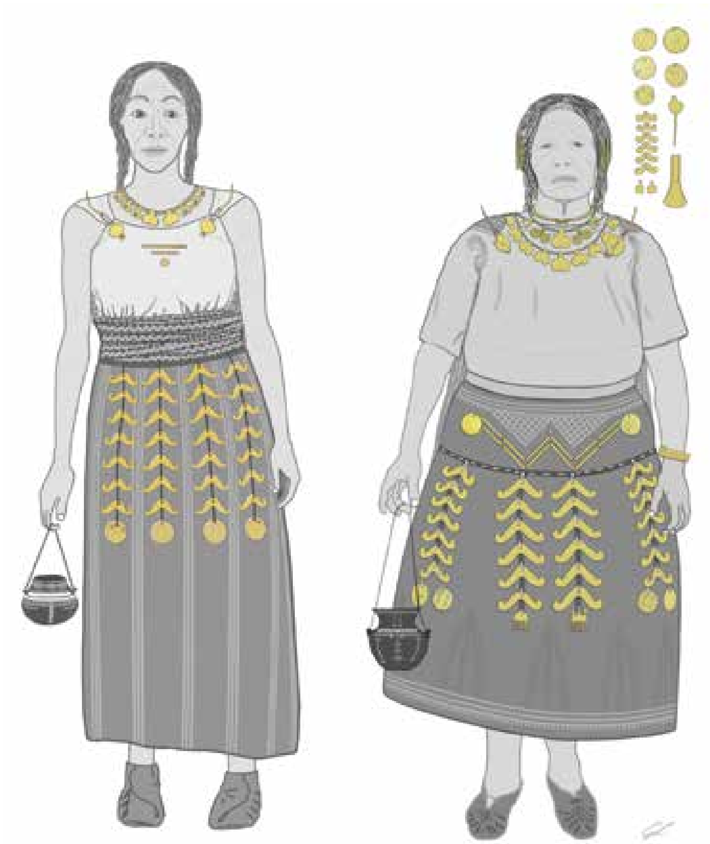

Fig. 15. Reconstruction of the costumes worn by women of special social standing in the community of the Encrusted Pottery culture. The reconstruction is based on the hoard of Zalaszabar (the additional ornaments on the right depict the pieces present in the assemblage but not included in the reconstruction) (©Géza Szabó, ©László Gucsi)

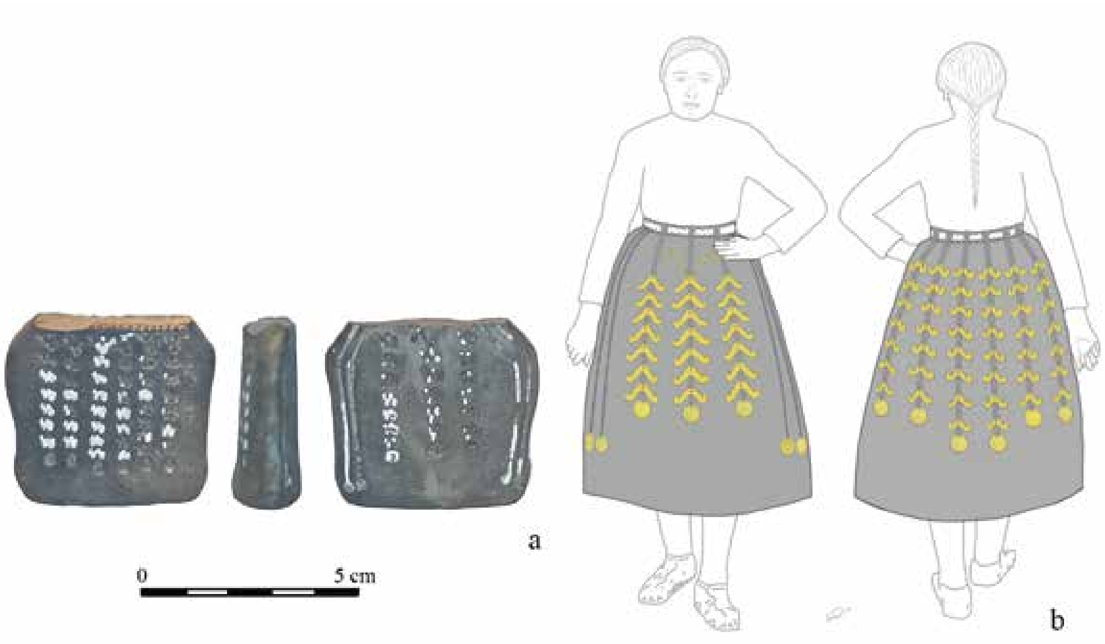

Fig. 16. a. Female clay figurine fragment from Izmény (after *Kiss 2019*);
b. Reconstruction of a high-ranking woman's attire (©Géza Szabó, ©László Gucsi)

customization; some items may have even been cast for a certain occasion or an individual on the spot *(fig. 15)*.[45]

The varying number of pendants in hoards and the motifs depicted on ceramic vessels all indicate that the ornaments were arranged into one to three strands containing two to eight pendant pieces. The female attire could have ranged from simple to elaborately decorated garments as it is represented by the clay figurine unearthed at Izmény *(fig. 16. a)*.[46] On this figurine not only the front of the garment but the back is decorated as well: the pendants were arranged into strands of six and three including six to eight omega-shaped pendants. The strands were always closed by a disc-shaped pendant at the bottom end *(fig. 16. b)*.

This also implies that, in contrast to previous assumptions,[47] the Zalaszabar hoard containing 11 disc-shaped and 32 omega-shaped pendants belonged to a single but very lavishly ornamented garment. It is possible given the unusually large number of disc-shaped pendants in the assemblage, that there may have been more than one of these ornaments attached at the end each vertical row of omega-shaped pendants (*fig. 11:* motifs MV4i1, MV5n, MVII6k).

Despite of the broad distribution and relatively lengthy duration of the Encrusted Pottery culture, the number of hoards (like the one from Mucsi) that can be linked directly to the population is small. The scarcity of such assemblages suggests that the ornaments were acquired in stages, throughout a long period of time and passed down through generations before their final deposition due to an unknown reason. Although the composition of the ornaments was most probably prescribed reflecting the office or social rank held by the owner, the composition of the assemblage was flexible enough to express personal preferences or tastes. Since the acquisition and possession of the disc- and omega-shaped pendants continued for generations, it is likely that a long time had passed between the production and the deposition of these pieces. This potential chronological gap is the cause of an ongoing discussion between archaeologists,[48] namely whether the so-called Tolnanémedi-type hoards can be dated to the second half of the Middle Bronze Age (RB A2b–c), or to be considered within the – now rather broad – Koszider period (1700/1600–1450 cal BC, RB B).[49] István Bóna classified the Tolnanémedi-type hoards consistently to the phase prior to the Koszider period,[50] while Amália Mozsolics considered it as part of the Koszider horizon.[51] Research today is still divided along these two opinions.[52] However, the ornaments included in the Mucsi hoard underscore the idea that the pieces of the Tolnanémedi-type hoards were continued to be produced and assembled throughout a long period of time, from the second half of the Middle Bronze Age onwards. The assemblages where crescent-shaped pendants also appear among the disc- and omega-shaped pendants may be dated more towards the established Koszider period. Based on the above, given the composition of the Mucsi hoard, it can also be considered within the Koszider period. More research is required to explore whether the assembly of such hoards were due to spiritual motivations or whether there were practical considerations in play as well, linked to the socio-economic changes taking place during the end of the Middle Bronze Age in the Carpathian Basin.

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[45] This assumption is further supported by the wide-ranging results of the compositional and typological analyses carried out on the Zalaszabar hoard. Homer's Iliad furthermore describes an event where the craftsperson prepared ornaments and other accessories necessary for the funerary attire right next to the pyre.

[46] *Kiss 2019* fig. 2.

[47] For an overview, see *Kiss 2019.*

[48] *Kiss 2012a* 89.

[49] *Szabó 2017.*

[50] *Bóna 1958* 224; *Bóna 1975* 214–220, 226; *Bóna 1992* 41–42.

[51] *Mozsolics 1967* 124, Abb. 36.

[52] *Vadász – Vékony 1979* note 126; *Kovács 1994a; Kovács 1994b* 159; *Honti – Kiss 2013* 750; *Kiss 2009* fig. 7.

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VAJK SZEVERÉNYI – PÉTER CZUKOR – ANNA PRISKIN – CSABA SZALONTAI

CSANÁDPALOTA-FÖLDVÁR
A LATE BRONZE AGE 'MEGA-FORT' IN SOUTHEASTERN HUNGARY

In memoriam Alexandru Szentmiklosi (1971–2019)

Zusammenfassung: In diesem Beitrag werden die spätbronzezeitliche Siedlung von Csanádpalota-Földvár und die Ergebnisse der ersten Grabungskampagne an diesem Ort vorgestellt. Während der Rettungsgrabungen von 2011 bis 2013 wurde eine befestigte Siedlung von enormer Größe mit mehreren Wallanlagen und Gräben freigelegt. Auf die ersten Rettungsgrabungen folgten nichtinvasive zerstörungsfreie Untersuchungen, kleinere gezielte Freilegungen und die Erforschung des regionalen Kontexts der Stätte.

Keywords: fortified settlements, Late Bronze Age, Carpathian Basin

Csanádpalota-Földvár is a recently discovered Late Bronze Age 'mega-fort' in Csongrád-Csanád County, Southeastern Hungary. The settlement is located 20 km east of the modern city of Makó, and practically occupies the area between the towns of Csanádpalota and Nagylak, both on the Hungarian–Romanian border *(fig. 1).* The size of the enclosed area is estimated to be ca. 460 hectares; this makes it the largest known prehistoric fortified settlement in Hungary.

The Late Bronze Age fortified settlement of Csanádpalota has been the subject of our research since 2011, although some archaeological work had been conducted at the site earlier as well. The aim of this article is to present briefly the results of the surveys and excavations carried out during the past decade and to place Csanádpalota into a wider regional context of the emergence of a 'fortified landscape' and 'mega-forts' in the southern Great Pannonian Plain around the 14th century BC.[1]

The site is located on the Hungarian–Romanian border, just north of the Maros River, at the junction of three modern counties (Csongrád-Csanád and Békés in Hungary and Arad in Romania). In the east, it is bordered by the Krakk Creek, which joins the Csanádpalota Creek here. The surface of the site is dominated by the current and ancient, dry riverbeds of these two creeks. At the southern end of the site, near Nagylak, a large, swampy area can be found, which used to be a probably seasonally flooded area called Balatonya before the river regulations *(fig. 2).*

The immediate environment of the site belongs to the drainage of the Maros (Mureş) River. From the end of the Pliocene, the Maros built a large, 80-100 km wide alluvial fan. During the Quaternary, the Maros, located in the axis of the fan, changed its riverbed in accordance with the then current slope. During most of the Quaternary, it flew towards the north, the Körös Region; however, towards the end of the period, during the Late Pleistocene and Early Holocene, its bed shifted from the north towards the southern Tisza valley, as evidenced by

[1] *Harding 2017* 12–13.

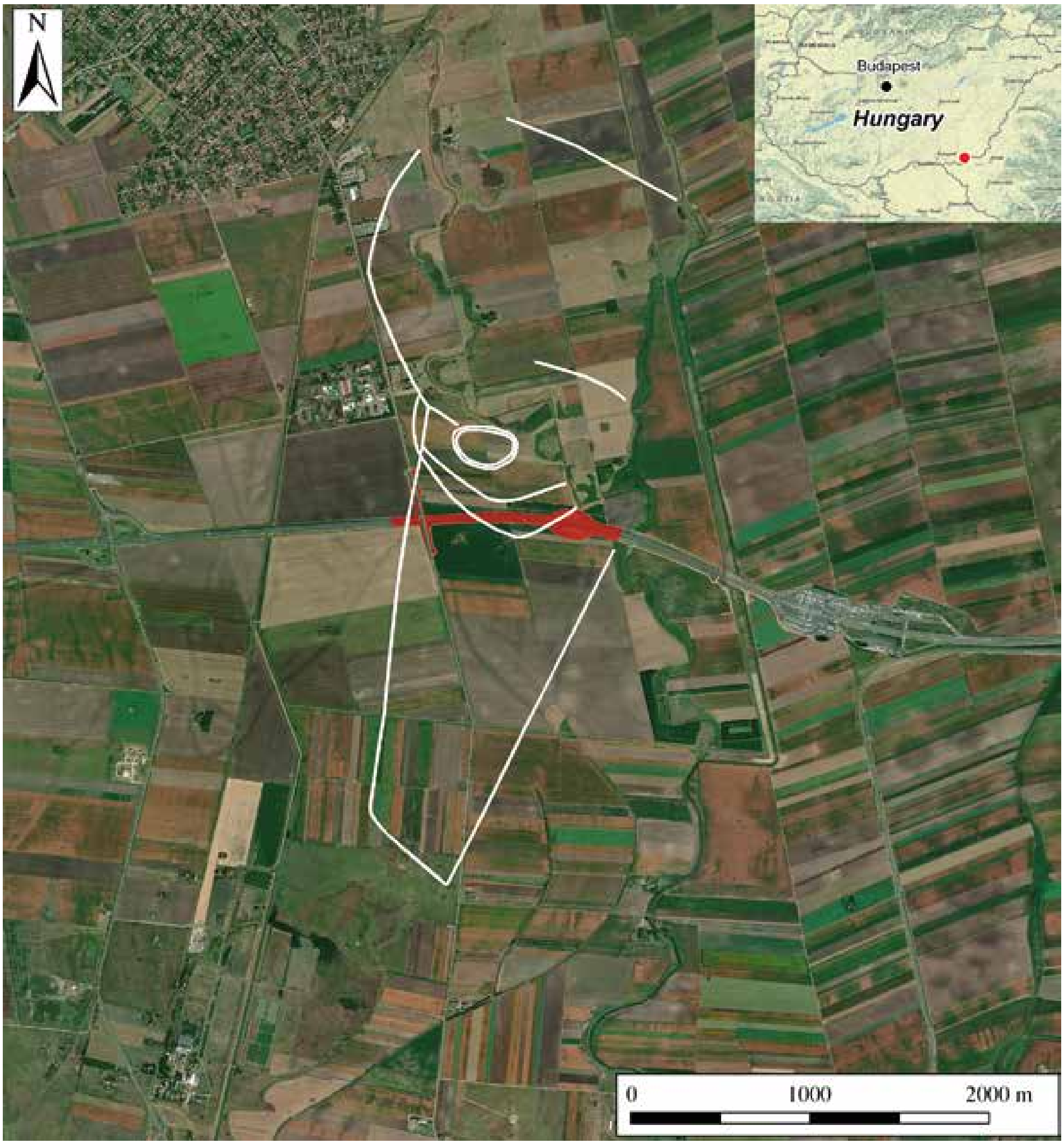


Fig. 1. The location of Csanádpalota-Földvár and the ditches, identified on Google Earth images

many hydrogeographical remains, such as the remnants of former main branches, e.g. the Száraz-ér (‘Dry Creek’).[2] According to a recent project trying to date these Late Pleistocene/Holocene riverbeds, the Maros flew just a little south of its current channel during the Bronze Age.[3]

In terms of geography, it is at the junction of three landscape microregions. According to the traditional nomenclature,[4] it is in the south-easternmost corner of the Csongrád Plain (part of the Körös–Maros interfluve region), which is a low alluvial plain with 81 to 101 m asl stretching east of the Tisza River. The perfect plain is disturbed only by the ancient channels of the Száraz-ér – an important waterway before the river regulations of the 19th century – in the east and

[2] *Andó 1993; Mike 1991* 680–692.

[3] *Sümeghy et al. 2013.*

[4] *Pécsi – Somogyi 1967; Marosi – Somogyi 1990.*

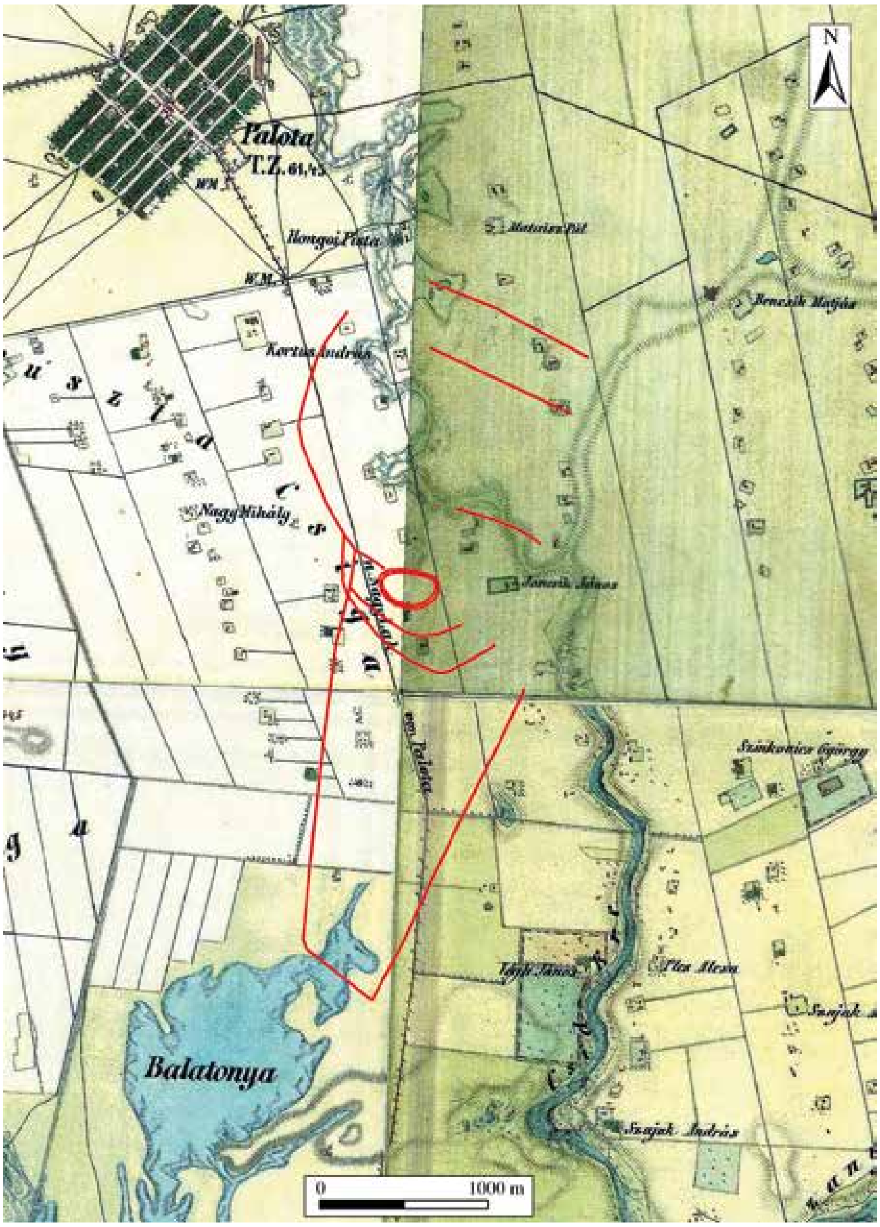


Fig. 2. Csanádpalota-Földvár on the Second Habsburg Military Survey Map (©Péter Czukor)

southeast. Immediately to the east stretches the Csanád ridge (also part of the Körös–Maros interfluve region), a loess covered alluvial fan with a height of 97 to 104 m asl. It is characterized by a rich formation of ancient meridional riverbeds and oxbow channels, and its main river is also the Száraz-ér. To the south lies the Maros Angle (part of the Lower Tisza Valley region), a low floodplain between 78 and 88.4 m asl. Its surface is broken up only by the ancient, filled-up channels, oxbows and backwaters of the Tisza and Maros rivers, with loess covered, slightly elevated, unflooded 'islands' between them.[5]

