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Cover
House of Linear Pottery Culture from Site 16 at Targowisko.
Photo by ADAM GOLAŃSKI, modified by Joanna Kulczyńska-Kruk

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PREFACE

ON THE BANDKERAMIK TO THE EAST OF THE VISTULA RIVER

In recent years, the eastern province of the Linienbandkeramik (LBK) distribution area, stretching between the Seine and Dnieper Rivers, has increasingly become the focus of scientific interest. Mobility and exchange contributed to the comparatively high degree of homogeneity observed across the vast zone of LBK interaction. Since the LBK lands to the east of the Vistula River and the Carpathian Mountains once formed an integral part of the Bandkeramik cultural complex, it comes as no surprise that the emblematic element of the LBK, the longhouse, is now proven to have existed in its easternmost regions. The increasing interest in the area is also demonstrated by a current project funded by the German Research Foundation: "The Easternmost Settlements of the Bandkeramik in their Regional Context" (DFG 394525779).

We are pleased that our proposal to publish a special volume devoted to the Bandkeramik east of the Vistula has been accepted by the editorial board of the renowned journal Sprawozdania Archeologiczne. Many of the contributions assembled here are more or less closely related to the aforementioned project. The collected contributions are spatially located in a geographical triangle formed by the Vistula, Middle Dnieper and Lower Danube Rivers.

In December 2020, during the initial preparatory work for this volume, our dear friend and colleague Stanislav Ţerna died in a tragic accident. This comes as a heavy blow for us personally, and is at the same time a great loss for the archaeology of south-eastern Europe. We dedicate this special volume to his memory.

Maciej Dębiec and Thomas Saile

Stanislav Țerna

09.09.1984 – 29.12.2020

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ARTICLES

Dmytro Haskevych[1]

BESIDE OR BY TURN? THE BUH-DNISTER FORAGERS AND THE LINEAR BAND POTTERY FARMERS ON THE SOUTHERN BUH RIVER (UKRAINE)

ABSTRACT

Haskevych D. 2021. Beside or by turn? The Buh-Dnister foragers and the Linear Band Pottery farmers on the Southern Buh River (Ukraine). *Sprawozdania Archeologiczne* 73/1, 9-55.

For a long time, finds of the Linear Band Pottery culture (LBK) on the Southern Buh numbered only two bowls from the Buh-Dnister culture site of Bazkiv Ostriv. After the recent discovery of a few more vessels and four stationary LBK settlements, some scholars have assumed the Neolithic incomers regularly inhabited the most of the region. However new direct AMS dates on the Buh-Dnister pottery have shown the existence of the indigenous hunter-gatherers here from 5300 to 5000 BC. Therefore, today, the cluster of four sites is the only verified area that was settled by the early farmers near the town of Zavallia. The occurrence of the settlements at very this place is explained by the fertile local soil and the desire of the inhabitants to control the huge deposit of graphite, which was a centre of an extensive exchange network for the North-Pontic indigenous groups. This could have given the local LBK community significant social prestige through the active production and exchange of valuable goods.

Keywords: Neolithic, Linear Band Pottery culture, Southern Buh River basin, radiocarbon, ceramic imports, graphite

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INTRODUCTION

The Linear Band Pottery culture (LBK) is one of the most studied Neolithic cultures in Europe. Its bearers were the first farmers, settling large areas where the hunter-fisher-gatherer lifestyle predominated before. Therefore, the periphery of the culture is the most fertile ground for examining the interaction between societies of these two types during the classical Neolithization processes. Recently, they have been well studied for the northern LBK border in Poland and Germany (*e.g.*: Terberger and Kabaciński 2005; Czekaj-Zastawny *et al.* 2013; Czerniak *et al.* 2016; *etc.*). On the eastern border, in Ukraine, such works are at the initial stage now. A newly discovered cluster of LBK sites on the Southern Buh River (Kiosak 2017a) has raised the issue of the spatial and temporal relationship of the farming newcomers and the indigenous foragers of the Buh-Dnister culture (BDC). For a long time, it was believed only the latter populated the region, interacting and exchanging with their western neighbours as seen in the archaeological materials. But now, it is increasingly believed that the Southern Buh basin is a part of the LBK area (Kiosak 2013; Kiosak *et al.* 2014; Kiosak 2017a). In some publications, this region is included in the map of the LBK oecumene. Moreover, the disappearance of the Buh-Dnister traditions began to be considered as a possible result of the expansion of the LBK bearers there about 5300 BC. Therefore, finds that were previously treated as evidence of exchange came to be regarded as possible mixing of materials from different periods in collections of both cultures (Kiosak 2013, 77; 2016a, 143; 2017b, 131). This paper focuses on analyses of such cases and presents new facts, as well as the results of radiocarbon dating, in order to shed new light on the discussion of the natural-geographical and social context of the distribution of the LBK on the eastern border of its area.

1. CURRENT STATE OF ART

1.1. Possible evidence of interaction

During the last decades, many researchers have more or less exhaustively listed the finds providing evidence of contacts between the BDC and LBK groups (*e.g.*: Zvelebil and Dolukhanov 1991, 253; Bezusko and Kotova 1997, 148; Larina 1999, 99; Zvelebil and Lillie 2000, 74; Larina and Dergachev 2017, 132-133; Tovkailo 2005, 41; Haskevych 2007, 121; 2014, 5; Kiosak 2017a, 256; 2017b, 119-122, 129-131; Saile 2020). But here, all these finds will be reviewed again with an emphasis on some controversial and poorly elucidated issues regarding to both the artefacts themselves and the context of their discovery. They are given in chronological order according to the first publications, because this is important for understanding the creation of current views on the problem under discussion.

1.1.1. BAZKIV OSTRIV

48°33'07"N, 29°21'30"E (approximately)

Skybyntsi village, Haisyn district, Vinnytsia region, Ukraine (hereinafter, a location is given according to the new administrative division of Ukraine adopted in 2020).

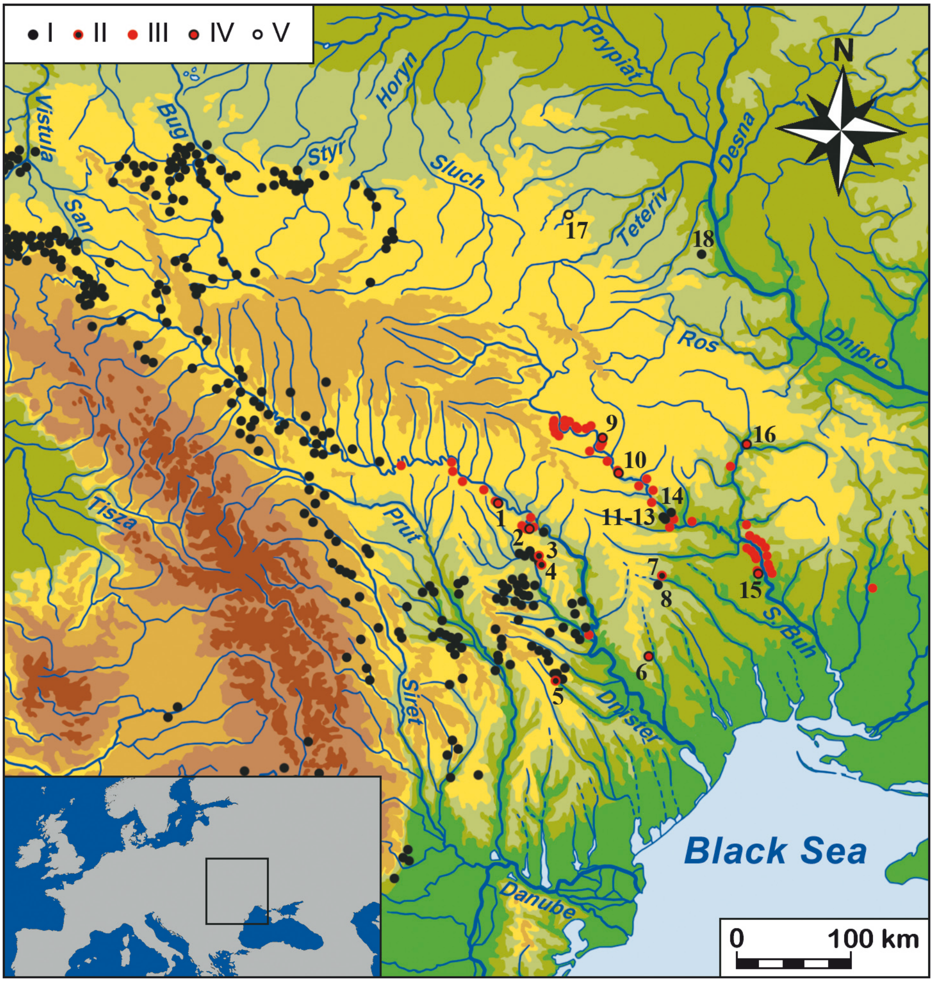


Fig. 1. The LBK and BDC sites between the Vistula, Danube and Dnipro (distribution of LBK sites after Lenartovych 2013, fig. 2, 3; Saile 2020, fig. 2, 9, 11; supplemented and with alterations). Only the main sites mentioned in the article have been numbered. Legend: I – LBK site; II – LBK site with BDC pottery; III – BDC site; IV – BDC site with LBK pottery; V – isolated find of LBK pottery. Sites: 1 – Tătăreuca Nouă XV; 2 – Soroca V; 3 – Gura Camencii VI; 4 – Ţâra II; 5 – Ruseştii Noi I; 6 – Hirzhove; 7 – Mainova Balka and Mainova Balka III; 8 – Ananiv; 9 – Shchurivtsi-Porih; 10 – Bazkiv Ostriv; 11 – Kamiane-Zavallia; 12 – Hnyla Skelia; 13 – Synie Ozero; 14 – Zhakchyk III; 15 – Gard; 16 – Dobrianka-3; 17 – Fasova; 18 – Vita Poshtova 2

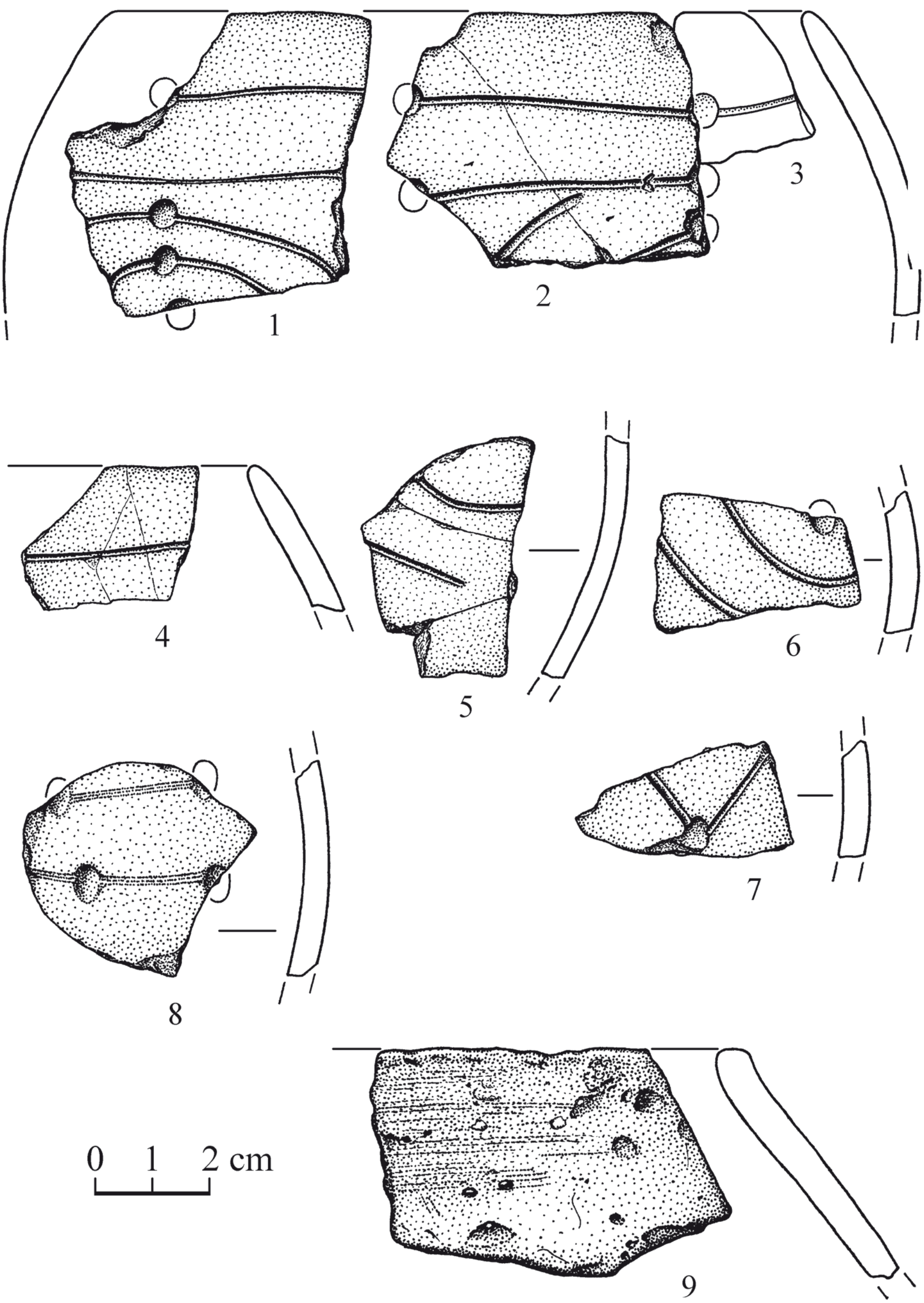


Fig. 2. The LBK pottery from the sites of Bazkiv Ostriv (1-7 – vessel No. 82; 8 – vessel No. 83) and Shchurivtsi-Porih (9). 3 – after Passek and Chernysh (1963, 13, fig. 3), 9 – after Haskevych (2008, 164, fig. 4: 1). Illustrations by D. Haskevych

The first of the materials of interest are the fragments of two LBK bowls with the "music-note" decoration from the BDC site of Bazkiv Ostriv, situated on the island of the same name in the middle of a rapid part of the Southern Buh (Fig. 1). One of these potsherds was found during the surveys in 1959. This provoked large-scale excavations on an area of more than 300 m^2, carried out by Valentine Danilenko the same year (Danilenko 1969, 62-70; Haskevych 2017). He discovered at least 9 more LBK fragments of small and medium size scattered in the northern and eastern parts of the excavation at a depth of 0.6-0.9 m. The distance between the potsherds most remote from each other is at least 20 m. There are 9 LBK fragments (3 of them are joined in one) in the collection now (Fig. 2: 1, 2, 4-8). Another potsherd is known only from a published drawing (Fig. 2: 3).

Tatiana Passek and Kateryna Chernysh published 3 fragments of one bowl in 1963 (Passek and Chernysh 1963, 13, fig. 3). However, they mistakenly interpreted these finds as fragments of two vessels. Afterwards, Danilenko graphically reconstructed them in the same way (Danilenko 1969, 66, fig. 16: 12, 13). Later, this mistake was corrected by Nadezhda Kotova (2002, 20, 168, fig. 44: 5; 2003, 28, 210, fig. 44: 5), but she did not identify the only fragment of the second vessel, a photo of which was published previously (Danilenko 1969, 68, fig. 19: 1).

At the turn of millennium, seven conventional radiocarbon dates were measured on animal bones from the site (Telegin *et al.* 2000, 63, 64; Burdo 2002, 433; Kotova 2002, 104; 2003, 139-140). They cover a range of 6426-5374 years BC; in this article, all ^{14}C dates have been calibrated using OxCal v 4.3.2 software (Bronk Ramsey 2009) and the IntCal13 atmospheric curve (Reimer *et al.* 2013), and are given with a 95.4% confidence level. Information about seven new AMS dates obtained in 2019 will be presented below.

1.1.2. RUSEŞTII NOI I

46°55'22"N, 28°40'08"E

Ruseştii Noi village, Ialoveni district, Republic of Moldova

There is a lower LBK layer in the multilayered site of Ruseştii Noi I, situated on the left bank of the Botna River (Fig. 1). Vsevolod Markevich excavated the site on a total area of 308 m^2 in 1960 and between 1962-1964 (Larina and Dergachev 2017, 229-232). Among the Neolithic finds, one fragment of a vessel made of paste tempered with a graphite and vegetation admixture and decorated with coupled strokes was regarded by him as BDC pottery (Markevich 1973, 24-25; 1974, 117, 130). Later, Kotova published an outlined drawing of one potsherd from the site. She described it as being decorated with "imprints of a comb stamp" (Bezusko and Kotova 1997, 149, 150, fig. 1: 1). However, it is not clear whether Markevich previously mentioned just this fragment or some other.

1.1.3. ȚÂRA II

47°50'05"N, 28°24'37"E

Țâra village, Florești district, Republic of Moldova

The LBK settlement of Țâra II, situated on the left bank of the Reut River (a right tributary of the Dnister), was discovered by Markevich in 1958 and excavated by Passek in 1959-1960 (Fig. 1, Passek and Chernysh 1963, 29-30; Larina and Dergachev 2017, 167-169). Her oral report about one potsherd of a BDC vessel found on the surface was published by Markevich (1973, 22). Any information about it is missing.

1.1.4. SOROCA V

48°07'54"N, 28°19'14"E

Soroca city, Soroca district, Republic of Moldova

The next published LBK vessel in a BDC context was found at the site of Soroca V, situated on the right bank of the Dnister (Fig. 1). Markevich discovered and excavated the site on an area of 60 m^2 in 1966 (Markevich 1974, 102-118). Its date, estimated by one conventional ^{14}C measurement on charcoal of *Fraxinus sp.* from a fireplace, falls into the time span of 5631-5235 years BC (Quitta and Kohl 1969, 250). The find in question was described as *"a fragment of a thin-walled vessel* <...> *decorated with a thin drawn line with a pit"* (Markevich 1974, 116, 130). Many authors mentioned this potsherd, but its representation has never been published.

Much later, a group of researchers saw a "clear LBK influence" in the shape of one pot from the site (Larina *et al.* 1999a, 19; Larina and Dergachev 2017, 132). According to Markevich (1974, 116, fig. 65: 3), this vessel was made using typical Buh-Dnister technology. Interestingly, Mykola Tovkailo associates such a shape with the early Trypillia culture (Tovkailo 2005, 32). In addition, it occurs in both fine ("table") and coarse ("kitchen") ware of the Criş sites in Moldova (Dergachev and Larina 2015, 152, 157, fig. 105: 11, fig. 109).

