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Uniform in diversity: Typological and technological analysis of Bronze Age fine ware from Kakucs-Turján

Robert Staniuk [a,b,*], Attila Kreiter [c], Gabriella Kulcsár [d], Mateusz Jaeger [e]

[a] Institute of Archaeology, University College London, 31-34 Gordon Square, WC1H 0PY London, United Kingdom
[b] Institute for Pre- and Protohistory, University of Kiel, Johanna-Mestorf-Strasse 2-6, 24119 Kiel, Germany
[c] Hungarian National Museum, H-1113 Budapest, Daróci út 3, Hungary
[d] Hungarian Academy of Sciences, Research Centre for the Humanities, Institute of Archaeology, Tóth K. u. 4, 1097 Budapest, Hungary
[e] Adam Mickiewicz University in Poznań, Institute of European Culture, ul. Kostrzewskiego 5-7, 62-200 Gniezno, Poland

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ABSTRACT

The ceramic variability of fine ware pottery in Early and Middle Bronze Age Carpathian Basin (2600/2500–1500/1450 BCE) has been used as an argument for the existence of distinct, large-scale communities. The recent technological studies of coarse ware ceramics have shown that different stylistic groups are characterized by uniform technological traits, suggesting that current narratives result from an *a priori* classification of material culture. To verify whether fine ware ceramics were characterized by similar traits, a sample of 33 vessels from a multi-layered, fortified settlement of Kakucs-Turján (Hungary) was analyzed in terms of vessel forms and underlying production processes. The analyses compared the classical local and non-local provenance objects to determine whether the impressionistic categorization of vessels is supported by discrete parameters. The results indicate that similarly to coarse ware, Early and Middle Bronze Age ceramics in the Carpathian Basin was characterized by uniform production processes suggesting the impact of multi-directional and persisting interaction across the Carpathian Basin.

1. Introduction

The Early and Middle Bronze Age in the Carpathian Basin (2600/2500–1500/1450 BCE) (Dani et al., 2019, 2016; Fischl et al., 2014; Kiss et al., 2019; Staniuk, 2020; Szabó, 2017) is considered a time of intensifying agglomeration, emergence of innovations and formation of large-scale social phenomena (Gogâltan, 2017; Sofaer, 2006; Sørensen and Rebay-Salisbury, 2008). In archaeological research the co-occurrence of these changes is classically explained by a top-down narrative linking the appearance of bronze with the establishment of long-distance connections, resulting in the formation of interregional power institutions (Earle and Kristiansen, 2010; Kristiansen and Earle, 2015). This approach is generally grounded in culture-historical studies, where the conjunction of funerary rites and visual differences between grave inventories, specifically fine ware ceramics, was used to delimit distinct cultural groups (Bóna, 1992, 1975; Kalicz, 1982) (Fig. 1).

Recently, the clear-cut differences between cultural groups have become questioned as the existence of over-arching similarities between chronological phases, pottery styles, and settlement structures has become documented (Kienlin, 2020a; Kiss et al., 2019; Kreiter, 2007). One of the crucial findings was the identification of uniform *chaîne operatoire* of coarse ware pottery in assemblages linked to different groups (Kreiter, 2007; Kreiter et al., 2006; Michelaki, 2008). The long-term perspective applied in these studies, corresponding to the late third and first half of the second millennium BCE, suggests that even if this period was characterized by increasing importance of expressing social status via burial rite (Duffy, 2020; Duffy et al., 2019; Przybyła, 2016), this process was taking place in an environment of increasing connectivity and interaction (Cavazzuti et al., 2021; Jaeger, 2018). This raises a problem inherent to the founding principles of the existing cultural schemes, *i.e.* the visual differences between material culture as markers of distinct social identities. Since coarse ware is considered one of the best markers for studying interaction zones (Gosselain, 2000; Hodder, 1982; Holmqvist et al., 2018), its uniformity across the Carpathian Basis raises the question whether this phenomenon is also recognizable in the conventionally used marker of interaction zones – fine ware. If fine ware was used by cultural groups to express distinct social identities, then its typological and technological analysis should

* Corresponding author at: Institute of Archaeology, University College London, 31-34 Gordon Square, WC1H 0PY London, United Kingdom.
E-mail address: r.staniuk@ucl.ac.uk (R. Staniuk).

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provide evidence of clear differences between vessels attributed to specific stylistic groups. However, if fine ware was created by groups engaged in constant, mutual interaction, their parameters should overlap across vessel attributed to different groups.

In order to answer this question, 33 ceramic samples from the multilayered, fortified settlement of Kakucs-Turján were selected for macroscopic typological and technological analysis, followed by microscopic fabric analysis. The selected fine wares represent objects classically considered as local and non-local, thus providing the means of determining whether such categories are supported by particular parameters. The results of typological and technological analyses were evaluated using multivariate statistics, *i.e.* correspondence analysis (Greenacre, 2007).

2. Kakucs-Turján settlement – the case study

The settlement of Kakucs-Turján is found in the Middle Danube Valley, ca. 30 km south-east of present-day Budapest (Fig. 1). The surrounding Kakucs microregion comprises of five tell-like settlements documented using aerial imagery, field surveys, geophysical prospection and excavations (Jaeger and Kulcsár, 2013; Kulcsár, 1997; Szeverényi and Kulcsár, 2012). Chronologically, the area underwent increasing occupation since the Late Copper Age-Early Bronze Age period, as evidenced by Makó-Kosihy-Čaka finds, although the most numerous collection of finds is related to the Middle Bronze Age Vatya style (Kulcsár, 2011; Kulcsár et al., 2014). The current radiocarbon dating indicates that the microregion ceased to be occupied in the 15th century BCE (Jaeger et al., 2018; Jaeger and Kulcsár, 2013).

The site was discovered in 2010 on the basis of aerial photography, where an outline of a bipartite settlement structure was documented (Kulcsár et al., 2014, p. 5). The geophysical investigation of the area indicated that the settlement was characterized by a tripartite structure formed by a system of internal and external ditches (Niebieszczański et al., 2019). The observed differences lead to the identification of three distinct occupational zones – A, B, C (Fig. 2). Zone A was characterized by the most intensive overlap of geophysical anomalies, the majority of which could be attributed to house structures and a pathway system (Niebieszczański et al., 2018). Zone B was partially destroyed by a field road, although evidence of long-term occupation was related to the presence of pits and household remains. Zone C was devoid of any major structures and was considered an area delimited for pasture. The structure of the site was subject to further analyses using a set of cores, in order to determine the sedimentological and stratigraphic characteristics of the distinct settlement parts. The analysis indicated the presence of a mound in zone A, linked to the establishment of a tell-like construction practice, where the architectural remains were levelled by means of re-depositing archaeological sediment (Pető et al., 2019; Pető et al., 2015).

Zone A was selected for excavations due to the best visibility of magnetic anomalies marking archaeological features. A 110 m^2 sized trench was opened to provide a sufficient perspective of the archaeological features. The changing form of spatial occupation and the associated archaeological features allowed the identification of 12 settlement phases and a disturbed ploughing zone (Jaeger et al., 2018; Staniuk, 2020). Initially, the inhabitants lived on natural soil (phases Kakucs 01-03). Around 1950 BCE, the settlement sequence became characterized by the deposition of increasingly thicker layers of waste, which marked the emergence of tell-building practice (phases Kakucs 04-11). This occupational stage was characterized by the most intensive record of household architecture – a total of three subsequent households was recognized in the upper layers of the settlement (Jaeger et al., 2018; Staniuk, 2020).

Site chronology was supplemented with typological and radiocarbon dating. The recovered ceramic finds, especially decorations, allowed a

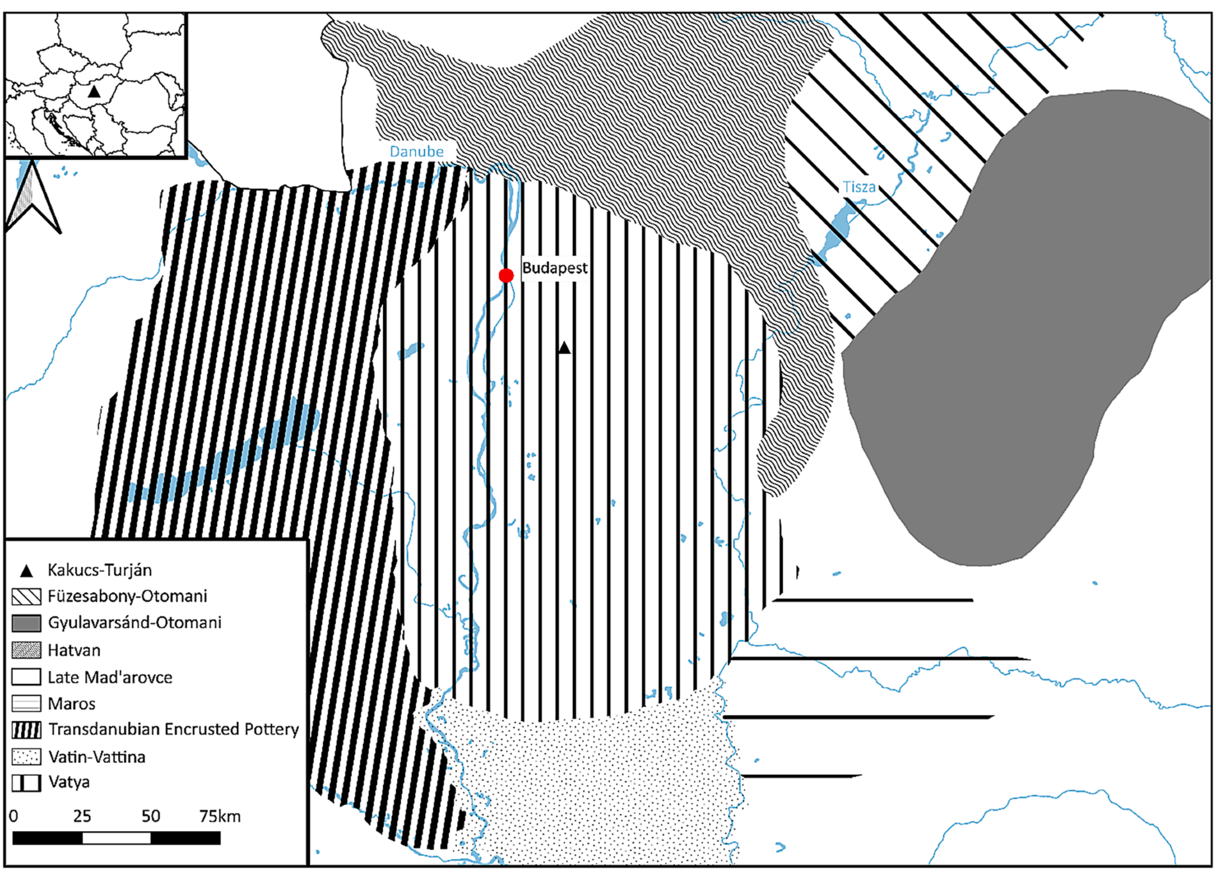

Fig. 1. Middle Bronze Age cultural groups in the Carpathian Basin (after: Staniuk, 2018, fig. 2).