[5] A recent reconsideration of the borders of geographical microregions in Hungary based on complex landscape ecological aspects places the area of the site in the Lower Maros floodplain microregion: *Deák 2010; Deák 2017.*

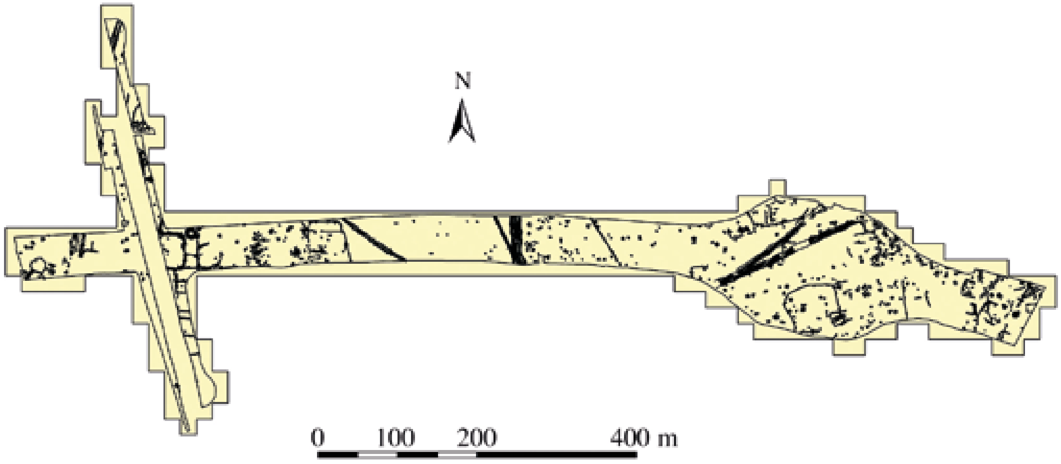


Fig. 3. Area of preventive excavations at Csanádpalota between 2011 and 2013 (©Péter Czukor)

History of research at the site

The site was first registered by Imre Szatmári in 1984 during surveys for an MA thesis, as a site with 'Early Iron Age' (Ha A–B and Ha C–D), Sarmatian, Avar and Árpádian-period materials.[6]

The site was first identified as a Bronze Age fortified settlement in 2005 by one of the current authors (Csaba Szalontai), when he and his colleagues from the Móra Ferenc Museum in Szeged carried out archaeological surveys in order to identify archaeological sites affected by the planned track of the M43 highway built between Szeged and the Hungarian–Romanian border (although at that time it was dated to the Middle Bronze Age).[7] He identified the oval central enclosure of the fortified settlement north of the track of the highway, and named the site 'Juhász T. tanya' after the abandoned farmstead just south of the track of the highway. At this time, he collected all the archival aerial photos and manuscript maps of the area, and had a 3D terrain model made.[8]

Intensive research at the site started in 2011, with the launch of the preventive excavations preceding the construction of the second section of the M43 highway between Makó and the Hungarian–Romanian border. Between 2011 and 2013, large-scale excavations were carried out in a 12-hectare-large area along the track of the highway, immediately south of the central oval enclosure *(fig. 3)*, with the participation of three of the current authors (Vajk Szeverényi, Anna Priskin and Péter Czukor). Already in 2011, we unearthed a large ditch in the western end of the area to be excavated. By following the line of the ditch on aerial photos *(fig. 4. 1)* and Google Earth images, we identified a series of enclosures surrounding a ca. 460-hectare-large area *(fig. 4. 2)*.[9] We excavated ca. 1000 archaeological features, of which 96 belonged to the Late Bronze Age settlement. We also unearthed settlements from the Sarmatian, Avar and Árpádian periods,[10] and two separate Avar-period cemeteries.[11] Special attention was paid to traces of the subsistence

6 *Szatmári 1984* 16–18.
7 *Szalontai 2006; Szalontai 2017.*
8 *Szalontai 2012.*
9 *Priskin et al. 2013; Czukor et al. 2013.*
10 E.g. *Szabó 2013.*
11 *Szeverényi – Priskin – Czukor 2014.*

1

2

Fig. 4. 1. The continuation of the ditch outside the excavated area, identified on an aerial photo (©Pazirik Kft.); 2. Enclosures 1–4b at Csanádpalota-Földvár on a Google Earth satellite image

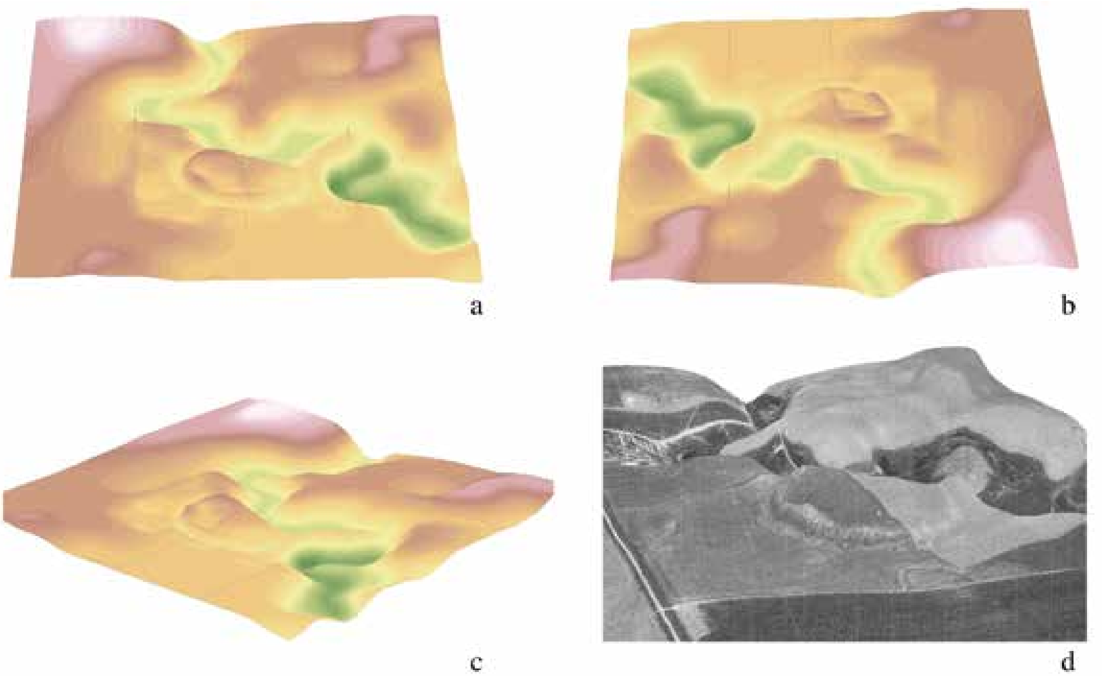


Fig. 5. a–c. 3D terrain model of Enclosure 1; d. An aerial photo wrapped on the digital elevation model (©András Kamarási, ©Antall Redencki)

economy and food production at the site, and the preliminary results of these investigations have already been published.[12]

Parallel to the excavation campaigns, we initiated the pedestrian survey of the whole site as well. Between 2012 and 2015, we surveyed the area of the central oval enclosure. By 2016, we surveyed about two thirds of the 460-hectare-large enclosed area.

In 2013, we carried out pedological coring and geophysical prospection in a small section of the central enclosure to determine where the ditch and rampart should be cut through. Both the coring and the geophysical survey were repeated on a larger scale in 2013 and 2015 to provide a complete picture of the central area of the settlement. In 2013, we cut through the rampart and ditch of the central enclosure to determine its date and structure.[13] In 2021, we started a smaller excavation in the central area of Enclosure 1 based on the data of the geophysical survey.[14]

Structure of the site

Csanádpalota-Földvár is a complex, multivallate enclosed settlement, parts of which can be identified on aerial photos and satellite images *(fig. 1)*. Although some of the elements of the enclosure are clearly visible and easy to interpret, others are not so straightforward. As a result, new images and data already force us to revise our previous interpretations with regard to the structure of the site,[15] and this reinterpretation will most certainly continue in the future as well. Many of the elements of this system of enclosures (mostly ditches, in some cases associated with a rampart) have not yet been excavated and will certainly need further fieldwork to be

[12] *Szeverényi et al. 2015a; Szeverényi et al. 2015b.*

[13] *Priskin et al. 2013; Szalontai et al. 2017.*

[14] *Szeverényi et al. 2021.*

[15] *Szeverényi – Priskin – Czukor 2014* 44; *Czukor et al. 2017* 220–222.

Enclosure	Length (m)	Enclosed area (ha)
1	970	7
2	2180	24
3	2895	43
4	10500	460

Table 1. Data on the enclosures of Csanádpalota-Földvár

verified. Here we provide only a simple description of these enclosures, and those that have already been investigated with other means as well will receive a slightly more detailed treatment in the subsequent sections. This analysis is based on Google Earth images, a high-definition video taken from a drone in 2013, and the above-mentioned geomagnetic survey from 2015.

An oval enclosure comprising a double ditch and a rampart forms the centre of the site (Enclosure 1) *(fig. 4. 2)*. According to the first 3D terrain model *(fig. 5)*, it is possible that in the northeast it was connected to the Csanádpalota Creek, and it has been suggested that it might have been a moat.[16] This, however, will need further investigation (e.g. coring in the ditch, reconstruction of Bronze Age water levels, etc.). The area enclosed by the double ditch is ca. 7 hectares *(Table 1)*. To the south, it is surrounded by two semi-circular ditches (Enclosures 2 and 3), both of which seem to join the Csanádpalota Creek in the east *(fig. 4. 2)*. The southern one seems either to end in the Csanádpalota Creek in the northwest as well, or to run into the northern part of the external enclosure (Enclosure 4a), while the other seems to join a longer, linear ditch in the west (the southern part of the external enclosure: Enclosure 4b). A short, slightly arching, E–W oriented ditch north of the Csanádpalota Creek might also be part of Enclosure 3, making it a slightly irregular, pen-annular, oval enclosure *(fig. 4. 2)*.

The most external enclosing ditch, Enclosure 4 has so far been considered a roughly linear feature running between the southern city-limits of Csanádpalota in the north and the Hungarian–Romanian border in the south.[17] Based on our 2015 geophysical survey and a re-examination of the Google Earth images, however, it seems that this is actually two enclosures: one starts from the northwestern corner of Enclosure 1 and runs first to the northwest, and then turns in an arch to north and northeast (Enclosure 4a) *(fig. 1, fig. 2)*. Here it reaches again the creek and the surrounding swampy area in the southeastern city-limits of Csanádpalota, where the line is impossible to follow on the satellite images. There are, however, two parallel lines running WNW–ESE in the north between the two creeks, which might be the northern part of Enclosure 4a; they might have been the northern border of the site. This, however, is still very much uncertain and will need verification on the ground.

The other, southern part of this most external ditch, Enclosure 4b, is a linear ditch running roughly from the north to the south and then back *(fig. 1, fig. 2)*. It starts from Enclosure 4a, from the vicinity of its starting point. Then it runs SSW for 2.3 km, where it turns in an angle first to SE and then back to NNE. It runs in that direction for ca 2.3 km again to join the Krakk Creek.

[16] *Szalontai 2012* 284.
[17] *Szeverényi – Priskin – Czukor 2014* 44; *Czukor et al. 2017* 220–222.

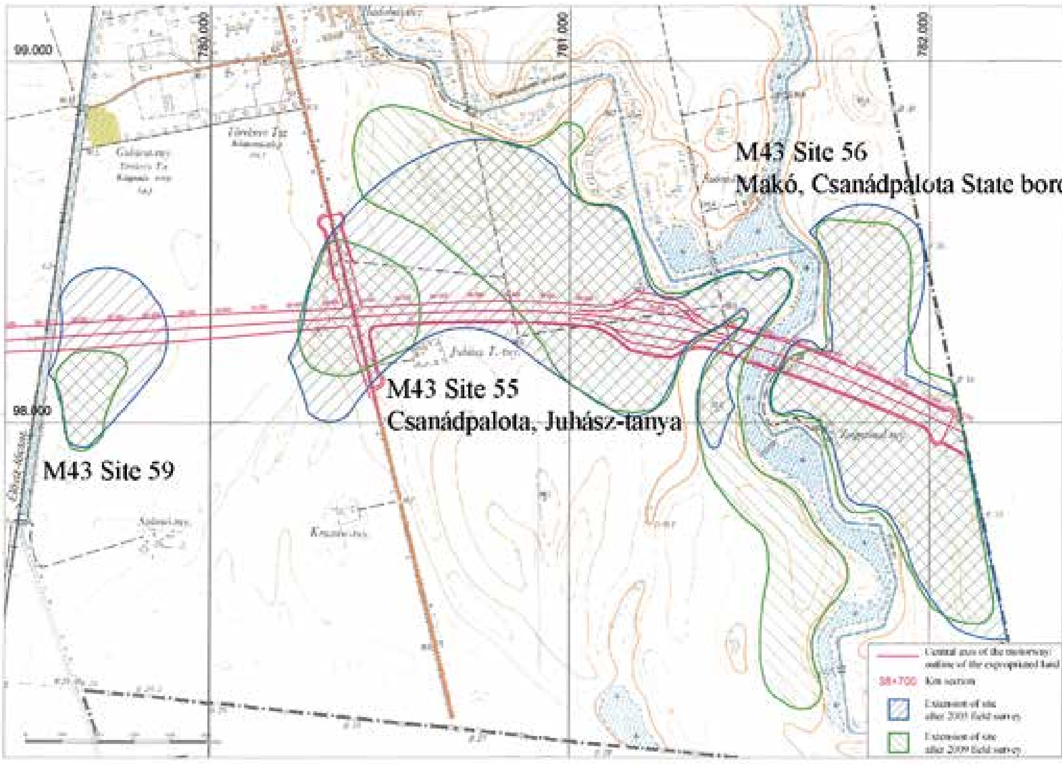


Fig. 6. Map of Csanádpalota-Juhász T. tanya after the first two surveys (2005, 2009) (©Csaba Szalontai, ©Csanád Fekete)

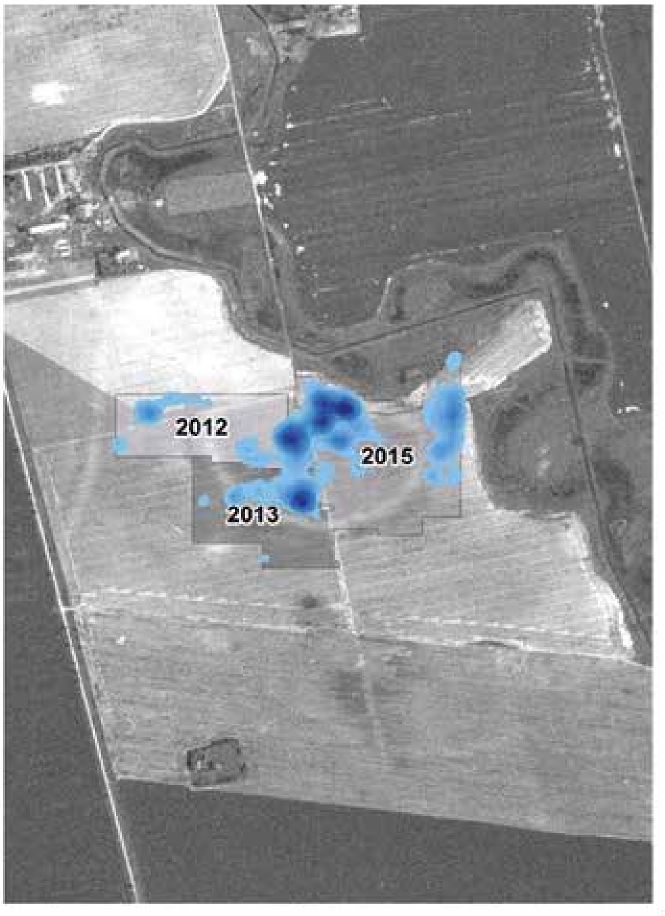
Archaeological field surveys

Three kinds of pedestrian archaeological surveys have been conducted at the site so far: simple surveys that recorded the existence of the site, and two kinds of systematic survey – intensive and extensive.

After the initial identification of the site in 1984, pedestrian archaeological surveys at the site started again in 2005, preceding the planning of the M43 motorway, when Csaba Szalontai first identified the fortification. A large, horseshoe-shaped area was registered named Csanádpalota-Juhász T. tanya, with occupations identified from the Bronze Age and the Sarmatian and Árpádian periods.[18] The survey was repeated in 2009; it confirmed the existence and occupational periods of the site, although its extension was considered to be slightly smaller *(fig. 6)*.

In 2012, 2013 and 2015 we carried out a systematic survey in the area of Enclosure 1 in 10×10 m grids. We could collect a relatively small amount of strongly fragmented Late Bronze Age pottery, small amounts of Medieval pottery, and daub. The distribution of Late Bronze Age pottery *(fig. 7. 1)* shows more intensive activities within the enclosure, with significant concentrations in the south and the north along the N–S axis of the oval enclosure, and smaller concentrations just outside the ditch in the northeast and the northwest. The distribution of daub *(fig. 7. 2)* practically coincides with the line of the enclosure, with significant concentrations in the southern, eastern and northwestern sections. These results indicate that the structure of the rampart most probably included a significant amount of packed clay, which was burnt at some point.