1.1.5. MAINOVA BALKA

47°43'13"N, 30°03'05"E

Ananiv town, Podilsk district, Odesa region, Ukraine

For a long time, Mainova Balka was the easternmost known site of the LBK. Serhiy Dvorianinov discovered it in 1976, to the north-east of the town of Ananiv, on the bank of a small brook that flows along the bottom of a ravine to the Tyligul River, which flows into the Black Sea between the Dnister and Southern Buh estuaries (Fig. 1). The finds collected on the surface were published in his article, where the author suggested that the population of the LBK "forced out" the population of the BDC from the Buh-Dnister interfluve

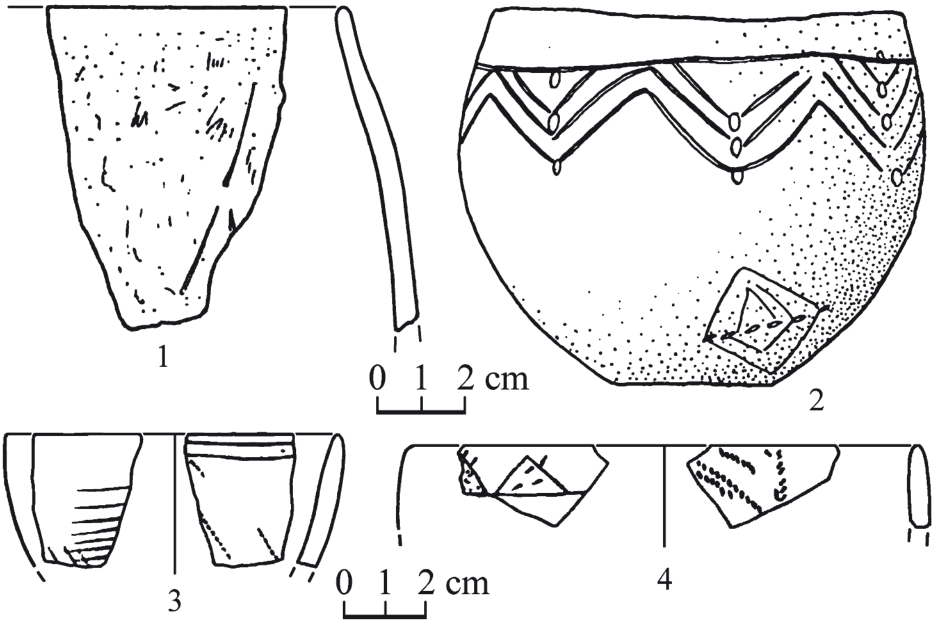


Fig. 3. 1 – The BDC vessel from the LBK site of Mainova Balka (after Larina *et al.* 1999a, 13, fig. 2: 10); 2 – the LBK bowl from the BDC site of Gard (after Tovkailo 2014, 202, fig. 11: 3); 3, 4 – syncretic (?) vessels from the LBK site of Gura Camencii VI (after Larina and Dergachev 2017, 277, fig. 27: 4, 5)

(Dvorianinov 1982). Ihor Sapozhnikov and Vladislav Petrenko excavated a test-trench of 10 square meters on the site in 1989. The trench opened a part of some deeper feature. Among the finds within, some potsherds of the BDC pottery were identified. Only one of them was published (Fig. 3: 1). It is a fragment of the cylindrical upper part of a vessel with a rim 20 cm in diameter. There is an abundant admixture of organic fibres as well sand and graphite in its clay. Incised diagonal lines are scarcely observable on its outer surface (Petrenko and Dvorianinov 1991; Petrenko and Sapozhnykov 1993; Larina *et al.* 1999a, 13, 19, fig. 2: 10; Larina *et al.* 1999b, 27, 31, fig. 2: 10). Two conventional ^{14}C dates measured on animal bones from the test-trench fall into the wide time span of 5630-4906 years BC (Sapozhnykov and Sapozhnykova 2005, 91, tab. 1).

Publishing his results, Dvorianinov mentioned in passing that one LBK "music-note" potsherd was found by him to the south of Ananiv. But, in the figure, he illustrated 15 fragments of pottery and 3 flint artefacts from the site, which he called "Ananiv" in the caption (Dvorianinov 1982, 94, 95, fig. 1: 20, 25-40, 42). Later, the discovery of LBK materials at the site of Mainova Balka III, situated a little bit to the north, across the small intermittent brooklet from Mainova Balka, was mentioned. It has not been ruled out that these sites are two parts of one settlement (Petrenko *et al.* 1993, 106).

1.1.6. TĂTĂREUCA NOUĂ XV

48°19’26”N, 27°58’52”E

Tătăreuca Nouă village, Donduşeni district, Republic of Moldova

A team headed by Valentine Dergachev and Klaus-Peter Vechler discovered and explored the BDC site of Tătăreuca Nouă XV on the right bank of the Dnister (Fig. 1) between 1996-1997 (Larina *et al.* 1997, 107-109). Remains of 50-60 vessels were found in the excavations, which covered a total area of 150 m². Analyzing them, Larina vaguely describes 12-13 vessels as *“connected with the LBK tradition through decorations”*, *“made in the LBK traditions”*, or as containing *“the LBK component”*. In the figure captions, she labelled three vessels as linear-band ones, and 12 others as linear-band “derivates” (Larina 2006, 42-44, 46, fig. 5). As a result, she decided that the site reflects some syncretic phenomenon, comprising traditions of the local BDC and the final LBK population, influenced by incomers from northern territories of the mixed forest zone of the Upper Dnister and/or Volhynia (Larina 2006, 50-52). Recently, 54 fragments of 14-16 vessels from the site were similarly called linear-band (Larina and Dergachev 2017, 235, 349, plate 99).

Four ^{14}C dates on three samples from the site were measured at the Kiel and Gliwice Laboratories. The AMS date of charred residue on the surface of a vessel indicated a time span of 5478-5081 BC, and another on antler yielded a date of 4882-4690 BC. One conventional date from animal bone fell into the middle Eneolithic (Wechler 2001, 29, 30).

1.1.7. GURA CAMENCII VI

47°53’02»N, 28°22’21»E

Gura Camencii village, Floreşti district, Republic of Moldova

The LBK settlement of Gura Camencii VI, situated on the left bank of the Reut (Fig. 1), was discovered by Markevich in 1960 and excavated by Makarova in 1974 (Passek and Chernysh 1963, 29; Larina and Dergachev 2017, 161-166). Potsherds of two semi-spherical bowls (Fig. 3: 3, 4), described as having been made with LBK technology and decorated with thin, incised lines as well as long imprints of a multitoothed stamp on the inside and outside, were found among the surface materials from the site. Larina treats them as indicators of eastern influence from the BDC area or from the even more distant territory of the Surskyi culture (Larina 1999, 81, 104, fig. 88: 1, 2; Larina *et al.* 1999a, 18, fig. 5: 1, 2; Larina and Dergachev 2017, 133, 277, plate 27: 4-5).

1.1.8. DOBRIANKA-3

48°46’19”N, 30°53’19”E

Pishchana village, Zvenyhorodka district, Cherkasy region, Ukraine

The multilayered site of Dobrianka-3 was discovered by Stanislav Smirnov in 1972. It is situated on a 17 m high granite elevation of the left bank of the Tikych River, which flows

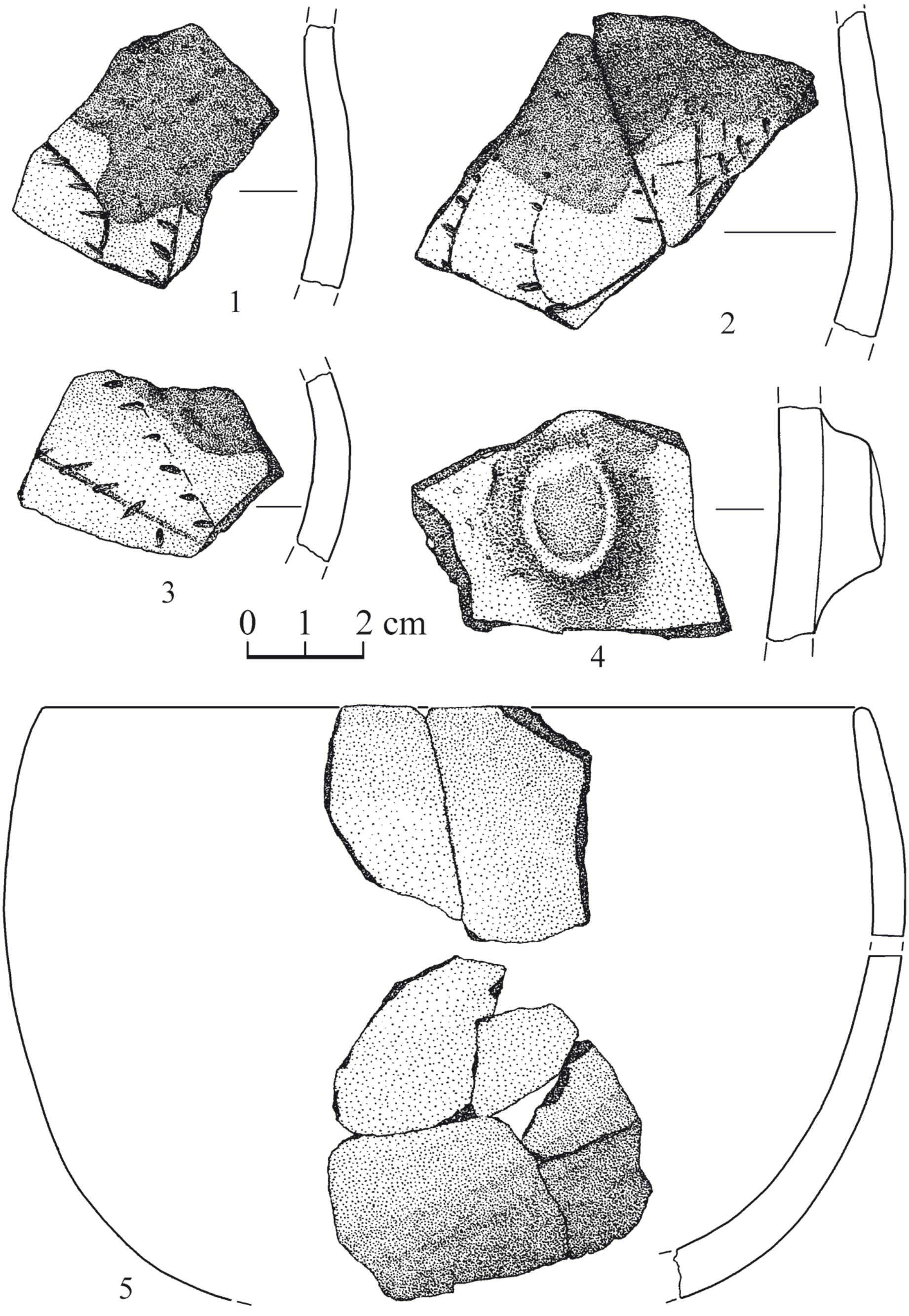


Fig. 4. The LBK vessels (1-5) from the BDC site of Dobrianka-3 (after Zalizniak *et al.* 2013, 228, fig. 25: 4-8). Illustrations by Andrii Sorokun

to the Syniukha River – a left tributary of the Southern Buh (Fig. 1). Leonid Zalizniak and Tovkailo excavated the site on a total area of about 185 m^2 in 2003-2006. In December 2004, viewing the BDC finds from there, the author of this paper attributed two potsherds to one fine LBK bowl with Šárka decoration (Fig. 4: 1-3). This was reflected in some articles by the excavators (Zalizniak *et al.* 2005a, 12, 13, fig. 4: 14; Zalizniak *et al.* 2005b, 99, 112, fig. 6: 14). But in their last, more complete publication of the site, 12 fragments of three LBK vessels (Fig. 4) were already mentioned (Zalizniak *et al.* 2013, 228, 234, fig. 25: 4-8).

In total, 10 radiocarbon measurements date the site. Six of them are conventional, obtained at the Kyiv laboratory on samples of animal bones and organic inclusions in ceramic paste. They cover the period from the middle of 7th to the middle of the 6th millennium BC (Zalizniak and Manko 2004, 141, 145). An AMS date measured at the Oxford Laboratory on a human bone from an individual buried stretched on his back, also fell into this period. Another AMS Oxford date on an auroch bone points to the Preboreal (Lillie *et al.* 2009, 260). Two AMS dates on animal bones measured at the Groningen Laboratory fall into the late Eneolithic and the middle Bronze Age (Biagi *et al.* 2007, 27). The fact that the last two samples were taken from the "Mesolithic" layer confirms the mixing of materials from different periods, previously noted by Zalizniak and co-authors (Zalizniak and Manko 2004, 138, 141, 142; Zalizniak *et al.* 2005a, 9; Zalizniak *et al.* 2005b, 97, 100).

1.1.9. SHCHURIVTSI-PORIH

48°49'57"N, 29°08'04"E (approximately)

Shchurivtsi village, Haisyn district, Vinnytsia region, Ukraine

The BDC site of Shchurivtsi-Porih, located on the left bank of the Southern Buh (Fig. 1), was discovered and investigated by Pavlo Khavliuk and Valentine Danilenko in 1955 and 1957. They cleaned off an outcrop on a steep edge of the lower river terrace, about 100 m long (Danilenko 1969, 117-118; Haskevych 2008, 169-173). The author of this paper attributed one, non-decorated potsherd to the LBK, after viewing collection of the site in 2007 (Haskevych 2008, 164, 170, fig. 4: 1). This is a fragment of the upper part of a coarse vessel with a strongly inverted rim 15 cm in diameter. The lip is flat and straight. The wall is 0.5-0.7 cm thick. The ceramic paste contains an admixture of gruss and a small amount of sand. The inner and outer surfaces are dark gray and uneven, with traces of smoothing and deep, cone-shaped defects (Fig. 2: 9). The fractures are dark grey too. Kiosak has also described this find as LBK (Kiosak 2017b, 120), but Saile considers it dubious (Saile 2020).

1.1.10. KAMIANE-ZAVALLIA

48°11'59"N, 29°59'58"E

Kamiane village, Podilsk district, Odesa region, Ukraine

This site, with flint finds from an indeterminate period of the Stone Age, was found by Volodymyr Stanko on the loess terrace of the right bank of the Southern Buh (Fig. 1), across from Zavallia (Holovanivsk district, Kirovograd region) in 1974 (Smolianinova and Stanko 1976, 121). Prospecting by the survey team of the Odesa archaeological museum revealed many fragments of LBK pottery with "music-note" decorations at the same place in 2011 (Kiosak 2013; Kiosak *et al.* 2014). Since then, Kiosak has excavated a large area with some LBK features there (Kiosak 2017a; 2017b, 122-128). Two ^{14}C dates on animal bone and an ash (*Fraxinus*) charcoal fragment encompass a time span of 5295-4960 BC (Kiosak and Salavert 2018, 122, 124).

Furthermore, a local amateur archaeologist and history teacher at the Zavallia secondary school, Oleksander Peresunchak, recently found three more LBK sites in the vicinity of Kamiane-Zavallia (Kiosak 2017a, 254; 2018). These are the sites of Hnyla Skelia and Synie Ozero on the right bank of Southern Buh, and Zhakchyk III on the right bank of the Mohylnianka rivulet. All four mentioned sites have yielded no BDC materials so far. But two known BDC sites, Zavallia and Zhakchik, are just about 2 and 3 km, respectively, from Hnyla Skelia. Thus, the fact that the indisputable LBK settlement cluster was located directly on the Southern Buh next to the BDC sites has strongly influenced the discussed issue.

1.1.11. GARD

47°48'14"N, 31°10'15"E

Bohdanivka village, Voznesensk district, Mykolaiv region, Ukraine

The first BDC materials found at the multilayered site of Gard, situated in the valley of the Southern Buh, on the right bank of the river in an area with rapids (Fig. 1), were excavated between 1930-1931. Danilenko continued that research in 1949 (Danilenko 1969, 139). Tovkailo has been excavating the site on a large area since 2006 (Tovkailo 2010; 2014). He discovered one LBK bowl with "music-note" decorations (Fig. 3: 2) in the BDC layer (Tovkailo 2014, 201-203, fig. 11: 3). Six conventional ^{14}C dates, measured in the Kyiv laboratory on organic inclusions in the BDC pottery and humus soil from this layer, fall into a time span of 6006-5210 years BC (Tovkailo 2010, tab. 2; 2014, 233, tab. 3).

1.1.12. HIRZHOVE

47°05'45"N, 29°49'19"E (approximately)

Hirzhove village, Rozdilna district, Odesa region, Ukraine

The multilayered site of Hirzhove, situated on a hillock on the right bank of the Kuchurhan River, a left tributary of the Dnister (Fig. 1), was discovered by Pavel Boriskovskiy and Volodymyr Stanko in 1961 and excavated by them on a total area of 216 m² between 1962-1963. A very few ceramic and flint finds from there were attributed to the BDC at that time (Stanko 1966; 1967). Much later, reviewing the collection, Petrenko clearly referred 92 potsherds to the Neolithic. Moreover, he believed that one of them was an undecorated piece of the wall of an LBK vessel, based on its close similarity to the finds from Mainova

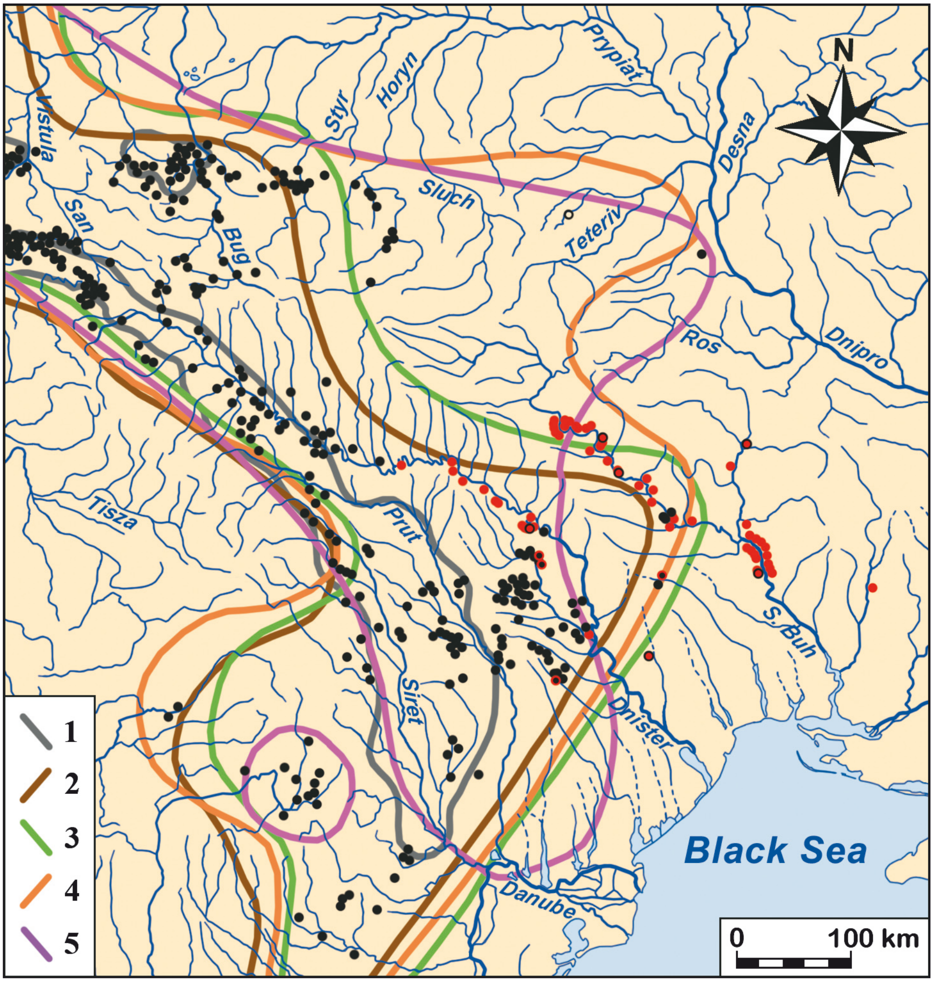


Fig. 5. The LBK and BDC sites between the Vistula, Danube and Dnipro (for detail, see Fig. 1) and some examples of the mapping of the eastern border of the LBK area. Legend: 1 – According to J. K. Kozłowski and S. K. Kozłowski (1977, 251, mapa 17); 2 – according to Lüning (1988, fig. 4); 3 – according to Bogucki (2000, 198, fig. 8: 1); 4 – according to Czekaj-Zastawny (2008, 33, fig. 1); 5 – according to Kadrow and Rauba-Bukowska (2017, 262, fig. 1)

Balka (Petrenko 2012, 234-236). Haskevych (2014, 5; Gaskevych 2015, 191) and Kiosak (2017a, 256; 2017b, 119-120) mentioned this in their publications, but Saile consi-ders that attribution unconvincing (Saile 2020).