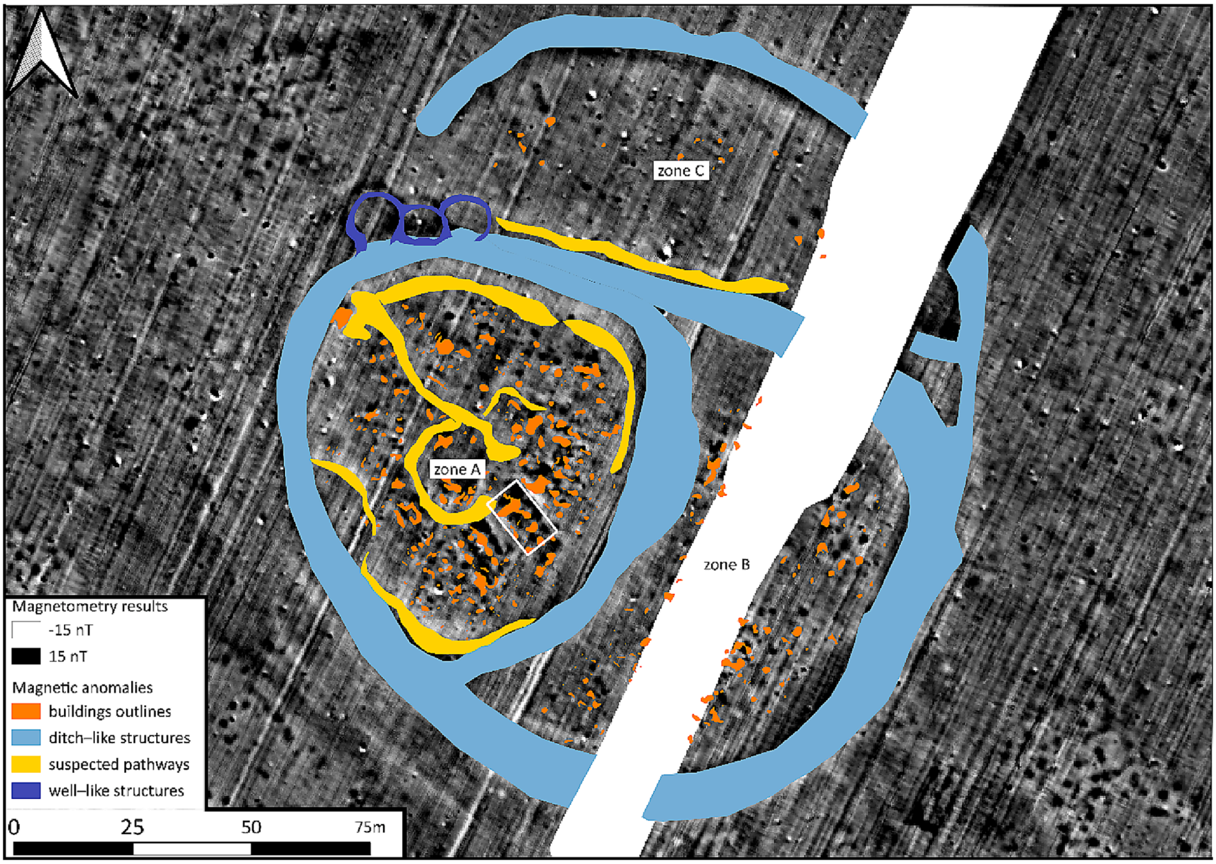

Fig. 2. Magnetometry of the multi-layered settlement of Kakucs-Turján. The headings over settlement areas indicates the location of settlement parts invoked in the text. The white outline indicates the position of the trench, where the samples were collected.

coarse chronological positioning of the site within the Early and Middle Bronze Age periods. A Bayesian chronological model was developed using 11 radiocarbon dates grouped according to the stratigraphic position of features, and showed that the phases of the Middle Bronze Age occupation corresponded to the early 20th century through 17th century BCE (Jaeger et al., 2018). Based on the established duration of the household structures at ca. 30 years, it was possible to extend the chronological scope of the sequence to an estimated ca. 2400 BCE with continuous occupation beginning ca. 2100 BCE (Staniuk, 2020).

3. Materials

Excavations of zone A provided a rich inventory of ceramic materials, where approx. 30,000 sherds corresponding to the Early and Middle Bronze Age were analyzed (Staniuk, 2020). Conventionally, the majority of finds were attributed to the Vatya style (Bóna, 1975), although finds characteristic of other ceramic styles were documented as well (Staniuk, 2018a). The diagnostic finds and well-preserved fine ware vessels allowed identification of up to 16 different pottery styles, including vessels typical for central Hungary (Bell Beaker, Nagyrév, Vatya), western Hungary (Kisapostag, Transdanubian Encrusted Pottery, Litzenkeramik), eastern Hungary (Füzesabony–Gyulavarsánd), north-western Carpathian Basin (Mad'arovce/Magyarád, Únětice), finally, south-western Carpathian Basin (Maros) (Figs. 3 and 4). The stylistic differences between the vessels was used to determine whether the different forms were linked to different production processes. Following the hypothesis that vessels of non-local origins would be distinguishable by distinct fabrics, a subset of 33 ceramic units was selected for the analysis. The sampled vessels originate from 8 out of 12 stratigraphic phases of the Kakucs-Turján settlement (Jaeger et al., 2018; Staniuk, 2020) (Table 1). Nine samples originate from the phase when the settlement was erected on natural soil (phases Kakucs 01–03). The remaining 24 were acquired from the later, tell layers of the settlement (Staniuk, 2020). Contextually, the samples can be attributed to the different stages of refuse disposal, including waste pits (Kakucs 01–03), levelling phases (Kakucs 07, 10), household use (Kakucs 05, 08), and household destruction (Kakucs 09).

4. Methods

Form analysis was conducted in order to determine the relationship between vessel function and shape. This required explicit formulation of types to determine whether vessels characterized by different appearance can be grouped into the same categories (Staniuk, 2020). Hierarchical classification based on the analysis of metric variables was applied to determine functional categories. Metric data was collected using calipers and recorded in mm. Afterwards, the shapes of specific vessel parts (lip, rim, neck, upper body, body transition, lower body, and base types) were used to determine the differences between specific vessels.

Technological analysis was executed simultaneously at two levels: microscopic fabric analysis (Kreiter, 2007; Quinn, 2013; Whitbread, 2001) and macroscopic investigation of forming techniques, surface finishing and firing atmospheres (Gosselain, 2018; Rice, 1987; Rye, 1981). Firing atmospheres were determined based on the color of samples.

During the microscopic fabric analysis the inclusion density, size categories, inclusion sorting and roundedness of the components were determined based on the guidelines of the Prehistoric Ceramics Research Group (2010). The variables were: inclusion density (rare (1–2 %), sparse (3–9 %), moderate (10–19 %), common (20–29 %), very common (30–39 %), abundant (40 %+)), size classification (very fine (<0,1 mm),

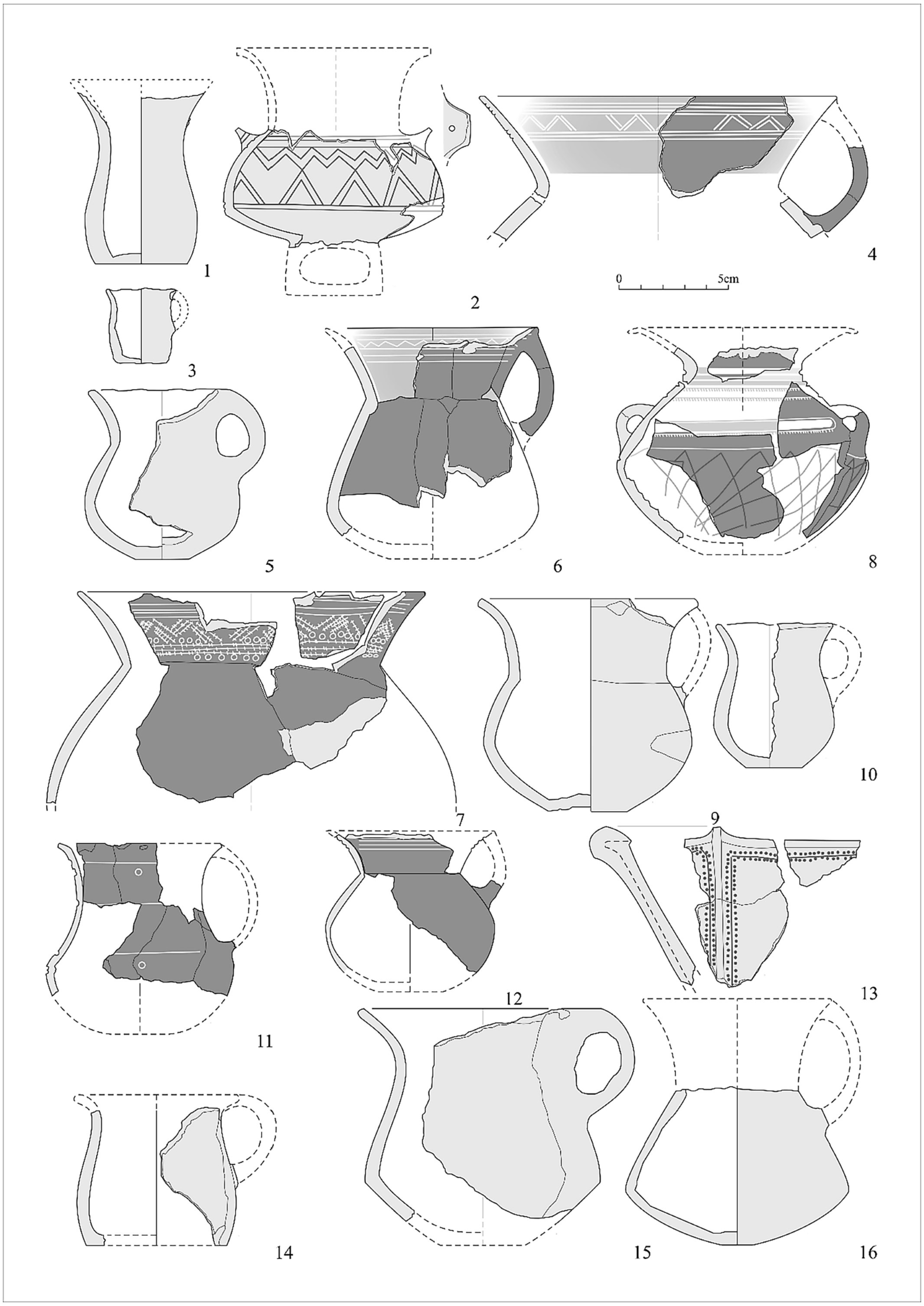

Fig. 3. Samples of EBA and MBA ceramics from Kakucs-Turján. Vessel numbers correspond to the information in Table 1. Drawings by K. Winter after L. Gucsi.

fine (0,1–0,25 mm), medium (0,25–1 mm), coarse (1–3 mm), very coarse (>3 mm)), inclusion sorting (poorly sorted, moderately- sorted, well-sorted, very well-sorted), and roundness classes (angular, sub-angular, subrounded, rounded, well-rounded).