[18] *Szalontai 2006; Szalontai 2012.*



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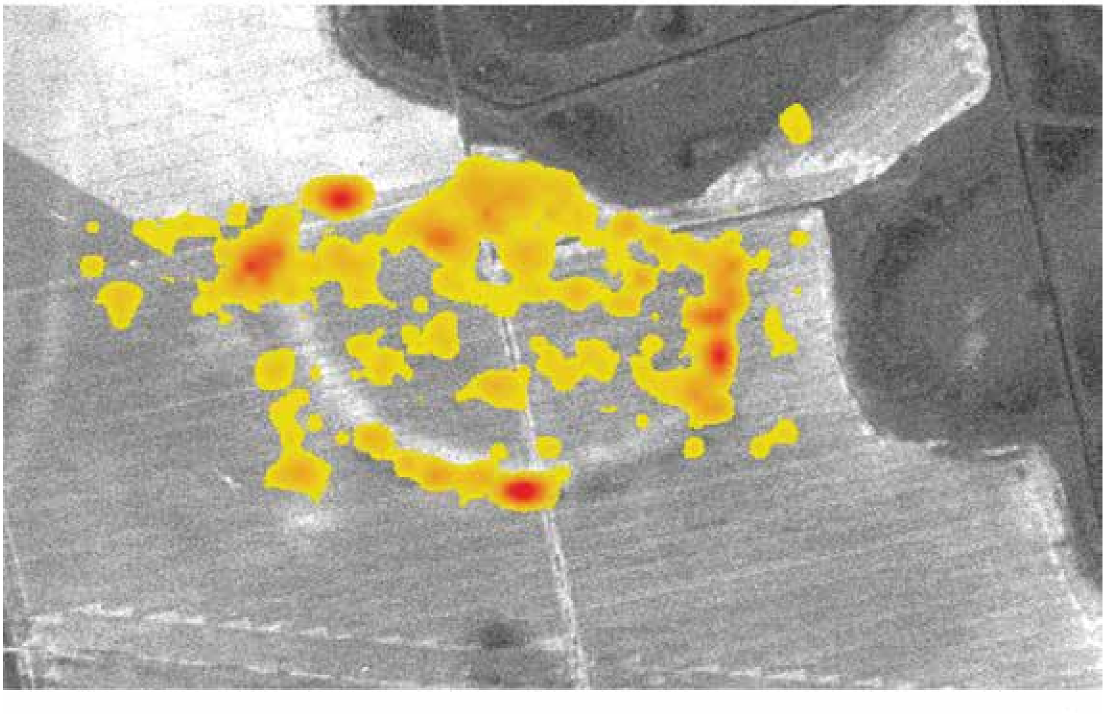

2

Fig. 7. 1. Distribution of Late Bronze Age pottery within Enclosure 1 of Csanádpalota-Földvár (©Péter Czukor); 2. Distribution of daub within Enclosure 1 of Csanádpalota-Földvár (©Péter Czukor)

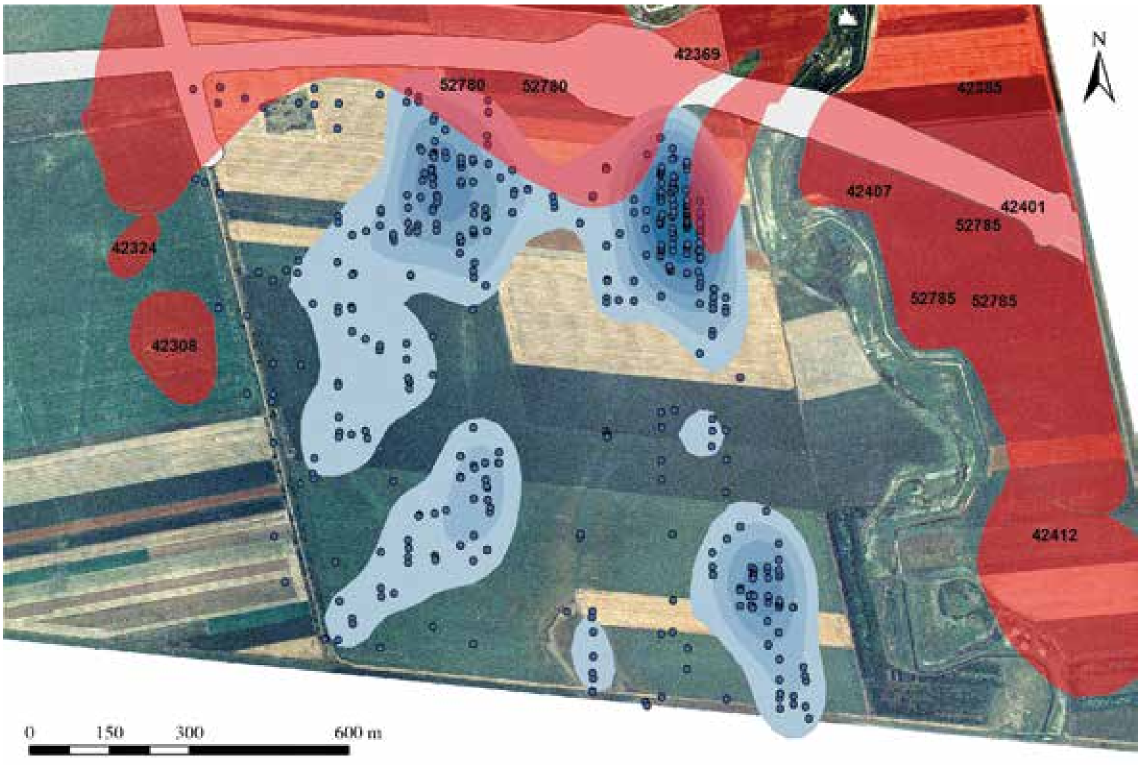

Fig. 8. Results of systematic transect survey at Csanádpalota-Földvár (©Péter Czukor)

In April and May 2016, we carried out a systematic extensive survey in ca. half of the area of the 460-hectare-large site, primarily in its southern and western part (ca. 228 hectares). We surveyed the area in transects 25 m apart from each other. The results show four, previously unidentified concentrations of Late Bronze Age finds south of Enclosure 3, but within Enclosure 4b *(fig. 8)*. These probably indicate intensive activity areas within the Bronze Age enclosures.

Geomagnetic prospection

Geomagnetic prospection was carried out in 2013 and 2015 at the site, in both cases within the area of Enclosure 1. The first measurement was on a very small scale (ca. 800 m^2), preceding the excavation of Enclosure 1 in 2013. Its aim was to verify the exact location of the rampart and the ditch before excavation. It was this survey that first clearly indicated that we are dealing with a double ditch in Enclosure 1.

The second survey was carried out on a much larger scale. It covers ca. 18 hectares, practically the whole area within Enclosure 1 and its immediate surroundings *(fig. 9)*. The oval double ditch of the enclosure is clearly visible in the image. The external oval anomaly seems to be a simple ditch based on the image, which was confirmed later by excavation as well. Within the internal ditch, a line possibly indicating a burnt rampart with timber structure is discernible in the northwest, south and east. In the northeast, it remains unclear if the ditches join the Csanádpalota Creek, since the curve of the enclosure indicates that the ditches do not actually make a full circle. Unfortunately, this area was impossible to survey as it is already part of the muddy bank of the modern canal of the creek.

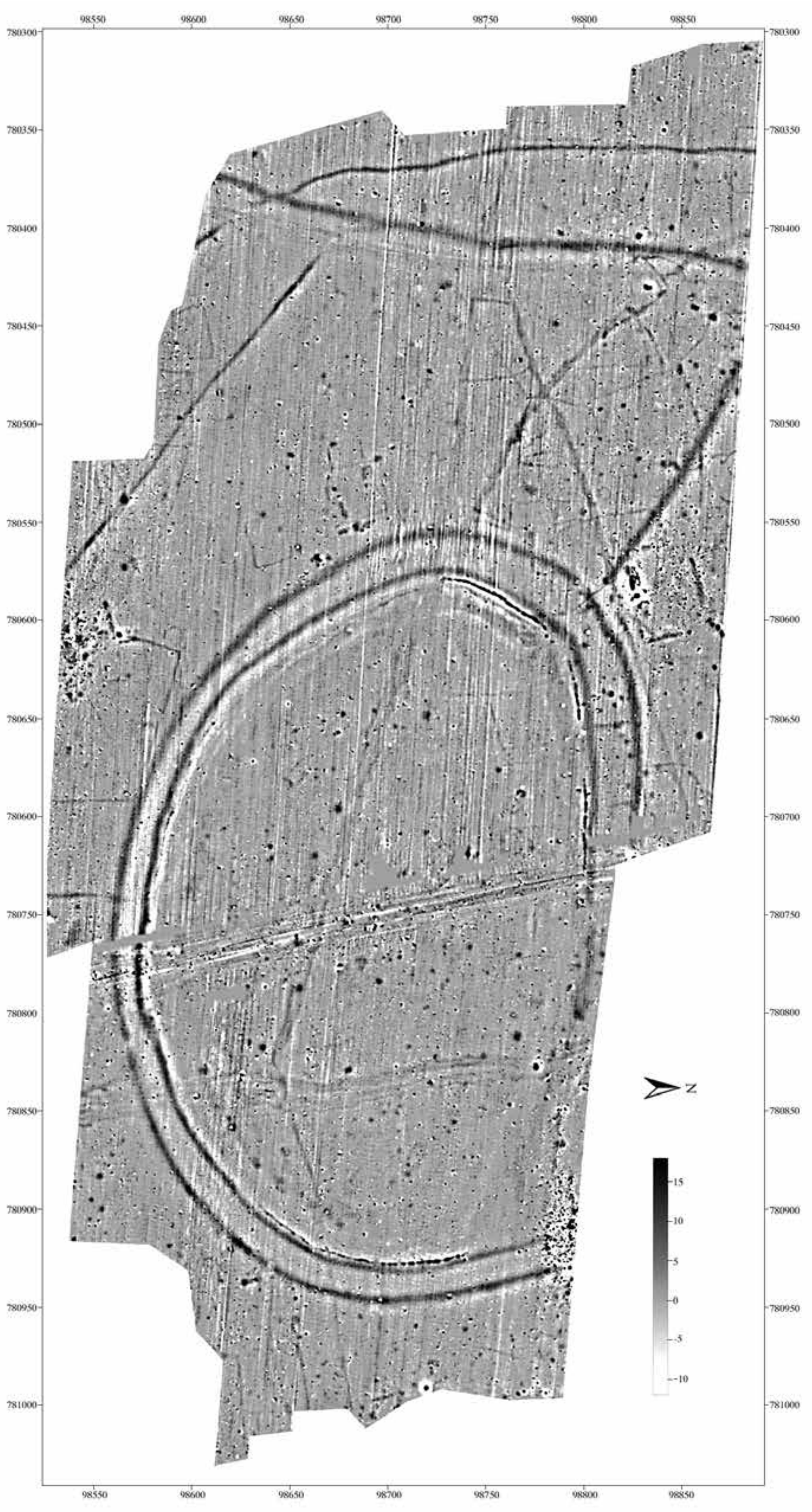

Fig. 9. Geophysical survey of the central area of Csanádpalota-Földvár
(©Gábor Márkus, Archeodata 1998 Bt.)

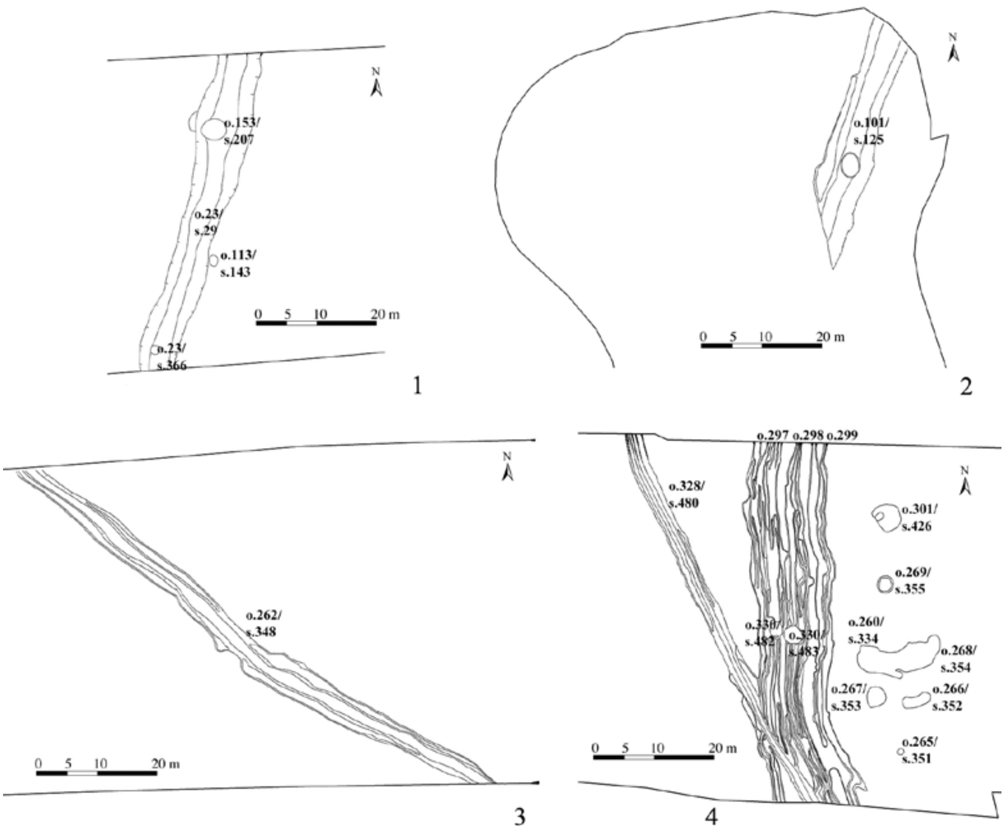

Fig. 10. Enclosure ditches of Csanádpalota-Földvár. 1. Ditch 23; 2. Ditch 101; 3. Ditch 262; 4. Ditches 328 and 297–299 (©Péter Czukor)

The parallel lines crossing Enclosure 1 in the centre in a roughly N–S direction are the anomalies caused by the current dirt road. However, to the east, a series of not entirely straight, but parallel lines running in a N–S direction are indeed Late Bronze Age ditches. These are shallow and narrow, parallel features whose continuation was actually unearthed during the large-scale preventive excavations *(fig. 10. 4).*

The geomagnetic survey indicates a large number of features within Enclosure 1, but their date and nature remain unclear until further excavation. The pedestrian surveys indicate mostly Late Bronze Age occupation, but other periods (mostly the Árpádian period) are also represented. Anomalies that would clearly indicate houses are not visible, although the arrangement of some anomalies might suggest timber-framed houses. Obviously, this needs to be verified through further excavations.

Most of the rectangular anomalies visible south and west of Enclosure 1 must belong to the Medieval village, whose remains were also excavated to the south, during the preventive excavations.

Excavation results in the external area

Excavation at the site started in 2011 and took two different forms. Between 2011 and 2013, an almost 12-hectare-large area was explored in the form of large-scale preventive excavations preceding the construction of the M43 highways between Szeged and the Hungarian–Romanian border (and going on to Arad, Romania). These excavations were organized and carried out by the Móra Ferenc Museum, Szeged.

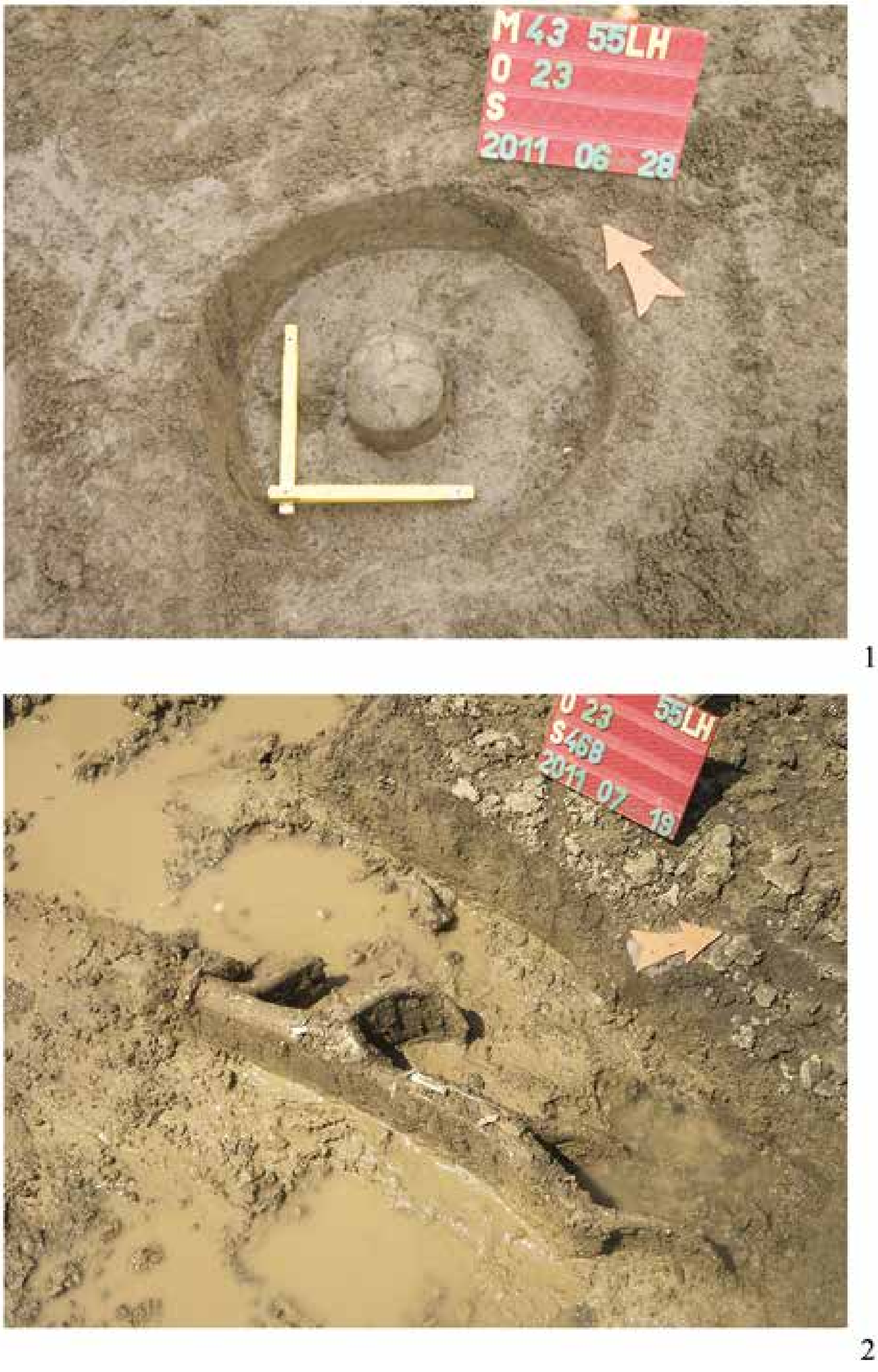

Fig. 11. 1. Vessel deposited at the bottom of Ditch 23 at Csanádpalota-Földvár (©Vajk Szeverényi); 2. Antler deposited at the bottom of Ditch 23 at Csanádpalota-Földvár (©Vajk Szeverényi)

The excavated area is located south of Enclosures 1 and 2. It was a ca. 60 m wide strap running in an east-west direction, cutting through Enclosures 3 and 4b. 119 080 m^2 was assigned for excavation, of which 104 907 m^2 was actually accessible. About 1000 archaeological features were excavated from multiple periods. The earliest finds belonged to the Late Bronze Age. These features were scattered throughout the excavated area with the exception of its easternmost end. A significant concentration of Late Bronze Age features was observed in the central part of the excavated area. The other periods at the site were represented by a Sarmatian settlement, an Avar settlement, two separate Avar-period cemeteries, and an Árpádian-period settlement.

Altogether 96 features belong to the Late Bronze Age: 64 pits, 29 ditches, and three find concentrations. No house remains or traces of other buildings were found. Several deep pits may have functioned as wells, although we could not identify any built structures in them.

The 29 excavated ditches can be assigned to two groups based on their sizes. The ditches in the first group belonged to the above described system of enclosures; they had U- or V-shaped cross-sections, and were 2-3 m deep and 4-7 m deep. Features 23 and 101 were part of Enclosures 4b, the southern part of the most external ditch, while Features 262 and 440 were part of Enclosure 3 *(fig. 1)*.

Feature 23 was located in the western end of the excavated area. It was a 6-7 m wide, 1.5-2 m deep, straight ditch running in a roughly N–S direction *(fig. 10. 1)*. Its fill contained numerous Late Bronze Age finds, fragmented and intact ceramic vessels *(fig. 11. 1)*, antler *(fig. 11. 2)* and bronze objects. Further, smaller features were identified at the bottom of the ditch. Feature 153 stands out among these. It was a large, beehive-shaped pit, whose outline appeared ca. 1 m deep within the fill of the ditch. Due to the high water table, its bottom could not be fully excavated, but it definitely reached deeper than the bottom of the ditch. These features indicate that the ditch had a long and complex history: after its construction and use, during the process of filling up another pit was dug into its fill. These features also yielded characteristic Late Bronze Age pottery, which shows that these events played out during a single archaeological period, but most probably in a number of consecutive phases.

The other group of ditches is represented by narrow and shallow features, which do not fit into the system of enclosures described above (e.g. Features 197–199, 326) *(fig. 10. 4)*. They have a different direction, and often cut each other or the larger ditches. These observations indicate that they might have a different function or chronological position. Based on the preliminary study of their finds, they also yielded Late Bronze Age ceramic material of the same pottery style, thus the extent and explanation of the chronological differences can be established only after a more detailed analysis.

Ca. 400 m of the external ditches of the Csanádpalota enclosures were excavated. No traces of a built rampart or its burnt remains could be observed. It is possible that only a simple earthen rampart was built from the soil removed from the ditches during their construction, which have long since eroded.

Only one other phenomenon connected to the structure of the enclosures could be observed. Two sections of Enclosure 3 were excavated, where it crossed the track of the highway. In the eastern excavated section, we found a gate *(fig. 12)*. At this point, there is a 5-meter-long break in the semi-oval enclosure. On both sides, the depth of the ditch decreases suddenly, in a step-like fashion. At the end of the ditch sections six larger postholes (four in the NE, two in the SW), ca. 50 cm in diameter, indicated the existence of a wooden structure (a gate?), which provided access to the internal area in a NW–SE direction. In the vicinity of the gate two large pits with rich material were excavated (Features 439 and 474), and the ditch terminals near the gate also yielded larger amounts of Late Bronze Age finds.