Two conventional ^{14}C dates on organic inclusion in one fragment of the BDC pottery from the site were measured at the Kyiv laboratory. They fall into a time span of 6465-5668 years BC, which agrees with the conventional dates on two animal bones that had previously been connected with the Mesolithic materials (Stanko and Svezhentsev 1988, 117; Manko 2006, 19).

The mention of two more finds not itemized here may also have influenced the views of some researchers. Zbenovych saw a fragment of a thick-walled vessel with a pattern that reminded him of the Šárka decoration among pottery from the BDC site of Savran, excavated by Danilenko on the Southern Buh in 1949 and 1955. Thanks to the thorough description of this potsherd, published by Zbenovich in 1989 (176), the author of this paper was able to confidently identify it in the collection. It turned out to be a rim of a rare vessel with a typical *Cardium* decoration. An abundant admixture of the valves of brackish seed shrimps of *Cyprideis torosa littoralis* in its ceramic paste indicates that it was made on a seashore (Gaskevych 2011, 277, fig. 1: 1). The second such find included some LBK pottery at the BDC settlement of Tsekynivka on the Dnister, which Marek Zvelebil and Malcolm Lillie (2000, 74) briefly mentioned without any specified information or references.

Two conclusions are possible from the above overview:

1) only five of the twelve examined cases are connected to the Southern Buh catchment (Bazkiv Ostriv, Dobrianka-3, Shchurivtsi-Porih, Kamiane-Zavallia and Gard);

2) among them, two LBK bowls from Bazkiv Ostriv, first published in 1963, remained the only evidence of the possible BDC – LBK contacts in this region until 2005.

However, already at the end of the 20th century, most of the Southern Buh basin began to be mapped as part of the LBK area (Fig. 5). Why?

1.2. The Southern Buh area on the LBK distribution maps

Upon first publishing the bowls from Bazkiv Ostriv in the catalogue of LBK settlements from the territory of the Soviet Union, Passek and Chernysh correctly called this site a "place of an isolated find" of the linear-band ware (Passek and Chernysh 1963, 6, fig. 2: 1). However, later, Telehin mapped Bazkiv Ostriv with the same mark as the rest of the LBK settlements (Telegin 1979, 230, fig. 1: 32). Moreover, he placed this mark about 50 km upstream of the real location of the site. It should be stressed that Bazkiv Ostriv is not mentioned in the text of his article, and the number of the mark is omitted in the explanation of the LBK affiliation of the sites in the caption under the map. However, some researchers did not pay attention to this nuance. Janusz K. Kozłowski republished Telehin's figure without the numbers and list of mapped sites (Kozłowski 1985, 68, fig. 12). As a result, the only mark on the Southern Buh is perceived here as a full-fledged LBK settlement without any restriction. It seems that this was a reason for expanding the LBK area to the middle reaches of the Southern Buh on the well-known maps of Jens Lüning (1988, fig. 4) and Peter Bogucki (2000, 198, fig. 8: 1).

Unlike the Central European archaeologists, researchers from Ukraine and Moldova definitely connect Bazkiv Ostriv with the BDC. Thus, Larina mapped one unnamed site with the *"LBK materials in a foreign cultural environment"*, situated on the Middle Buh, in some of her works. Following Telehin, she marked it northwest of the real location of Bazkiv Ostriv. This error is about 60, 90 and 100 km in a straight line in the different publications (Larina 1999, 11, fig. 1, 2; 2006, 53, fig. 7; 2009, 51, fig. 1; Larina and Dergachev 2017, 9, fig. 3). The fact that all these cases pertain to the same settlement is confirmed by another map, on which it is called "Bazkiv Ostriv" and marked even further, on the right bank of the upper reaches of the Southern Buh near town of Khmelnyk, approximately 155 km in a straight line from its actual location (Larina 2009, 58, fig. 4: 35). On the other hand, Bazkiv Ostriv is mapped absolutely correctly in Larina's other works published at the same times (Larina 1994, 58, fig. 1: 6; Larina and Kuzminova 1994, 238, fig. 1: 6; Larina *et al.* 1999b, p. 30 fig. 1: 3).

The previous confusion over the location of Bazkiv Ostriv has passed into publications by Agnieszka Czekaj-Zastawny. According to a caption under her LBK distribution map, it was drawn up using the data of both Bogucki and Larina. As a result, she included both the Upper and Middle part of the Southern Buh basin in the LBK area (Czekaj-Zastawny 2008, 33, fig. 1). Maciej Dębiec and Thomas Saile mapped one unnamed LBK site on the upper reaches of the Southern Buh, and the second one somewhat to the north (Dębiec and Saile 2015, 16 Abb. 15; Saile 2020, fig. 2). The grounds for this were also the marks on Larina's maps (Dębiec, personal communication 15.10.2020). The LBK area covers the upper part of the Southern Buh catchment on the map published by Sławomir Kadrow (Kadrow and Rauba-Bukowska 2017, 262, fig. 1; Kadrow 2019, 319, ryc. 1).

The given cases of the reiterated errors in the interpretation and mapping of Bazkiv Ostriv could leave the impression of a steady presence of LBK communities at different places on the Southern Buh banks. This impression could become yet stronger after the discovery of several LBK shards at Dobrianka-3 and Shchurivtsi-Porih. The erroneous treatment of Mainova Balka as being located in the Southern Buh basin (Dolukhanov *et al.* 2009, 102; Kiosak 2013, 75; 2017b, 121, fig. 4: caption; Kiosak *et al.* 2014, 85) could also have played a negative role. That is why the discovery of the first real long-term LBK settlement of Kamiane-Zavallia has promptly led to the supposition that *"two-thirds of the Bug-Dniester cultural territory <...> was a regular region settled by the LBK people rather than a rare invasion into the domain largely belonging to the Bug-Dniester culture. We expect more LBK sites to be found in this area"* (Kiosak 2017b, 128). The contradictions in the absolute chronology of the BDC were also used to support this view.

1.3. Problems in the absolute chronology of the BDC

The radiocarbon dating of the BDC is analyzed in several special publications (Haskevych, 2007, 2014, Haskevych *et al.* 2019), as well as in publications on other topics (*e.g.*: Tovkailo, 2005, 2014; Kiosak 2017b; Kiosak and Salavert 2018). A brief summary of how the problem that rose within this sphere at the turn of the millennium has influenced issue of LBK – BDC contacts is given below.

Only a few dates were measured on samples from BDC sites before 1997. They cover the period of the 60th-47th centuries BC, confirming the traditional view that the local Southern Buh and Dnister foragers lived side by side and had contact with the LBK farmers over several hundred years. A large series of dates encompassing the time span of the 65th-54th centuries BC was derived from bones from the Southern Buh BDC sites between 1997-2000 (Kotova 2002, 22-24, 103-104, table 9; 2003, 31, 32, 130-133, 139-140, table 9). Based on these dates, Kotova created her own periodization scheme, according to which the culture disappeared around 5300 BC. The previous dates, which contradict these views, were simply ignored by her without explaining the reason (Kotova 2002, 24, 40; 2003, 32, 58). However, some sites of the North steppe Southern Buh area, which yielded pottery that combined the traditions of the late BDC and the early Trypillia culture, were published in subsequent years (Tovkailo 2005, 37-39). Explaining this syncretism, Kotova supposed the BDC population existed up to 5000 BC despite the absence of relevant ^{14}C dates in the series she used (Kotova 2015, 46).

The divergent views regarding the BDC dates of 5300-5000 BC cast doubt on the existence of the indigenous, Southern Buh population at the time indicated by two dates from Kamiane-Zavallia. Therefore, Kiosak has questioned the organic linkage of the Linear Band "imports" with the rest of the materials found at the BDC sites (Kiosak 2016a, 143; 2017b, 137). Not least, this became possible due to the recent revision of the stratigraphy of the main BDC sites, explored by Danilenko on the Southern Buh in the 1950s.

1.4. Problems in stratigraphy of the BDC sites

Most of the BDC sites are situated in a river valley on the edge of periodically flooded river terraces, or just on riverbanks and islands at places well-suitable for fishing. Therefore, they were settled many times, and thick cultural levels, rich in materials of different times and cultures, arose there. It was these places that had attracted Danilenko, who was trying to get more finds from smaller areas during his rescue excavations before the construction of a cascade of reservoirs on the Southern Buh (Haskevych 2013; Haskevych *et al.* 2019, 217-219). However, in his publication of these sites, he always divided each into clear cultural layers with finds of distinctive types (Danilenko 1969, 62-139). This allowed him to propose a three-period chronological scheme of the BDC as a sequence of one non-pottery and six pottery phases. The researcher believed that the design of the pottery of each phase was characterized by a unique style (Danilenko 1969, 150-155). For example, at Bazkiv Ostriv, he clearly attributed the LBK bowls to the layer containing vessels decorated with the so-called "Samchyntsi" style (Danilenko 1969, 66).

A careful analysis of field reports and finds from a number of old sites, as well as new excavations carried out on some of them, has shown a lack of features and clearly distinguishable cultural layers there. Materials of different types and ages are mixed in most of the settlements that had been previously considered to be sites yielded reference collections of certain periods and phases of the culture (Haskevych 2013; 2017). This enabled the following three conclusions to be drawn, which are important for the discussed issue.

1. The synchronicity of the LBK and BDC materials that were found nearby at the same depth in Bazkiv Ostriv, Dobrianka-3 and Gard, may be doubtful. Kiosak referred it to support his supposition.

2. The correlation of ^{14}C dates measured on bone with the finds of BDC pottery found near respective samples may also be erroneous. So, Kotova's scheme becomes questionable. Some vessels, which were considered by her as early, may actually be late, and vice versa. The start of the BDC around 6400 BC and its disappearance around 5300 BC become unconvincing too.

3. The future acquisition of new ^{14}C dates from bones or charcoal found in mixed contexts at sites explored decades ago and submerged afterwards (Bazkiv Ostriv, Shchurivtsi-Porig), or from recently excavated sites (Dobrianka-3, Gard), cannot provide a solution to the problem.

Based on the above, there are two more or less reliable ways to check the synchronicity of the BDC finds and the possible LBK "imports" in the Southern Buh catchment: a) direct radiocarbon dating of BDC pottery from sites with LBK potsherds; b) searching for syncretic vessels combining characteristic traits of the BDC and one of the other cultures, reliably dated to a time after 5300 BC, in collection of these sites.

The first data of both kinds have been recently obtained during research on materials from the site of Bazkiv Ostriv.

2. NEW DATA FROM THE BAZKIV OSTRIV SITE

2.1. New direct radiocarbon dates on BDC pottery

To begin addressing the problem in the BDC chronology, 11 direct AMS dates on pottery were measured within the framework of a special Japanese-Ukrainian archaeobotanical project at the Radiocarbon Dating Laboratory of the University Museum at the University of Tokyo in 2019. Nine fragments of BDC vessels with organic inclusions in their ceramic paste and two samples of carbonized crust on the surfaces of the potshards were selected from the collections of three sites: Shumyliv-Cherniatka, Hlynske I and Bazkiv Ostriv (Haskevych *et al.* 2019). The last site yielded seven dates, which cover a wide period between 6597-4847 BC (Tabl. 1, Fig. 6, 7).

An examination of the reliability of the new dates in light of the probable "old" carbon and freshwater reservoir effect (Haskevych *et al.* 2019, 230-232) has shown that the measurements on samples of vessel No. 23 (Fig. 6: 1), and vessel No. 21 (Fig. 6: 4) with a CO_2 content of 0.7% are the most questionable. It is noteworthy that one of them yields the earliest, very controversial date of the late first half of the 7th millennium BC (Fig. 7). The

Table 1. Results of direct AMS radiocarbon dating on the BDC pottery from the Bazkiv Ostriv site (after Haskevych *et al.* 2019)

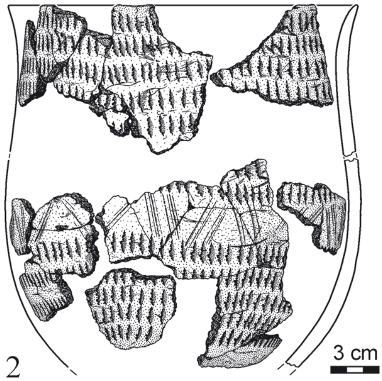
Lab No	Material	^{14}C age BP	Calibrated age cal BC (2σ)	CO_2 content (%)
Shumyliv-Cherniatka				
TKA-20826	Charred residues (inner)	5725±30	4683–4491	49.0
TKA-20827	Organic inclusions in the ceramic paste	5805±25	4723–4558	3.5
Hlynske I				
TKA-20828	Organic inclusions in the ceramic paste	7080±30	6016–5899	1.1
TKA-21090	Organic inclusions in the ceramic paste	7795±30	6686–6532	0.6
Bazkiv Ostriv				
TKA-20829	Organic inclusions in the ceramic paste	7710±25	6597–6477	0.7
TKA-20830	Organic inclusions in the ceramic paste	6855±30	5807–5666	1.1
TKA-20831	Organic inclusions in the ceramic paste	6625±25	5621–5514	2.4
TKA-20832	Organic inclusions in the ceramic paste	6970±25	5972–5769	0.7
TKA-20833	Organic inclusions in the ceramic paste	6190±35	5288–5030	1.1
TKA-20834	Organic inclusions in the ceramic paste	6040±25	5003–4847	5.6
TKA-21091	Charred residues (inner)	6145±35	5211–5000	21.3

reliability of two measurements on samples of vessel No. 1 (Fig. 6: 2) and vessel No. 2 (Fig. 6: 5), both with a CO_2 content of 1.1%, is moderate. Finally, only three measurements on vessel No. 22 (Fig. 6: 3) and No. 39 (Fig. 6: 6) should be recognized as the most reliable. The partial overlap of the intervals of two dates from samples of different materials (organic inclusions and carbonized crust) taken from the same vessel (No. 39) confirms this too (Fig. 7).

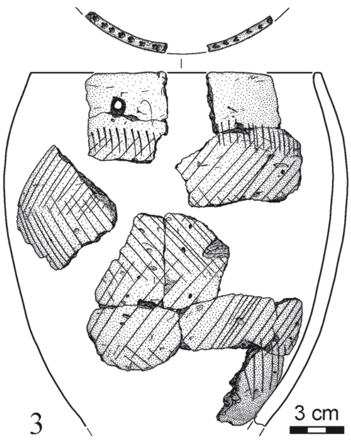
Thus, the date of 5288-5030 BC (TKA-20833), of moderate reliability, as well as the dates of 5003-4847 BC (TKA-20834) and 5211-5000 BC (TKA-21091), of high reliability, indicate a time after 5300 BC. The period covered by them together accurately corresponds to the time of the two dates from Kamiane-Zavallia (Kiosak and Salavert 2018, 122). It should also be emphasized that the fragments of both vessels (No. 2 and No. 39) that yielded these dates were found in several compact clusters in the same part of the excavation with large fragments of LBK bowl No. 82.

Typologically, both vessels are typical “Samchyntsi” ware, which was defined by Danilenko (1969, 118, 119). In general, vessels of this type are pots with rounded or pointed bottoms and slightly S-shaped, cylindrical, or oblong spherical bodies. They are mostly made of raw material with an abundant coarse-grained mineral admixture of quartz and

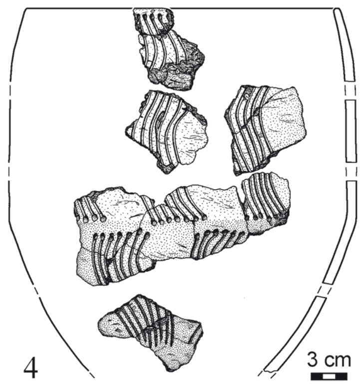
TKA-20829 – 7710±25 uncal BP (6597–6477 cal BC)



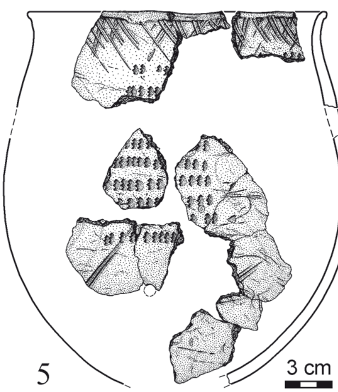
TKA-20830 – 6855±30 uncal BP (5807–5666 cal BC)



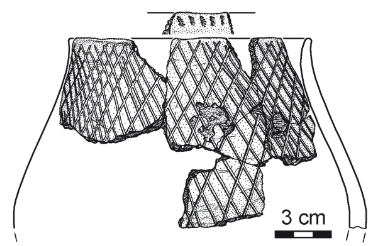
TKA-20831 – 6625±25 uncal BP (5621–5514 cal BC)



TKA-20832 – 6970±25 uncal BP (5972–5769 cal BC)



TKA-20833 – 6190±35 uncal BP (5288–5030 cal BC)



TKA-20834 – 6040±25 uncal BP (5003–4847 cal BC)
TKA-21091 – 6145±35 uncal BP (5211–5000 cal BC)

Fig. 6. Bazkiv Ostriv. The sampled BDC vessels and their direct AMS radicarbon dates; 1 – vessel No. 23; 2 – vessel No. 1; 3 – vessel No. 22; 4 – vessel No. 21; 5 – vessel No. 2; 6 – vessel No. 39 (after Haskevych *et al.* 2019). Illustrations by D. Haskevych

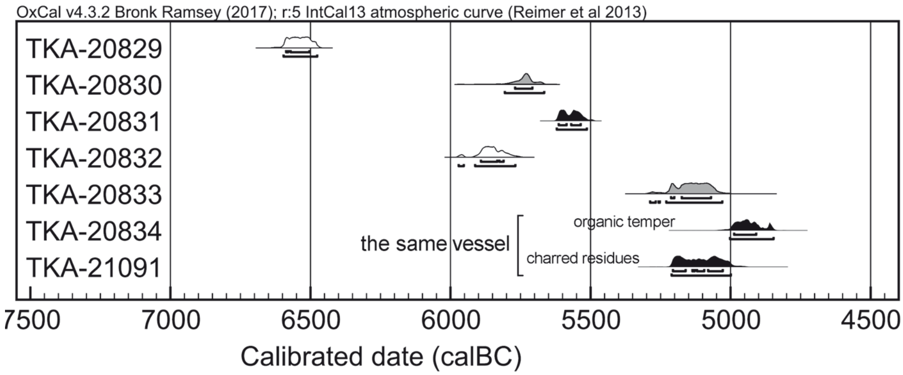


Fig. 7. Bazkiv Ostriv. Plot of the AMS dates, measured the samples with a CO_2 content of: white – 0.7%, grey – 1.1%, black – 2.4% or more (after Haskevych *et al*. 2019, 232, fig. 14)

feldspar gruss and a small admixture of fibrous organic remains. Inclusions of graphite, micaceous sand and crushed shells are more rare. The external surface is usually slightly burnished and most frequently dark grey or dark brown, and less often fulvous or reddish. Almost all vessels are decorated, frequently only on their upper part. The specific Samchyntsi-style design consists of rows of the elongated impressions of a notched stamp (including a comb), imprinted with the stab-and-drag technique, and arranged into an encircling horizontal belt or vertical zone. Sometimes, these belts or zones are separated off by horizontal or diagonal bunches of lines drawn with a notched stamp, or by such lines arranged into a grid or herringbone pattern. Another characteristic trait is the decoration of internal rims by one row of these impressions. Less frequent are a grid or some irregular angular figures applied with single, narrow, superficial lines (Haskevych 2008; Gaskevych 2011, 280-283).