Correspondence analysis was applied to analyze the relationships between form-based, technological and integrated variables (Greenacre, 2007). Since the majority of variables were categorical, excluding rim diameter and vessel height, the selection of analytical method was based on the potential of applying multivariate statistical analysis capable of incorporating categorical data. Software package PAST (Hammer et al., 2001), version 4.04 (2020) was applied.

5. Results and discussion

First, the results of the form-based investigations are presented; afterwards, the outcome of the technological analysis. The final part focuses on the results of the combined analysis.

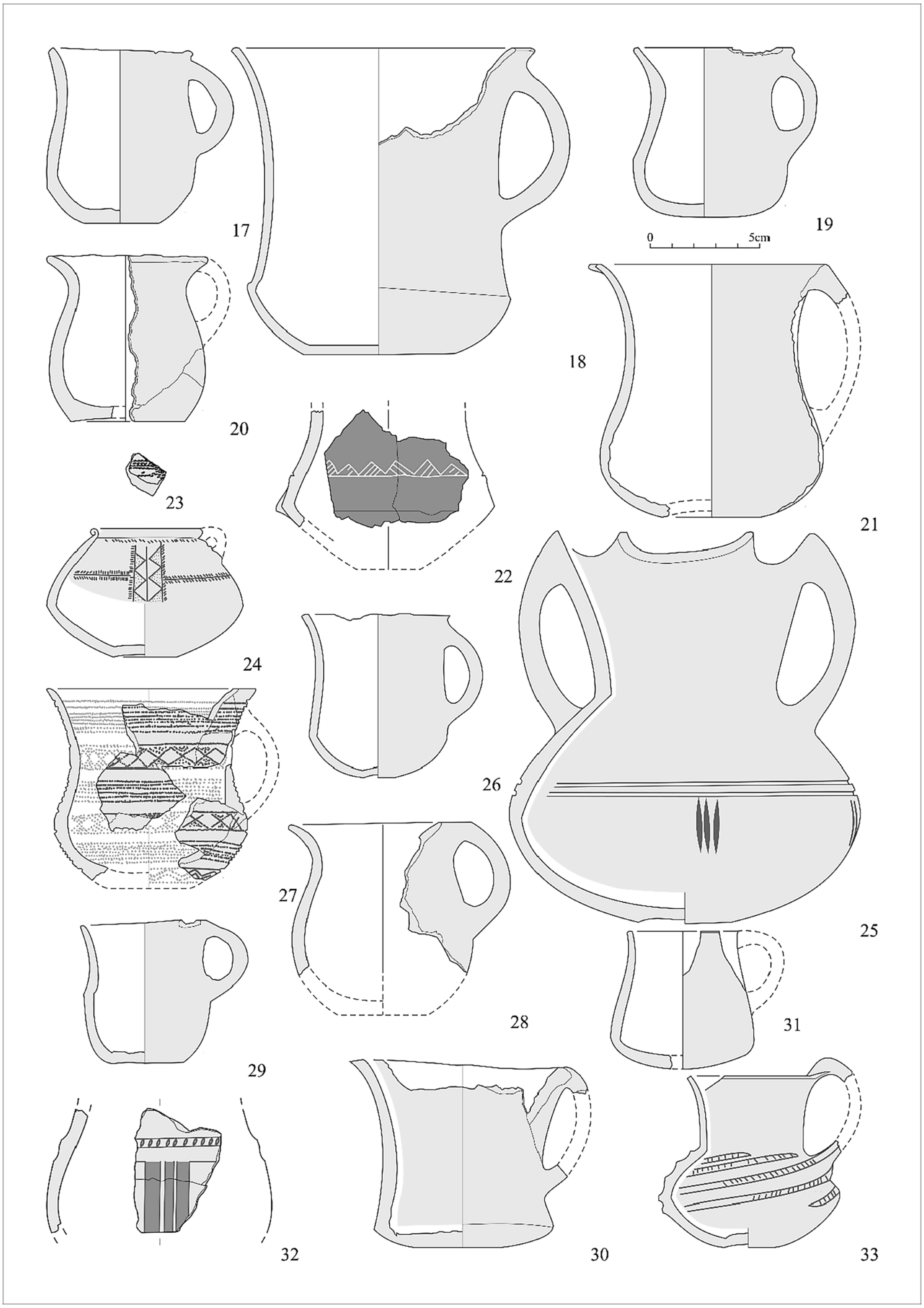

Fig. 4. Samples of EBA and MBA ceramics from Kakucs-Turján. Vessel numbers correspond to the information in Table 1. Drawings by K. Winter after L. Gucsi.

5.1. Form analysis

The samples used in the study fall into three base types: cups (11), jugs (20) and a wagon model (1). In one instance the fragmentation of the original vessel form made it impossible to determine the functional type; the sample was included in the study due to the uniqueness of its decoration (sample 23, *Litzenkeramik*).

The vessel function suggests a link with form variability: cups comprised of six shapes, while jugs were constituted by eleven. Implementation of detailed stylistic information allowed further division of 16 types into 17, which was used to set the cut-off point for further formal analysis.

The two functional types have overlapping size ranges, suggesting that their production was similar in terms of the required motoric skills with the differences representing choices aimed at specific conventions (Fig. 5). The single outlier was sample 25 which represents a tall, fine ware jug. In spite of these similarities, the analyzed set was rather heterogeneous with half of the documented specific types occurring once

Table 1
Sample description.

ID	Functional classification	Form classification	Stylistic classification	Provenance	Relative chronology	Fabric	Phase
1	Cup	–	Nagyrév	Local	Early Bronze Age	3/b	Kakucs 01
2	Jug	Form 12	Nagyrév	Local	Early Bronze Age	1	Kakucs 02
3	Cup	Form 4	Early Bronze Age	Local	Early Bronze Age	2	Kakucs 02
4	Jug	Form 15	Kisapostag	Local	Early Bronze Age	2	Kakucs 02
5	Jug	Form 10	Nagyrév–Vatya	Local	Early–Middle Bronze Age transition	2	Kakucs 02
6	Jug	Form 14	Kisapostag	Local	Early Bronze Age	4	Kakucs 02
7	Jug	Form 16	Kisapostag–Vatya	Local	Early–Middle Bronze Age transition	4	Kakucs 02
8	Jug	–	Transdanubian Encrusted Pottery	Non-local	Middle Bronze Age	9	Kakucs 02
9	Cup	Form 1	Nagyrév	Local	Early Bronze Age	4	Kakucs 03
10	Jug	Form 14	Vatya	Local	Middle Bronze Age	1	Kakucs 05
11	Jug	Form 16	Kisapostag	Local	Early Bronze Age	4	Kakucs 05
12	Cup	Form 8	Transdanubian Encrusted Pottery	Non-local	Middle Bronze Age	11	Kakucs 05
13	Wagon model	–	Vatya?	Local	Middle Bronze Age	5	Kakucs 05
14	Jug	Form 2	Vatya	Local	Middle Bronze Age	1	Kakucs 07
15	Jug	Form 2	Vatya	Local	Middle Bronze Age	1	Kakucs 07
16	Jug	Form 15	Nagyrév–Vatya	Local	Early–Middle Bronze Age transition	12	Kakucs 07
17	Jug	Form 13	Vatya	Local	Middle Bronze Age	4	Kakucs 07
18	Cup	Form 5	Nagyrév	Local	Early Bronze Age	4–5	Kakucs 07
19	Jug	Form 14	Vatya	Local	Middle Bronze Age	5	Kakucs 07
20	Jug	Form 2	Vatya	Local	Middle Bronze Age	5	Kakucs 07
21	Jug	Form 3	Vatya	Local	Middle Bronze Age	6	Kakucs 07
22	Jug	Form 3	Maďarovce/Magyarád	Non-local	Middle–Late Bronze Age transition	6	Kakucs 07
23	Indeterminate	–	Litzenkeramik	Non-local	Middle Bronze Age	8	Kakucs 07
24	Cup	Form 7	Makó-Kosihy-Čaka	Local	Late Copper Age –Early Bronze Age	7	Kakucs 08
25	Jug	Form 9	Maros	Non-local	Middle Bronze Age	1	Kakucs 08
26	Cup	Form 5	Vatya	Local	Middle Bronze Age	1	Kakucs 09
27	Cup	Form 5	Bell Beaker	Local	Early Bronze Age	3/a	Kakucs 09
28	Jug	Form 2	Nagyrév	Local	Early Bronze Age	5	Kakucs 09
29	Cup	Form 4	Vatya	Local	Middle Bronze Age	5	Kakucs 09
30	Cup	Form 6	Únětice	Non-local	Middle Bronze Age	4	Kakucs 09
31	Cup	Form 8	Vatya	Local	Middle Bronze Age	1	Kakucs 10
32	Jug	Form 3	Vatya–Koszider	Local	Middle–Late Bronze Age transition	10	Kakucs 10
33	Jug	Form 11	Füzesabony-Gyulavarsánd	Non-local	Middle Bronze Age	8	Kakucs 10

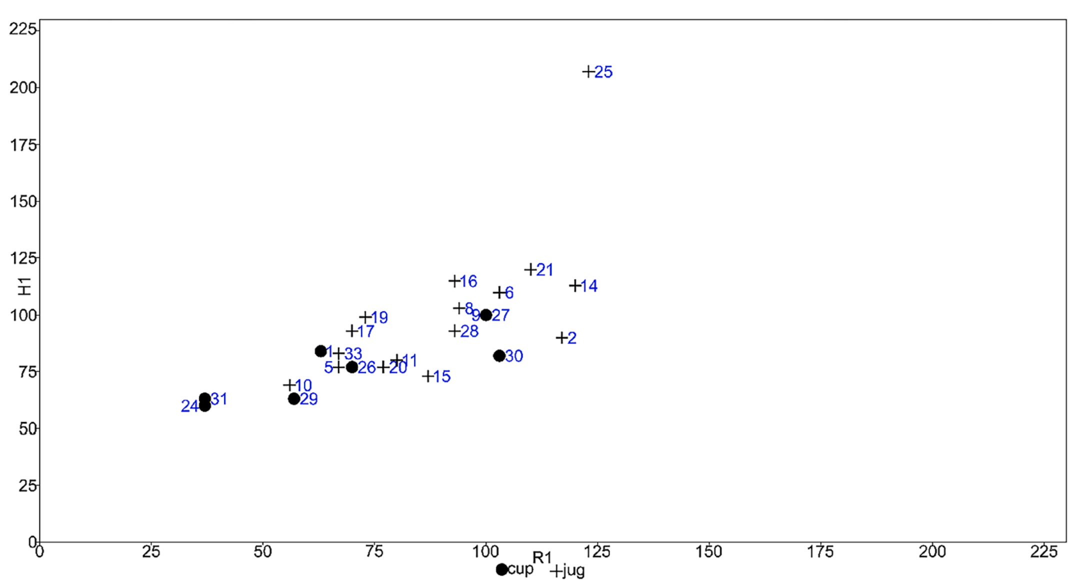

Fig. 5. Form similarities: the two functional groups are characterized by similar distribution of vessel size.

(Table 1).