Altogether 64 Late Bronze Age pits were unearthed at the site. These had a rather varied shape and depth: most were oval, some completely irregular and amorphous. The character of their fill and the material they contained were also rather varied: some had a homogeneous fill with hardly any finds; others had a complex, layered fill with large amounts of archaeological materials. We would like to highlight a few of the latter category, since their interpretation might be important with regard to the establishment of the role and function of the whole settlement. Many of the pits with complex fills (e.g. Features 44/51, 407/685, or 474/834) contained special finds: large amounts of fine pottery, bronze objects, stone implements, or complete antlers. We attempted to use much finer methods during their excavation, based on which the mode and sequence of the deposition of the finds can be reconstructed.

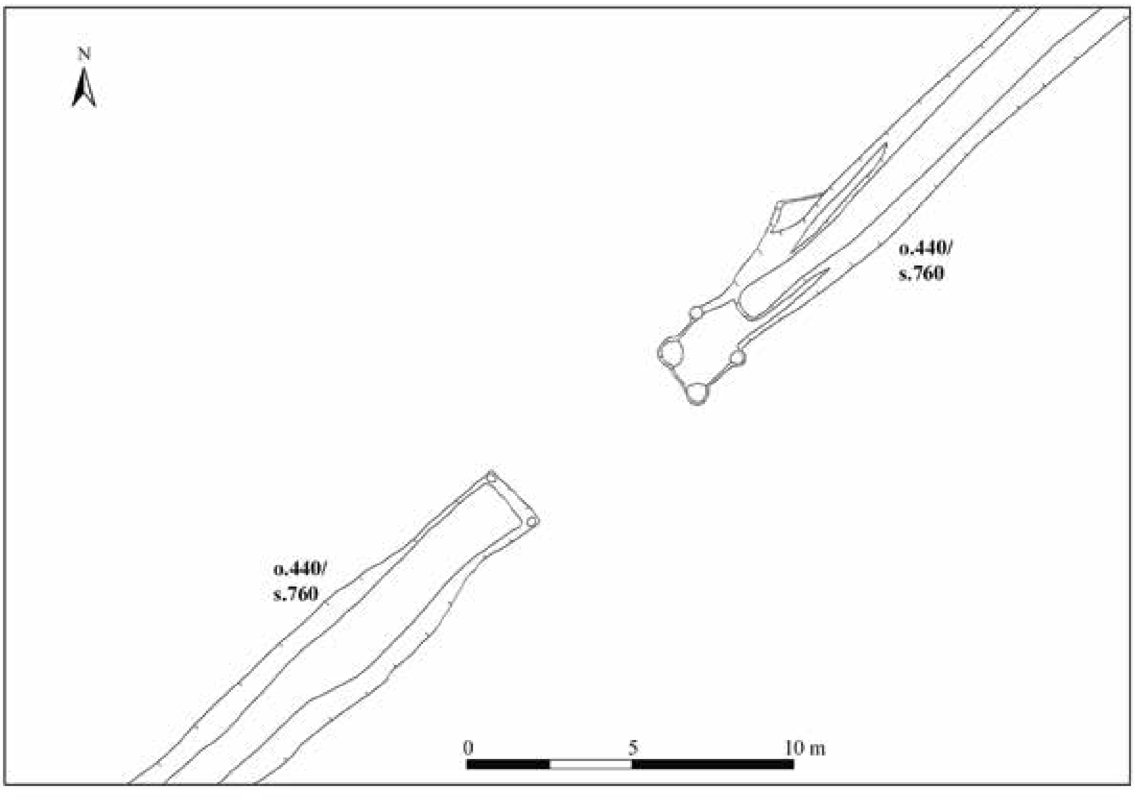

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Fig. 12. 1. Gate in Ditch 440 at Csanádpalota-Földvár (©Péter Czukor); 2. Posthole of the gate in Ditch 440 at Csanádpalota-Földvár (©Péter Czukor)

Fig. 13. Pit 44 at Csanádpalota-Földvár (©Péter Czukor)

Fig. 14. Pit 407 at Csanádpalota-Földvár (©Péter Czukor)

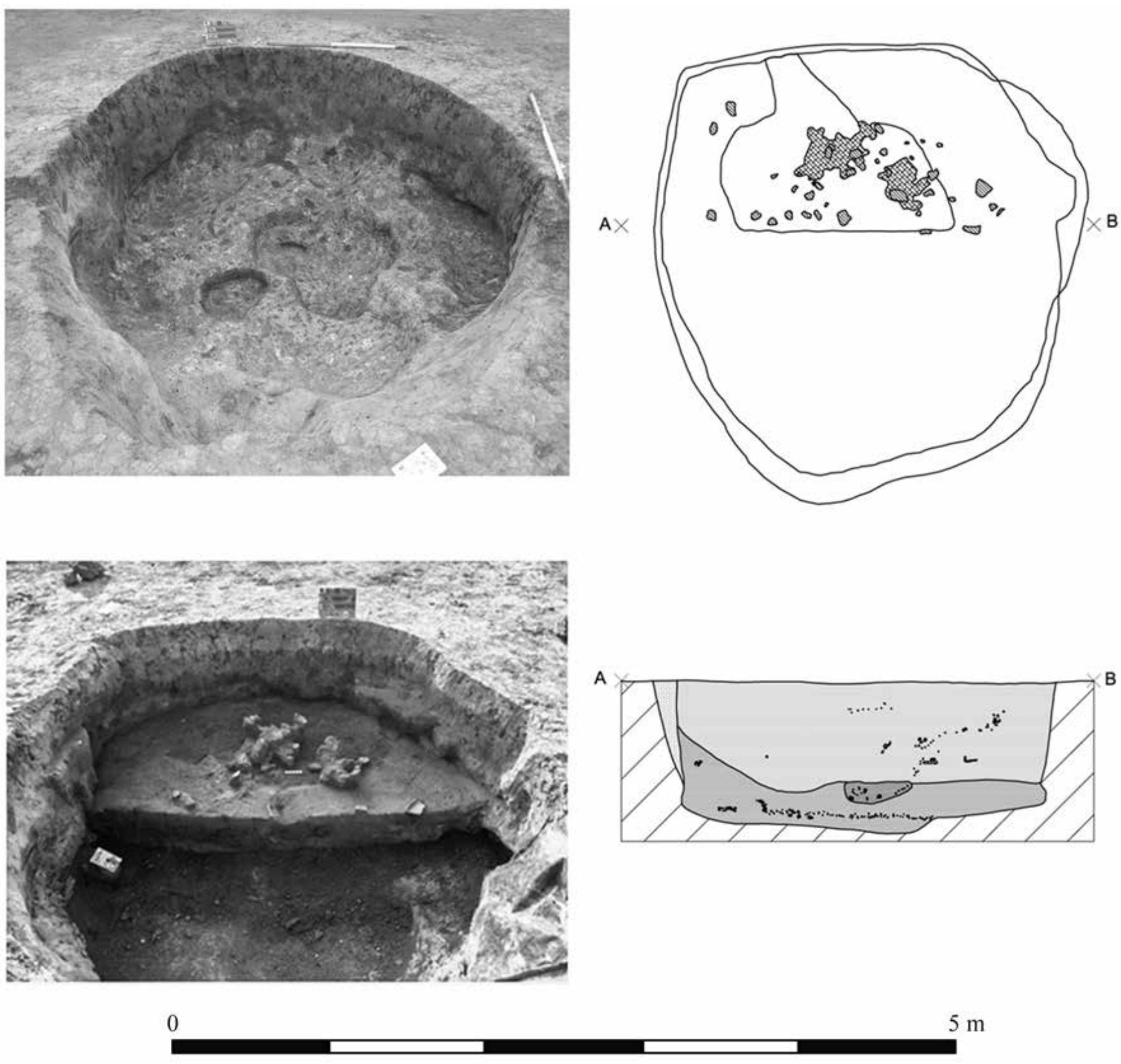

Fig. 15. Pit 474 at Csanádpalota-Földvár (©Péter Czukor)

Pit 44 had a complex sequence of layers in its fill *(fig. 13)*. In the uppermost layer the sherds of a large, collapsed, richly decorated vessel with vertical channelling and large knobs was discovered, mixed with fragments of smaller cups. In the layer below, in the southern part of the pit, we found arched pieces of burnt daub and we observed a blackish burnt fill under the large urn-like vessel. The bottom of the pit yielded further large, thick pieces of burnt daub. The context and the charred fill indicate some kind of a burning episode, possibly of ritual character.

Feature 407, a pit 4 m in diameter and 0.65 m in depth, also seems to be special. Its walls were sloping and 3-4 scoops had been dug into its bottom. The dark brown fill of the pit complex contained characteristic channelled Late Bronze Age pottery and a bronze knife. Along its northwestern, step-like side a debris of burnt daub was observed, in which a bowl was discovered. In front of the debris, an animal skull and other animal bones had been placed at the bottom of the pit *(fig. 18)*. The pit yielded altogether 164 pieces of pottery sherds.

Feature 474 was a round pit ca. 3 m in diameter and 1.5 m in depth. It also yielded a significant amount of material in clearly identifiable layers *(fig. 15)*. More than 400 pieces of pottery sherds were unearthed, which belonged to at least 34 vessels, mostly fine ware. A large amount of cattle, sheep and goat bones were also found, together with a complete skeleton of a young sheep, although not placed in anatomical order, and the remains of a pig, a dog and hare from another layer. According to the calculations based on the minimum number of individuals, altogether 600 kg meat belonged to the bones found in the pit.[19] The pit also seemed special from the point of view of botanical remains: the sample taken from its fill contained 745 charred grains of common or bread wheat.[20]

Excavation results in the central area

Smaller scale excavations in the central area were carried out in 2013. Based on the results of the systematic survey, coring and the first geophysical prospection of the central Enclosure 1, we were able to identify more precisely the location of the enclosure.

We opened a 3×40 m trench running north–south, perpendicular to the rampart. The remains of the rampart appeared in the central part of the trench, but due to agricultural cultivation had only survived to about the height of 50 cm. Its internal structure, presumably made of packed clay, was only indicated by a 30-40 cm wide stripe of burnt daub *(fig. 16. 1)*. On the inside of the rampart, parallel to it, a row of postholes was discovered, which might have been part of a palisade wall *(fig. 16. 2)*. Two nearly 3 m deep ditches with V shaped cross-sections ran through the central and southern parts of the trench *(fig. 17)*. The ditches – similarly to the ditch segments discovered earlier along the motorway track during the preventive excavation – contained a large amount of characteristic Late Bronze Age ceramics.

Late Bronze Age finds

We are only in the first phase of the analysis of the Late Bronze Age material from the site, thus here we can give only a preliminary overview of some of the more important finds. The large majority, ca. 5200 pieces of the ceramic material comes from the pits, while the ditches yielded ca. 1200 finds. The ratio is slightly different with metal objects: 21 from the ditches and 31 from the pits or other features.

The pottery found at Csanádpalota can be safely dated to the Reinecke B D–Ha A1 phase based on its parallels. However, the stylistic analysis and 'cultural affiliation' of Late Bronze Age channelled pottery from the southern part of the Great Pannonian Plain has been notoriously difficult and controversial (not to mention our general disbelief regarding traditional concepts of 'archaeological cultures'). Terms such as 'Csorva', 'Proto-Gáva', 'Pre-Gáva', 'Gáva I' and 'Cruceni–Belegiš II' have often been used simultaneously, and sometimes interchangeably, for such materials, and researchers do not always agree upon the differences and overlaps between these terms.[21] The clarification of this terminological controversy is beyond the scope of this preliminary report, and for the sake of simplicity the term 'Pre-Gáva' – preferred, or at least used, by many Hungarian scholars – will be employed here to describe this material, with the caveat that it has very strong connections with the pottery found to the south, labelled Cruceni–Belegiš II.

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19 *Szeverényi et al. 2015b* 101.

20 *Szeverényi et al. 2015b* 106.

21 E.g. *Trogmayer 1963; Trogmayer 1992; Gumă 1993; Gumă 1997; V. Szabó 1996; V. Szabó 2017; Przybyła 2005; Szentmiklosi 2009; Bader 2012; Sava 2020; Sava – Ursuţiu 2021.* See also V. Szeverényi – A. Priskin – P. Czukor: The Late Bronze Age pottery from Csanádpalota. Csorva – Proto/Pre-Gáva – Cruceni–Belegiš? Paper presented at the international conference "Local Tradition, Culture, Contact or Migration? The pottery Belegiš-Gáva Type as a Chronological and Cultural Marker in Southeast Europe During the Late Bronze Age." Timişoara, 8th–11th October 2018.

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Fig. 16. 1. Burnt daub indicating the packed clay rampart of Enclosure 1 (©Péter Czukor);
2. Postholes of the palisade of Enclosure 1 (©Vajk Szeverényi)

Fig. 17. Ditch of Enclosure 1 (©Vajk Szeverényi)

Within the ceramic material, it is easy to discern a group of coarsely manufactured domestic ware, usually fired to red or orange and tempered with larger pieces of grog. Shapes include mostly larger bowls and storage vessels, often decorated with finger impressions or finger-impressed cordons. In some cases the vessel surface is smoothed, in others it is rusticated or untreated. In contrast, finer ware consists of vessels with thinner wall, and often medium or highly polished surface. Sometimes the use of graphite[22] can also be observed on their surface, Pit 474 even contained a piece of graphite.

One of the most distinctive vessel types of the period is the so-called 'Pseudo-Protovillanova' type urn, an unhandled, often richly decorated amphora-type vessel with conical neck, often flaring rim, and a low, biconical belly. Various regional and chronological variants are known from the Carpathian Basin.[23] Fragments from such vessels were found in a number of features, e.g. a conical neck with everted rim and horizontal channelling on the neck from Ditch 101/125 or a vessel with vertically channelled belly and conical neck from Pit 44/52.

Fragments of bowls with inverted, horizontally facetted or diagonally channelled rim are quite frequent from the Late Bronze Age features. The shape was widespread since the final phase of the Middle Bronze Age, and continued to be used in the Late Bronze Age as well. Facetted and channelled rims, however, are characteristic for the beginning of the Urnfield period in Transdanubia (Western Hungary)[24] and the Pre-Gáva period in the Great Pannonian Plain.[25]

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[22] *Kreiter et al. 2014*.

[23] For classifications, see *Forenbaher 1988* and most recently *Váczi 2017*.

[24] E.g. *Patek 1968* 102, Taf. 6. 28–29, 31.

[25] E.g. *Trogmayer 1963* Taf. 11. 8, Taf. 14. 8, etc.; *B. Hellebrandt 1990* fig. 3. 2, 4–5, fig. 5; *V. Szabó 1996* fig. 26. 8, 10, etc.

Various variants of bowls with channelled shoulder and funnel-shaped neck are also attested. They have parallels from a large number of Late Bronze Age sites from both the southern Plain (e.g. Csorva, Igrici, Szentes, Tiszapüspöki, Şuşani [Romania], etc.)[26] and the western Carpathian Basin (e.g. Balatonmagyaród, Očkov [Slovakia], Čaka [Slovakia], Vál, etc.).[27] A variant of this form are bowls with carinated shoulder.

Carinated cups with high handles with numerous variants are also among the most frequent finds. Ditch 23 yielded the fragment of such a fine, well-fired, thin-walled cup *(fig. 18. 2)*. Its high handle is attached to the slightly everted rim. Groups of short, vertical incisions decorate its shoulder. This cup also represents common type of the RB D–Ha A1 phase; its parallels are known e.g. from the vessel depositions of Battonya,[28] Igrici[29] or Tiszapüspöki.[30]

Another almost intact cup was found in the same ditch. Originally, it had three knobs on its belly (two are now broken off), arranged symmetrically together with its handle. The latter had originally been pulled up above the rim, but only its stub remains. It is a carinated cup with a truncated cone shaped lower part, slightly arched neck and everted rim. There is an incised decoration on its shoulder, between the knobs, consisting of V-shaped line bundles and a double garland motif *(fig. 19. 3)*.

A similar, blackish cup was found in Feature 101 *(fig. 20. 1)*. Its handle is fragmentary. The belly is slightly bulging, its base is flat; the handle starts from the belly and rises above the rim. The belly is decorated with incised vertical and oblique line bundles and knobs. The shape of these cups is a common feature in the RB D–Ha A1 phase in the Plain, although the version decorated with knobs is rarer. It is known from a vessel deposition from Debrecen.[31] Decoration on similar cups has been attested from Debrecen[32] and Giroc-Mescal, Romania.[33]

Similar, but deeper cups are also attested, e.g. from Ditch 23, a large wall fragment of such a deep cup with a broken-off handle, and channelled wavy lines or garlands running around its shoulder *(fig. 18. 1)*. This is also a wide-spread vessel shape and decorative motif in the RB D–Ha A1 phase in the southern Great Plain, known e.g. from the mound of Şuşani (Romania)[34] or Timişoara-Fratelia (Romania).[35]

Two rim fragments are rather unusual. One was found in Feature 279. It was part of a vessel of unknown shape with arched neck and everted rim, with the lower and upper stub of the handle. Above the upper stub, a triangular 'snake-head' or 'bird-head' protome protrudes upward from the rim, decorated with circular motifs made up of burnished lines and line dots. A similar pattern can be seen on the neck and under the handle as well *(fig. 19. 1)*. A similar protome was found in Feature 101, more rhombic in shape and decorated with impressed dots and lines *(fig. 19. 2)*. Similarly shaped handles and decoration is known from Timişoara-Fratelia (Romania), from Cruceni–Belegiš II context.[36]

[26] E.g. *Trogmayer 1963* Taf. 11. 1; *B. Hellebrandt 1990* fig. 3. 1; *V. Szabó 1996* fig. 8. 4–5; *V. Szabó 2017* fig. 10; *Stratan – Vulpe 1977* Taf. 18. 143–145.

[27] *Horváth 1994* fig. 13. 1; *Paulík 1962* Abb. 17. 1; *Točík – Paulík 1960* fig 24. 6; *Petres 1960* Taf. 14. 5.

[28] *Sz. Kállay 1986* fig. 4. 3.

[29] *B. Hellebrandt 1991* fig. 7. 3.

[30] *V. Szabó 2004a* fig. 11. 46.

[31] *Poroszlai 1984* Pl. 1. 4–6.

[32] *Poroszlai 1984* Pl. 4. 1.

[33] *Szentmiklosi 2009* Pl. 67. 1–2, 4.

[34] *Stratan – Vulpe 1977* Taf. 6. 97, 99.

[35] *Gumă 1993* Pl. 16. 1.

[36] *Szentmiklosi 2009* Pl. 123. 3, Pl. 148. 9.