Both the previously measured direct radiocarbon dates on pottery from the site of Dobrianka-1 (Manko 2013, 216; 2016, 271, 278) and the new date from vessel No. 1 from Bazkiv Ostriv indicate that the "Samchyntsi" ware appeared in the first half of the 6th millennium BC. Therefore, it was a customary type of ceramics for the local hunter-fisher-gatherers, and its production was ongoing at the time when the LBK groups settled the Southern Buh banks. Based on this, the sought-for syncretic vessels must combine some of the above characteristics with traits of pottery of the western cultures of the last quarter of the 6th millennium BC or later.

2.2. Pottery with traits of the Linear Circle

During excavation, the explored area of 247 m^2 was drawn on the field plans of the Bazkiv Ostriv site. Also marked on the plans are 1353 fragments of pottery. But today, the collection of the Institute of Archaeology of the NAS of Ukraine includes only 701 potsherds of different times and cultures, recognised by the author of this article as comprising 90 vessels, which have been numbered for a renewed inventory list. The rest of the ceramic finds are considered to have been lost in the 1970s. About a dozen BDC vessels, identified as possibly syncretic, are subdivided into four groups by their dominant western feature.

2.2.1. PLASTIC APPLICATIONS

This kind of pottery decoration is absolutely non-typical for the Eastern European sub-Neolithic population, but characteristic for their western and southern agro-pastoral neighbours. At Bazkiv Ostriv, among the pottery made of ceramic paste with admixtures of abundant coarse minerals and relatively little vegetation, only vessel No. 64 is decorated with small knobs at the very edge of rim, as well impressions and incised lines below (Fig. 8: 1). No fewer than 9 of its fragments were found at a depth of 0.8-1 m in the western part of the excavation. Fragments with the knobs are absent in the collection now. One of them, however, is known from a published photo (Fig. 8: 1a). Describing the vessel, Danilenko calls the knobs “densely placed” (Danilenko 1969, 66, 68, fig. 18: 4). The photographed knob is flattened (lens-shaped?), vertical and about 1.5 cm large. Knobs of this shape, size, orientation and location rarely occur on pottery from LBK sites. For example, at Zwięczyca 3 in southeastern Poland, similar, densely placed knobs are reported on a vessel decorated with a human-face motif and regarded as “imported” from the Bükk culture area (Sebők 2014, 80, 81, 83, Abb. 20: 7). Also, vertical knobs about 2.5 cm to 5 cm large, applied beneath the rims of the vessels, were noted on wares from that site (Dębiec 2014, 214, 221, 237, Taf. 55: 3, Taf. 62: 7, Taf. 78: 13). The row of impressions is rather traditional for BDC pottery. A zone filled with diagonal incised lines arranged into a herringbone pattern occurred on pottery of the both the cultures of the Eastern Linear circle (*e.g.*: Kalicz and Makkay 1977, 301, 330, 338, Taf. 93: 1, Taf. 126: 9, Taf. 137: 9, 12) and the late BDC sites in the Southern Buh basin (Danilenko 1969, 125, fig. 98; Tovkailo 2005, 129, 130, fig. 47: 13, fig. 48: 7). A shape of vessel No. 64 may be restored very approximately.

2.2.2. CARINATED SHAPE

In the 6th-5th millennium BC, biconical vessels were not made by hunter-gatherers in the territory of Ukraine; rather, preference was given to more easily produced conical and cylindrical shapes. At Bazkiv Ostriv, among the ware designed with Samchyntsi technology, vessel No. 76, published by Danilenko (Danilenko 1969, 66, fig. 16: 10), has the sharpest body corner. Just two joined fragments found on the surface represent it. Double horizontally incised lines run around the vessel above and below the rib, which has a diameter of 15-16 cm. Groups of diagonally incised lines extend up and down from them

(Fig. 8: 3). The less pronounced, more rounded body corner is visible on vessel No. 50 that is firstly published here. It is scantily decorated with two rows of fingernail imprints under the outside rim, and one row of such imprints on the very edge of the inner rim (Fig. 8: 2). Five fragments of this vessel were found in the western part of the excavation, at a depth of 0.7-0.8 m.

It is believed that in Southeastern Europe, the spread of biconical pottery is associated with the emergence of the Vinča culture. As Agathe Reingruber has pointed out, although this happened about 5300 BC (according to the radiocarbon dates from the eponymous tell), earlier carinated vessels are known to the east and north of the Danube (Reingruber 2018, 85-92). In particular, they were found at some Körös sites in Eastern Hungary

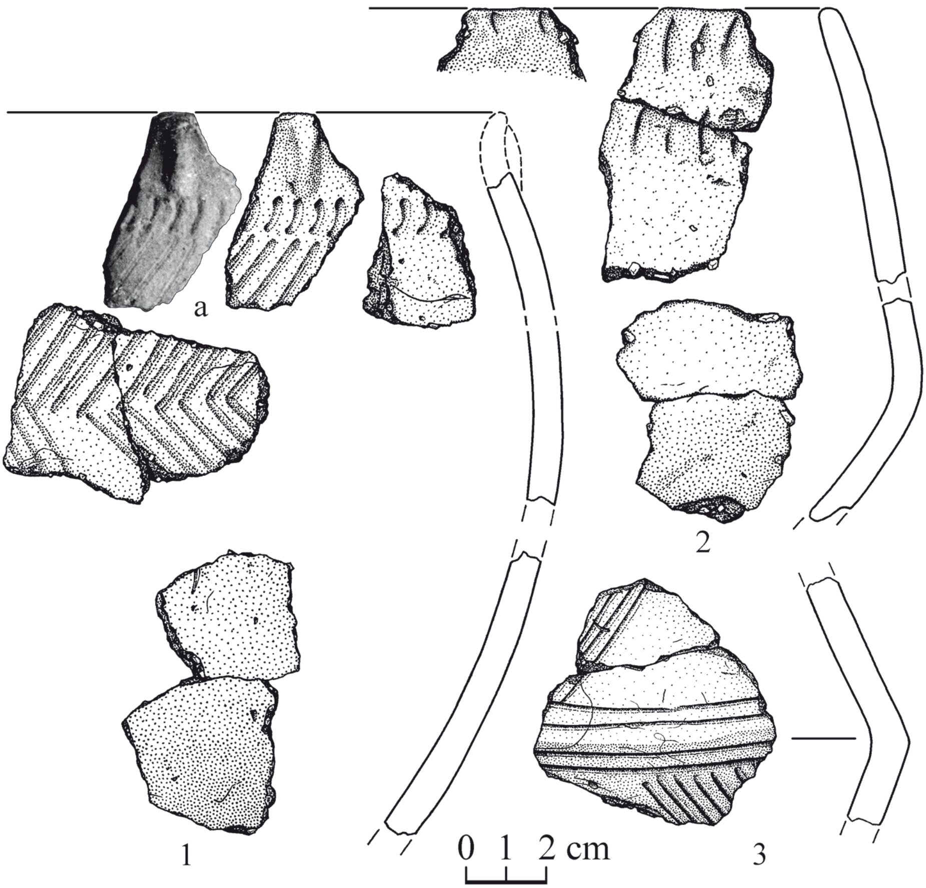


Fig. 8. Bazkiv Ostriv. 1 – vessel No. 64 with plastic applications (1a – after Danilenko 1969, 68, fig. 18: 4); 2 – vessel No. 50 with rounded body corner; 3 – vessel No. 76 with sharp body corner. Illustrations by D. Haskevych

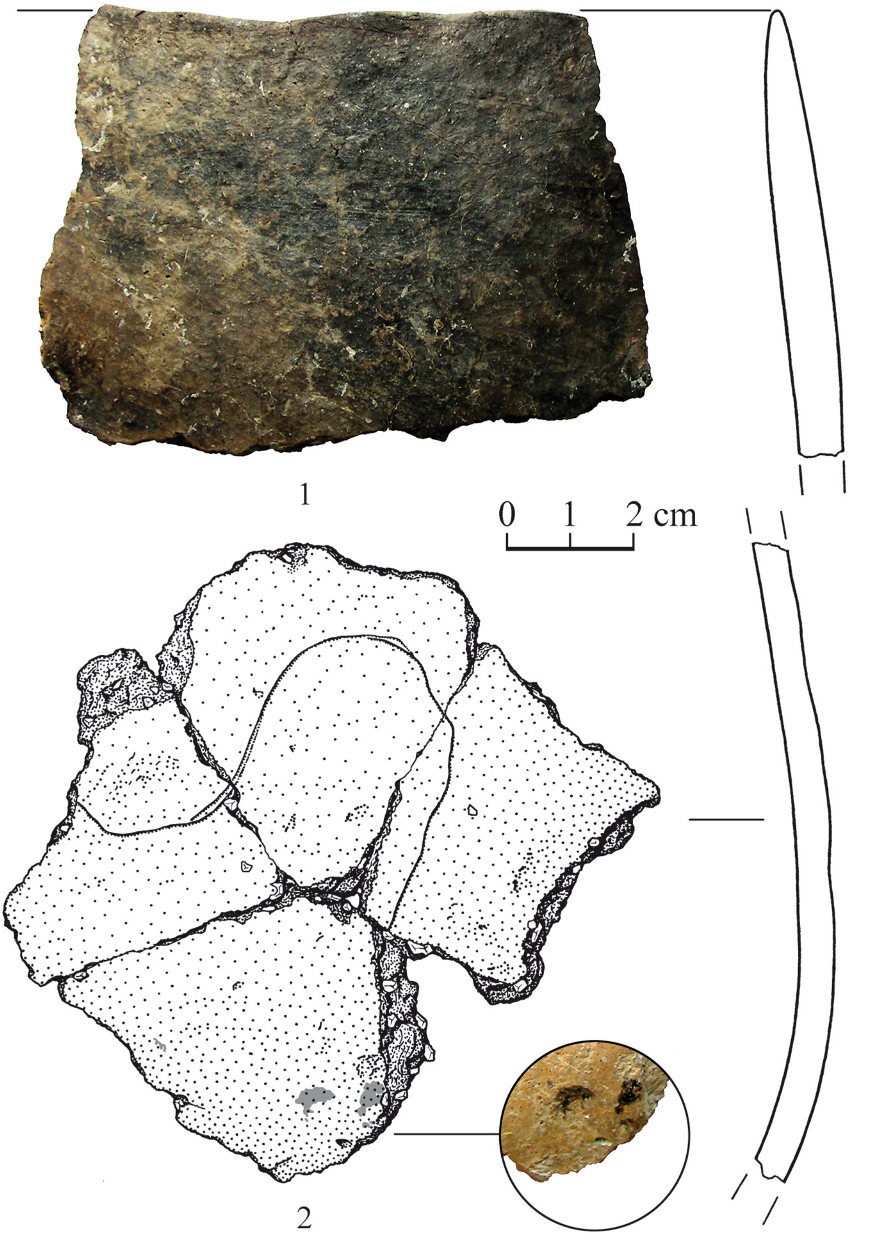


Fig. 9. Bazkiv Ostriv. 1-2 – vessel No. 47 (after Gaskevych 2017a, 241, fig. 6).
The colouring and painted decoration are marked with grey. Illustration and photos by D. Haskevych

(Makkay 1990) and the Criş sites in Romania (Ursulescu 2000, 211, 214, fig. 1) and Moldova (Dergachev and Larina 2015, 135, 157, fig. 92, 109), dated between the early – middle 6th millennium BC (Yanushevich 1989, 609; Wechler 1998, 74; Larina 1999, 98; Kovalenko 2017, 157, 158). Therefore, there is no certainty that vessels No. 76 and No. 50 are younger than 5300 BC. However, this also cannot be ruled out, due to the bundles of incised lines that are not typical for Criş and Körös pottery but are widespread in the further cultures of the Eastern Linear Circle.

2.2.3. COLOURING AND PAINTED DECORATION

Here, the word "colouring" refers to any ancient dyeing of the vessel surface, including accidental contamination by gleing and waterproofing agents, food, *etc.* "Painting" is one of the colouring manifestations, when the intentional dyeing creates a semantic effect discernable through the elements of decoration, arranged into compositions.

The first potsherd with probable painting was found by Danilenko. He drew it among the fragments of the Samchyntsi vessels without comments in the text (Danilenko 1969, 66, fig. 16: 6). Strips of different widths arranged into a spiral-like (?) motif are discerned on this figure. Examining the collection, the author of the current article discovered this potsherd (Fig. 9: 1) as well fragments of six more vessels with traces of red to dark brown painting and/or colouring. Their detailed characteristics are stated in a special publication (Gaskevych 2017a), the main facts and conclusions of which are presented here.

There are a few cases of easily identifiable painted decorations: a volute-like (?) end of some figure on vessel No. 66 (Fig. 10: 2), straight parallel stripes on vessel Nos. 73 (Fig. 10: 3) and 79 (Fig. 10: 4), and one curved stripe on vessel No. 17 (Fig. 12: 1). The preservation of the painting is very bad. But the difference in elemental composition between the painted and unpainted surfaces of vessel No. 66, recorded by X-ray fluorescence analysis, has eliminated doubts. The search for analogies to these decorations is pointless due to their simplicity. However, the incised decorations reported on some of these vessels (sometimes directly under the painting) attract attention. These include decorations with a single, very thin, straight vertical line (Fig. 11: 5), a meander shaped by such a line (Fig. 9: 2), as well as short segments of single, wider, deep lines (Fig. 11: 2, 3). Also of interest are herringbone compositions of parallel diagonal lines (Fig. 10: 4), rounded and angular figures filled with vertical lines, and frequent, short incisions on the inner rim (Fig. 13: 1-3). They are characteristic of the Eastern Linear Circle Neolithic, especially of the Szakálhát culture. It should be emphasized that two of these vessels have a flat bottom (Fig. 12: 4; 13: 5). On the other hand, rows of imprints of a short comb stamp, used for decorating Samchyntsi wares, have been applied to one of the vessels with colouring (Fig. 12: 2, 3). All vessels with colouring are made of very similar ceramic paste of the typical Samchyntsi composition.

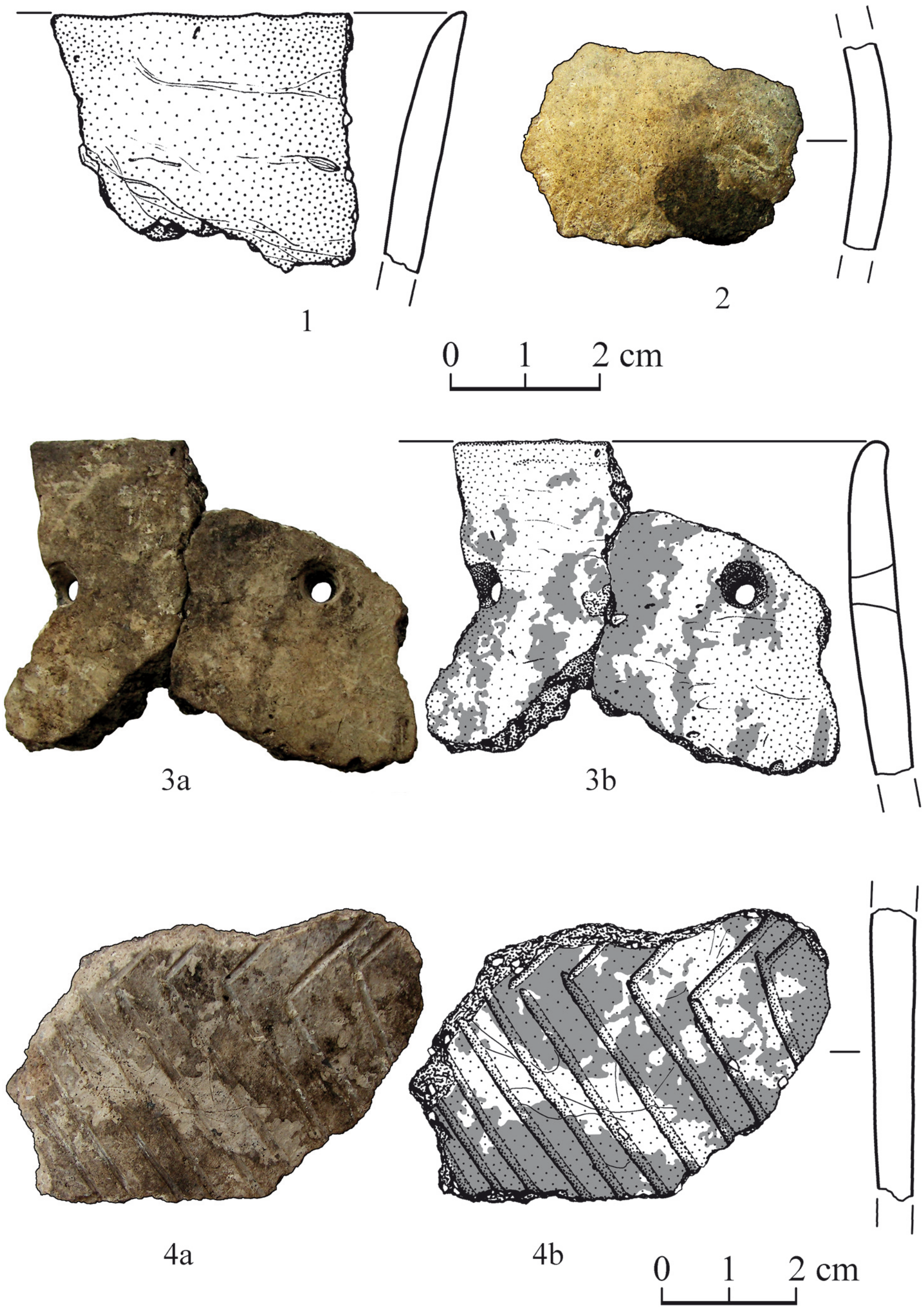


Fig. 10. Bazkiv Ostriv. 1, 2 – vessel No. 66; 3 – vessel No. 73; 4 – vessel No. 79 (after Gaskevych 2017a, 242, fig. 7). The colouring and painted decoration are marked with grey. Illustrations and photos by D. Haskevych