Correspondence analysis of vessel metrics and shapes showed dense clustering in spite of visual differences (Fig. 6). Rim diameter and vessel height were responsible for creating a dense cluster of all samples, while vessel shapes were forming three axes of differentiation: vessels characterized by a larger rim size (forms 1, 2, 5, 6, 12, 16, 17), vessels characterized by a larger height (forms 3, 4, 8, 9, 10, 11, 13, 14, 15), and a single outlier which was unique in terms of vessel form (form 7). The results suggest that in case of Kakucs-Turján, form differentiation was generally bound to maintaining persistent functional categories, perhaps attributed to amount of contained liquids and the way of pouring them out of the vessel.

5.2. Petrographic analysis

Microscopic fabric analysis of the selected 33 samples was carried out on traditional thin sections in order to assess possible similarities and differences in raw materials and tempers used for potting, and in turn to distinguish local and imported ceramics. Amongst the 33 samples there are 26 which are assumed to be locally made (see Table 1). These

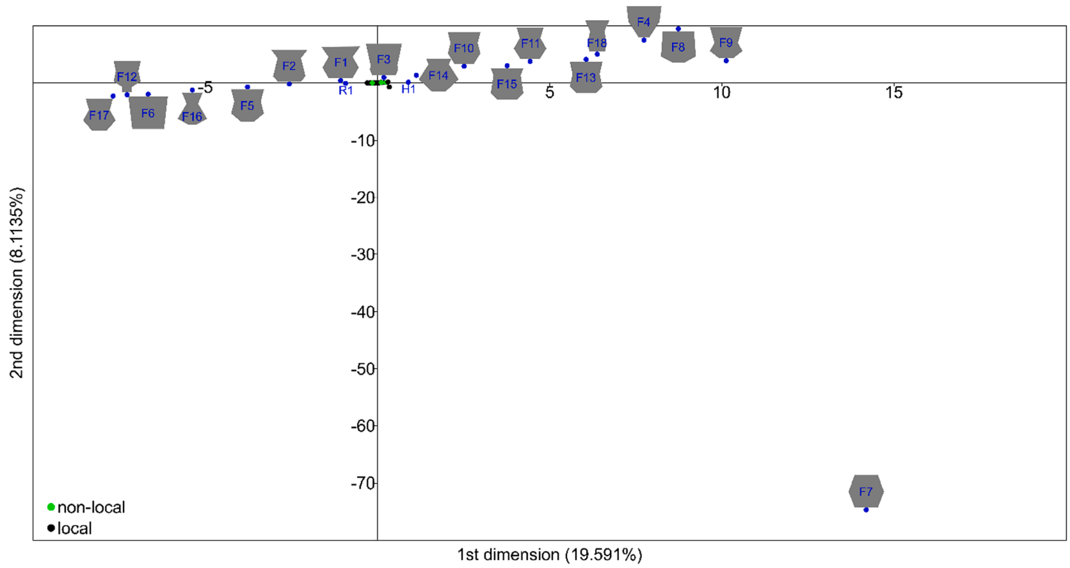

Fig. 6. Correspondence analysis of metric and shape data.

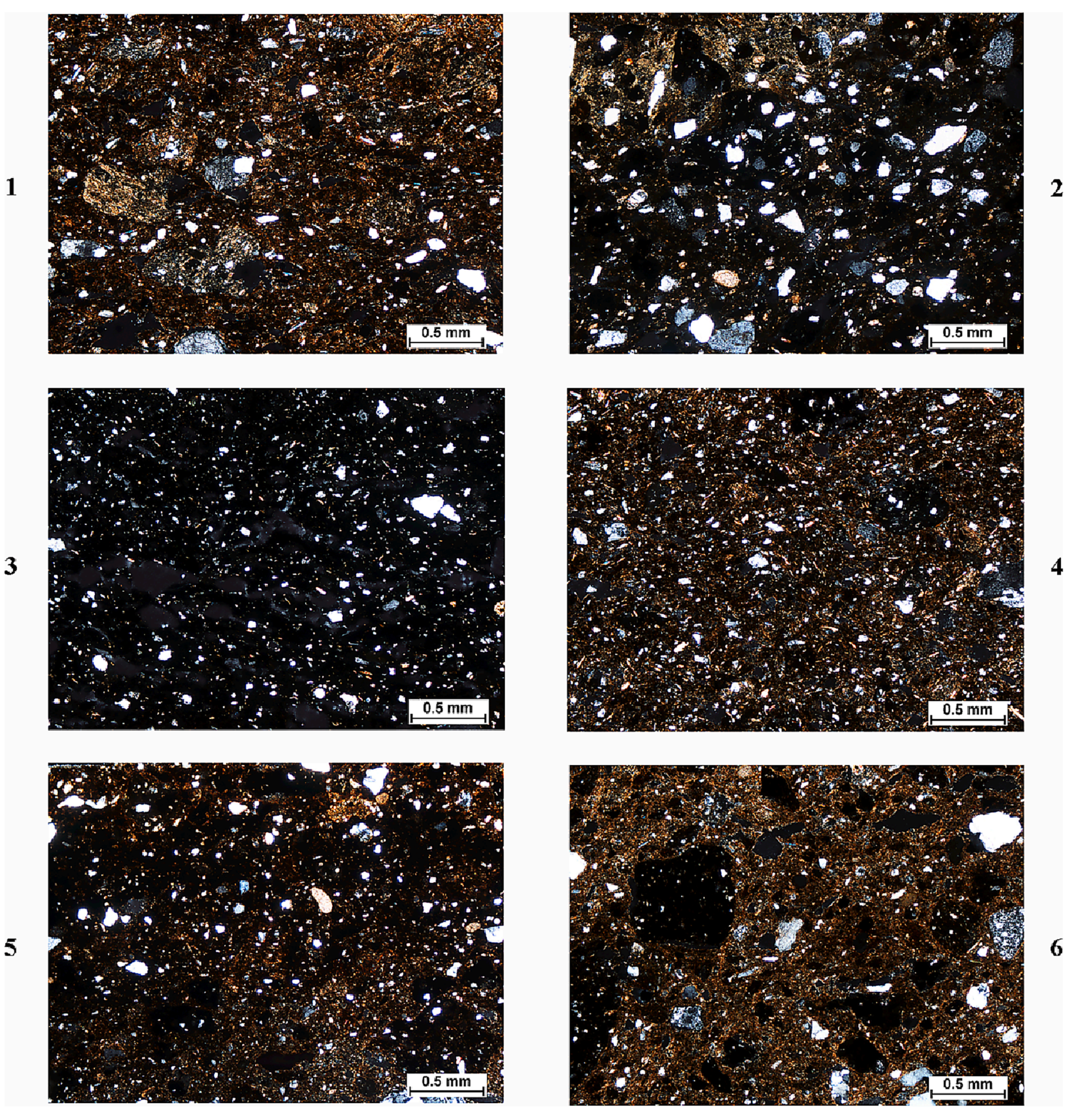

Fig. 7. Characteristic appearance of fabrics 1–6. 1: Fabric 1, Sample 2, Nagyrév jug; 2: Fabric 2, Sample 5, Nagyrév-Vatya jug; 3: Fabric 3, Sample 1, Nagyrév cup; 4: Fabric 4, Sample 7, Kisapostag-Vatya jug; 5: Fabric 5, Sample 29, Vatya cup; 6: Fabric 6, Sample 31, Vatya cup. All micrographs are 40x, +N.

belong to Vatya style vessels and to chronologically preceding local stylistic groups at Kakucs-Turján, such as Makó-Kosihy-Čaka, Bell Beaker, Nagyrév and Kisapostag. Following the geographical principle, seven vessels are assumed to be imported/non-local: Transdanubian Encrusted Pottery (n = 2), Únětice (n = 1), Maďarovce/Magyarád (n = 1), Litzenkeramik (n = 1) and Füzesabony-Gyulavarsánd (n = 1), and Maros (n = 1). In the local and non-local vessels, twelve fabric groups were established (Figs. 7 and 8). The analyzed ceramics were made from calcareous (Fabrics 1, 2, 5, 6, 10, 11) and non-calcareous (Fabrics 3, 4, 7, 8, 9, 12) raw materials. Within these raw materials there are differences mainly in the amount and size of non-plastic inclusions, both natural and added (Table 2), which were used to distinguish between fabric groups. As a result, 12 fabrics were distinguished. The detailed results of microscopic fabric analysis are presented elsewhere (Kreiter, 2020; Kreiter and Skoda, 2017), here only the summary of the results are provided (Table 2).

Microscopic fabric analysis revealed that even though several raw materials, showing different compositions, were used for pottery production, with the exception of one untempered fabric (9) the fabrics contain grog (fabrics 1, 3, 4, 7, 8), grog and sand (fabrics 2, 5, 6, 10) or just sand (fabrics 11, 12) tempering, confirming macroscopic analyses of these vessels. Of the 33 analyzed samples, 29 contain grog tempering. In the following we discuss the assumed imported vessels' raw materials in relation to the assumed local vessels.

The Maros jug's (sample 25) raw material is very similar to those of Nagyrév and Vatya vessels in Fabric 1. The Maros sample does not have a distinguishing petrographic characteristic that would suggest its difference from local vessels.

The Bell Beaker cup's (sample 27) fabric is very similar to a Nagyrév cup (sample 1); both belong to Fabric 3 validating the initial classification.

The Únětice cup (sample 30) does not seem to be imported either. It has a very similar raw material to Nagyrév, Kisapostag and Vatya vessels in Fabric 4 and it does not contain characteristic minerals that would suggest that it was imported.

The Maďarovce/Magyarád jug (sample 22) also shows a similar sandy raw material to a Vatya jug (sample 21) in Fabric 6 and is similar to other local Nagyrév, Kisapostag and Vatya ceramics in Fabric 4.