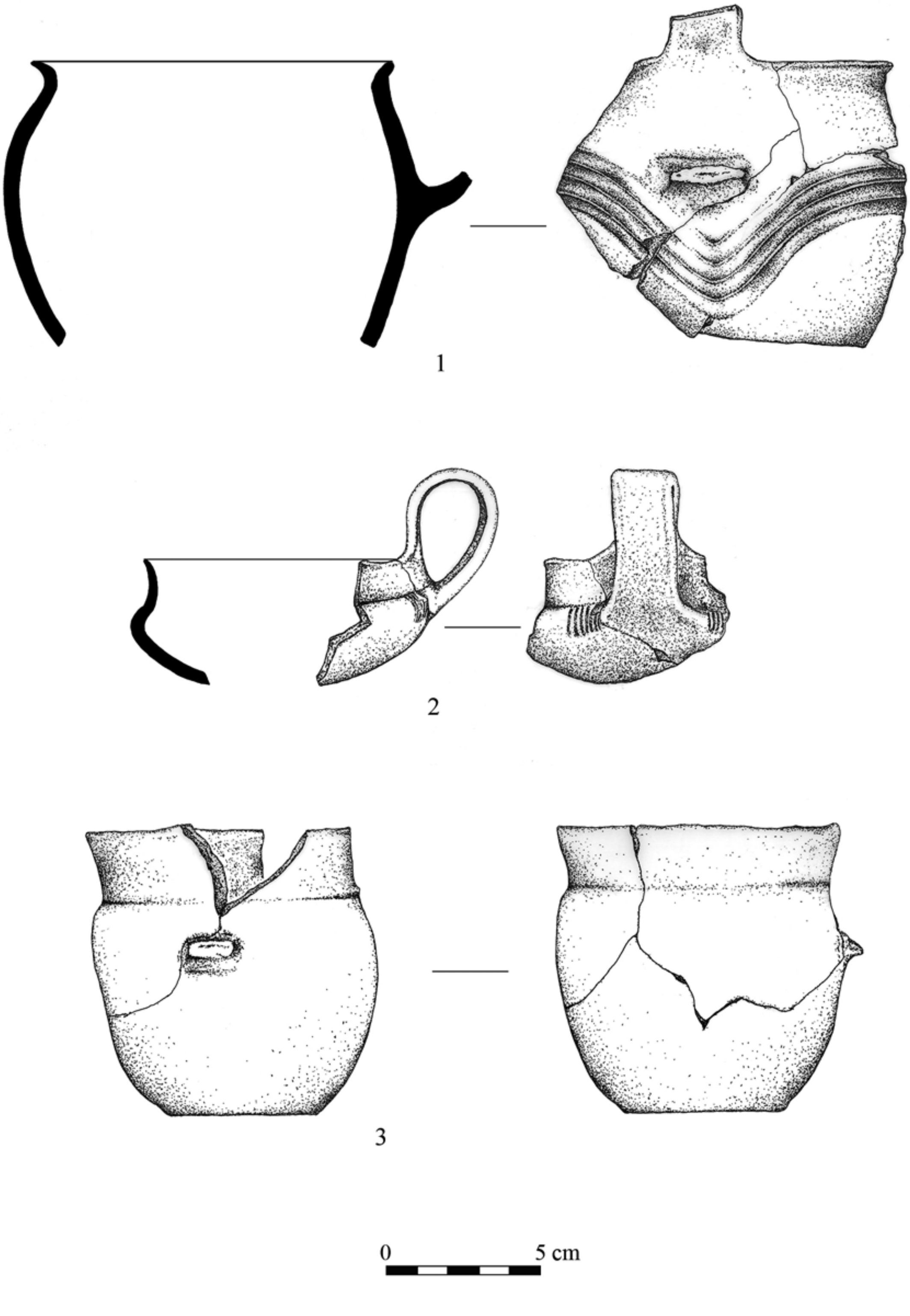

Fig. 18. Selected ceramic finds from Csanádpalota-Földvár (©Judit Zoé Nagy)

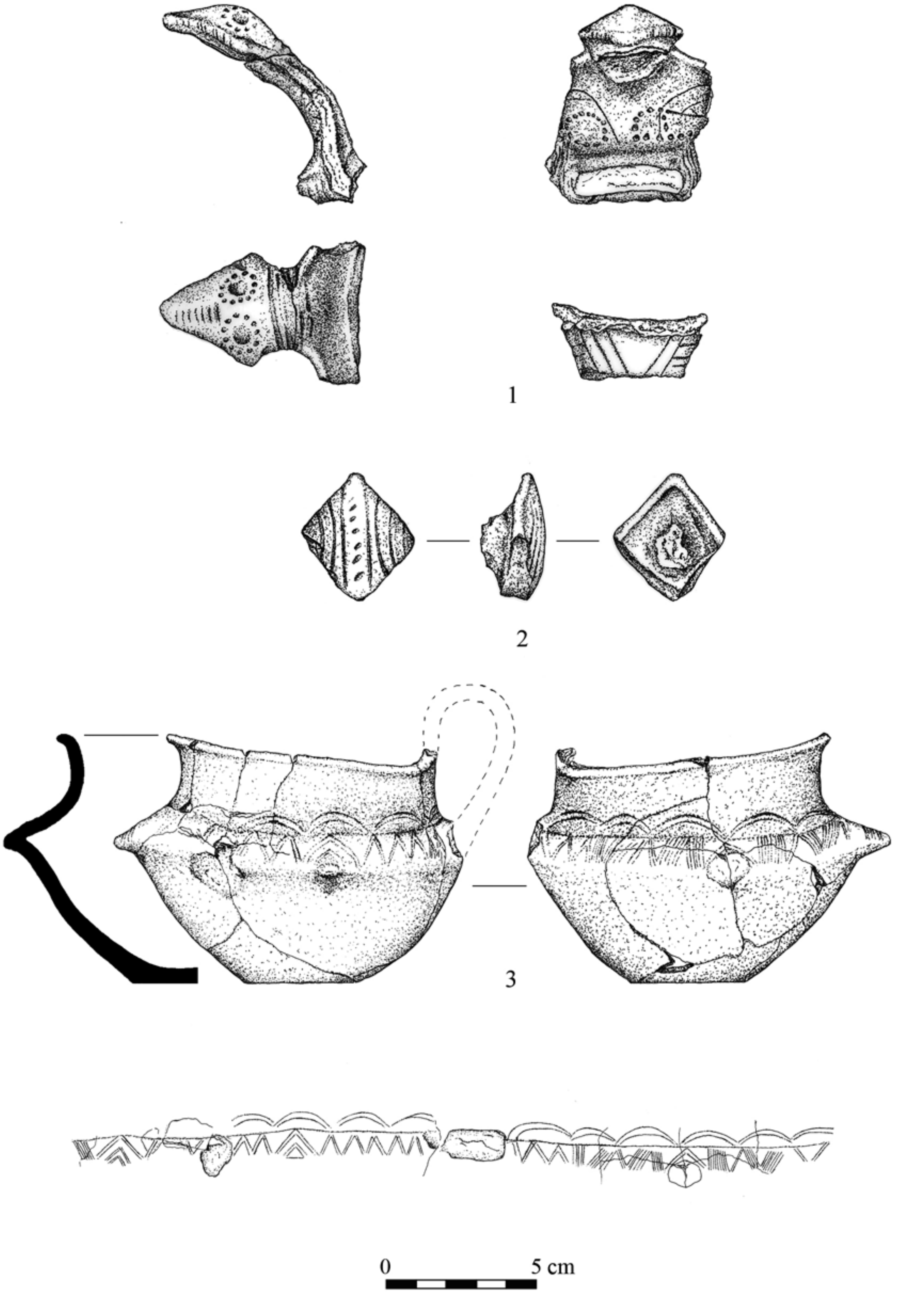

Fig. 19. Selected ceramic finds from Csanádpalota-Földvár (©Judit Zoé Nagy)

One-handled jars with oval body and funnel-shaped neck represent a widespread form both in the Plain[37] and in Transdanubia[38] in the RB D and Ha A1 phases. One such specimen with slightly bulging belly was found in Feature 23. Its broken handle had probably been pulled up above the rim *(fig. 18. 1)*.

Altogether 48 metal objects and four pieces of slag were excavated from Late Bronze Age features at the site. The intact objects include two bronze arrowheads, two bronze bracelets, a bronze socketed axe, a bronze flat axe, a bronze knife, three bronze pins and two spiral bronze wires. The majority of the metal objects are made up of small, unidentifiable bronze fragments.

Perhaps the most exquisite object from the site is a single-edged, straight-backed, tanged bronze knife from Pit 407. Its hilt consists of two bone plaques with incised line-bundle decoration, which were fastened to the tang by three bronze rivets *(fig. 20. 2)*.

Radiocarbon dates

Based on the ceramic material, the settlement can be dated to the RB D–Ha A1 period. A series of radiocarbon dates have been obtained to determine the place of the site on the absolute timescale as well. As indicated above, the use of the settlement and the construction of the various enclosures probably took place over a longer period of time, with a number of subphases. To some degree, these radiocarbon dates – combined with a more detailed analysis of the find material – will help identify and date these phases more precisely. At the moment, however, they only provide a general absolute chronological framework, and more measurements of carefully chosen samples from good contexts will be needed to achieve this goal.

According to our current knowledge of Late Bronze Age absolute chronology in Hungary, the period begins (and the Middle Bronze Age ends) around ca. 1450 cal BC (coterminous with the RB B–C1 transition).[39] There are very few available radiocarbon dates for the RB D–Ha A1 phase,[40] based on which this phase is placed to ca. 1350–1150 cal BC. Our dates confirm this picture and a series of similar dates have recently been published from fortified sites from Romania and Serbia as well.[41]

Altogether 10 samples have been measured so far from Csanádpalota-Földvár *(fig. 21; Table 2)*.[42] One of the samples, from Feature 153/207, was dated to the Avar period (ca. AD 540–610, 1σ range), all the other proved to be of Late Bronze Age date. The date from Feature 153 can be explained by its complex context: here two pits, a Late Bronze Age (Feature 153) and an Avar period pit (Feature 23/365) were dug into Ditch 23; furthermore, they also cut each other, which caused some mixing of their materials.

The Late Bronze Age dates range between ca. 1430 and 1120 cal BC. Samples from two ditches and five pits have been dated so far. Based on the assumed relative chronology of the

37 *Sz. Kállay 1986* fig. 3. 6.

38 E.g. *Patek 1968* Taf. 64. 1, Taf. 70 (centre); *Ilon 1996* Pl. 8. 3.

39 E.g. *P. Fischl et al. 2013* 357–358; *O'Shea et al. 2019; Duffy et al. 2019;* see *Müller – Lohrke 2009* for Central European absolute dates.

40 E.g. *Ilon 1996* 153–154; *Ilon 2014a* 32–39; *Ilon 2014b* 128–129; *Ilon 2015* 247–250; see also generally for Late Bronze Age radiocarbon dating *Harding 1980; Sperber 1987; Della Casa – Fischer 1997.* See also most recently *Quinn et al. 2020* for Middle and Late Bronze Age dates from Southwestern Transylvania.

41 *Szentmiklosi et al. 2011; Harding 2017; Gogâltan et al 2019; Lehmphul et al. 2019; Sava – Gogâltan – Krause 2019; Molloy et al. 2020.*

42 All radiocarbon measurements were carried out at the HEKAL AMS ^{14}C facility of the Institute for Nuclear Research, Debrecen *(Molnár et al. 2013a; Molnár et al. 2013b)*. The dates were calibrated with the OxCal (v4.4) software *(Bronk Ramsey 2009)* using the IntCal20 Northern Hemisphere radiocarbon calibration curve *(Reimer et al. 2020)*.

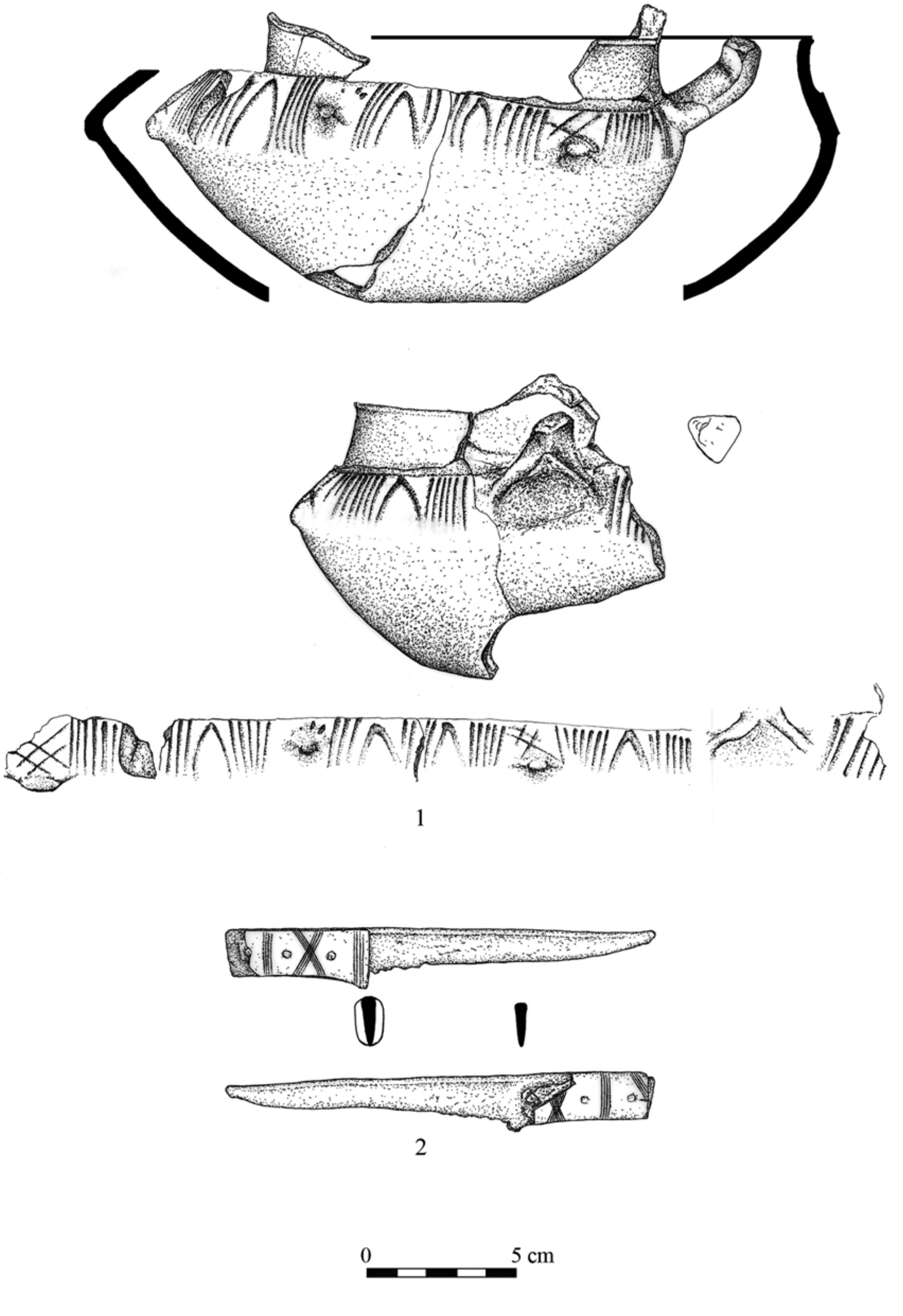

Fig. 20. Selected ceramic finds and bronze knife from Csanádpalota-Földvár (©Judit Zoé Nagy)

Feature ID	Feature type	Sample material	Lab code	Uncalibrated BP age	Calibrated 1σ range	Calibrated 2σ range	$\delta^{13}C$ (estimated)
201 (Enclosure 1)	ditch	animal bone	DeA-3470	2976±35	1260–1120 BC	1380–1050 BC	-25‰
153/207	pit	animal bone	DeA-3471	1498±33	AD 540–610	AD 430–650	-25‰
474/834	pit	charred grain	DeA-3483	3012±35	1380–1200 BC	1390–1120 BC	-25‰
474/834	pit	charred grain	DeA-3484	3025±36	1380–1210 BC	1400–1130 BC	-25‰
474/834	pit	charred grain	DeA-3485	3037±35	1380–1230 BC	1410–1130 BC	-25‰
23/468 (Enclosure 4b)	ditch	animal bone	DeA-8209	3074±25	1400–1290 BC	1420–1260 BC	-25‰
440/1245	pit	animal bone	DeA-8210	2964±24	1220–1120 BC	1270–1090 BC	-25‰
44/51	pit	animal bone	DeA-8211	3119±24	1430–1320 BC	1450–1300 BC	-25‰
439/1118	pit	charred grain	DeA-8296	3009±27	1290–1200 BC	1390–1120 BC	-25‰

Table 2. Calibrated radiocarbon dates from Csanádpalota-Földvár

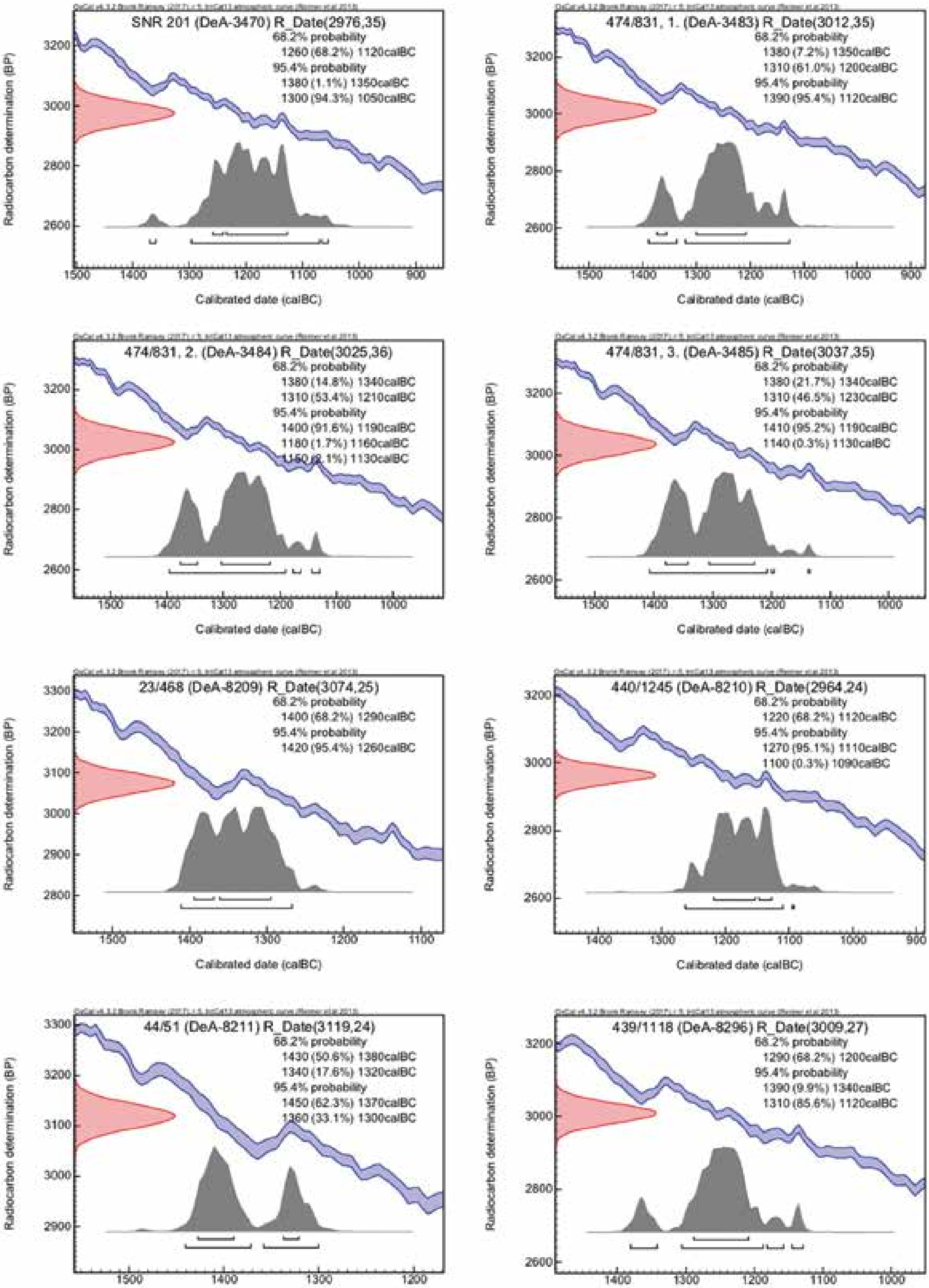

Fig. 21. Calibrated radiocarbon dates from Csanádpalota-Földvár

construction of the various ditches, one would expect the earliest dates from Enclosure 1 and the latest from Enclosures 4a and 4b. However, the earliest date (Feature 44/51: 1430–1320 cal BC, one sigma range) comes from the westernmost excavated Late Bronze Age feature, which lies already outside Enclosure 4b. The latest dates are known from two pits (Pit 439: 1290–1200 cal BC and Pit 440: 1220–1120 cal BC, one sigma range) and Enclosure 1 (ID 201: 1260–1120 cal BC, one sigma range).