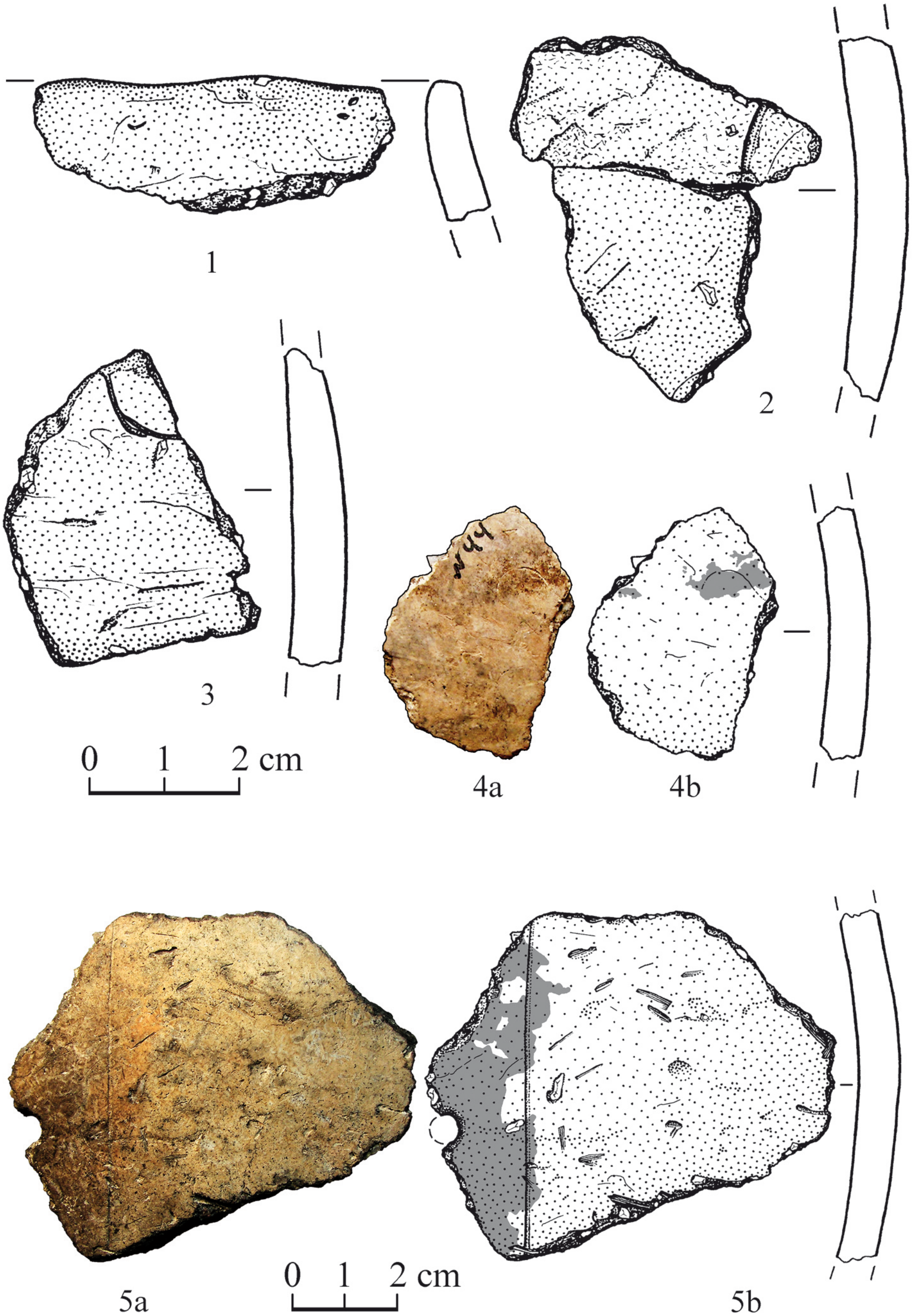


Fig. 11. Bazkiv Ostriv. 1-4 – vessel No. 81; 5 – vessel No. 17 (after Gaskevych 2017a, 237, 243, fig. 3, 8). The colouring and painted decoration are marked with grey. Illustrations and photos by D. Haskevych

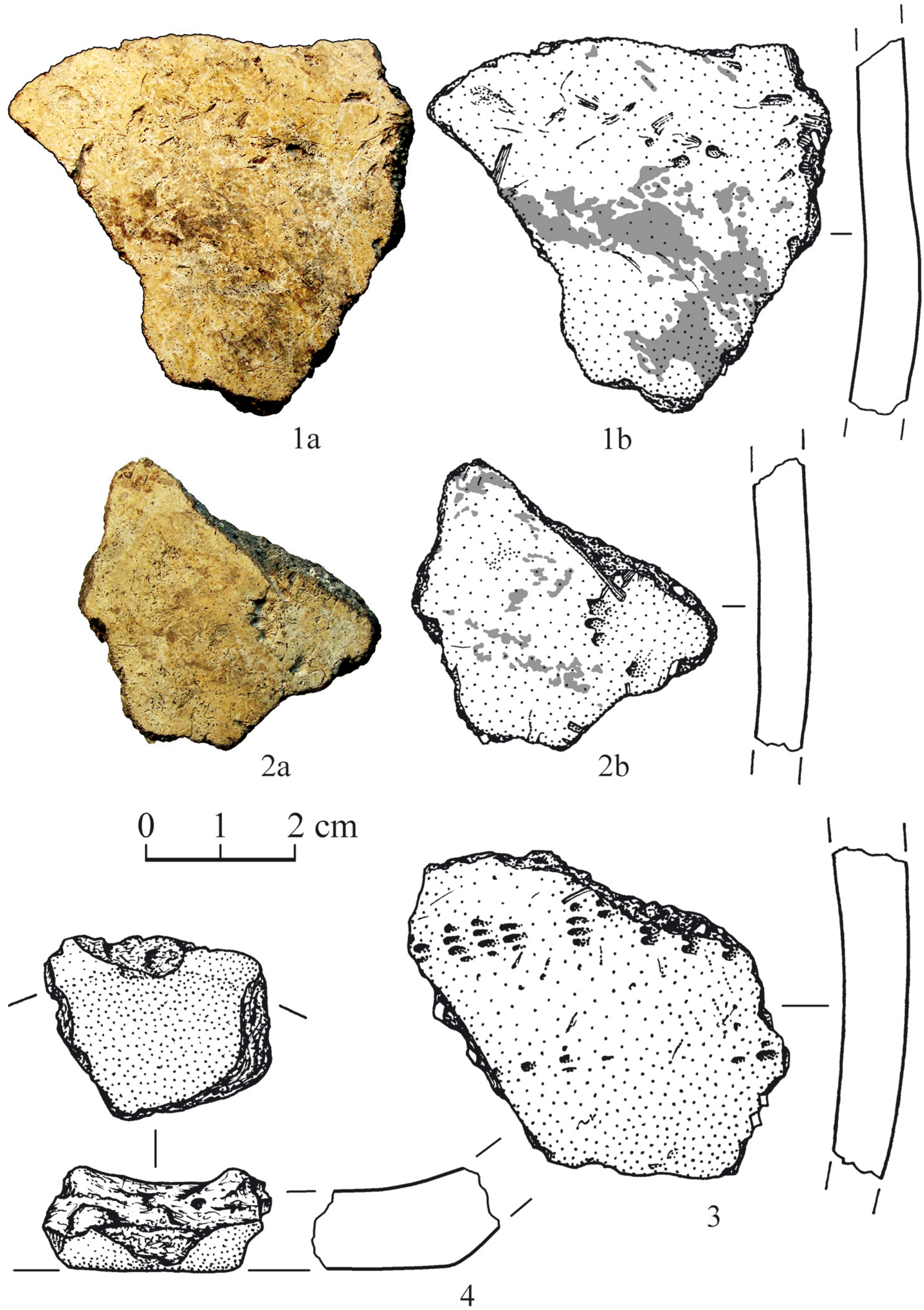


Fig. 12. Bazkiv Ostriv. 1-4 – vessel No. 17 (after Gaskevych 2017a, 238, fig. 4). The colouring and painted decoration are marked with grey. Illustrations and photos by D. Haskevych

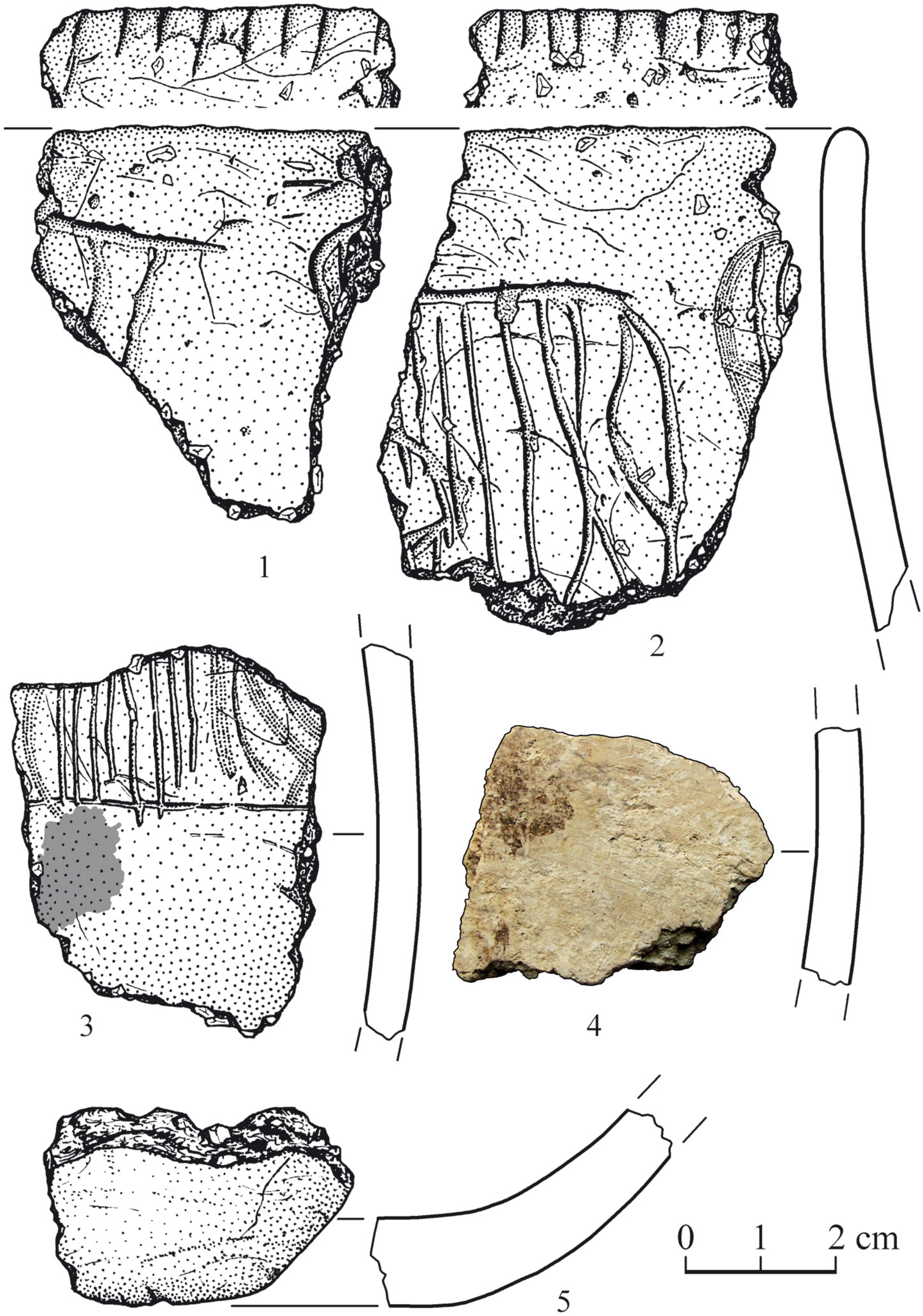


Fig. 13. Bazkiv Ostriv. 1-5 – vessel No. 44 (after Gaskevych 2017a, 239, fig. 5). The colouring and painted decoration are marked with grey. Illustrations and photo by D. Haskevych

2.2.4. MEANDER DECORATION

In addition to the aforementioned fragment with a meander shaped by a single, very thin, incised line, the meander decoration is also on vessel No. 38. No fewer than 26 fragments of it were found at a depth of 0.7-1 m (with a higher concentration at 0.9 m) in the western part of the excavation. Shortly after their discovery, they were reconstructed with plaster into an entire vessel. The image of this restoration (Fig. 14) is probably the most referenced one when it comes to BDC pottery. Its clearest traits are its flat lip, somewhat thinned and inverted rim, straight walls and pointed bottom. However, the proportions of the restored shape and the presence of a rounded body corner in the lower part can be questioned. The rim diameter is about 20 cm. The walls are 0.5-0.7 cm thick. The maximum thickness of the bottom is 2.2 cm. The outer surface is smooth and is slightly burnished with a reddish, reddish grey, brown, and greyish brown colour. The meandered band of 5-6 parallel incised lines, each 2-3 mm wide, the loops of which are alternately left empty or filled with a fine, diagonal mesh grid of 1-mm-wide incised lines, covers the top of the vessel. The ceramic paste, tempered with a small amount of fine sand and thin organic fibres, is very different from the Samchyntsi paste with a coarse-grained mineral admixture. The only Samchyntsi feature of the vessel is its pointed bottom (Haskevych 2008, 281; 2017, 198, 199).

Fig. 14. Bazkiv Ostriv. Vessel No. 38 with meander decoration (after Haskevych 2008, 280, fig. 4: 2b). Illustration by D. Haskevych

The chronological position of vessel No. 38 is contradictory. On the one hand, first Danilenko, and then Kotova considered it one of the most ancient vessels on the Southern Buh, attributed to the pre-Criş time (Danilenko 1969, 150-151; Kotova 2002, 39; 2015, 60-62). However, neither they nor any other researcher have so far shown any close analogies to this pot in the Early Neolithic of the Balkans or Eastern Europe outside the BDC area. On the other hand, Danilenko wrote that *"precisely such ornamental compositions, despite their exceptional ancientry, are already close to the early Trypillia ones"* (Danilenko 1969, 69). Nicolae Ursulescu and Dergachev saw in this vessel signs of "Vinčazation", by which they very broadly mean to be the spread of some Anatolian-Balkan influences during the Early to Middle Neolithic transition (Ursulescu 2000, 212). Indeed, in the Middle Neolithic of the Danube-Carpathian region, a zone filled with a fine, diagonally incised mesh grid is characteristic of Dudeşti pottery, and a meandered band of parallel incised lines is characteristic of all the Linear Pottery cultures. But their combination occurs on the richly ornamented vessels of the relatively late Bükk culture (*e.g.*: Kalicz and Makkay 1977, 305, 314, Taf. 98: 8, Taf. 108: 8). Thus, vessel No. 38 can be considered as the most striking syncretic BDC pot due to combination of the "western" meander decoration with the pointed bottom of the local foragers' pottery.

3. DISCUSSION

The new radiocarbon dates from Bazkiv Ostriv indicate that the indigenous BDC groups populated the Southern Buh area during the time that the LBK settlements existed near Zavallia. In addition, it seems, there are traits that imitate the traditions of the distant Szakálhát and Bükk cultures in the syncretic pottery from Bazkiv Ostriv. Obviously, any contacts between the inhabitants of the Southern Buh and the inner portion of the Carpathian arc were impossible without the active or passive participation of the LBK communities of the Dnister basin, which separates the Southern Buh from the mountains. Therefore, the previous view that the seven LBK vessels found at the BDC sites of Bazkiv Ostriv, Shchurivtsi-Porih, Dobrianka-3 and Gard were "imports", reflecting such contacts, is correct.

Thus, only four sites situated on the Southern Buh near Zavallia are actual evidence of the migrations of the LBK groups in this river's catchment. They form a triangle, covering an area of about 15 km^2 (Fig. 15). Therefore, the portion of the Southern Buh area described by Kiosak as "a regular region settled by the LBK people" is of just such a size today. To understand whether other, similar clusters of LBK sites could exist on the Southern Buh, the reasons that contributed to the emergence of the settlements around Zavallia should be clarified. An analysis of the natural conditions of the mentioned region is necessary for this in the first place.

3.1. Landscape

The problem of relating LBK colonization with certain ecological niches and landscapes has long attracted researchers. Larina has developed it in detail for the eastern periphery of the area of this culture (Larina and Kuzminova 1994; Larina 2009).

According to Larina, all settlements in the extreme eastern area of the LBK are located within the forest-steppe zone. At the same time, a general tendency to settle on the most fertile soils of each part of the region is observed. In Volhynia, these are typically podzolized chernozem-like soils. On the Upper and Middle Dnister, preference was given to chernozems (black earth) in the river valleys and on the flat plateaux covered with meadows of broad-leaf herbs (forb meadows). Between the Prut and the Southern Buh, the typical, leached, and carbonate chernozems were formed under cereal-grass meadow steppes. Soils of all these types are characterized by a very high natural fertility. However, it should be noted that they were just beginning to form during the existence of the LBK settlements there.

The preference for certain soils also accounts for the high settlement concentration. Frequently, sites are clustered at distances ranging from 0.2 to 1.5 km. This is especially clear in such microregions as the valleys of the Great and Middle Ciuluc rivers, as well the upper reaches of the Reut within the Bălți bunchgrass-cereal steppe in the Prut-Dnister interfluve, and along the Chornoguzka River in Volhynia (Larina 2009, 66, 67). Almost the same, high concentration is observed for the settlements of the cluster near Zavallia, where the distance between sites ranges from 2 to 7 km.

Complex archaeobotanical studies carried out on the site of Kamiane-Zavallia has not yet provided a clear understanding of the characteristics of the surrounding ancient landscape (Salavert *et al.* 2020, 8). Thus, it is necessary to turn to the low-resolution maps of modern landscapes and soils to analyze the environmental conditions of the settlements of the LBK and BDC groups on the Southern Buh. The landscape map of Ukraine shows that the entire upper reaches and almost the entire middle reaches of the Southern Buh are situated within the forest-steppe zone. Most of this territory is covered by deciduous forest landscapes with light grey, grey, dark grey and brown forest soils, as well as podzolized chernozems on the elevated loess plains. From the north and south, they are surrounded by two wings of meadow-steppe landscapes with typical, carbonate, and leached chernozems, which had been forming under the forb meadow steppes with islets of oak groves, forested gullies, light forests and bushes. This is one of the oldest landscapes in the region, preserved only on the poorly dissected watershed-adjacent areas of the loess plains (Loza 2010, 31, 32, fig. 1.08). The cluster of the LBK sites near the town of Ananiv is located within the southern wing of these landscapes. Also, the sites near Zavallia are located in the place where the Southern Buh crosses the strip of these landscapes (Fig. 15). According to the online map of soils from the web portal of the Public Cadastral Map of Ukraine (https://map.land.gov.ua), these sites are located on deep, meagre-humic carbonate chernozems. At the same time, chernozem-meadow and meadow gley soils are nearby them within the Southern Buh valley, as well as meadow-marshy soils at the mouth of the Mohylnianka rivulet.

The strip of chernozems stretches further, deep into the interfluvial plateaus to the southwest and northeast of Kamiane-Zavallia. In particular, Mainova Balka, which is located 53 km to the south, occupies an area covered by chernozem-meadow soils and is

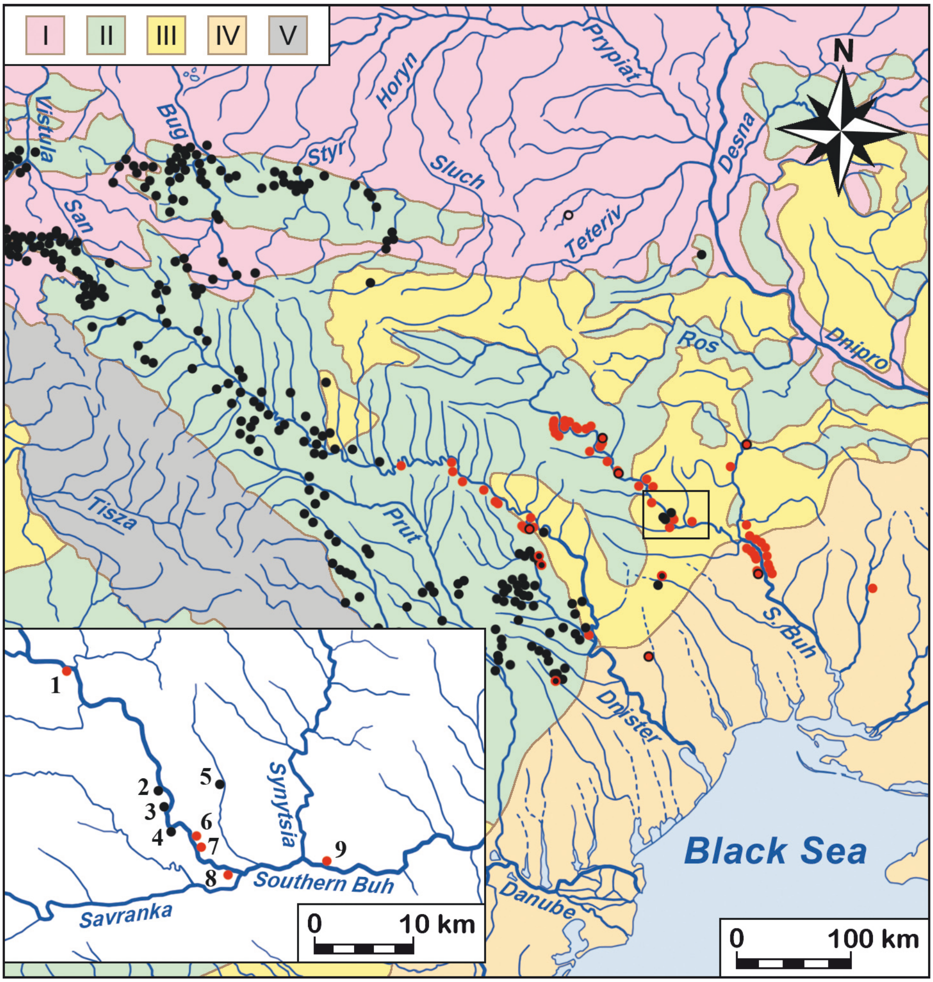


Fig. 15. Distribution of the LBK and BDC sites (for detail, see Fig. 1) on a map of the present-day landscapes. Base map: Loza 2010, 30, 31, fig. 1.08; with simplification.
Legend: I – Coniferous-deciduous forest landscapes; II – broadleaf forest landscapes; III – meadow-steppe landscapes; IV – steppe landscapes; V – mountain-forest and mountain-meadow landscapes. Sites: 1 – Haivoron-Polizhok (Solhutiv Ostriv); 2 – Synie Ozero; 3 – Kamiane-Zavallia; 4 – Hnyla Skelia; 5 – Zhakchyk III; 6 – Zavallia; 7 – Zhakchyk; 8 – Savran; 9 – Melnychna Krucha

surrounded by deep medium-humic chernozems. But chernozems come to an end further upstream of the Southern Buh, a little to the west of Kamiane-Zavallia. And it is there the high concentration of BDC sites, surrounded by grey podzolized soils, which were formed under the forest, are visible (Fig. 15). Therefore, the automatic inclusion of the non-chernozem part of the Southern Buh region in the area of the LBK, the bearers of which preferred chernozems, seems inconsistent in itself, and even more so taking into account the absence of LBK sites there.