The conspicuous amphibole content of a Makó-Kosihy-Čaka cup (sample 24) in Fabric 7 is a distinct feature. However, a recent study of ceramics from a Makó site at Diósd-Sas-hegy also shows amphibole in the raw material (Kreiter et al., 2020). Both Kakucs-Turján and Diósd are

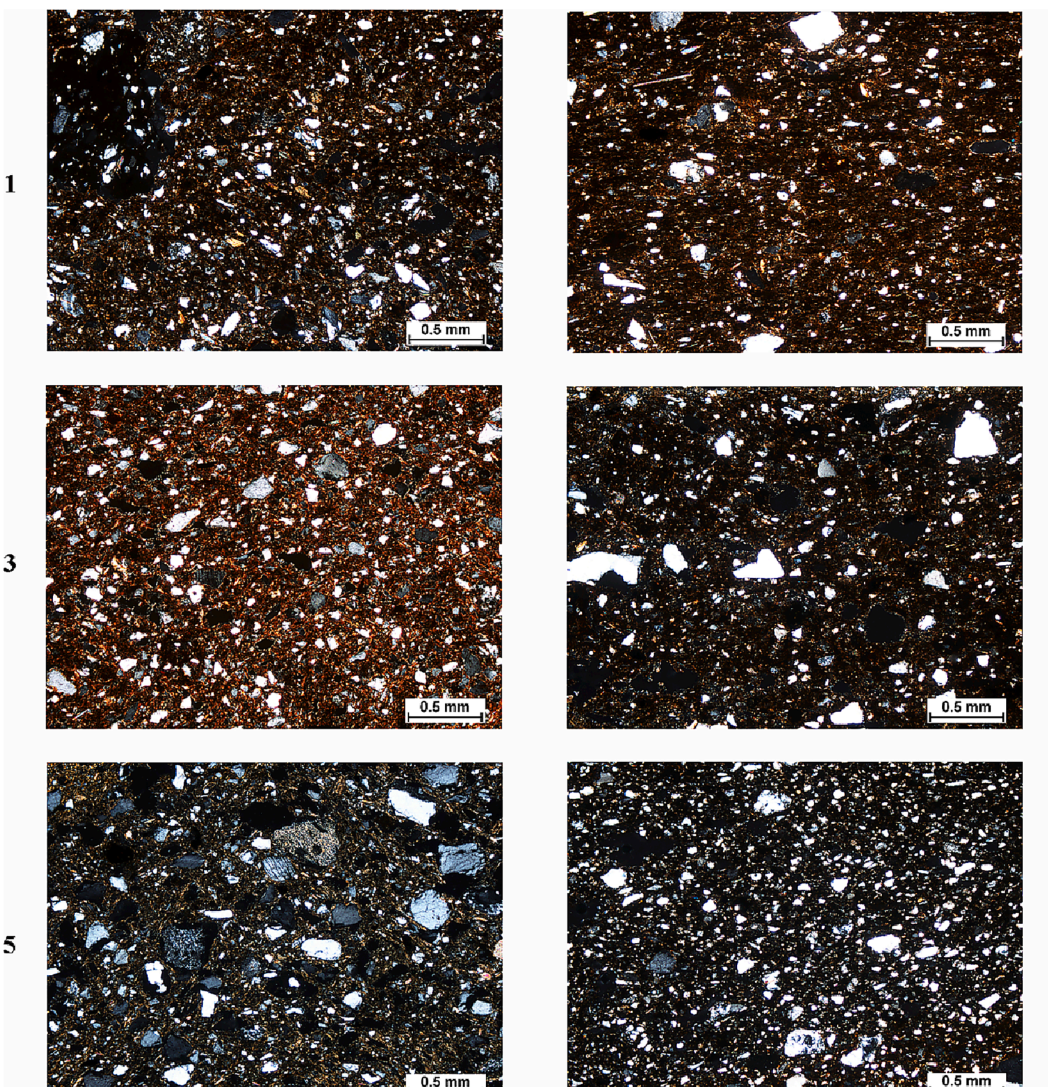

Fig. 8. Characteristic appearance of fabrics 7–12. 1: Fabric 7, Sample 24, Makó-Kosihy-Čaka cup; 2: Fabric 8, Sample 23, Litzenkeramik; 3: Fabric 9, Sample 8, Transdanubian Encrusted Pottery jug; 4: Fabric 10, Sample 32, Vatya-Koszider jug; 5: Fabric 11, Sample 12, Transdanubian Encrusted Pottery cup; 6: Fabric 12, Sample 16, Nagyrév-Vatya jug. All micrographs are 40x, +N.

Table 2
Main characteristics of fabric groups. Qtz = quartz, Cal = calcite, Ms = muscovite, Fsp = feldspar, Pl = plagioclase, Am = amphibole, Bt = biotite, Grt = garnet, Ep = epidote, Zrn = zircon, Hem = hematite, Opx = orthopyroxene, Px = pyroxene, VF = very fine, F = fine, M = medium, C = coarse, RA = rare, SP = sparse, MO = moderate, CO = common, VC = very common.

Fabric group	Main non-plastic mineral inclusions in raw materials assumedly without tempering				Temper type, size/amount	Ceramic style and sample No.
	Size/amount	Main components	Accessories	Calcareous		
1	VF/MO F–M/SP	Qtz, Ms, Fsp, Cal	Am, Bi, Grt, Ep, volcanic glass	yes	Grog (VF–C/MO-CO)	Maros jug: 25 Nagyrév jug: 2 Vatya jug: 10, 14, 15 Vatya cup: 26, 31
2	VF/SP F/MO M/RA	Qtz, Cal, Fsp	Am	yes	Grog (F–M/MO–CO Sand (F/SP)	Nagyrév-Vatya jug: 5 Kisapostag jug: 4 Early Bronze Age cup: 3
3	VF/MO F/SP	Qtz, Ms, Fsp, Cal	–	only sample 1	Grog (F–M/MO)	Bell Beaker cup: 27 Nagyrév cup: 1
4	VF/MO–CO F/SP–MO	Qtz, Ms, Pl	Grt, Ep, volcanic fragments	–	Grog (M/RA–SP: 9, 7, 17, 11, 6, 18; M-C/RA–SP: 30)	Nagyrév cup: 9 Kisapostag-Vatya jug: 7 Únětice cup: 30 Vatya jug: 17 Kisapostag jug: 6, 11 Nagyrév cup: 18
5	VF/SP F/MO	Qtz, Ms, Fsp, Cal	Am, Px, Ep and volcanic glass	yes	Grog (F–M/RA–SP: 13, 19; M-C/MO: 29, 28, 20) Sand (M-C/SP)	Vatya(?) wagon model: 13 Vatya cup: 29 Vatya jug: 19, 20 Nagyrév jug: 28
6	VF/CO	Qtz, Cal (shell fragments), Fsp, Ms	–	yes	Grog (M/CO: 21, M/MO: 22) Sand (F–M/SP)	Vatya jug: 21 Maďarovce/Magyarád jug: 22
7	VF/CO F/MO M/SP	Qtz, Ms, Am	coarser Fsp (spongy cored), Opx, porphyritic volcanic fragments	–	Grog (M/RA)	Makó-Kosihy-Čaka cup: 24
8	VF/MO–CO F/SP C/RA	Qtz, Ms, Fsp	–	–	Grog (only in 33, M/SP)	Füzesabony-Gyulavarsánd jug: 33 Litzenkeramik: 23
9	VF/CO F/MO–CO	Qtz, sericitic Fsp, Ms	–	–	–	Transdanubian Encrusted Pottery jug: 8
10	VF/MO F/SP	Qtz, sericitised and zoned Fsp, Cal	Am, Ep	yes	Grog (F–C/SP) Sand (M/SP)	Vatya-Koszider jug: 32
11	VF/SP F–M/CO	Qtz, perthitic Fsp, Ms	Cal, Ep, Bi, Zrn, Grt and volcanic fragments	yes	Sand (F/MO)	Transdanubian Encrusted Pottery cup: 12
12	Cannot be distinguished from temper	Qtz, sericitised Fsp	Am, Ep, Hem	–	Sand (VF/VC; F/MO; M/RA)	Nagyrév-Vatya jug: 16

located on an area formed by the sediments of the Danube (Gyalog, 2005; Kuti, 1976; Molnár, 1977; Somogyi, 2010), therefore amphibole seems to be present in the sediments of the Danube. Such amphibole content in sediments may also appear near to the volcanic chain of the North Hungarian Mountains, but in the case of Diósd and Kakucs-Turján it is more likely that the Danube's alluvium contained amphibole.

Furthermore the Füzesabony-Gyulavarsánd jug (sample 33) from Kakucs-Turján does not show the typical volcanic components, which are common in the north-eastern part of Hungary, where the Füzesabony-Gyulavarsánd stylistic groups existed, for example, in the ceramics of Füzesabony-Öregdomb and in the area of the North Hungarian Mountains (Kreiter, 2019; Kreiter and Szathmári, 2017; Szeverényi et al., 2020). The Füzesabony-Gyulavarsánd jug's (sample 33) raw material is more similar to local Nagyrév and Vatya vessels.

The Litzenkeramik vessel (sample 23) does not seem to be imported either because its raw material shows similarities to local vessels in Fabric 4 in terms of inclusion types.

The Transdanubian Encrusted Pottery jug (sample 8) has a very well sorted raw material but it has no distinct minerals that would suggest its non-local origin. However, the lack of grog tempering is a distinct feature of this jug. Since no other sample shows such well-prepared raw material, this jug may be an import. A Transdanubian Encrusted Pottery cup (sample 12) has a sandier fabric than other fabrics, which makes it unique but the types of inclusions are similar to those of local vessels. Therefore, its non-local origin is uncertain.

Although the general ceramic assemblage of Kakucs-Turján was attributed to the Vatya style, the macroscopic analysis of ceramic technology belonging to different settlement phases indicated changes in the preparation of raw materials through time, especially in terms of the increasing variability of tempering agents and their quality (Staniuk, 2020, p. 293). From the perspective of microscopic fabric analysis, similar observations were supported by the appearance of coarser sand tempering in fabric 10 (sample 32).

5.3. Forming techniques

The determination of forming techniques was made at the macrostructure level. The forming techniques showed differences in the manufacturing process. The most common documented technique was pinching (n = 12), followed by coiling (n = 6), with a relatively similar occurrence of combined pinching and coiling (n = 5). The average wall thickness was 4,6 cm, with two outliers (samples 1, 30). In 10 instances the documentation of the manufacturing technique was limited due to the fine quality of the vessels and the removal of indications of forming processes during the finishing of the vessel.

5.4. Surface treatment

The external surface treatment of vessels was characterized by five types: smoothing (n = 5), light burnishing (n = 14), burnishing (n = 12), fine burnishing (n = 1), and indeterminate (n = 1). The prevalence of burnishing as an external surface treatment suggests a preference for lustrous surfaces.

The internal surface treatment of vessels was characterized by eight types: smoothing (n = 11), light burnishing (n = 3), burnishing (n = 2), fine burnishing (n = 1), light burnishing and smoothing (n = 1), burnishing and smoothing (n = 13), scraping (n = 1) and indeterminate (n = 1). This suggests a much broader scope of skills used for vessel manufacturing than shown by external surfaces. However, the different qualities related to the vessel sides can be explained by the decreasing accessibility towards manipulating the interior as the vessel was being made.

5.5. Firing

Oxidized, reduced, and mixed firing atmospheres were documented. The diversity of the documented firing atmospheres suggests that firing took place in only partially controlled circumstances, potentially due to the prevalence of bonfire firing. By firing smaller vessels underneath large forms it was possible to achieve some level of control over the firing atmosphere as evidenced by the presence of vessels fired in completely reduced atmosphere.

5.6. Integrating micro- and macroscopic findings

The analysis of technology-based variables indicates the presence of at least three groups corresponding to craft-based distinctions and chronological periods (Fig. 9). The main outlier is sample 8, which is characterized by a high-quality fabric without distinguishable non-plastic inclusions. This artefact was initially classified as belonging to the Transdanubian Encrusted Pottery style. The quality of the vessel suggests a high degree of skill employed in its production. The distinct technology of the vessel supports its non-local origins.

The largest, central cluster represents a combination of relatively common skills, such as burnishing or well-defined firing atmosphere. Fabric-wise, the cluster comprises of a mix of grog and/or sand-based clay mixtures. Stylistically the group comprises of the majority of samples corresponding to the Füzesabony, Kisapostag, Maros, Maďarovce/Magyarád, Füzesabony-Gyulavarsánd, Nagyrév, Transdanubian Encrusted Pottery, Únětice, and Vatya styles. The technological overlap between the different stylistic groups indicates that the patterns of technological uniformity documented in coarse ware (Kreiter, 2007) were also employed in the production of fine ware. The entire cluster comprised of local and non-local ceramics, indicating that the clear-cut determination of find provenance was technologically not possible.