At the present state of our research, we think it is impossible yet to determine the date of the construction of the enclosures or the date of the abandonment of the site. While the (2 sigma) probability ranges of the dates available so far cover the period between ca. 1450 cal BC and 1050 cal BC, this does not necessarily mean that these dates are the upper and lower borders of the period of (Bronze Age) occupation at the site. While some of the dates come from short-lived samples (seeds), most of them come from unarticulated bones of animals from various contexts. These thus only indicate that the given features were still in use ('open') at some time during the ranges given by the measurements, and do not provide more exact dates for their creation or filling up/abandonment, or even the sequence of their construction. For example, in the case of the dates from Ditch 23 (= Enclosure 4b) and 201 (= Enclosure 1), one sigma dates (ca. 1400–1290 cal BC and 1260–1120 cal BC respectively) would indicate the chronological priority of Enclosure 4b, which archaeologically seems unlikely. The two sigma ranges, however, overlap considerably (ca. 1420–1260 cal BC and 1380–1050 cal BC, respectively), and indicate only the time-span when the ditches were still in use, and material could have entered them (deposited at the bottom or just thrown in). Thus, theoretically they allow the construction of Enclosure 1 to be earlier than that of Enclosure 4b. To sum up, while these dates so far give us an indication of the time span of the Late Bronze Age occupation (ca. 1430–1120 cal BC), we will need much more dates from short-lived samples from well-chosen contexts, before we can use them to establish the dates of the beginning, the various construction phases and the abandonment of the settlement more precisely.

Summary and future work

The aim of the present article was to provide a brief description of the Late Bronze Age settlement of Csanádpalota-Földvár and the results of the first few field campaigns at the site. During the preventive excavations of 2011–2013, the site proved to be a multivallate 'mega-fort' of huge dimensions. The first rescue excavations were followed by a series of other investigations and small scale excavations, and research into the regional context of the site.

Already at the beginning of our work at Csanádpalota we became aware that its enclosures do not stand alone, but form part of a larger network of smaller and larger fortified settlements, even 'mega-forts', in the southern part of the Great Pannonian Plain, such as Orosháza-Nagytatársánc,[43] Sântana-Cetatea Veche (Romania),[44] Corneşti-Iarcuri (Romania),[45] and the recently identified Iđoš-Gradište (Serbia).[46]

Thanks to previous work both in Hungary and abroad, series of such sites have now been identified and investigated to various degrees and with various methods. A series of smaller

[43] *Banner 1939.*

[44] *Gogâltan – Sava 2010; Gogâltan – Sava – Mercea 2013; Gogâltan – Sava 2018; Sava – Gogâltan – Krause 2019; Gogâltan – Sava – Krause 2019.*

[45] *Heeb – Szentmiklosi – Wiecken 2008; Szentmiklosi et al. 2011; Heeb et al. 2018; Lehmphul et al. 2019.*

[46] *Molloy et al. 2017; Molloy et al. 2020.*

fortified sites from the period have been located and partly excavated,[47] and work on non-fortified settlements started as well.[48] As a consequence, our understanding of Late Bronze Age settlement and society in the region has been considerably transformed during the last decade.[49]

Since 2020, we have been able to launch a new project that will examine the Late Bronze Age settlement history of this region, and the economic organisation and socio-political make-up of the communities living here between ca. 1400 and 1100 BC.[50] Nevertheless, due to the much larger geographic scale of the emergence of these mega-forts, a macro-regional approach – and the close collaboration of multiple international research teams with a micro-regional and regional focus – seems indispensable for the understanding of these sites and the historical processes[51] that led to their appearance and later abandonment.[52]

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47 E.g. Végegyháza-Zsibrik-domb: *Lichtenstein – Rózsa 2008; Milo et al. 2009;* Újkígyós-Örökföldek: *Bóka 2020;* Munar-Wolfsberg (Romania): *Sava – Gogâltan 2017;* Medgyesegyháza-Lagzi-dűlő: *Szeverényi et al. 2017* 143–144; Makó-Rákos-Császárvár: *Szeverényi et al. 2017* 139–141.

48 E.g. Şagu, Sit A1_1 (Romania): *Sava – Hurezan – Mărginean 2011; Sava 2019;* Csanádalberti-Fekete-halom: *Szeverényi et al. 2021* 60–61.

49 Compare *V. Szabó 2004b* for earlier views, based on older data.

50 *Szeverényi et al. 2021.*

51 *Czukor et al. 2017; Szeverényi et al. 2017.* See also *Molloy 2022 preprint* for a wider review of Late Bronze Age site abandonment.

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ANNA PRISKIN

THE ANALYSIS OF BRONZE AGE MACROLITHIC TOOLS A CASE STUDY FROM CSANÁDPALOTA-FÖLDVÁR (SOUTHEASTERN HUNGARY)

Zusammenfassung: Folgender Überblick beschreibt die Ergebnisse der Analyse, der das makrolithische Material der spätbronzezeitlichen befestigten Siedlung am Fundort Csanádpalota-Földvár unterzogen wurde (Ausgrabungen der Autobahn M43 zwischen 2011 und 2013). Ziel der Arbeit war einerseits die Unterbreitung einer neuen und in der ungarischen Forschung bis dato nicht verwendeten Methodik zur Analyse von makrolithischen Gegenständen, andererseits die Betonung der Nützlichkeit besagter Methodik für sozialarchäologische Schlussfolgerungen bezüglich prähistorischer Gesellschaften. Die Forschungsarbeit ist eine experimentelle Studie, die sich mit der auf makrolithischen Gegenständen basierenden, vergleichenden Analyse des spätbronzezeitlichen Siedlungssystems und der Wirtschaft Süd-ost-Ungarns auseinandersetzt. Unsere Ergebnisse deuten nicht auf eine Zentralisierung der Produktion an den befestigten Siedlungen hin.

Keywords: macrolithic implements, functional analysis, economy, Bronze Age, Southeastern Hungary

On the Békés-Csanádi-plateau (southeastern part of the Great Hungarian Plain) in the middle phase of the Late Bronze Age (ca. 1350–1100 BC) fortified settlements, often with monumental sizes, emerged, surrounded by smaller fortified sites and even smaller non-fortified villages and hamlets. According to one possible interpretation, this settlement pattern could have had multiple tiers in a hierarchical structure, where fortified and unfortified settlements had a super-/subordinate relationship. Currently we are conducting a micro-regional, multi-scalar, interdisciplinary research project aimed at the investigation of the social, political and economic organization of Bronze Age communities in SE Hungary and the neighbouring areas of Romania, with a focus on the Late Bronze Age.[1]

Part of the investigation of each settlement is the analysis of macrolithic tools with a multilevel methodology, whose results will contribute to the reconstruction of Bronze Age subsistence economy. The present study is aimed at the brief presentation of the methodology and the first results of the analysis of the Late Bronze Age macrolithic material from Csanádpalota-Földvár (previously Csanádpalota, Juhász T.-tanya, M43 motorway Site 43/55).[2]

1 The project has received funding from a number of sources during the previous years: Hungarian National Fund (NKA, Grant Nos. 3234/230, 207134/306 and 207134/00383), National Research, Development and Innovation Office (OTKA FK 135805), Wenner-Gren Foundation (Dissertation Fieldwork Grant no. 9472).

2 The analysis and its results are part of my PhD thesis titled Subsistence and Society: Analysis of macrolithic tools and subsistence economy in the Late Bronze in the southern Great Hungarian Plain in preparation at the Universitat Autònoma de Barcelona.

The attention paid, and significance assigned in Hungarian research to macrolithic tools – and consequently the number of publications analysing them – is still negligible compared to other classes of finds. Nevertheless, the Bronze Age is still among the better researched periods in this regard. Thanks to the research by Katalin T. Biró and Tünde Horváth, there are quite a few publications on lithic finds. It has to be noted, however, that they focused primarily on chipped and polished stone tools, and less on macrolithic implements. The lithic material of Middle Bronze Age 'Vatya' settlements (multi-layered tells) in central Hungary have been examined in more detail. Thus this period is better researched regarding stone tools.[3] Tünde Horváth's work filled a large gap, and it is still the only work on the analysis of macrolithic tools in Hungarian archaeology. The investigation of macrolithic material from Late Bronze Age settlements is even scarcer; only the analyses of two sites have been published in Hungary.[4]

Theoretical background

In recent years an increasingly lively debate has emerged about the character of Bronze Age European societies. During the past decades a major school of thought has suggested that European Bronze Age societies are characterized by some form of chiefdom type socio-political organization.[5] According to this approach, one archaeological evidence for chiefdoms is the presence of multi-level settlement hierarchies with large, fortified centres at the top tier. As mentioned above, during the middle phase of the Late Bronze Age a series of mega-forts appeared in the southern part of the Great Hungarian Plain (e.g. Csanádpalota, Corneşti-Iarcuri [Romania], Sântana-Cetatea Veche [Romania], Iđoš-Gradište [Serbia]). These could, in theory qualify as the centres of such polities. In these chiefdom type societies[6] the sources of the power of political leaders are manifold, and can be military, ideological and economic in nature. Regarding the economy, it has been theorized that political leaders achieved and maintained their power through the control of two sources: (1) control over the subsistence economy, food production and food processing, termed staple finance[7] or corporate strategies;[8] (2) control over specialist craftsmanship, exotic objects and exchange with other communities, termed wealth finance[9] or network strategies.[10] Another group of researchers identifies already the earliest (non-Aegean) states in European history in the Bronze Age of Southwestern and Central Europe.[11]

This has been questioned recently by another, increasingly vocal school, which suggests that the concept of chiefs and chiefdoms is outdated and cannot be a priori assumed for Bronze Age European societies.[12] These studies suggest, among others, that power is not a priori given, but must be negotiated and maintained; it is not static, vested in a single person ('chief'), but fluid, dispersed and contextually specific. The concept of heterarchy perhaps fits this approach better, and provides a framework for understanding complex, lateral networks within a society.[13] This

[3] *Horváth 2000; Horváth 2004* 1–339; *Horváth 2005; Horváth et al. 2016; Horváth – Kozák – Pető 1999; Horváth – Kozák – Pető 2000a; Horváth – Kozák – Pető 2000b.*

[4] *T. Biró 1995a; T. Biró 1996.*

[5] *Gilman et al. 1981; Kristiansen 1991; Kristiansen 1998; Earle 1997.*

[6] *Service 1962; Carneiro 1981; Earle 1987; Earle 1991; Earle 1997.*

[7] *D'Altroy et al. 1985; Earle 1997* 70–73.

[8] *Blanton et al. 1996; Feinman 1995; Feinman 2001.*

[9] *D'Altroy et al. 1985; Earle 1997* 73–75.

[10] *Blanton et al. 1996; Feinman 1995; Feinman 2001.*

[11] *Lull et al. 2010; Lull et al. 2011; Lull et al. 2013; Meller 2019.*

[12] *Pauketat 2007; Kienlin 2012; Brück – Fontijn 2013.*

[13] *Ehrenreich – Crumley – Levy 1995; Pauketat 2007* 62–63.

approach clearly requires more data on variation in patterns of production and consumption not associated with central settlements.

Based on the analysis of macrolithic materials from individual sites I investigate how these competing approaches can be reconciled with the evidence on the organization of the subsistence economy and food processing. The study of the control over food production and food processing is of great relevance and will provide the starting hypothesis, as staple finance or corporate strategies emphasize control over subsistence production and the mobilization of staple surplus. It means the ability of leaders to generate surplus from the lands owned by the group. Such surplus is sometimes collected as tribute and kept in storage areas in central settlements, close to the residence of the leaders, and then redistributed among followers.

The analysis of the spatial and contextual distribution of macrolithic tools used for food processing may shed light on the organization of production. The concentration of such finds in larger numbers at fortified central sites may indicate central control, while the lack of such concentration may indicate a less hierarchical access to foodstuffs, primarily grain, or the lack of tribute based economies.

One of the simplest forms of redistribution is the provision of feasts. Here control over the preparation of food is especially important.[14] Evidence for such feasts can indeed be found in the LBA material in the study area, indicated by special deposits that often include macrolithic material as well.[15]

Methodology

Definition of macrolithic or ground stone tools

According to Selina Delgado-Raack and Roberto Risch, the category of ground stone or macrolithic tools refers to lithic artefacts manufactured from sedimentary, igneous, and metamorphic rocks, and can be manufactured by percussion, polishing or abrasion. It includes lithic implements that can be used for abrasion, polishing, grinding, pounding, pulverizing, etc.: abraders, polishers, smoothers, grinding tools, percussors, hammer stones, anvils, axes, casting moulds, etc.[16]

Following Jenny L. Adams' approach, macrolithic tools can be categorized into groups based on the types of activities carried out with them. Processing tools (1) include grinding, pounding and pulverizing tools used to transform certain materials. Manufacturing tools (2), such as abraders, percussion tools, etc. are used to form other implements. Tools and paraphernalia (3) manufactured by abrasion, polishing or impaction are used as everyday objects, such as axes, moulds, containers, jewellery, statues, or even worked building stones. Implements used for the forming of both ground stone tools and flaking tools are pecking stones or hammer stones (4).[17] Their sizes usually depended on the size of the available raw materials: e.g. pebble-based polishers used during pottery manufacture are a few cm large, while a larger grinding slab can reach up to 50-60 cm in length. The extent of the use of macrolithic tools in various prehistoric periods is more or less similar, but there are no significant formal/typological differences between the tool types of these periods. Consequently, this class of objects is less suitable for typo-chronological analyses. Instead of formal analysis, the functional analysis of such objects is much more promising. Tools of similar shape could be used for varied purposes, and a single specimen could be implemented for a number of different activities, creating multiple working surfaces on the object. Through the study of macrolithic implements we can gain information on (1) the

[14] *Dietler 1990; Dietler 1996; Dietler 2001; Hayden 1996; Hayden 2001.*
[15] *Szeverényi – Priskin – Czukor 2014; Szeverényi et al. 2015.*
[16] *Delgado-Raack – Risch 2009.*
[17] *Adams 2002* 1.

exchange network of the given community through which the socially appropriated raw material was acquired, (2) the work object as intentionally created by people from the raw materials, and (3) the work means, the activities and transformative work on other raw materials with the help of macrolithic tools.[18]

Analytical method

The analysis of the macrolithic material is carried out based on a three-level methodology. At the first level, I analyse the individual macrolithic tools based on the various parameters detailed below. At the second level, I carry out the contextual analysis of the macrolithic tools within the given sites, through the comparison of the various types of features, finding spots and tool types. At the third level, I attempt to reconstruct the Late Bronze Age subsistence economy and its organization at a microregional level based on the comparative analysis of the lithic material of the various types of settlements of the microregion.[19] For the data to be comparable, identical data registration and analytical method is required. Csanádpalota-Földvár was the pilot site, where the methodology was first employed. During later fieldwork and analysis, minor modifications were made, primarily in sampling methods (e.g. taking soil samples from the immediate environment of grinding stones), as a result of which the spectrum of applicable analytical methods widened.

During excavation, all lithic finds were collected systematically, and contexts were documented in detail. As a result of maximum lithic find recovery, there is a large amount of lithic tools and raw materials in the collection. The recovery of lithic finds was complemented with systematic soil sampling from all contexts and features. As a consequence, we have good botanical data.[20]

The systematic inventory of the macrolithic material was carried out based on the method developed by Roberto Risch and complemented and refined by Selina Delgado-Raack.[21] During the classification of the macrolithic tool types I used the terminology developed by Roberto Risch, complemented with Jenny J. Adams' observations.[22]

The first step of the analysis, morphometric investigation means the analytical description of the tools based on metric, formal characteristics and preservation of the tools. Based on the preservation of tools, we can gain insight into how long the implements found at the given settlement were in use. In lack of close raw material sources it may be assumed that implements made of high quality raw materials were made use of as long as possible: for example, after the breakage of a larger-sized implement, the remaining piece may have gained a new function, and may have been used as long as its size permitted (perhaps with new and new functions). Based on the extent of fragmentation, I categorized the material into three groups. Group 1 contains completely intact implements; Group 2 contains pieces whose preserved size is at least one third of the original implement; and Group 3 contains the more fragmented lithics preserved to less than one third of their original sizes.

The classification of macrolithic tools is carried out based on the morphological and petrographic characteristics and assumed function.[23] The categories listed below include only those tool types that are attested in the studied material.

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18 *Risch 2008.*

19 The results of the analysis of the third level will be presented in a future paper.

20 The archaeobotanical analysis was carried out by Andrea Torma.

21 *Risch 1995; Delgado-Raack 2008.*

22 *Adams 2002.*

23 *Adams et al. 2009; Delgado-Raack – Gómez-Gras – Risch 2009; Delgado-Raack – Risch 2009.*

Abrader (ALS):[24] small handheld tools with one or two coarse working surface. They could have been used for the removal of certain substances from a surface or for the transformation of a surface.

Abrader/whetstone (ALS/PIA): fine-grained tools with two or more working surfaces. They could have been used for the transformation of surfaces or for metal sharpening, the latter case is usually indicated by a grooved working surface.

Abrader/hammerstone (APE): tools with two or more active working surfaces with percussion and abrading use-wear traces.[25]

Flake (LAS): a removed piece of raw material created as a result of percussion.

Stone slab (LOS): abrasive slab with abrasive active surface, usually a large-sized slab.[26] Adams defined a separate category for the so-called lapstone, which is a smaller, handheld implement with use-wear traces of abrasion, sheen or impact fractures on the surface, depending on the type of activity it had been used for.[27] The implement could be used for the processing of both animal or plant based foodstuffs.[28]

Mace (MAM): a rounded, perforated artefact.[29]

Mould (MDE): stone mould for the casting of metal objects. It has the negative shape of the metal object on its obverse side, and usually has traces of heating on its surface.

Grinding slab (MOL): large sized stone tools, the lower, passive piece of the double grinding equipment, usually with abrasion use-wear traces on the obverse and reverse sides, and percussion and friction traces on the obverse side.

Handstone/grinder (MUE): the upper part of the grinding equipment with abrasive traces on the obverse and reverse side of the tool.

Hammerstone (PEC): a usually irregularly shaped, handheld tool formed from a large pebble. Traces of strong blows can be seen on the active surface.[30]

PEC-PIA-YUN: multifunctional tool with two active and a passive working surface.