The Southern Buh valley intersects a strip with chernozem soils that are extremely favourable for agriculture, and at the same time sufficient moisture on an area about 200 km long. However, LBK settlements were found only in one place here. Kiosak believes that other, yet to be found sites exist within the rest of the Southern Buh region. If this is true, then why do LBK settlements in the Prut-Dnister interfluves, on the Dnister and in Volhynia together number in the hundreds, while only four sites are on the Southern Buh? Is the archaeological study of the region so bad? For an answer, it is worth looking at the study of another early farming culture in the region – Precucuteni-Cucuteni-Trypillia. Such an analysis is quite justified, because the nature of the economy and settlement strategy of the Trypillia and LBK communities was similar. This is confirmed by frequent finds of their materials at the same places, for example, in Mainova Balka, Zhakchyk 3, Ruseştii Noi I, Floreşti I, Nicolaevca V, Nezvisko and many other sites.

To date, a number of catalogues of Trypillia sites have been published for some administrative and geographical regions of Ukraine. For example, Serhii Husiev has counted 300 plus monuments of this culture throughout the Middle Southern Buh region (Husiev 1995, 24). According to Ivan Zaets, 198 Trypillia sites were discovered in the Vinnytsia region as of 2001 (Zaets 2001, 10-12, fig. 3). And, their number rises there year to year: 295 sites in 2004 (Kvitnytskyi 2004), 352 sites in 2008 (Maidaniuk 2008), and 403 sites in 2015 (Rud 2015, 135). In the Kirovograd region, among 66 Trypillia monuments discovered as of 2015, 63 were found within the Southern Buh catchment (Sobchuk 2015). At least 124 Trypillia sites are known in the Odesa region (Polishchuk 2004). Thus, in the discussed area, and particularly in ecological niches attractive to early farmers, the level of archaeological survey can be considered rather satisfactory.

So, the reason for the small number of LBK sites on the Southern Buh is their actual sparsity, or even singleness. In this regard, the mapping of only the early Trypillia sites (Precucuteni-Trypillia A) of the first half – middle of the 5th millennium BC is very demonstrative. Among the huge array of Trypillia settlements, they (without unverified finds or sites of the Luka-Vrublevetskaia, Borisovka, and Trostianets types, frequently assigned to the so-called "transitional", AIV-BI phase) make up a very small percentage. They are relatively numerous in the Prut-Dnister interfluve and along the middle reaches of the Dnister. Their number decreases in the Dnister-Buh interfluve. About a dozen settlements were found in the valley of the Southern Buh and its tributaries, the Mohylnianka rivulet and the Synytsia River. And only one settlement is located far to the east, in the Siniukha River basin (Fig. 16). It is noteworthy that, on the Southern Buh, they are concentrated in the same region where Kamiane-Zavallia is located. The remains of Trypillia dwellings, so-called “ploshchadky,” have been found at a number of sites here. Further upstream and downstream of the Southern Buh, Early Trypillia pottery occurs only as accidental, isolated finds, or among the materials of the BDC sites Shumyliv-Cherniatka, Puhach 1, Puhach

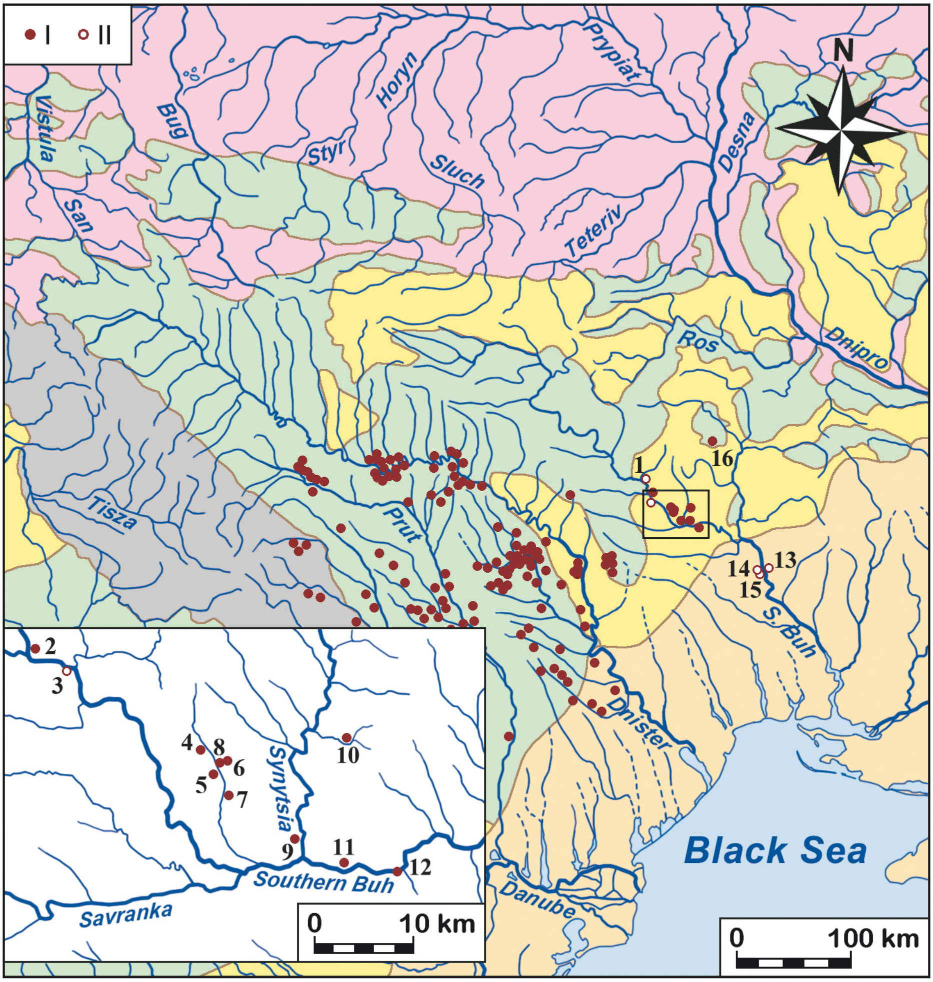


Fig. 16. Distribution of the Precucuteni-Trypillia A sites (based on Zbenovich 1989, 15, fig. 1; Burdo 2001, 196, 200, fig. 1, 2: 1; Sorochin and Dergaciov 2010, 235; supplemented and with alterations) on a map of the present-day landscapes (for detail, see Fig. 15). Legend: I – Precucuteni-Trypillia A site; II – Precucuteni-Trypillia A pottery at BDC sites. Sites: 1 – Shumyliv-Cherniatka; 2 – Haivoron; 3 – Haivoron-Polizhok (Solhutiv Ostriv); 4 – Mohylne I; 5 – Mohylne II; 6 – Mohylne III; 7 – Mohylne IV; 8 – Mohylne V; 9 – Sabatynivka II; 10 – Danylova Balka; 11 – Hrenivka; 12 – Krasnenke; 13 – Puhach I and II; 14 – Gard III; 15 – Gard; 16 – Hrebeniukiv Yar

2, Gard, Gard 3, and Gard 4 (Tovkailo 2005). It is significant that Early Trypillia dwellings have not been found there until now. Two new direct AMS radiocarbon dates with high reliability, which were taken from both organic inclusions in ceramic paste and charred residues on the surface of one BDC vessel from Shumyliv-Cherniatka, show that hunter-fisher groups continued to settle the region until the middle of the 5th millennium BC (Table 1, Haskevych *et al.* 2019).

The identical regularities in the locations of LBK and Early Trypillia sites, both in general and in the area under discussion, clearly show that, on the Southern Buh, the communities of the first farmers were strongly attached not to the entire strip of black earth, but only a small section of about 40 km long in a straight line between the present-day town of Haivoron and the village of Kosharo-Oleksandrivka. It can be assumed that other factors determined their choice of just this very place in addition to the fertile soils.

3.2. Graphite

It has previously been noted that the triangle formed by LBK sites on the Southern Buh clearly outlines the Zavallia graphite deposit (Gaskevych 2017b, 42). In terms of prospected resource and production scale, it is the largest in Europe and one of the largest in the world. It represents a synclinal fold, 5 × 2 km in area, bordered by granite and filled with limestone, stretching from the west to the east under both banks of the Southern Buh. The graphite-bearing gneisses lie along the northern and southern flanks of the fold (Ivant-

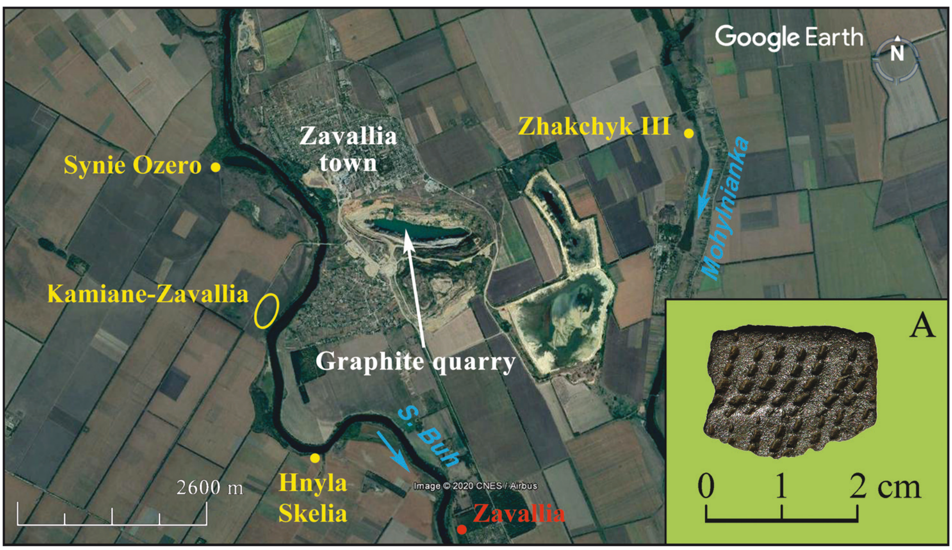


Fig. 17. The LBK (yellow) and BDC (red) sites near Zavallia. Base satellite photo: Google Earth. A – Potsherd tempered with graphite from the BDC site of Zavallia. Photo by D. Haskevych

siv 1972). On the left bank, their industrial development has been going on since the 1930s (Fig. 17). On the right bank, minor work was carried out nearby the Synie Ozero site. Operations in another section, located directly next to the Kamiane-Zavallia site, will begin shortly. A number of promising graphite ore occurrences are known at a distance of up to 30 km from here (Kropivnyi *et al.* 2019, 97). Some of them form outcrops and were being developed by hand as far back as the beginning of the 20th century (Shpylovyi and Biletskyi 2019).

No doubt, the local hunter-gatherers well knew the outcrops of graphite-bearing clays eroding by the Southern Buh. The BDC site of Zavallia was discovered on the left bank of the river, a little south of the current Zavallia quarry (Fig. 17). Here, Danilenko picked up seven flint artefacts and three fragments of two vessels decorated with comb imprints in 1955 (Danilenko 1969, 120). The ceramic paste of the vessels is oversaturated with graphite, which is why their surfaces shine like silver (Fig. 17A).

It is believed that BDC pottery made of clay with graphite admixture (hereinafter referred to as graphite pottery), found on sites in areas adjacent to the Southern Buh itself, and possibly in the Syniukha basin and on the Dnister (list of sites see: Gaskevych 2020, 339, fig. 5.32), was made of graphite ore from Zavallia. These vessels are mainly ornamented with comb imprints (Samchyntsi style) and zones filled with incised and channelled lines (Pechera and Savran styles, according to Danilenko). Also, one graphite vessel with incised meanders was found by Danilenko at the site of Haivoron-Polizhok (Danilenko 1969, 115, fig. 85: 2).

Danilenko thought that graphite vessels could get from the Buh far to the east, right up to the Dnipro River (Danilenko 1969, 120). In these remote areas, graphite pottery is known among the sub-Neolithic materials from the Inhul River basin (Novorozanivka), the middle reaches of the Dnipro (Uspenka, Buzky I), the Dnipro rapids region (Vovchok, Sobachky, Strilcha Skelia, Kizlevyi V, Mykilske II cemetery), and the Northern Azov Sea area (Kamiana Mohyla-1). The aforementioned sites are related to the Kyiv-Cherkasy, Surskyi and Azov-Dnipro cultures. Therefore, it is not surprising that some of the graphite pottery from there differs from that of the Southern Buh. Two explanations for this are possible. First, it was not ready-made graphite vessels that were brought there, but graphite-rich clay itself. However, finds of any graphite raw material are still unknown on the sites. Second, these vessels may have been made by local potters with other, non-Buh graphite raw materials, because there are three known major graphite-bearing zones: Buh-Teteriv, Inhul, and Azov within the Ukrainian Shield. The choice between these two explanations requires special mineralogical studies (Gaskevych 2017b; 2020).

Graphite was also used in the production and decoration of pottery of the more western cultures. In the Balkans, the fabrication of graphite-coated vessels emerged in the Struma River basin in the Neolithic (Sapareva Banja, Sitagroi I, Acropotamos-Topolnitsa, *etc.*). Later such wares were widespread in the areas of the Chalcolithic cultures of the Lower Danube area (Chokhadziev 2000; Leshtakov 2004). Graphite and graphite-coated pottery is characteristic for some LBK sites within the Upper Danube area in Austria, Moravia and Bavaria (Tichý 1961; Pechtl and Eibl 2011; Kitzig and Ramminger 2016). A graphite pendant was found at the LBK site of Brzezie 17 in southern Poland (Czekaj-Zastawny 2014, 86-87, fig. 52; Trąbska and Wesełuchy-Birczyńska 2014). Finds of LBK graphite vessels from Moldova and Ukraine are not mentioned, with the exception of those from the Kamiane-Zavallia settlement (Kiosak 2017a, 258). Thus, this local tradition of the LBK group on the Southern Buh either appeared on-site under the influence of BDC potters, or it was brought by the natives of Bavaria or Bohemia, who preserved the traditional, Upper Danube attitude of graphite materials as prestige goods. A shoe-last adze, made of metabasite from the Iser Mountains in northern Bohemia, was found close by the Kamiane-Zavallia site (Saile *et al.* 2016, 7). This may indirectly indicate the possibility of such a distant but quick migration, which was intentionally aimed at the Zavallia graphite deposit (Gaskevych 2017b).

3.3. The LBK expansion and exchange networks

Wherever the residents of Kamiane-Zavallia may came from, on the Southern Buh, they found themselves in the very centre of a large exchange network of the indigenous population. Controlling the graphite deposit or simply being there, they possessed a significant advantage in the exchange. This exchange could have centred on one or both of the local graphite or the other natural resources from the LBK area (*e.g.*, high-quality flint from the Dnister and Prut deposits) or from the neighbouring regions of the Lower Danube (*e.g.* salt). The influence of the Dudeşti ceramic traditions in the pottery of Kamiane-Za-vallia and the nature of the flint raw materials show the connection of its inhabitants with the populations of these regions (Saile *et al.* 2016, 7; Kiosak 2017a, 262-263). They could also have exchanged some agricultural products, which were probably highly valued by local hunter-gatherers, who, according to the latest data, did yet not practice farming (Endo *et al.* 2019; Haskevych *et al.*, 2020).

So, the LBK vessels found at the BDC settlements could have value not only in and of themselves but also as containers for some prestige goods, liquids or substances, including graphite. In this regard, attention is drawn to the mention of the easternmost finds, described as LBK pottery. These are fragments of several vessels discovered by Arkadii Dobrovolskyi at the Vovchok site in the Dnipro Rapids region in 1929. They are known only from drawings published by Danilenko, who assigned them either to the Linear Band ("Danube") culture or to the Dudeşti culture (Danilenko 1969, 22, 47, 188, 216, fig. 3-VI: 3-5, fig. 139: 1, 4, 7). But it is important to note that graphite pottery was also found at this site (Danilenko 1969, 47).

It seems that the tendencies that developed in the Neolithic continued in the subsequent periods. Graphite was found in the ceramic paste of some Early Trypillia vessels from the sites of the Gard group, as well as at the Sabatynivka II and Hrebeniukiv Yar sites

(Zbenovich 1989, 90; Tovkailo 2005, 34-35). At the beginning of the Trypillia BI stage, western farmers massively populated the entirety of the Southern Buh area and entered the Dnipro catchment. Among their very numerous sites, it is the settlements located along the Southern Buh, not far from Zavallia (Berezivka, Sabatynivka I), that are characterized by the strong impacts of the Gumelniţa population (Tsvek 1999, 35), which made graphite-coated and graphite-decorated wares (Beilekchi 1978; Subbotin 1983; Leshtakov 2004). Moreover, materials of some North-Pontic Eneolithic steppe cultures are also abundant at these sites (Tsvek 1999, 35). According to Kiosak's calculations, at the Trypillia BI settlement of Shamrai, located nearby the Kamiane-Zavallia site, approximately every third fragment is either from the vessels of the steppe Skelia culture or has mixed Trypillia-"steppe" characteristics (Kiosak 2016b). The settlement of Berezivka yielded a horse-head pommel-sceptre (Danilenko 1974, 95).

The above outline of the settlement pattern of the LBK and Trypillia communities in the Southern Buh area makes it possible to raise the question of the nature of their distant migrations. These first farmers poorly used the agricultural potential of the vast area of the Buh-Dnister interfluve with its extremely fertile soils, which is evidenced by the sparsity of the LBK sites and the small number of Trypillia A settlements found there. It is obvious that the factors of demographic pressure and simple agricultural colonization were not the leading ones. Therefore, models taking into account the factor of social prestige as a driving force of the first farmers' mobility (Hofmann 2016, 238-239; Spriggs 2016, 486-487) deserve more attention. Pursuit of the production and exchange of prestige goods, as well as control over key points on routes of their transportation through mountains, rivers and watersheds, might have determined the direction of the development of new lands. Success of such activities on the eastern LBK frontier is evidenced by signs of social stratification, recorded, for example, by the ritual-burial complex in Nezvisko (Dębiec 2016). Deep penetration of the LBK groups into foreign territories is demonstrated by the Vita-Poshtova-2 settlement, located on the outskirts of Kyiv (50°17'35.27"N, 30°23'21.95"E), at a distance of 10 km from the Dnipro valley, and about 275 km from the nearest known LBK settlements in Volhynia (Gaskevych 2006). Results of the exchange included the appearance of single vessels with typical linear-band decorations at the hunter-gatherer sites of Vovchok, Gard, Bazkiv Ostriv, Shchurivtsi, Dobrianka 3, and Fasova (Fig. 1).