The final constrained and linearly arranged cluster was linked to two specific fabrics (3 and 8) and smoothed exteriors combined with burnished interiors. It comprised predominantly of Late Copper Age-Early Bronze Age styles, *i.e.* Makó-Kosihy-Čaka, Bell Beakers, and Litzenkeramik. In this case the overlap of stylistically local and non-local ceramics suggests the existence of restricted, yet shared technological practices prior to the formation of tell settlements. The separation of this group from the central cluster where contemporary Nagyrév and Kisapostag ceramics were positioned, suggests the existence of stronger differences between ceramics producing groups in this time-period.

5.7. Integrating form and technological analysis

To determine whether the stylistic differences can be attributed to different production processes the form and technological data was combined in a single analysis (Fig. 10). The results show an overlap between functional categories, represented by mouth diameter and vessel height, as well as the majority of technological variables (cf. Supplementary materials). The result is a dense cluster of samples at the intersection of the 1st and 2nd axis. Sample 24 is again the only major outlier, divergent both in terms of form and manufacturing traits (mixed firing, burnished interior, smoothed exterior). The distance between sample 8 and the sample cluster was reduced, indicating that while technologically distinct, it is generally like the bulk of the analyzed samples.

While the axis of vessel differentiation is shaped by mouth diameter and vessel height (cf. Fig. 6) it was accompanied by burnished exterior surfaces, oxidized or reduced firing atmosphere (not mixed), smoothed interiors, and the majority of documented fabrics. A strong relationship between fabrics and forms was documented between fabric 4 and forms 1, 2, 5, 6, 12, 16, and 17. In other instances the forms and fabrics overlap, further supporting the mostly local origins of visually distinct forms. The clustering did not support the stylistic distinction between vessel forms and their potential provenance.

5.8. Discussion

Bearing in mind the prevalence of cultural classification based on visual differences found in burials (Bóna, 1992; Tasić, 1984), the results

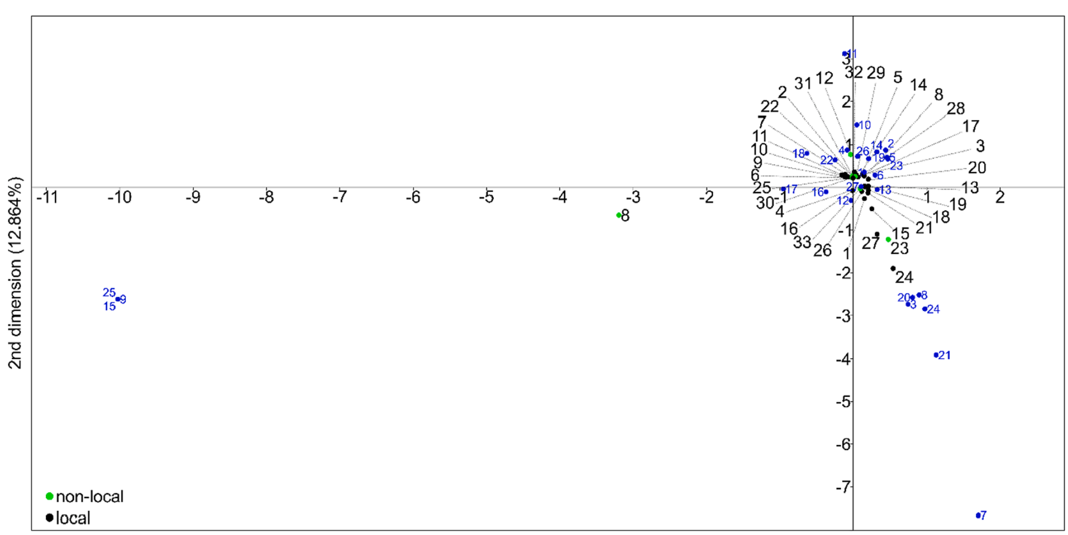

Fig. 9. Technology-based correspondence analysis: 1- Fabric 1, 2 – Fabric 2, 3 – Fabric 3, 4 – Fabric 4, 5 – Fabric 5, 6 – Fabric 6, 7 – Fabric 7, 8 – Fabric 8, 9 – Fabric 9, 10 – Fabric 10, 11 – Fabric 11, 12 – Fabric 12, 13- grog, 14 – sand, 15 – no inclusions, 16 – pinching, 17 – coiling, 18 – reduced firing, 19 – oxidized firing, 20 – mixed firing, 21 – smoothed exterior, 22 – burnished exterior, 23 – smoothed interior, 24 – burnished interior, 25 – scraped interior, 26 – two surfaces interior, 27 – thickness [mm].

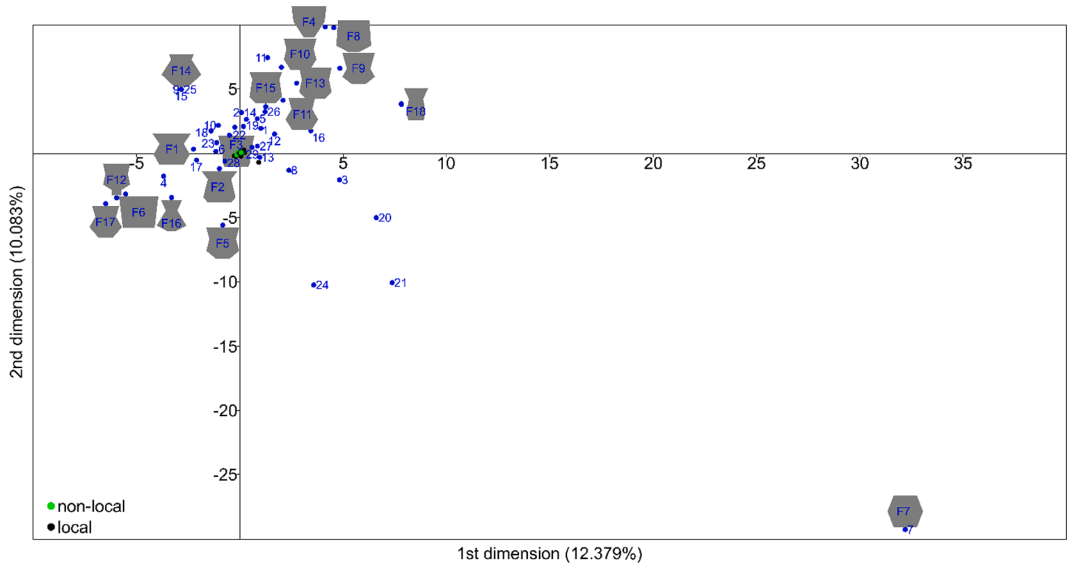

Fig. 10. Form- and technology-based correspondence analysis: 1- Fabric 1, 2 – Fabric 2, 3 – Fabric 3, 4 – Fabric 4, 5 – Fabric 5, 6 – Fabric 6, 7 – Fabric 7, 8 – Fabric 8, 9 – Fabric 9, 10 – Fabric 10, 11 – Fabric 11, 12 – Fabric 12, 13- grog, 14 – sand, 15 – no inclusions, 16 – pinching, 17 – coiling, 18 – reduced firing, 19 – oxidized firing, 20 – mixed firing, 21 – smoothed exterior, 22 – burnished exterior, 23 – smoothed interior, 24 – burnished interior, 25 – scraped interior, 26 – two surfaces interior, 27 – thickness [mm], 28 – rim diameter [mm], 29 – vessel height [mm].

indicate that such clear-cut distinctions cannot be directly re-applied to settlement ceramic materials. The divergent shapes of fine ware ceramics corresponded to three functional categories limited in terms of use manipulation beyond storing, pouring, and drinking small amounts of liquid (Rice, 1996; Roux, 2019). The significance of recognizing the practical aspects of material culture instead of amplifying visual differences is an essential step towards re-integrating datasets oriented primarily along cultural differentiation (Vicze, 2011).

Returning to the question of identifying vessel origins, in majority of cases the types of inclusions do not provide enough evidence to distinguish between local and assumedly imported ceramics. The characteristic heavy minerals (amphibole, biotite, epidote, garnet) and volcanic fragments found in several samples and fabric groups may originate from the Visegrád or Börzsöny Mountains (north Hungary), which are crossed and eroded by the Danube River (Gyalog, 2005; Kuti, 1976; Molnár, 1977; Somogyi, 2010). In light of this, these inclusions could be present in local sediments around Kakucs-Turján as this was also experienced at other analyzed sites situated close to the Danube (Kreiter, 2009, 2007; Kreiter et al., 2020). In other words, vessels assumed to be imports by their stylistic features were similar to local Kisapostag, Nagyrév and Vatya vessels and could not be attributed to different production areas. Should some of these ‘foreign’ vessels be considered good copies and not evidence of other areas in the Carpathian Basin with similar geological conditions, the evidence of imitation points towards a complex interplay of interaction, exchange, and appropriation taking place in the second millennium BCE. This is especially relevant for reconsidering the movements of objects and people from supposedly northern fringes of the Carpathian Basin, as evidenced by ‘local’ characteristics of Únětice and Maďarovce/Magyarád forms (Harding, 2021; Müller, 2015).

The macroscopic fabric analysis revealed that the potential variability in raw materials was linked to common production choices possibly derived from a domestic mode of production. This result corresponds well with what we see at other Middle Bronze Age sites in Hungary, suggesting its prevalence among local communities (Earle et al., 2011, 2013; Kreiter, 2019; Kreiter and Szathmári, 2017; Szeverényi et al., 2020). The increasing agglomeration of households into larger settlements which enabled increasing interaction with the immediate inhabitants and their kin most likely amplified the potential of encountering people and objects of non-local origins (Kienlin, 2020b; Robin, 2020; Yanagisako, 1979). The emergence of standardization, understood as a decreasing variability in processes responsible for material culture production, can be attributed to the increasingly cooperative behavior of inhabitants resulting from cohabitation (Roux, 2015; Sherif, 2015). As such the process of homogenization in terms of functional categories and the *chaîne operatoire* observed in Kakucs-Turján can be associated with the already documented pattern of coarse ware homogenization between 2100 and 1500 BCE (Kreiter, 2007; Michelaki, 2006; Staniuk, 2021).

Explanatory models of this emerging agglomeration and its ties with the formation of a cohesive social model remains unsolved, partially due to the limited studies of ceramic inventories which can be linked to high-resolution chronological studies of socio-economic units. As such only a general model of intensifying interaction between inhabitants of different sites as evidenced in the alteration of vessel manufacturing skills resulting in the hybridization of original forms with local preferences can be suggested on the basis of available data (Furholt, 2017; Maran, 2012; Stockhammer, 2012). To a degree, this suggestion can be given credibility given by the large number of contemporary settlements in the Kakucs microregion, as well as the evidence of individual mobility in the region (Cavazzuti et al., 2021; Przybyła, 2016; Staniuk, 2021). Since the number of ‘foreign’ vessels found in Kakucs-Turján is relatively low, movement of people or potters from different communities is difficult to estimate. Nevertheless, these ‘foreign’ vessels suggest a relationship between the inhabitants of Kakucs-Turján and several other stylistic groups in the Carpathian Basin, indicating the presence of complex relationships and social networks in the Bronze Age.