The analysis of lithic raw materials is based on macroscopic investigation and the petrographic analysis of thin sections. The results are compared to the database of lithic raw materials in Hungary. In an earlier phase of research, we attempted to identify primary (mine) and secondary (river sediments) raw material sources through field surveys.[31]

Functional analysis is based on the observation of manufacture and use-wear traces, as a result of which grinding tools, abrading tools, pecking tools and percussion tools can be distinguished. The various tools could have played an active or a passive role during these activities. Use wear traces on the surface of the implements will provide information on the manufacture of the tools (e.g. reuse or transformation of a used implement) or their use. It can be determined what kind of materials they came in contact with (bone, leather, wood, pottery, pigments), what kinds of changes these caused on the surface of the tool.[32]

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[24] The abbreviations used refer to the Spanish names of the various tool types.
[25] *Vučković 2019* 24.
[26] *Risch 1995* 41.
[27] *Adams 2002* 145.
[28] *Delgado-Raack et al. 2020* 13.
[29] *Vučković 2019* 26.
[30] *Adams 2002* 151.
[31] Petrographic analysis was carried out by Dr. Bálint Péterdi.
[32] *Adams 2008; Bofill 2012; Bofill et al. 2013; Dubreuil – Savage 2013; Tsoraki 2007.*

Contextual analysis involves the study of the settlement features and the find contexts of the macrolithic stone implements. During contextual analysis I examine the relationship between the excavated features and the macrolithic finds they yielded, and the possible patterns that can be recognized. Based on the given settlement features and the tool types found in them it can be determined what kinds of activities had been carried out in the given area, we may even reconstruct special activity areas (e.g. for food preparation, metallurgical or pottery workshop). The extent of the fragmentation of the tools and their quantity may also provide clues to the function of the given feature.[33]

Materials

Csanádpalota-Földvár

The site of Csanádpalota-Földvár is located in Southeastern Hungary, 1.5 km south of the modern town, a few hundred meters from the Hungarian–Romanian border. In the 1980s, during field surveys in the vicinity of Csanádpalota, numerous Late Bronze Age sites were identified in the area of the – then unknown – fortified settlement.[34] Later research revealed that all these separate sites were part of a huge, 460-hectare-large fortified settlement. At most sites, the Late Bronze Age component was mixed with medieval material, although a few yielded only Late Bronze Age sherds. The central, oval enclosure of the settlement was identified during survey as a 600×250 m large, N–S oriented ridge, with a 200×100 m large oval depression in its centre.[35]

During the mid-2000s, field surveys were carried out here along the planned track of the M43 motorway. The track passed through the external part of the large fortified site to be identified only subsequently and was named Site no. 55 Juhász T.-tanya[36] *(fig. 1).* During the excavations that were launched in 2011, when using the satellite images of Google Earth to follow the traces of a large ditch discovered in the western part of the excavated area (Feature 23), the outlines of an extremely large ditch system could be identified surrounding the already known oval enclosure *(fig. 2).* These images and our later field research demonstrated that a ca. 460-hectare-large fortified mega-site with multiple enclosures is located in the area.[37] During the excavation of the site between 2011 and 2013, ca. 12 hectars were unearthed in the area between the two external enclosures surrounding the settlement *(fig. 3).* More than 100 features were excavated that yielded so-called Pre-Gáva (Cruceni–Belegiš II) material from the middle phase of the Late Bronze Age (ca. 1350–1100 BC). In the excavated area of the track of the motorway, pits, ditches and remains of a gate leading into the central area were unearthed. Most of the pits contained everyday remains, however, a few other pits seemed to contain special, structured depositions; these were mostly located near the above-mentioned gate. The unearthed ditch sections mostly belonged to the enclosures of the large ditch system (Enclosures 3 and 4).

After the excavation of the motorway track in 2011–2013, research on the mega-fort continued as part of a research project, using a number of different non-invasive methods and small-scale excavations in the central part of the site, within Enclosure 1.[38]

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33 The comparative analysis of the macrolithic finds from other contemporaneous sites from the region will be carried out in a future work.

34 *Szathmári 1984.*

35 *Szathmári 1984* 14.

36 *Szalontai 2006.*

37 *Czukor et al. 2013; Priskin et al. 2013.*

38 *Szeverényi et al. 2021; Szeverényi et al. 2022* in this volume.

Fig. 1. Aerial photo of the central enclosure of Csanádpalota-Földvár (©Pazirik Kft.)

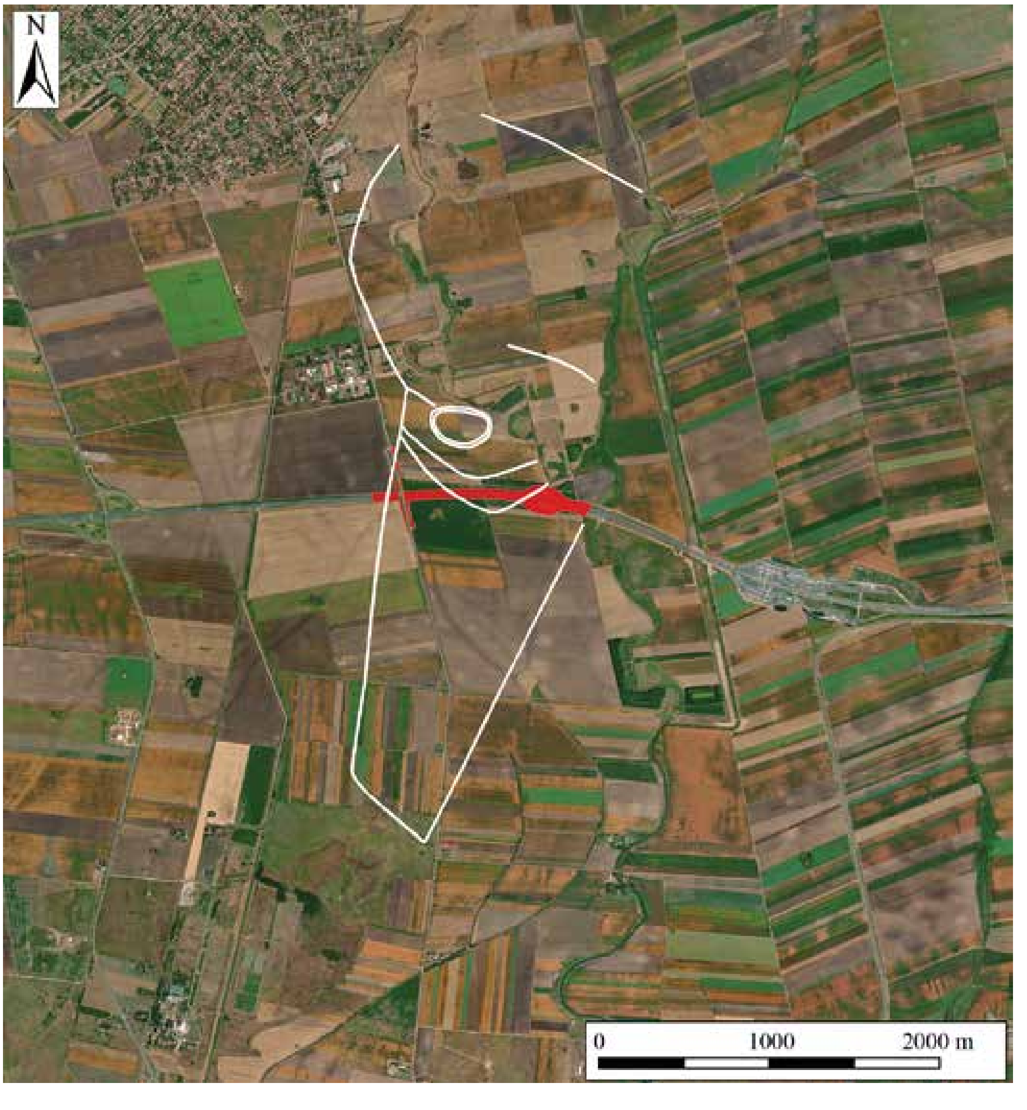

Fig. 2. The enclosures of Csanádpalota-Földvár with the excavated area in red (©Péter Czukor)

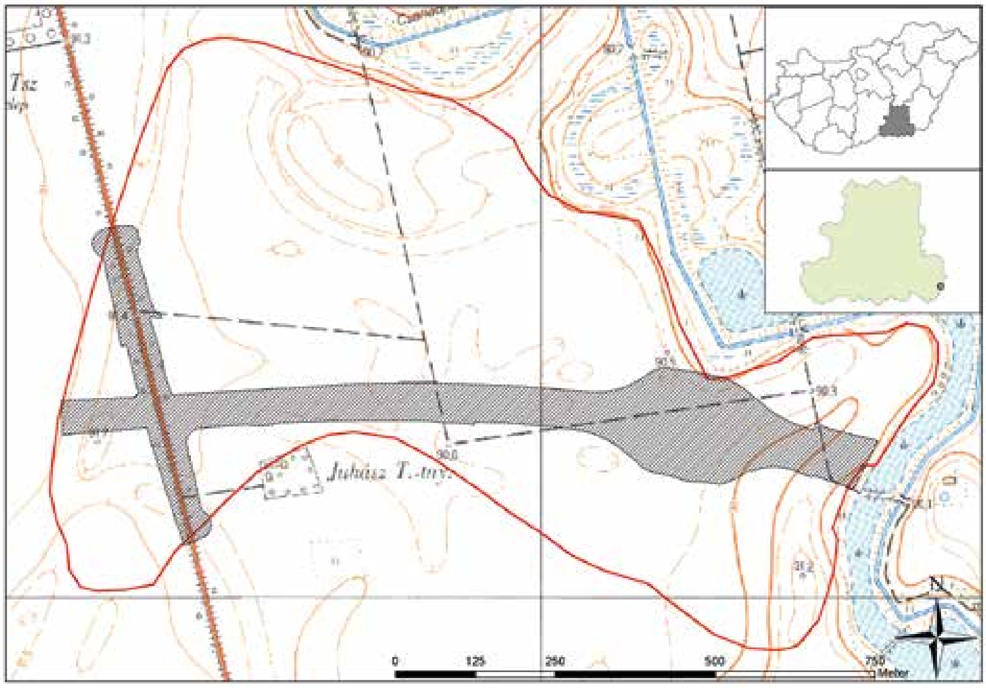

Fig. 3. Csanádpalota-Földvár excavated area in 2011 and 2013 (©Péter Czukor)

Macrolithic material
The lithic material under study comprises 238 pieces from 45 Late Bronze Age features: 32 pits and 13 ditches, of which four belong to the main enclosures. During the excavation – despite the circumstance characterising large-scale preventive excavations with regard to time and attention to detail – all lithic finds were collected and documented, and systematic soil sampling was also carried out from all datable features.

Results

The majority of the macrolithic finds are indeterminable lithic finds and raw material pieces (138 pieces), while the number of macrolithic tools is 100.

With regard to preservation, the following could be observed: 12 tools belong to Group 1 (intact), 12 tools belong to Group 2 (at least one-third preserved), while 76 belong to Group 3 (less than one-third preserved).

On the finds of Group 1 clear traces of manufacturing and/or use could be observed. Primarily small-sized tools remained intact: abraders (4), abrader/hammerstone (2), and hammerstone (1). It is interesting that the find material includes a single intact grinding slab and three handstones *(Diagram 1)*. The number of finds in Group 2 is also rather low, however, more tools types could be identified: abrader (2), abrader/hammerstone (3), sharpener (1), stone-slab (4), grinding slab (1), multifunctional tool (1) *(Diagram 2)*. The majority of the tools under study belong to Group 3, where less than one-third of the original size has been preserved *(Diagram 3)*. The number of grinding stones and stone slabs is large compared to that of the other tools.

Petrographic analysis
The analysis of the raw material of the macrolithic objects was carried out both macroscopically and microscopically, with thin section analysis on samples macroscopically determined as vulcanites. Based on macroscopic analyses, 9% of the 'macrolithic' objects turned out to be

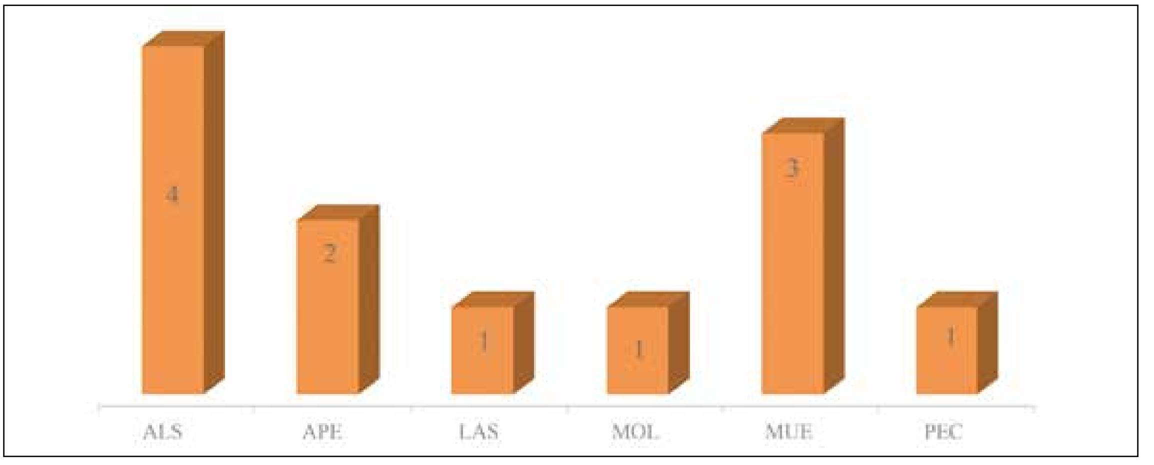

Diagram 1. Preservation of the macrolithic tools – Group 1 (n=12)

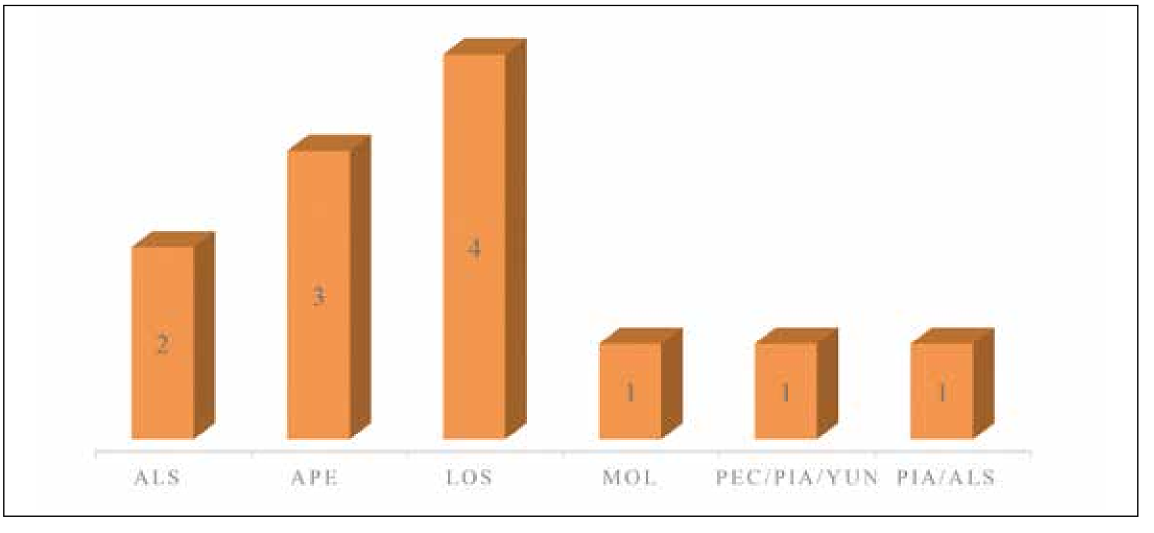

Diagram 2. Preservation of the macrolithic tools – Group 2 (n=12)

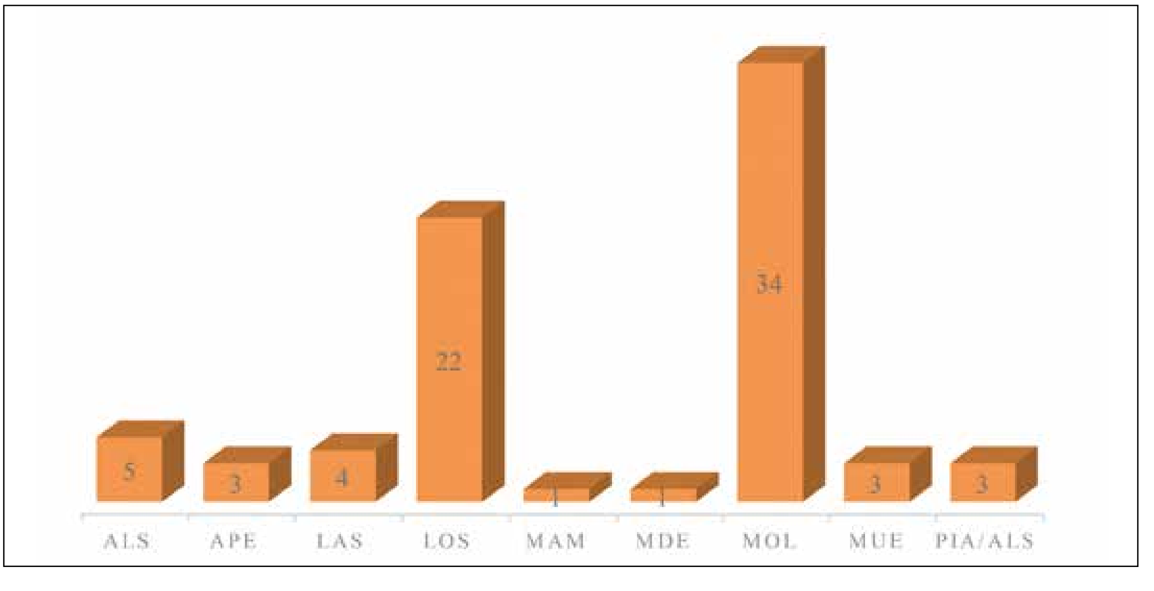

Diagram 3. Preservation of the macrolithic tools – Group 3 (n=76)

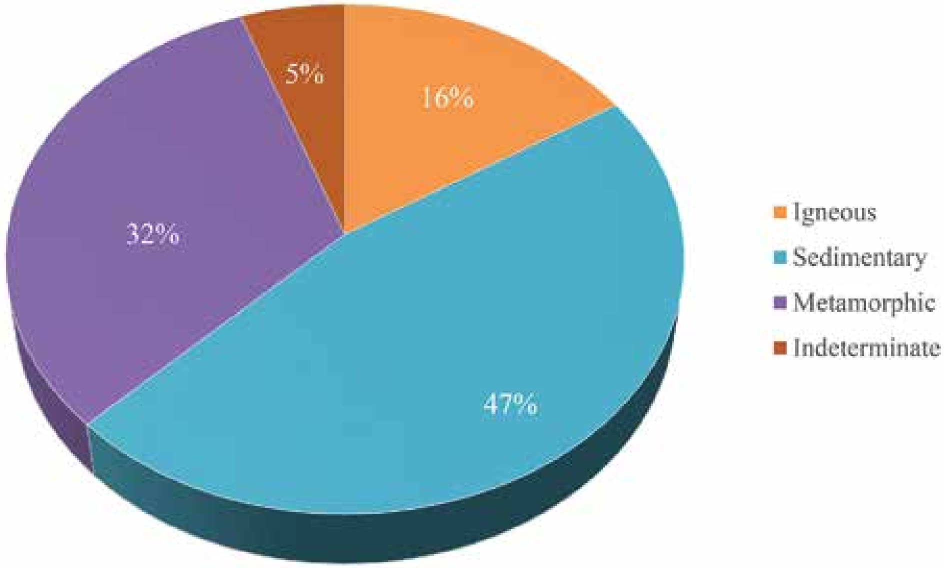

Diagram 4. Raw material of the macrolithic tool types (n=100)

artificial material (mostly plastering and daub) or carbonate concretion. The following percentage values are referring to the number of the remaining macrolithic objects. About 20% of the material is of gravel (pebble) origin. Gravels/pebbles were counted together with the corresponding raw materials, except quartzite-pebbles. The majority of the 238 pieces of the macrolithic finds (47%) was made of sandstone of various colours (grey, light grey, red) and sandstone pebbles; this was the most frequently used raw material at the site. Many of the identified tools (51 pieces) were also manufactured from this material: these were primarily grinding and pulverizing tools, less frequently abrading and percussing tools. Metamorphic rocks (32%) include raw materials such as quartzite, mica-schist and gneiss, which were often preserved in a very fragmented, crumbly state. With regard to tools, those made of quartzite is larger (12 pieces): this is the primary raw material of abrader-hammerstones (APE), but also includes a few grinding slabs (MOL), handstones (MUE), abraders (ALS) and stones slabs (LOS). Volcanic rock forms 16% of the whole material. In the case of tools, andesite is the most frequent (14 pieces), the other volcanic rocks (basalt, dacite, volcanic tuff) are represented by only one or two pieces in the material. With regard to tool types, it is evident that they were raw materials of grinding and pulverizing tools (grinding slab, handstone, stone slab). Because the raw material determination of most of the finds rely upon macroscopic characterization, it was impossible some cases due to the weathering of the finds *(Diagram 4)*.[39]

The source of the raw materials is assumed to be located in the Maros/Mureş valley (various types of sandstones, quartzite, quartzite pebbles, metadolerite), in the Apuseni Mountains (vulcanites, limestone, sandstone, granitoids), and the Southern Carpathians (mica-schist) all ca. 150-200 km away from the site.[40] The sources in the Upper Maros valley and the Apuseni Mountains were accessible via a route along the Maros river while those in the southern Carpathians could be reached following the Tisza, then the Danube rivers.