A relatively recent historical analogue, illustrating the possible dynamics of the first stages of the Neolithization process in the territory between the Dnister and the Dnipro, is the initial European colonization of North America. It began with the penetration of groups of trappers, prospectors and merchants deep into the interior of the continent. There, they engaged in exchange with the indigenous population and founded a network of trading posts at the crossroads of communication lines. Over time, some such settlements became centres of the agricultural development of the territories, and even later – cities. It is no coincidence that the term "frontier" itself entered Neolithic archaeology from studies concerning American history, where it was used previously (*e.g.* Turner 1935).

CONCLUSIONS

For 40 years, archaeologists discussing the LBK finds in the Southern Buh catchment have mentioned only the discovery of two so-called “imported” bowls with “music-note” decorations from the BDC site of Bazkiv Ostriv. New, individual finds of some linear-band vessels in several sub-Neolithic sites at the start of the 21st century, as well as the discoveries, in the years since 2011, of the first LBK sites of Kamiane-Zavallia, Hnyla Skelia, Synie Ozero and Zhakchyk III on the Southern Buh near Zavallia, have allowed archaeologists to assume that two-thirds of the BDC area was *“a regular region settled by the LBK people”*. This supposition was enabled due to the imprecision of the chronological scheme, which indicated the disappearance of the BDC around 5300 BC, and publications with an erroneous mapping of Bazkiv Ostriv as a linear-band site in different locations along the Southern Buh, as well as the erroneous location of the LBK settlement of Mainova Balka within the Southern Buh basin.

New, direct radiocarbon dating of the organic inclusions in the ceramic paste and charred residues on surface of the vessels from the BDC sites of Bazkiv Ostriv and Shumyliv-Cherniatka have shown that the local sub-Neolithic groups continued to live in the middle reaches of the Southern Buh at the time of the existence of the LBK sites here and even later. The peculiarities of the pottery from Bazkiv Ostriv also confirm this. The syncretic vessels with plastic, painted and incised meander decorations, as well as carinated shapes, probably demonstrate the attempts of the local population to imitate the ware of its more western Neolithic neighbours – in particular the bearers of the Szakálhát and Bükk cultures. So, the previous opinion regarding the finds of two LBK vessels as “imports” looks more reasonable today. The same applies to five LBK vessels from three other BDC settlements, located in the Southern Buh valley (Shchurivtsi, Gard) and along its tributaries (Dobrianka-3). To date, therefore, the cluster of four sites, situated near Zavallia on an area of about 15 km^2, is the only verified region regularly settled by the LBK farmers here.

The sparsity of LBK sites in the Southern Buh region may not be explained by poor archaeological investigation, because several hundred settlements of the early farmer Trypillian culture have been discovered there over the last century. The latter are found in different landscapes with different soil fertility. However, the earliest of them, the Precuteni-Trypillia A sites, occupy only a very narrow, about 40-km-long part of the middle reaches of the Southern Buh, at the same place where the LBK settlements were located before. It is possible that in addition to fertile soils, one reason for this is the local graphite deposits. The four aforementioned LBK sites surround the largest deposit of graphite in Europe. The finds of linear-band pottery tempered with graphite and an adze made of stone originating from the Jizera Mountains may suggest that people from the Upper Danube, where graphite was considered a prestige good in the Neolithic, intentionally migrated to this area. Graphite was also prestigious in the Northern Black Sea region, where an extensive network of exchange based on it and/or ware made of existed in the same period.

Control over this deposit of graphite, or even just living in close proximity to it, gave the local early farmer groups significant advantages as mediators in exchange. In addition to graphite, they could have exchanged natural resources (salt, high-quality flint), as well as some prestigious agricultural products from the LBK area or from the neighbouring regions of the Lower Danube. Connections with inhabitants of such regions have been recorded by finds of potsherds with Dudeşti-style decorations among the vessels from Kamiane-Zavallia. All of the above observations allow us to assert that the main motive for the migration of LBK communities was not demographic pressure or the search for new agricultural lands, but rather the effort to obtain social prestige through active participation in the production and exchange of prestigious goods, both within the area of the culture and beyond.

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THE LINEAR POTTERY CULTURE SETTLEMENT IN THE UPLAND ZONE BETWEEN THE VISTULA AND BUG RIVERS – CURRENT STATE AND PERSPECTIVES OF RESEARCH

ABSTRACT

Szeliga M. 2021. The Linear Pottery culture settlement in the upland zone between the Vistula and Bug Rivers – current state and perspectives of research. *Sprawozdania Archeologiczne* 73/1, 57-100.

There are 171 sites known from the interfluvial of the Vistula and Bug Rivers that attest to settling it between the Gniechowice and early Želiezovce phases of the Linear Pottery culture (LBK). The earliest finds concentrate only in the south-eastern part of this area, mainly in the Hrubieszów Basin. The intensification of settlement occurred in the music-note phase, along with the colonisation of the whole Lublin region and the emergence of the settlement oecumene proper. It mainly encompassed the loess zones and was a network of clusters located along small and medium rivers. Their development is corroborated, *e.g.*, by traces of far-reaching, multidirectional contacts. The current state of research limits the scope of interpretations concerning the development of individual settlement clusters (especially the chronology and scope of the development of the LBK and the character and scale of colonisation and economic activity). Field research needs to be intensified to obtain new archaeological and environmental data on particular microregions.

Keywords: Early Neolithic, LBK, Lublin Region, interfluvial zone of the Vistula and Bug Rivers, upland areas, settlement

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INTRODUCTION

Although the first pieces of information on the LBK finds from the Lublin region were published over sixty years ago (Podkowińska 1959, 38; 1960, 75), the question of LBK settlement across the upland interfluvial zone of the Vistula and Bug Rivers unfortunately remains problematic and unresolved. On one hand, this state of affairs results from the fact that only a small percentage of the sources have been published (this notably concerns the most numerous inventories yielded by excavation works). On the other, it has been effected by the slow pace of obtaining new sources (with a clear quantitative disproportion between the materials gained through surface survey and those that come from archaeological digs, where the former are clearly more numerous). These obstacles are important reasons why only one comprehensive study on the LBK finds from the entire Lublin region has been published so far, which was issued in the second half of the 1980s (Brzozowski 1988). That publication remains the only source that presents the territorial dispersion of LBK finds over the entirety of the upland areas spreading between the Vistula and Bug Rivers. All subsequent publications have focused exclusively on the south-eastern (Zakościelna 2007b, fig. 1) or southern (Czekaj-Zastawny 2008, 231-235, map 4) parts of this vast territory.

The intensification of excavation works conducted during the last ten years and more, and the considerable number of new sources obtained as a result, necessitate an update and a summary of the current state of research on LBK settlement across the Lublin region. It appears that despite the still unsatisfactory degree to which the source material has been presented in publications, the above-mentioned conditions provide new perspectives for investigating the character and intensity of LBK settlement, as well as the stylistic development of this culture in the discussed territory. At the same time, this leads us to reflect on the potential of the available corpus of sources and its utility in future research. The above-mentioned issues, together with the presentation of the updated corpus of sources, are the main subjects of this paper.

AREA OF STUDY

The analysed territory is located within the historic Lublin region and encompasses the boundary between the belt of uplands and lowlands, which spreads from the middle Vistula Valley in the west to the Bug Valley in the east, and from the Sandomierz Basin in the south to the valleys of the lower Wieprz, Tyśmienica and Włodawka Rivers in the north (Fig. 1: 1-2). The southern and central parts of this vast zone are composed of geographically dominant loess areas, which have a strictly upland character, and which belong to the north-eastern territory of the belt of Polish Uplands. Their characteristic features are considerable morphogenetic and hypsometric diversity, as well as the presence of a fertile soil cover

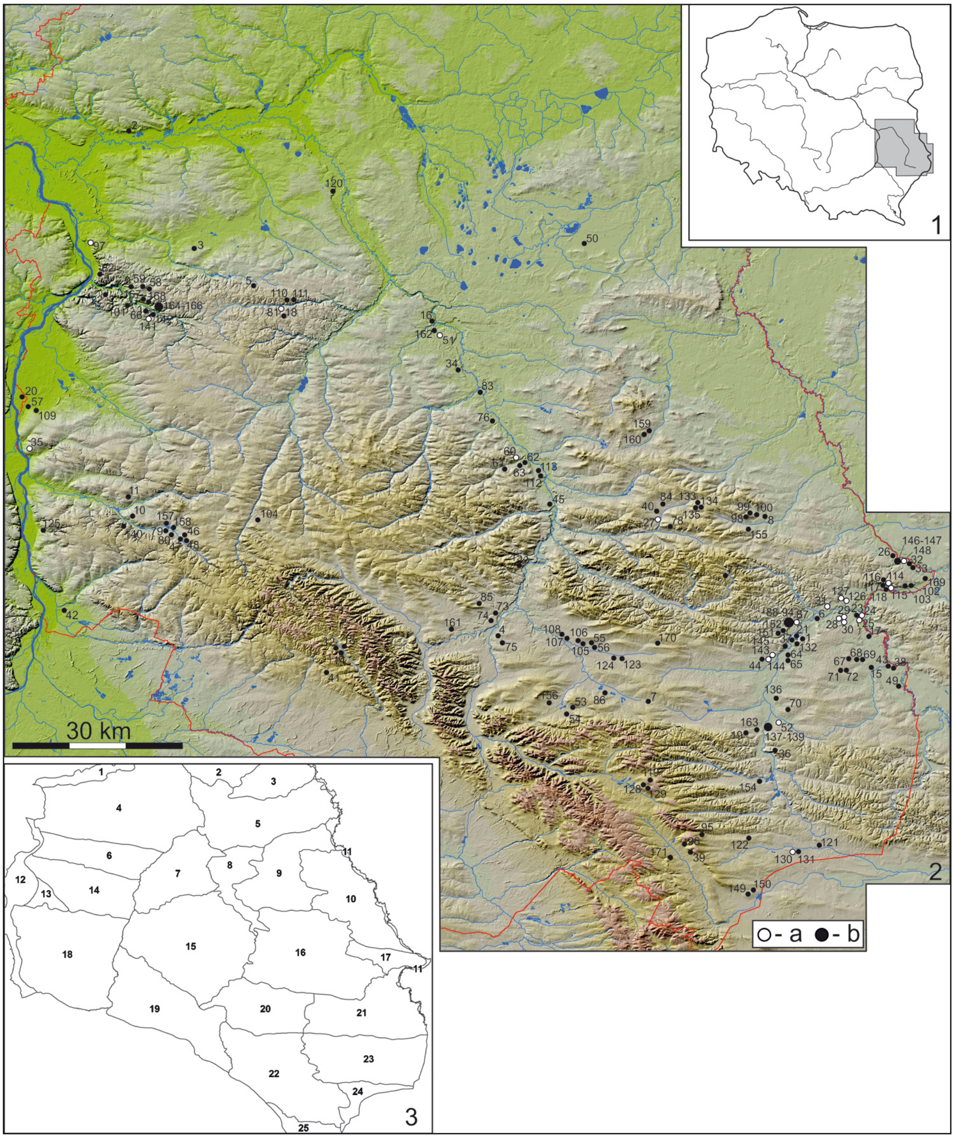

Fig. 1. Arrangement of LBK settlements across the Lublin region: 1 – location of the discussed territory; 2 – dispersion of the excavated sites (a) and of those discovered during surface survey (b) (map based on Gawrysiak 2004, dispersion of the sites after Brzozowski 1988, fig. 1; Zakościelna 2007, fig. 1; Czekaj-Zastawny 2008, map 4, with additions); 3 – physical-geographical regionalisation of the Lublin region: 1 – Wieprz Ice-Marginal Valley; 2 – Sosnowica Depression; 3 – Włodawa Heights; 4 – Lubartów Heights; 5 – Łęczna-Włodawa Lakeland; 6 – Nałęczów Plateau; 7 – Świdnik Plateau; 8 – Dorohucza Depression; 9 – Chełm Hills; 10 – Dubienka Depression; 11 – Middle Bug River Valley; 12 – Małopolska Gap of the Vistula River; 13 – Chodel Depression; 14 – Bełżyce Plateau; 15 – Giełczew Hills; 16 – Grabowiec Interfluve; 17 – Horodło Ridge; 18 – Urzędów Heights; 19 – Western Roztocze; 20 – Zamość Basin; 21 – Hrubieszów Basin; 22 – Middle Roztocze; 23 – Sokal Ridge; 24 – Bełz Plain; 25 – Eastern Roztocze (after Solon *et al*. 2018)

developed on the loess substratum. The northern foreland of the upland area is of a transitional upland-lowland character, with a gentle, rolling or hilly landform. These areas are characterised by slight differences in elevation and a more complex hydrographic network with a much less fertile soil cover, developed mainly on the sandy-clay glacigenic substratum (*e.g.*, Michalczyk and Wilgat 2008, fig. 1; Turski *et al.* 2008, 259-264).

The geomorphological diversity of the territories encompassed by the discussed zone is reflected by their classification in several macro-regional units. They are, above all, the entire Lublin Upland with the Roztocze, as well as the western parts of the Volhynian Upland and of the Pobuże Basin and, to a much lesser degree, the southern areas of Volhynian Polesia, Western Polesia, and the Southern Podlasie Lowland (Kondracki 2002; Solon *et al.* 2018, fig. 2). Together, they make an extremely diverse landscape mosaic composed of numerous depressions, elevations and plains that are considerably elevated and have a rich ecosystem diversity. This variety, which is, on one hand, combined with high soil quality (this especially applies to the upland loess area) and with preferable hydrographic conditions, and, on the other, with the presence of numerous and various groups of flora and fauna, undoubtedly contributed to the considerable value of the discussed zone in the eyes of the prehistoric settlers, even in the earliest phase of the Neolithic.

SHORT HISTORY OF PREVIOUS RESEARCH

In the middle of the 1960s, only 12 LBK sites from the Lublin region were known. They are located in its eastern part, that is, between the Wieprz and Bug Rivers (Gurba 1961, fig. 4). Seven of them were identified during excavation works, which, in most cases, led to discovering a somewhat small number of settlement features (Gródek 6, Werbkowice-Kotorów I; *cf.* Liana and Piętka-Dąbrowska 1962, 147-155; Dąbrowska and Liana 1963, 45-47; Uzarowiczowa 1964, 436-439), or to finding more or less numerous diagnostic sets of artefacts found on the secondary deposit (Strzyżów 1 and 2; Werbkowice-Kotorów II; *cf.* Podkowińka 1960, 46, 71, tabl. I: 1; Dąbrowska, Liana 1963, 55; Głosik and Gurba 1963, 361). At the same time, the stylistic diversity of the pottery attested to its association with both the pre-music-note and music-note phases of the LBK (Uzarowiczowa 1964, fig. 3, 8; Liana and Piętka-Dąbrowska 1962, tabl. XXXIII: 3, 5, 12, 13). Furthermore, the cremation grave, as well as a small set of pottery discovered at site 2 in Gródek were associated with the earliest (Gniechowice) phase of the discussed archaeological culture (Kempisty 1962, fig. 1-2). The richest inventory discovered at that time was obtained during rescue research at the settlement of Tarnoszyn, site 1, which is dated to the music-note phase (Gurba 1961, 212, fig. 1; 1970, 177, fig. 2). This collection, despite being comprehensively analysed (Chorostowska 1966), has never been fully published. The only exceptions are flint materials, whose analysis (Zakościelna 1981, 4-9) remains the most important point of reference for studies on LBK flint-knapping in the Lublin region.

The corpus of sources was significantly enriched in the 1970s and 1980s as a result of an intense surface survey conducted within the framework of the Polish Archaeological Record (Polish: AZP). Excavation works carried out in the western (*e.g.*, Kaliszany 2, Puławy-Włostowice 3, Wąwolnica 1) and eastern (*e.g.*, Hrubieszów-Podgórze 1A, Lipowiec, Podhorce 2, Świerszczów 28, Wieniawka 6) parts of the Lublin region, also yielded new discoveries. The obtained materials are linked with the classical and late LBK phases (*cf.* Kącki 1982, 4, fig. 1; Kokowski 1985, fig. 1: b; Zakościelna 1988a, 9; 1988b, 27, 28). As to the results of the surface survey, a small set of pottery from Sumin, associated with the Zofipole phase, is particularly noteworthy (Brzozowski 1986, 72, tabl. 23: a-d). In total, 76 LBK sites were known at the end of the 1980s. These were the basis of a separate study (Brzozowski 1986), published in a compressed and substantially abridged form (Brzozowski 1988). The great majority of the mentioned finds have not been examined, and are still in need of a thorough analysis, followed by publication.

The last decade of the 20th century was, above all, a time of new surface discoveries, made especially in the eastern part of the Lublin region (Tab. 1). At that time, only two sites were discovered during excavation research, and data on the LBK finds yielded by them is limited to general pieces of information presented in brief field reports. Four archaeological features and an unspecified collection of artefacts, which were associated with the Zofipole phase, come from the site of Hrubieszów-Podgórze 5 (Niedźwiedź and Panasiewicz 1994, 52, fig. 2). Research at the multicultural site of Łopiennik Dolny 3 resulted in the discovery (in the secondary deposit) of flint and stone artefacts, as well as pottery that comes from the music-note phase of the LBK (Zakościelna and Gurba 1991; 1992). A serendipitous discovery of an incomplete vessel (linked with the pre-music-note phase of the LBK) in the escarpment of site 1B from Gródek supplemented the above-mentioned discoveries (Buszewicz 1990, 9, fig. 3: 4). Unfortunately, the subsequent excavation carried out at this site did not yield new Early Neolithic materials (Niedźwiedź 1994). The publication of the results of the zooarchaeological analysis performed on the materials from one of the pits explored at the site of Świerszczów 28 was of great importance for the study of the LBK in the interfluve between the Vistula and Bug Rivers (Nadachowski and Wolsan 1999). So far, this is the only such data concerning the Lublin region.

Particularly important and numerous source materials have been obtained during the last twenty years, especially as a result of rescue excavation research carried out prior to construction works. Without question, the most abundant relics of LBK settlement were discovered at Bogucin 6 site and are represented by 51 features, as well as by several hundreds of pottery fragments and flint artefacts (Tab. 1). The arrangement and character of the discovered features indicate that the settlement included at least four longhouses, whereas the pottery represents the styles of the classical and late music-note phases, as well as of the early Želiezovce phase (Gawryjołek-Szeliga and Szeliga 2012, 71-73). Other, much less numerous sets were also found at Hrubieszów-Podgórze 5 and Świerszczów 3 during research conducted prior to the construction of the bypass going around Hrubieszów.

Both sites yielded only sparse LBK features (associated with the construction and use of single residential structures of the longhouse type) and inventories of flint and ceramic artefacts. In the former case, they are associated with the classical and late music-note phases (Gawryjołek-Szeliga *et al.* 2013, 48-49), whereas those from the latter one come from phase Ia of the LBK (Szeliga and Gawryjołek-Szeliga 2021). Single features containing numerous artefacts from the music-note phase were analysed during archaeologically supervised works at the sites of Hrubieszów-Kolonia Sławęcin 12 (Szeliga *et al.* 2017, 8) and Leopoldów 5 (Jączek and Kubera 2018, 7). A considerable collection of pottery linked with the music-note phase of the LBK was also discovered during excavation works conducted at the multicultural site of Horodysko 3. Unfortunately, all the mentioned finds were discovered in the secondary deposit (Bronicki 2016, 33-35). Independently of this accumulation of new discoveries, attempts to analyse earlier finds of the LBK from the Lublin region have been also initiated during the last 20 years. So far, the materials from Świerszczów 28 (Gawryjołek-Szeliga 2009) and Puławy-Włostowice 3 (Szeliga 2018) have been researched. The analyses of the rest are at an advanced stage of realisation.