6. Conclusions

The functional and technological similarity of the Early and Middle Bronze Age vessels from Kakucs-Turján suggest that visual differences cannot be solely used to distinguish between local and non-local ceramics. The majority of vessels stylistically attributed to non-local styles were generally indistinguishable from local ceramics. While evidence of a technological change between the late third and second millennium BCE was documented, only in one case could it be attributed to the emergence of new ceramics form. The findings raise question whether classical culture-historical typologies, where visually distinct finds can be attributed to specific cultural groups, can be maintained for settlement contexts where visual differences of ceramic materials most likely represent the impact of interaction networks developing in the second millennium BCE Carpathian Basin.

CRediT authorship contribution statement

Robert Staniuk: Conceptualization, Writing – original draft, Writing – review & editing, Methodology, Data curation, Visualization, Investigation. **Attila Kreiter:** Conceptualization, Writing – original draft, Writing – review & editing, Methodology, Data curation, Visualization, Investigation. **Gabriella Kulcsár:** Conceptualization, Writing – original draft, Writing – review & editing, Supervision. **Mateusz Jaeger:** Conceptualization, Writing – original draft, Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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References

Bóna, I., 1992. Bronzezeitliche Tell-Kulturen in Ungarn. In: Meier-Arendt, W. (Ed.), Bronzezeit in Ungarn: Forschungen in Tell-Siedlungen an Donau und Theiss. Stadt Frankfurt am Main, Frankfurt am Main, pp. 9–41.

Bóna, I., 1975. Die mittlere Bronzezeit Ungarns und ihre südöstlichen Beziehungen. Akadémiai Kiadó, Budapest.

Cavazzuti, C., Hajdu, T., Lugli, F., Sperduti, A., Vicze, M., Horváth, A., Major, I., Molnár, M., Palcsu, L., Kiss, V., 2021. Human mobility in a Bronze Age Vatya 'urnfield' and the life history of a high-status woman. PLoS ONE 16, e0254360. https://doi.org/10.1371/journal.pone.0254360.

Dani, J., Fischl, K.P., Kulcsár, G., Szeverényi, V., Kiss, V., 2016. Visible and invisible inequality: changing patterns of wealth consumption in Early and Middle Bronze Age Hungary, in: Meller, H., Hahn, H.P., Jung, R., Risch, R. (Eds.), Arm Und Reich - Zur Ressourcenverteilung in Prähistorischen Gesellschaften. 8. Mitteldeutscher Archäologentag Vom 22. bis 24. Oktober 2015 in Halle (Saale), Tagungen Des Landesmuseums Für Vorgeschichte Halle. Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt, Halle (Saale), pp. 219–241.

Dani, J., Köhler, K., Kulcsár, G., Major, I., Melis, E., Patay, R., Szabó, G., Hajdu, T., Futó, I., Huszánk, R., Kiss, V., 2019. Case studies on the dating of Bronze Age Cremation Burials in Hungary. In: Palincaș, N., Ponta, C.C. (Eds.), BridgingScience and Heritage in the Balkans: Studies in Archaeometry, Cultural Heritage Restoration and Conservation. Archaeopress Archaeology, Oxford, pp. 29–37.

Duffy, P.R., 2020. River networks and funerary metal in the Bronze Age of the Carpathian Basin. PLoS ONE 15, 1–20. https://doi.org/10.1371/journal.pone.0238526.

Duffy, P.R., Parditka, G.M., Giblin, J.I., Paja, L., 2019. The problem with tells: Lessons learned from absolute dating of Bronze Age mortuary ceramics in Hungary. Antiquity 93, 63–79. https://doi.org/10.15184/aqy.2018.179.

Earle, T., Kreiter, A., Klehm, C., Ferguson, J., Vicze, M., 2011. Bronze age ceramic economy: the Benta Valley, Hungary. Eur. J. Archaeol. 14, 419–440. https://doi.org/10.1179/146195711798356746.

Earle, T., Kristiansen, K., 2010. Introduction: Theory and Practice in the Late Prehistory of Europe, in: Earle, T., Kristiansen, K. (Eds.), Organizing Bronze Age Societies: The Mediterranean, Central Europe and Scandinavia Compared. Cambridge University Press, Cambridge, pp. 1–33.

Earle, T., Kiss, V., Kreiter, A., Kulcsár, G., Nyíri, B., Szeverényi, V., 2013. Ceramic technology, design and creativity in Bronze Age Hungary: (re)constructing changes in material culture, Creativity: An Exploration Through the Bronze Age and Contemporary Responses to the Bronze Age. 10th – 11th April 2013. Cambridge.

Fischl, K.P., Kiss, V., Kulcsár, G., Szeverényi, V., 2015. Old and new narratives for Hungary around 2200 BC, in: Meller, H., Arz, H.W., Jung, R., Risch, R. (Eds.), 2200 BC – Ein Klimasturz Als Ursache Für Den Zerfall Der Alten Welt? 7. Mitteldeutscher Archäologentag Vom 23. Bis 26. Oktober 2014 in Halle (Saale) / 2200 BC – A Climatic Breakdown as a Cause for the Collapse of the Old World? 7th ArchaeologicalConference, Tagungen Des Landesmuseum Für Vorgeschichte Halle 12/II. Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt, Halle (Saale), pp. 503–523.

Furholt, M., 2017. Translocal communities – exploring mobility and migration in sedentary societies of the European Neolithic and early Bronze Age. Prähistorische Zeitschrift 92, 304–321. https://doi.org/10.1515/pz-2017-0024.

Gogâltan, F., 2017. The Bronze Age Multilayered Settlements in the Carpathian Basin (cca. 2500–1600/1500 BC). An old catalogue and some chronological problems. J. Ancient History Archaeol. 4, 28–55.

Gosselain, O.P., 2018. Pottery chaînes opératoires as Historical Documents [WWW Document]. Oxford Research Encyclopedia of African History. https://doi.org/10.1093/acrefore/9780190277734.013.208.

Gosselain, O.P., 2000. Materializing identities: an African perspective. J. Archaeol. Method Theory 7, 187–217. https://doi.org/10.1023/a:1026558503986.

Greenacre, M., 2007. Correspondence Analysis in Practice, Interdisciplinary Statistics. Chapman & Hall/CRC, Boca Raton, London, New York.

Gyalog, L., 2005. Explanatory book of the 1:100 000 surface geological map series of Hungary. Magyar Állami Földtani Intézet, Budapest.

Hammer, Ø., Harper, D.A.T., Ryan, P.D., 2001. PAST: Paleontological Statistics software package for education and data analysis. Paleontol. Electronica 4, 9.

Harding, A., 2021. Bronze Age Lives, Münchner Vorlesungen zu Antiken Welten. De Gruyter, Berlin/Boston.

Hodder, I., 1982. Symbols in Action. Ethnoarchaeological studies of material culture, Symbols in Action. Ethnoarchaeological studies of material culture. Cambridge University Press, New York.

Holmqvist, E., Larsson, Å.M., Kriiska, A., Palonen, V., 2018. Tracing grog and pots to reveal neolithic Corded Ware Culture contacts in the Baltic Sea region (SEM-EDS, PIXE). J. Archaeol. Sci. 91, 77–91. https://doi.org/10.1016/j.jas.2017.12.009.

Jaeger, M., 2018. Open communities – enclosed spaces. Kakucs-Turján settlement in the context of local tradition and interregional relations. In: Jaeger, M., Kulcsár, G., Taylor, N., Staniuk, R. (Eds.), Kakucs-Turján a Middle Bronze Age Multi-Layered Fortified Settlement in Central Hungary, Studien Zur Archäologie in Ostmitteleuropa / Studia Nad Pradziejami Europy Środkowej, Dr. Rudolf Habelt GmbH, Bonn, pp. 191–211.

Jaeger, M., Kulcsár, G., 2013. Kakucs-Balla-domb. A case study in the absolute and relative chronology of the Vatya culture. Acta Archaeol. Academiae Scientiarum Hungaricae 64, 289–320. https://doi.org/10.1556/AArch.64.2013.2.2.

Jaeger, M., Staniuk, R., Müller, J., Kulcsár, G., Taylor, N., 2018. History of Bronze Age Habitation. In: Jaeger, M., Kulcsár, G., Taylor, N., Staniuk, R. (Eds.), Kakucs-Turján: A Middle Bronze Age Multi-Layered Fortified Settlement in Central Hungary, Studien Zur Archäologie in Ostmitteleuropa / Studia Nad Pradziejami Europy Środkowej 18. Dr, Rudolf Habelt GmbH, Bonn, pp. 97–118.

Kalicz, N., 1982. Die terminologischen und chronologischen Probleme der Kupfer- und Bronzezeit in Ungarn, in: Aspes, A. (Ed.), Il Passaggio Dal Neolitico All'eta Del Bronzo Nell'Europa Centrale e Nelle Regione Alpina: Problemi Cronologici e Terminologici. Atti Del X Simposio Internazionale Sulla Fine Del Neolitico e Gli Inizi Dell'eta Del Bronzo in Europa, Lazise-Verona 8.-12. Ap. Museo Civico di Storia Naturale, Verona, pp. 117–137.

Kienlin, T.L., 2020a. Social life on Bronze Age Tells. Outline of a practice-oriented approach. In: Blanco-González, A., Kienlin, T.L. (Eds.), Current Approaches to Tells in the Prehistoric Old World. Oxbow Books, Oxford & Philadelphia, pp. 173–188.

Kienlin, T.L., 2020b. Bronze Age Tell Communities in Context. An Exploration into Culture, Society, and the Study of European Prehistory. Part 2: Practice. The Social, Space, and Materiality. Archaeopress, Oxford.

Kiss, V., Csányi, M., Dani, J., Fischl, K.P., Kulcsár, G., Szathmári, I., 2019. Chronology of the Early and Middle Bronze Age in Hungary. New results. Studia Hercynia 23, 173–197.

Kreiter, A., 2020. Ceramic petrographic report. In: Staniuk, R. (Ed.), Tradition and Practice. Study on Pottery, Chronology and Social Dynamic of the Hungarian Bronze Age, Studien Zur Archäologie in Ostmitteleuropa / Studia Nad Pradziejami Europy Środkowej 19. Dr. Rudolf Habelt GmbH, Bonn, pp. 447–458.

Kreiter, A., 2019. Nézőpont – Petrográfia/Viewpoint – Petrography, in: Dani, J., Kulcsár, G. (Eds.), CRAFTER. Európai Kézművesség a Bronzkorban És Ma/Crafting Europe in the Bronze Age and Today. Kiállítási Katalógus/Exhibition Catalogue. Déri Múzeum/Déri Museum, Debrecen, pp. 41–48.

Kreiter, A., 2009. Bronzkori kerámiák petrográfiai vizsgálata Bia-Öreg-hegy 1/4 (9965), Bia-Pap-réti-dűlő 1/26 (9987), Százhalombatta(Érd) Külső Újföldek 9/3 (10270), Százhalombatta(Érd) Belső Újföldek 9/4 (10271), Sóskút-Barátház 26/4 (11438), Százhalombatta-Százhalom 27/1. Budapest.