[39] *Péterdi – Sági – Priskin in print.*
[40] *Szakmány et al. 2009; Starnini et al. 2015.*

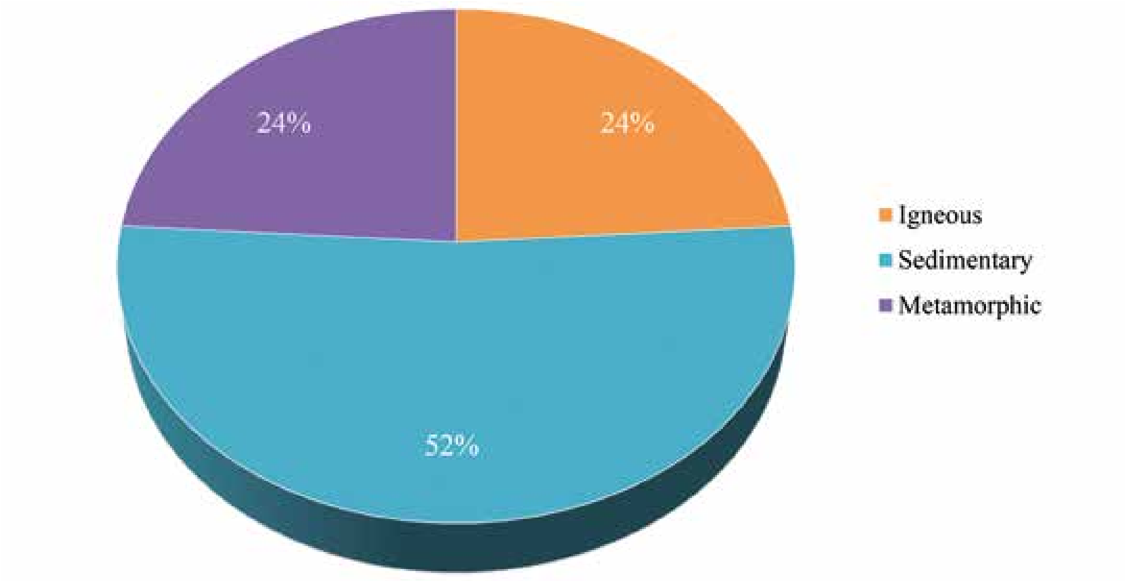

Diagram 5. Distribution of tool types – Functional group 1 (n=69)

Classification

Macrolithic tools are assigned through macroscopic formal analysis – typological classification – to one of the traditional stone tool types. This primary identification may be complemented – in some cases even changed – by data from morphometric, petrographic and use-wear analyses, based on which the tool types can be classified into so-called functional groups.[41]

There are 100 pieces of macrolithic tools in the studied material, most of which are fragments. Manufacture traces can be examined on intact specimens; however, their number is rather low in the examined material (12 pieces). The extent of transformation during the manufacture process is the greatest in the case of grinding slabs, handstones and moulds. In the case of tool fragments we can detect manufacturing traces on the remnants of the original surfaces (mostly the sides or edges).

The first functional group includes tools connected to food processing. These are grinding slabs, handstones and stone slabs. Grinding stones were primarily used in grinding, pulverizing and crushing of domestic and wild plants. Stone slabs were used for the processing of other materials, e.g. tempering materials for pottery, pigments, salt, etc. 68 tools from the material can be assigned to this group *(Diagram 5)*. With regard to the preservation of the tools, almost all of the 36 grinding slabs are fragments (Type 3), with the exception of a basalt grinding slab and another larger fragment where the front side was preserved. With regard to the raw material, pieces made of sandstone dominate in the material, although the ratio of vulcanite is the highest in this tool type. The intact piece is an oval grinding slab,[42] whose sides show clear manufacturing traces. In order to create the oval form, larger flakes were removed from the sides and edges. The front side displays the special traces of grinding: a used and renewed surface *(fig. 4. 1)*. The grinding slab, which has only its frontal side preserved, has a burnt work surface.[43] In the case of smaller grinding slab fragments, manufacturing traces on the preserved sides and a strongly worn surface could be observed. After the use of a tool as a grinding slab (e.g. due to fragmentation),

41 *Risch 1995; Adams 2002; Vučković 2019.*

42 Inv. no. MFM Ő.2012.16.5369 (Móra Ferenc Museum, Szeged).

43 Inv. no. MFM Ő.2012.16.5144.

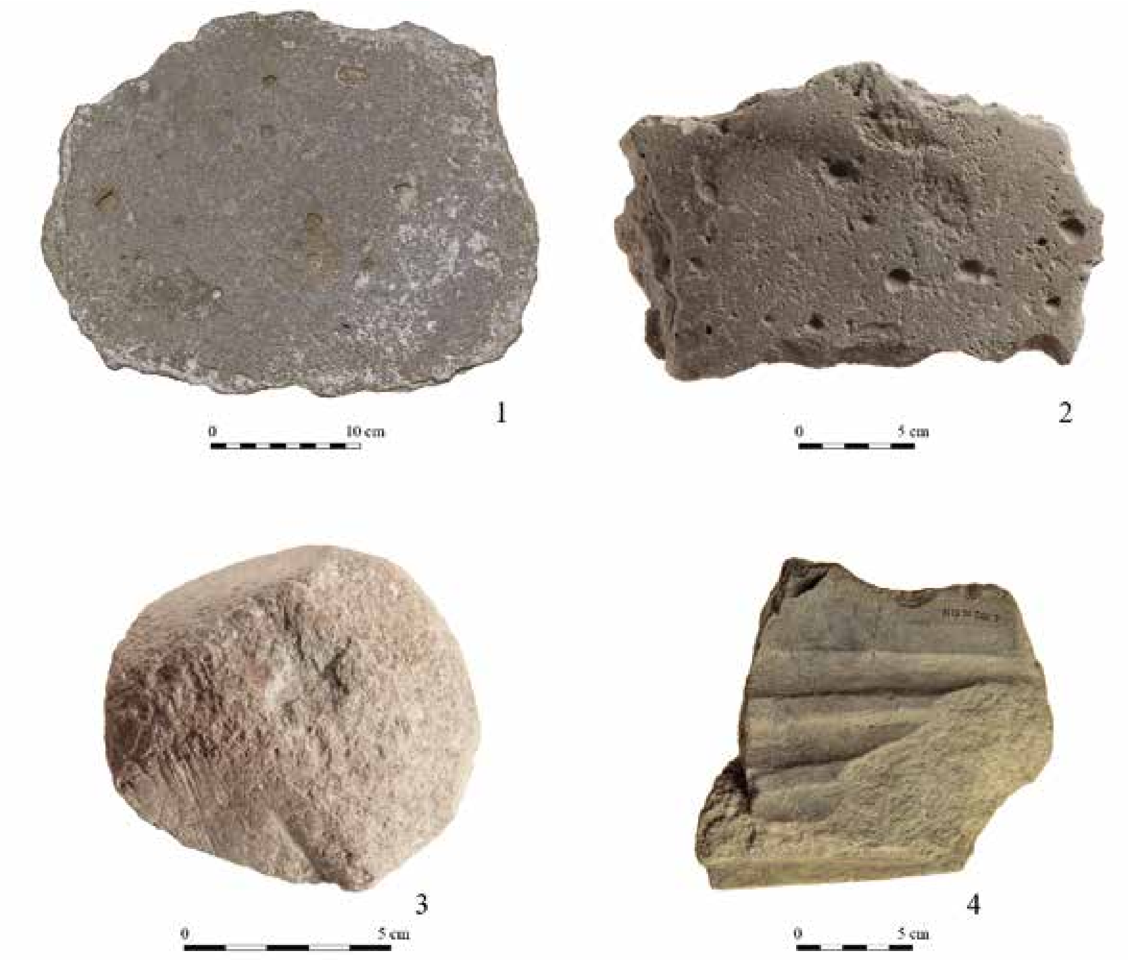

Fig. 4. 1. Complete grinding slab from ditch 440; 2. Complete handstone from pit 418; 3. Multifunctional tool from pit 267; 4. A pieces of mold from pit 348 (©Ákos Jurás)

pieces made of volcanic raw materials difficult to acquire were reused with a new function, e.g. as handstones.

The number of handstones or grinders compared to the size of the whole material and the number of grinding slabs is very low (6 pieces), but they include two intact specimens.[44] The small number of handstones might be explained by their secondary use, or by the use of wooden grinders. The intact pieces clearly show manufacturing traces, which, however, cannot be observed on the fragmentary ones. The intact handstones were manufactured from damaged grinding slabs *(fig. 4. 2)*. Most of the fragmentary pieces had strongly worn work surfaces.

With regard to the 26 pieces of stone slabs, none of them were intact, but in four cases at least two-thirds of the tools were preserved.[45] Manufacturing traces could be observed on only a single specimen.[46] The working surfaces of most of these tools were strongly worn and polished; on some of them it was possible to observe the renewal of the work surface.

Residue analysis has not yet been carried out on the grinding stones yet, we do have, however, good botanical data from all the contexts with macrolithic tools thanks to the systematic sample collection strategy.

[44] Inv. nos. MFM Ő.2012.16.5135, MFM Ő.2012.16.5159.
[45] Inv. nos. MFM Ő.2012.16.5047, MFM Ő.2012.16.5051, MFM Ő.2012.16.5129, MFM Ő.2012.16.5371.2.
[46] Inv. no. MFM Ő.2012.16.5129.

The next category includes tools used for abrasion and sharpening. These tools removed materials from the surface of the contact material. As a result, different use-wear traces were created on the working surfaces of the tools (striation, grooves). The intension of these special use-wear traces and the damage of the tool depends on the nature of the contact surfaces.[47]

The material includes 11 abraders (ALS) and five sharpener/abraders (ALS/PIA), of which four abraders[48] and one abrader/sharpener[49] were intact, the other were fragments belonging to Group 3. In the case of both types it could be established that the working surface could be formed on any sides and edges, and their morphology is convex. The fragmented working surfaces of the sharpener/abrader are fine-grained and polished. With regard to raw materials, abraders were made of sandstone, quartzite and micaschist, while all of the sharpener/abraders were made of sandstone.

Another functional group includes percussion tools, which have two or more active working surfaces, mostly on the edges of the tools. They are used to remove superfluous material from a surface, or transform and renew surfaces, such as the working surface of a grinding slab. During use, fatigue wear appears, but the nature of the damage on the contact surface – which can be broad and shallow or narrow and sharp – is determined by the shape of the working surface of the percussion tool and the force of the blow.[50] In the Csanádpalota material, nine percussion tools could be identified, a complete hammerstone[51] and eight abrader/hammerstones, of which two pieces were intact.[52]

There is a multifunctional tool[53] presenting three different working traces with different functions. Based on the preservation and fragmentation of the use-wear traces it can be reconstructed, how the various functions came after one another. The tool is fragmentary and its ventral surface is missing; however, on the dorsal surface narrow grooves parallel with each other and a wider and deeper channel besides them are clearly visible. The working surface between the grooves is strongly polished, thus the sharpener function was probably predated by an abrading/ polishing function. On the preserved sides of the fragment, traces of use as a hammerstone can be identified, which are cut through by the breakage surface, thus this function must predate the breakage of the tool. After its breakage, the orientation of the fragment changed, thanks to the direction of the breakage its previous side became its dorsal surface with anvil function, indicated by traces on the dorsal side created by strong downward pressure *(fig. 4. 3)*. Thus, the tool was a multifunctional abrader/sharpener-abrader/hammerstone-anvil (ALS/PIA-APE-YUN).

A mould fragment and a mace fragment belongs to the functional group of paraphernalia. We can assume the mould function of the fragment based on the shaping of its surface. Its dorsal surface and (lower) sides are hollowed, and two shallow, parallel grooves run on its ventral side. No use-wear traces (e.g. burning) can be seen on the surface, thus it is possible that it was damaged after its construction, and never fulfilled its function *(fig. 4. 4)*.

The lithic assemblage also contains a few flakes removed during the manufacture of the tools (5 pieces).

Contextual analysis

No buildings were found in the unearthed area; most of the excavated features are pits dug into the subsoil, which – based on their materials – were probably used as rubbish pits. Four large

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47 *Adams 2002* 77.
48 Inv. nos. MFM Ő.2012.16.5046, MFM Ő.2012.16.5050, MFM Ő.2012.16.5193, MFM Ő.2012.16.5194.
49 Inv. no. MFM Ő.2012.16.5146.1.
50 *Adams 2002* 151.
51 Inv. no. MFM Ő.2012.16.5114.
52 Inv. nos. MFM Ő.2012.16.5146, MFM Ő.2012.16.5128.
53 Inv. no. MFM Ő.2012.16.5347.

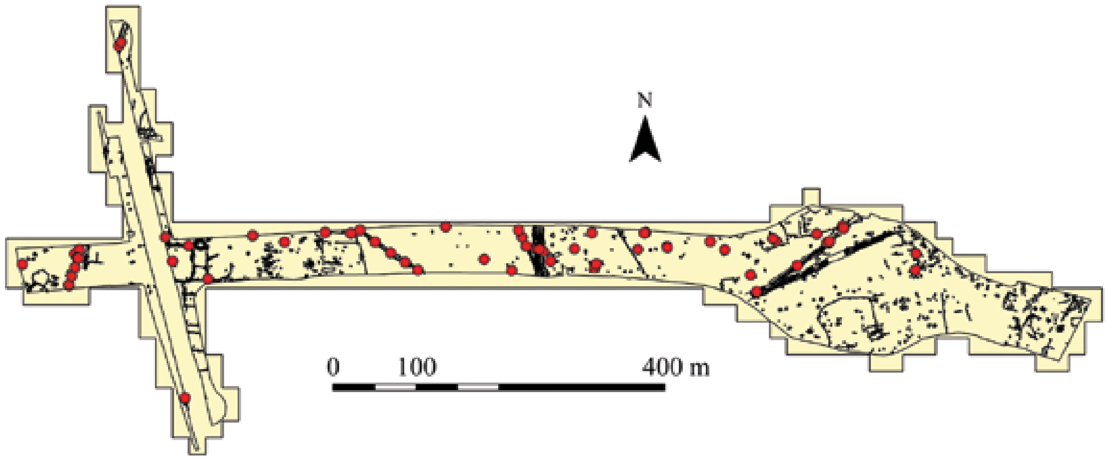

Fig. 5. Csanádpalota-Földvár LBA features with macrolithic materials (©Péter Czukor)

postholes were also excavated, which were part of a wooden gate structure, through which people could enter the internal area of the fortified settlement. In the area surrounding the gate, a few pits with special finds and structure were found, where traces of intentional, structured depositions could be identified. Within the settlement, a few smaller ditches were also observed; these could have had some form of spatial dividing function. 32 pits and ten ditches (four main enclosures and six smaller ditches) contained macrolithic finds *(fig. 5)*.

Of the 138 investigated pieces of lithic materials and undeterminable lithic finds, 60% came from the enclosures, 35% from pits and 5% from smaller ditches. The ratio of the context of the 100 pieces of macrolithic tools is the following: 47% from enclosures, 39% from pits, 10% from smaller ditches and 4% from pits with structured depositions. The ratio of the various tools in the given settlement feature types is varied.

The enclosures yielded 47 pieces of macrolithic tools, 76% of which is very fragmentary. They also contained 11 pieces of complete or nearly complete grinding stones, abraders, stone slabs, a sharpener/abrader, and an abrader/hammerstone. The largest number of tools was found in Ditch 23, however, the only complete grinding slab from the site was discovered in Ditch 440. The already mentioned postholes of a gate leading to the settlement were also found along this enclosure. The section of the ditch in the vicinity of the gate yielded a number of special objects, such as bronze pins and their fragments, the already mentioned grinding slab and an intact handstone (both made of the same andesite raw material). The placement of these objects into this section of the enclosure must have been the result of deliberate deposition, perhaps some kind of a ritual activity. Based on the extent of fragmentation and use-wear, tools in other ditch segments can probably be interpreted as discarded waste.

Macrolithic finds were found in six of the smaller ditches within the settlement, of which 10 were identifiable tools (grinding slabs, abrader and stone slabs), all of which were fragmentary. It may be suggested that these smaller ditches had an internal dividing function, or were fens, and the macrolithic tool fragments were discarded waste here as well.

32 pits yielded 43 pieces of macrolithic tools. Beside the storage and rubbish pits, three pits with special material were also excavated (Features 44, 439 and 474), where objects (e.g. bronze objects, knives, bone tools, pottery and macrolithic tools) had been deposited in numerous layers. The lithic material (27 pieces) from pits is very fragmentary, the number of complete or nearly complete specimens is 12. Two abrader/hammerstones were found in Pit 439. The most frequent tool types from pits were grinding slabs (13 pieces), stone slabs (9 pieces), and the multifunctional

abrader/hammerstones (6 pieces). The few unique pieces of the macrolithic material were all found in pits, e.g. the only real multifunctional tool of the lithic material from Feature 267, the hammerstone from Feature 342, and the mould from Feature 348.

Conclusions

Although the analysis of the macrolithic remains from Csanádpalota and other contemporary sites is still ongoing, we might be able to draw some preliminary conclusions based on the already available data and analytical results.

The extent of fragmentation observed at the site indicates the long-term use of macrolithic tools. These implements were used and reused even after breakage, sometimes with a change of function, until they became so fragmentary as not to be able to be used any more. This indicates, on the one hand, perhaps limited access to the sources of raw materials, which forced the community to make use of the already available tools as long as possible. On the other hand, it also indicates continuous domestic activities, thus continuous, longer term habitation at a site, whose function might not be as straightforward.[54]

If we return to the questions and hypotheses posed at the beginning of this paper regarding the social and economic structure of the polity under study, it is important to highlight that tools for food production and processing are not very abundant at the site. Their number is not very high and they are not concentrated spatially either. This does not indicate central control over food processing, contradicting the hypothesis of chiefs relying on staple finance and control over subsistence. Nevertheless, the excavated area is limited and is not located in the central part of the site, thus this picture might change with further excavations.

With regard to feasting (as a form of redistribution), it seems to be present, as indicated by large pits with structured depositions, which also contained macrolithic tools used for food processing. However, tools for food processing do not appear in large numbers, and the abrader/hammerstone tool type (APE) is the most frequent in these features.

Although no proper comparative material exists from the region and the period yet, it is my general impression that the type spectrum of tools is somewhat limited. Grinding implements and abraders and stone slabs used for the manipulation of softer materials are present, but there are hardly any tools for metallurgy, pottery manufacture, and many other economic activities. Here again the question must be raised that since the excavation was limited in comparison to the huge size of the site, we do not know if this indicates the lack of such activities, or the lack of such activities in this particular part of the settlement. If they are in fact lacking totally, that contradicts the theory of a central place, the residence of chiefs, who control specialized activities and crafts.

To sum up, at the current state of research, the analysis of macrolithic tools does not support the interpretation of the Csanádpalota 'mega-fort' as a chiefly centre of a regional polity, from where political leaders controlled the subsistence economy and specialised crafts to maintain their power. I hope to have been able to demonstrate the usefulness of the macrolithic implements to answer – at least partly – socio-economic questions about prehistoric. The study of macrolithic implements from Late Bronze Age settlements from Southeastern Hungary is ongoing, and through the comparative analysis of other sites from the region in the future we will hopefully gain a better understanding of prehistoric economy and society in the Great Pannonian Plain.

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[54] See *Szeverényi et al. 2014.*

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