Kreiter, A., 2007. Technological Choices and Material Meanings in Early and Middle Bronze Age Hungary. Understanding the active role of material culture through ceramic analysis (BAR International Series 1604), BAR International Series 1604. Archaeopress, Oxford.

Kreiter, A., Máté, L., Viktorik, O., 2020. Érd, Hosszú-földek alja és Diósd, Sas-hegy lelőhelyekről származó Kora bronzkori (makó és harangedényes) kerámiák petrográfiai vizsgálata. Budapest.

Kreiter, A., Skoda, P., 2017. Petrographic analysis of Bronze Age ceramics from Kakucs-Turján mögött. Budapest.
Kreiter, A., Sofaer, J., Budden, S., 2006. Analysis of Early and Middle Bronze Age Storage Vessel Building Techniques from Hungary. Ösrégészeti Levelek/ Prehistoric Newsletters 6, 85–91.
Kreiter, A., Szathmári, I., 2017. Középső bronzkori kerámiák vizsgálata Füzesabonyról. Budapest.
Kristiansen, K., Earle, T., 2015. Neolithic versus Bronze Age social formations: a political economy approach. In: Kristiansen, K., Šmejda, L., Turek, J. (Eds.), Paradigm Found – Archaeological Theory: Present, Past and Future. Essays in Honour of Evžen Neustupný. Oxbow Books, Oxford & Philadelphia, pp. 312–317, 10.1111/j.1365-2222.2007.02717.x.
Kulcsár, G., 2011. Untangling the Early Bronze Age in the Middle Danube Valley, in: Kovacs, G., Kulcsár, G. (Eds.), Ten Thousand Years Along the Danube, Varia Archaeologica Hungarica XXVI. Archaeolingua, Budapest, pp. 179–210.
Kulcsár, G., 1997. Előzetes jelentés Kakucs-Balla domb középső bronzkori telltelepülésének leletmentő ásatásáról 1992–1993. Pest Megyei Muzeumi Füzetek 4, 343–353.
Kulcsár, G., Jaeger, M., Kiss, V., Gábor, M., Müller, J., Pető, Á., Serlegi, G., Szeverényi, V., Taylor, N., 2014. The beginnings of a new research program - Kakucs Archaeological Expedition – KEX 1. Hungarian Archaeol. 1–7.
Kuti, L., 1976. Magyarország Földtani Térképe L-34-27 Dabas, in: Magyarország Fedett Földtani Térképe 1:100 000. Magyar Állami Földtani Intézet, Budapest.
Maran, J., 2012. One world is not enough: the transformative potential of intercultural exchange in prehistoric societies. In: Stockhammer, P.W. (Ed.), Conceptualizing Cultural Hybridization. Springer Verlag, Berlin Heidelberg, pp. 59–66, 10.1007/978-3-642-21846-0.
Michelaki, K., 2008. Making pots and potters in the Bronze Age Maros Villages of Kiszombor-Új-Élet and Klárafalva-Hajdova. Cambridge Archaeol. J. 18, 355–380. https://doi.org/10.1017/S0959774308000413.
Michelaki, K., 2006. Household ceramic economies: production and consumption of household ceramics among the Maros villagers of Bronze Age Hungary, BAR International Series 1503. Archaeopress, Oxford.
Molnár, B., 1977. A Duna-Tisza köz felsőpleisztocén (levantei) és pleisztocén földtani fejlődéstörténete. Földtani Közlöny 107, 1–16.
Müller, J., 2015. Bronze Age Social Practices: Demography and Economy. Forging Long-Distance Exchange, in: Suchowska-Ducke, P., Reiter, S.S., Vandkilde, H. (Eds.), Forging Identities. The Mobility of Culture in Bronze Age Europe, BAR International Series. Archaeopress, Oxford, pp. 231–236.
Niebieszczański, J., Jaeger, M., Pető, Á., Hildebrandt-Radke, I., Kulcsár, G., Staniuk, R., Taylor, N., Czebreszuk, J., 2019. Revealing the internal organization of a Middle Bronze Age fortified settlement in Kakucs-Turján through geoarchaeological means: Magnetometric survey and sedimentological verification of a housing structure. J. Archaeolog. Sci.: Rep. 25, 409–419. https://doi.org/10.1016/j.jasrep.2019.04.014.
Niebieszczański, J., Pető, Á., Serlegi, G., Hildebrandt-Radke, I., Galas, J., Sipos, G., Páll, D.G., Onaca, A., Spychalski, W., Jaeger, M., Kulcsár, G., Taylor, N., Márkus, G., 2018. Geoarchaeological and non-invasive investigations of the site and its surroundings. In: Jaeger, M., Kulcsár, G., Taylor, N., Staniuk, R. (Eds.), Kakucs-Turján a Middle Bronze Age Multi-Layered Fortified Settlement in Central Hungary, Studien Zur Archäologie in Ostmitteleuropa / Studia Nad Pradziejami Europy Środkowej 18. Dr. Rudolf Habelt GmbH, Bonn, pp. 43–71.
Pető, Á., Niebieszczański, J., Serlegi, G., Jaeger, M., Kulcsár, G., 2019. The site mapping of Kakucs-Turján by the means of horizontal and vertical proxies: Combining field and basic laboratory methods of geoarchaeology and archaeological prospection. J. Archaeol. Sci.: Rep. 27, 101999 https://doi.org/10.1016/j.jasrep.2019.101999.
Pető, Á., Serlegi, G., Krausz, E., Jaeger, M., Kulcsár, G., 2015. Geoarchaeological Survey of Bronze Age Fortified Settlements. Kakucs Archaeological Expedition - KEX 2. Hungarian Archaeology 1–10.
Prehistoric Ceramics Research Group, 2010. The Study of Prehistoric Pottery: General Policies and Guidelines for Analysis and Publication, 3rd Revise. ed.
Przybyła, M.S., 2016. Middle Bronze Age social networks in the Carpathian Basin. Recherches Archéologiques Nouvelle Serie 8, 47–84.
Quinn, P.S., 2013. Ceramic Petrography. The Interpretation of Archaeological Pottery & Related Artefacts in Thin Section. Archaeopress, Oxford.
Rice, P.M., 1996. Recent ceramic analysis: 1. Function, style, and origins. J. Archaeol. Res. 4, 133–163.
Rice, P.M., 1987. Pottery Analysis. A Sourcebook. The University of Chicago Press, Chicago and London.
Robin, C., 2020. Archaeology of everyday life. Annual Rev. Anthropol. 49, 373–390.
Roux, V., 2019. Ceramics and Society. A Technological Approach to Archaeological Assemblages. Springer International Publishing, Cham.
Roux, V., 2015. Standardization of ceramic assemblages: Transmission mechanisms and diffusion of morpho-functional traits across social boundaries. J. Anthropol. Archaeol. 40, 1–9. https://doi.org/10.1016/j.jaa.2015.04.004.
Rye, O.S., 1981. Pottery Technology. Principles and Reconstruction, Manuals on Archaeology 4. Taraxacum, Washington.
Sherif, M., 2015. Group Conflict and Co-operation. Their Social Psychology, Psychology Library Editions: Social Psychology 29. Psychology Press, London and New York.
Sofaer, J., 2006. Pots, houses and metal: technological relations at the Bronze Age tell at Százhalombatta, Hungary. Oxford J. Archaeol. 25, 127–147. https://doi.org/10.1111/j.1468-0092.2006.00253.x.
Somogyi, S., 2010. Ősvízrajz, in: Karátson, D. (Ed.), Pannon Enciklopédia. Magyarország Földje. Urbis Könyvkiadó, Budapest, pp. 254–257.
Sørensen, M.L.S., Rebay-Salisbury, K., 2008. Landscapes of the body: burials of the Middle Bronze Age in Hungary. Eur. J. Archaeol. 11, 49–74. https://doi.org/10.1177/1461957108101241.
Staniuk, R., 2020. Tradition and Practice. Study on Pottery, Chronology and Social Dynamic of the Hungarian Bronze Age, Studien zur Archäologie in Ostmitteleuropa / Studia nad Pradziejami Europy Środkowej 19. Dr. Rudolf Habelt GmbH, Bonn.
Staniuk, R., 2018. The World Within a Household - Kakucs-Turján mögött Case Study and the Interrelatedness of Middle Bronze Age pottery, in: Rezi, B., Németh, R.E. (Eds.), Bronze Age Connectivity in the Carpathian Basin. Proceedings of the International Colloquium from Târgu Mureş, 13-15 October 2016, Bibliotheca Muesi Marisiensis Series Archaeologica XV. Editura MEGA, Târgu Mureș, pp. 55–74.
Staniuk, R., 2021. Early and middle Bronze Age chronology of the carpathian basin revisited: questions answered or persistent challenges? Radiocarbon 63, 1525–1546.
Stockhammer, P.W., 2012. Performing the Practice Turn in Archaeology. Trans. Stud. 1, 7–42.
Szabó, G., 2017. Problems with periodization of the Early Bronze Age in the Carpathian Basin in light of the older and recent AMS radiocarbon data. Archeometriai Műhely XIV 99–116.
Szeverényi, V., Kreiter, A., Dani, J., Gucsi, L., Kiss, V., Kulcsár, G., Skoda, P., Szathmári, I., 2020. The Middle Bronze Age Füzesabony pottery style of the Carpathian Basin. In: Stojanović, B., Vučković, V., Filipović, V., Risch, R., Vasić, R., Kavur, M. (Eds.), CRAFTER Project: Bronze Age of Europe, an Overview Where Are We Now? Paraćin.
Szeverényi, V., Kulcsár, G., 2012. Middle Bronze Age Settlement and Society in Central Hungary, in: Jaeger, M., Czebreszuk, J., Fischl, K.P. (Eds.), Enclosed Space – Open Society. Contact and Exchange in the Context of Bronze Age Fortified Settlements in Central Europe, Studien Zur Archäologie in Ostmitteleuropa / Studia Nad Pradziejami Europy Środkowej 9. Bogucki Wydawnictwo Naukowe - Dr. Rudolf Habelt GmbH, Poznań-Bonn, pp. 287–351.
Tasić, N. (Ed.), 1984. Kulturen der Frühbronzezeit das Karpatenbeckens und Nordbalkans, Balcano-Pannonica. Balkanološki institut SANU, Beograd.
Vicze, M., 2011. Bronze Age Cemetery at Dunaújváros-Duna-dűlő, Dissertationes Pannonicae Series IV, 1. Eötvös Loránd University, Institute of Archaeological Sciences, Budapest.
Whitbread, I.K., 2001. Ceramic petrology, clay geochemistry and ceramic production – from technology to the mind of the Potter. In: Brothwell, D.R., Pollard, A.M. (Eds.), Handbook of Archaeological Sciences. John Wiley & Sons Ltd, Chicheste, New York, Weinheim, Brisbane, Singapore, Toronto, pp. 449–459.
Yanagisako, S.J., 1979. Family and household: the analysis of domestic groups. Ann. Rev. Anthropol. 8, 161–205.