CURRENT SOURCE DATABASE

According to the current state of research, there are at least 171 known sites linked with the LBK. The totality of the finds, presented in Fig. 1 and Tab. 1, were associated with this chronological and cultural horizon based on data published in earlier archaeological literature, as well as in the AZP documentation. Unfortunately, limitations caused by the Covid-19 pandemic made it impossible to complete the AZP surface survey at the time of preparation of this publication, thus the presented list certainly should be considered incomplete, and therefore only provisional.

The known sites are very diverse in terms of the numbers and characters of archaeological sources. The most abundant group are surface finds (147 sites, 85.96%), primarily represented by scarce or even single pottery sherds and only occasionally by larger groups of even more than 40 specimens (Tab. 1). The chronological and cultural identification of the pottery was based on its technological and stylistic features (presence of incised ornaments), but employing these criteria only occasionally made it possible to precisely classify the finds according to the internal LBK periodisation. Sporadically, non-pottery finds, usually diagnostic stone or obsidian artefacts, were associated with this horizon, whereas flint products were linked with it even less frequently (Tab. 1).

The excavated sites constitute only 14.04% of the entire corpus of sources (24 sites; Tab. 1). They are also very diverse in regard to the numbers and types of finds, encompassing inventories ranging froma few to several hundred specimens, mainly pottery sherds. Unfortunately, the small degree to which particular sites were researched and to which the obtained data was published often makes it impossible to precisely determine the quantitative and qualitative structures of these discoveries. Nearly all the excavated sites represent the remains of settlement and economic activities conducted by the LBK people, and sometimes include the remnants of residential structures of the longhouse type (at least at four sites; Bogucin 6, Hrubieszów-Podgórze 5, Puławy-Włostowice 3 and Świerszczów 3). It should be stressed that features were discovered at only 11 explored sites (Tab. 1). The rest of them only yielded different numbers of materials found either in the secondary deposit, within the non-feature layers and/or in the fills of younger features. This makes it difficult to correctly assess the scale and scope of human activity at particular sites and, as a result, to properly classify them. So far, we know only one funerary feature (cremation grave) located at the site of Gródek 2 (Kempisty 1962), but its cultural and functional identification has occasionally been questioned (Czekaj-Zastawny 2009, 36, fig. 8). Most probably, the damaged skeletal grave discovered at the site of Werbkowice-Kotorów I should be also linked with the LBK, which is indicated by the fact that it yielded a pendant made of a *Spondylus* shell (Kurzawska and Sobkowiak-Tabaka 2020, 66, fig. 4B).

TERRITORIAL DISTRIBUTION OF THE SITES

The territorial distribution of the finds indicates that there were at least several clusters of LBK settlements in the Lublin region (mainly located across the loess uplands), which were closely related to the regional hydrographic network. The vast majority of these sites are located in the south-eastern area of the discussed region, which is part of the western Volhynian Upland. They concentrate in the zone of black and brown soils that spread along the middle and lower Huczwa River and the adjacent left-bank section of the Bug, from the valley of the Bukowa River in the south to Horodło in the north (Fig. 1: 2). There are 63 sites located across these territories (constituting *ca.* 37% of the total number of LBK sites from the upland area of the interfluve between the Vistula and Bug Rivers), which are primarily parts of the Hrubieszów Basin, the Horodło Ridge and, to a much lesser extent, the Sokal Ridge (Fig. 1: 3). They are also the areas with the greatest number of excavated sites. The south-easternmost group of ten sites, located along the valleys of the Szyszła and Solokiya Rivers, and within the Bełz Plain (which is the western part of the Pobuże Basin) (Fig. 1: 2), is an addition to the settlement cluster of the Western Volhynian Upland.

The LBK sites from other areas of the interfluve spreading between Vistula and Bug Rivers are much more scattered. Their great majority are grouped in more than ten clusters of various sizes that are separated by vast zones yielding no materials (settlement voids?). The locations of these potential settlement microregions were strictly linked with the layouts and orientations of the local watercourses (Fig. 1: 2). The largest of them, containing from six to over ten settlements, are located on the Nałęczów Plateau (by the lower and middle Bystra river), in the Urzędów Heights (upper Wyżnianka), the Dorohucza Depression (middle and lower section of the Wieprz valley, near the mouth of the Łopa), near the Graboviec Interfluve (upper part of the Wełnianka and the Wojsławka with the Horodyszcze stream) and in the Zamość Depression (lower and middle section of the Czarny Potok stream valley near the mouth of the Łabuńka river and the upper part of the Wieprz near the mouth of the Stara Gorajka) (Fig. 1: 2-3). Slightly smaller clusters, encompassing from three to five sites, are located in the Middle (upper Wieprz) and Western Roztocze (valley of the Biała Łada River), as well as in the Chodel Basin, the eastern part of the Nałęczów Plateau (valley of the Ciemięga river) and on the Świdnik Plateau (mouth of the Giełczewka to the Wieprz). The rest of the LBK sites from the discussed region are widely dispersed, usually occurring individually and at considerable distances from each other and from the aforementioned settlement clusters. They are probably the remains of occasional economic expeditions to the territories located outside the main LBK settlement oecumene, within the loess uplands and sandy-clay zones of their northern foreland (Fig. 1: 2).

Despite the previously mentioned incompleteness of the corpus of sources, the territorial distribution of the sites across the upland part of the interfluve between the Vistula and Bug Rivers precisely corresponds to the previous findings on the general settlement preferences of the LBK societies in other, much better researched upland areas. This phenomenon is indicated by the fact that the vast majority of the analysed sites occupy territories with good quality soils formed on the loess substratum, and by the occurrences of settlement clusters on hillsides and high valley terraces of small and medium watercourses that flow to the Vistula, Wieprz, and Bug (Fig. 1: 2). Undoubtedly, such tendencies were among the most important factors influencing the organisation and structure of the LBK settlement network in the Lublin region (Brzozowski 1988, 6-7). They have close analogies in the territory of the upper Vistula drainage basin (Kruk 1973, 46-48, 72-74; Kruk *et al.* 1996, 41-48; Czekaj-Zastawny 2008, 98-104, 111-112) and across other European territories (*e.g.*, Modderman 1959, 3-6; Sielmann 1971, 80-124; Končelová 2012, 191-196).

STYLISTIC DIVERSITY OF THE POTTERY AND THE LOCAL PERIODISATION OF THE LBK

Generally, the diversity of the pottery from the upland interfluve spreading between the Vistula and Bug Rivers reflects the full scope of the stylistic development of the LBK recorded in south-eastern Poland, from the pre-music-note phase to the latest stage linked with the spread of the Želiezovce decoration style (*e.g.* Kulczycka-Leciejewiczowa 1979, 51-65; Czekaj-Zastawny 2008, 16-18). The least numerous, and at the same time the most enigmatic materials are linked with the early phase of the LBK (Fig. 2). So far, only six sites have yielded them. They are located exclusively in the eastern part of the Lublin region, especially in the Hrubieszów Basin (Szeliga and Gawryjołek-Szeliga 2021, fig. 11). These finds are a diverse group, found in only a few features having either a settlement character (Gródek 6, Hrubieszów-Podgórze 5, Świerszczów 3; *cf.* Uzarowiczowa 1964, 450-452, fig. 3;

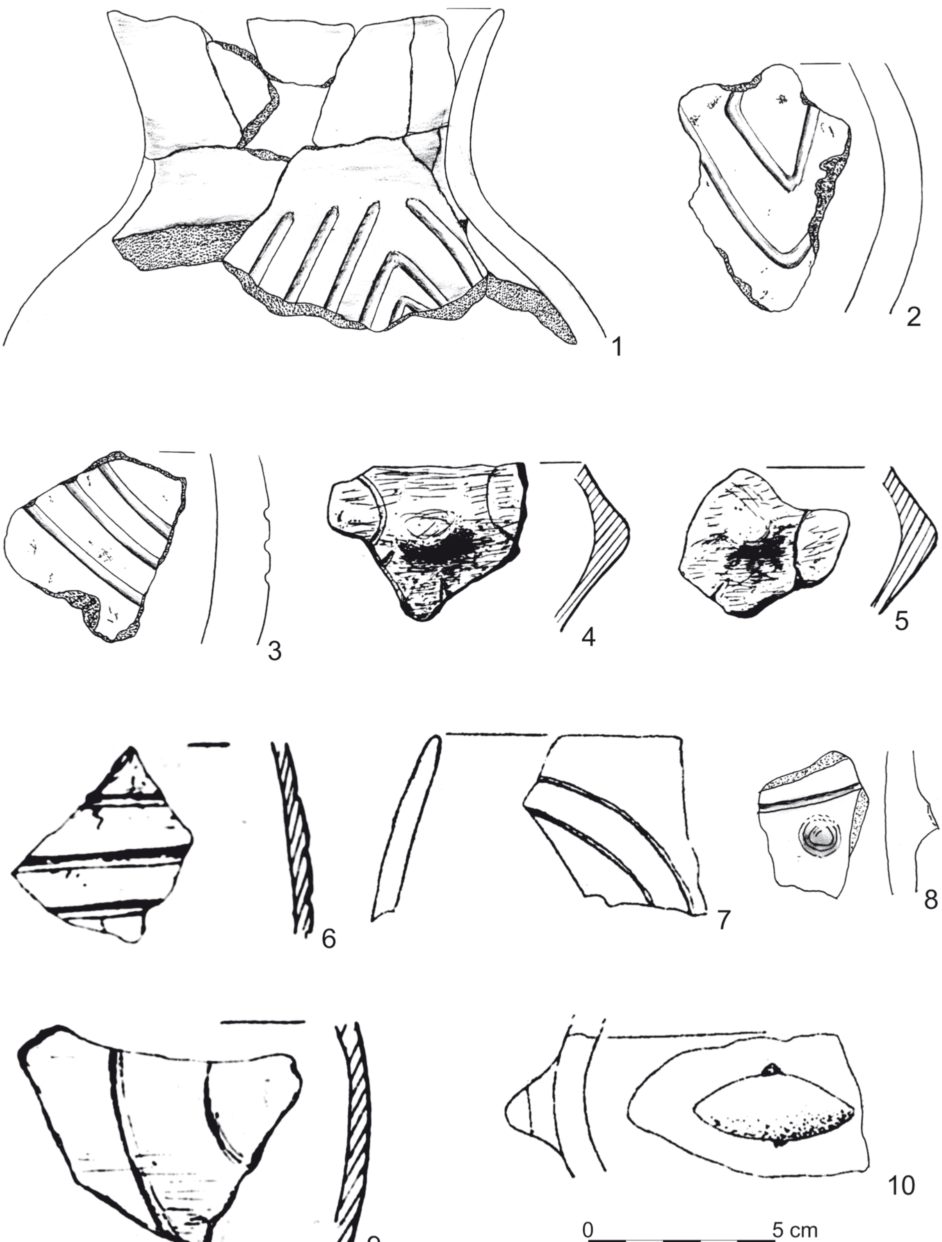

Fig. 2. Selection of LBK pottery from the Lublin region ornamented in the Gniechowice (1-5) and Zofipole (6-10) styles: 1-3 – Świerszów, site 3 (after Szeliga and Gawryjołek-Szeliga 2021, fig. 3: 1a, 3, 10); 4-5 –Gródek, site 2 (after Kempisty 1962, fig. 2: b-c); 6, 9 – Gródek, site 6 (1D) (after Uzarowiczowa 1964, fig. 3: n; 8: z); 7, 10 – Hrubieszów-Podgórze, site 5 (after Niedźwiedź and Panasiewicz 1994, fig. 2: 2, 4); 8 – Sumin, site 1 (after Brzozowski 1986, tabl. 23: d)

Niedźwiedź and Panasiewicz 1994, 52, fig. 2; Szeliga and Gawryjołek-Szeliga 2021) or a sepulchral character (Gródek 2; Kempisty 1962, fig. 1-2). However, this group of finds also includes quantitatively diversified pottery inventories (Sumin 1; Szeliga and Gawryjołek-Szeliga 2021, fig. 12: 16-19) or even single vessels (Gródek 1B; Buszewicz 1990, fig. 3: 4) that were not found in features, and thus have no archaeological contexts. The scope of the formal and stylistic diversity of the mentioned materials corroborates their association with the Gniechowice (Ia) and especially with the Zofipole (Ib) phases of the LBK across the territories located north of the Carpathians (*cf*. Kulczycka-Leciejewiczowa 1968, 61-67; 1979, 48-51; 1983). This fact allows us to associate the beginning of the LBK colonisation of the Lublin region with the culture's earliest phase, which indicates a certain intensification of the settlement process with the younger stage of the pre-music-note phase. At the same time, the territorial dispersion of thus classified finds allows us to narrow down the area of the earliest agricultural colonisation exclusively to the eastern part of the discussed region (more precisely to the Hrubieszów Basin and in the Middle Roztocze). This entails a discussion on the potential migration routes of the LBK settlers to these territories, as well as on the territories from which they migrated, taking into account the possibility that these societies arrived directly from Volhynia (*cf*. Szeliga and Gawryjołek-Szeliga 2021).

The main colonisation of the interfluve between the Vistula and Bug rivers occurred during the music-note phase of the LBK, with which the absolute greatest number of finds (including those obtained through excavation) is associated (Tab. 1). The territorial range of thus classified materials encompasses the entire territory to which this paper is devoted, and the presence of diagnostic pottery materials was confirmed in nearly all of the regional settlement clusters. Undoubtedly, the greatest numbers of finds come from excavation works conducted in the western (Puławy-Włostowice 3, Bogucin 6), central (Leopoldów 5, Łopiennik Dolny 3) and eastern (*e.g*., Horodysko 13, Świerszczów 28, Hrubieszów 5, Hrubieszów-Kolonia Sławęcin 12, Tarnoszyn 1) parts of the analysed region (Tab. 1). The styles of the numerous pottery inventories discovered at the above-mentioned sites are generally not extremely diverse, and are limited to decorative motifs, especially characteristic of the classical (NII) and late (NIII) stages of the music-note phase (Fig. 3). Particular inventories contain various proportions and quantities of such materials, attesting to the existence of certain territorial arrangements. The clear predominance of the late music-note motifs, including characteristic oblong or tear-shaped grooves (*cf*. Pavúk 1969, 271-273; Kadrow 1990, 62) has been recorded so far mainly at the sites located in the western part of the Lublin region (Bogucin 6, Puławy-Włostowiece 3; see Gawryjołek-Szeliga and Szeliga 2012, 73; Szeliga 2018, 189). In the inventories from the eastern zone of this territory, they were only an insignificant addition to the much more numerous classical music-note materials (see Zakościelna 2007b, 40; Gawryjołek-Szeliga 2009, 62; Gawryjołek-Szeliga *et al*. 2013, 48-49; Bronicki 2016, 42). It appears that these differences are important when considering the chronology, character and dynamics of the LBK stylistic development in the discussed area.

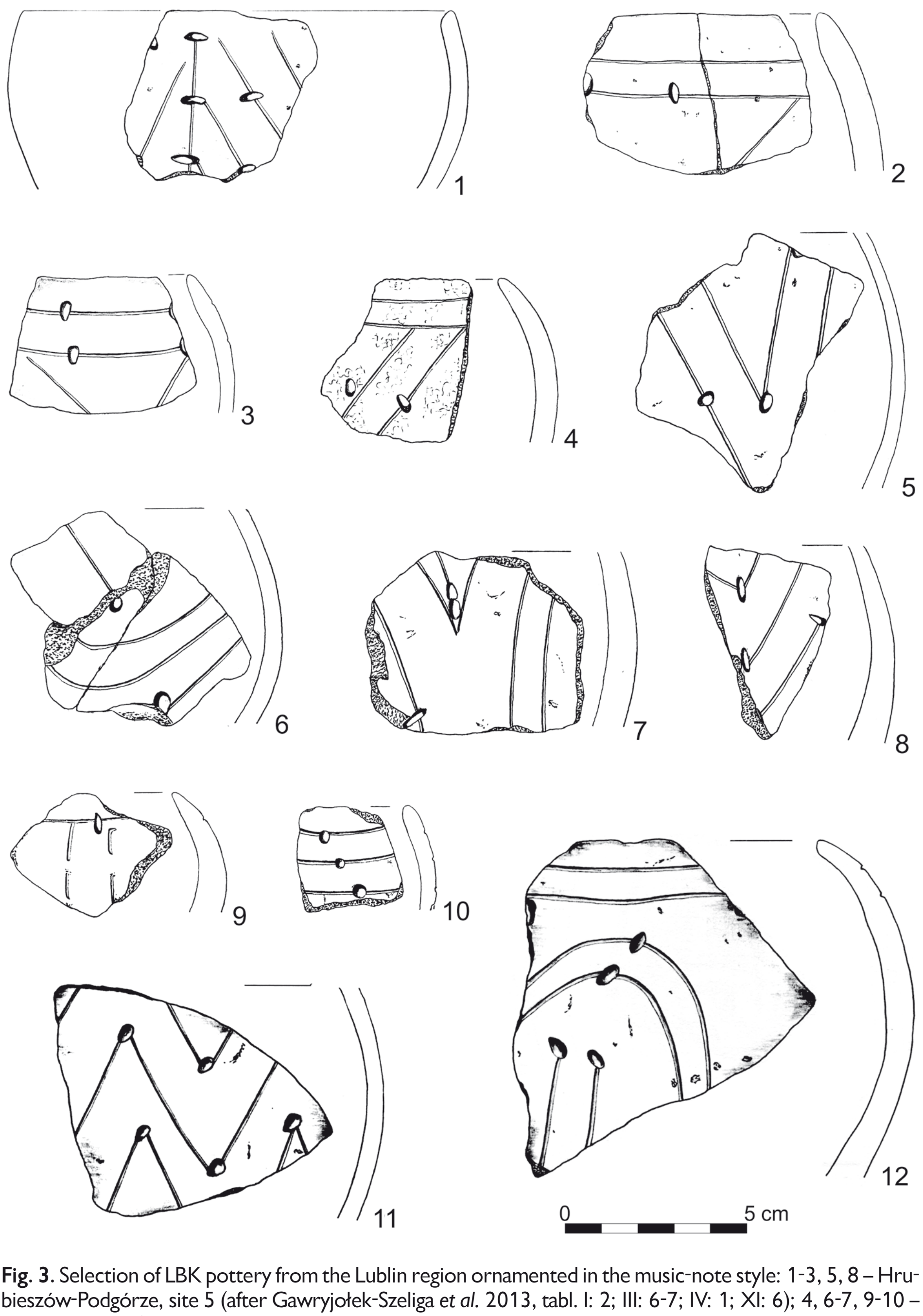

Fig. 3. Selection of LBK pottery from the Lublin region ornamented in the music-note style: 1-3, 5, 8 – Hrubieszów-Podgórze, site 5 (after Gawryjołek-Szeliga *et al*. 2013, tabl. I: 2; III: 6-7; IV: 1; XI: 6); 4, 6-7, 9-10 – Bogucin, site 6 (after Gawryjołek-Szeliga and Szeliga 2012, tabl. III: 2; VII: 3; XVII: 4; XXIV: 5; XXVI: 3); 11-12 – Puławy-Włostowice, site 3 (after Szeliga 2018, tabl. II: 9; XI: 1)

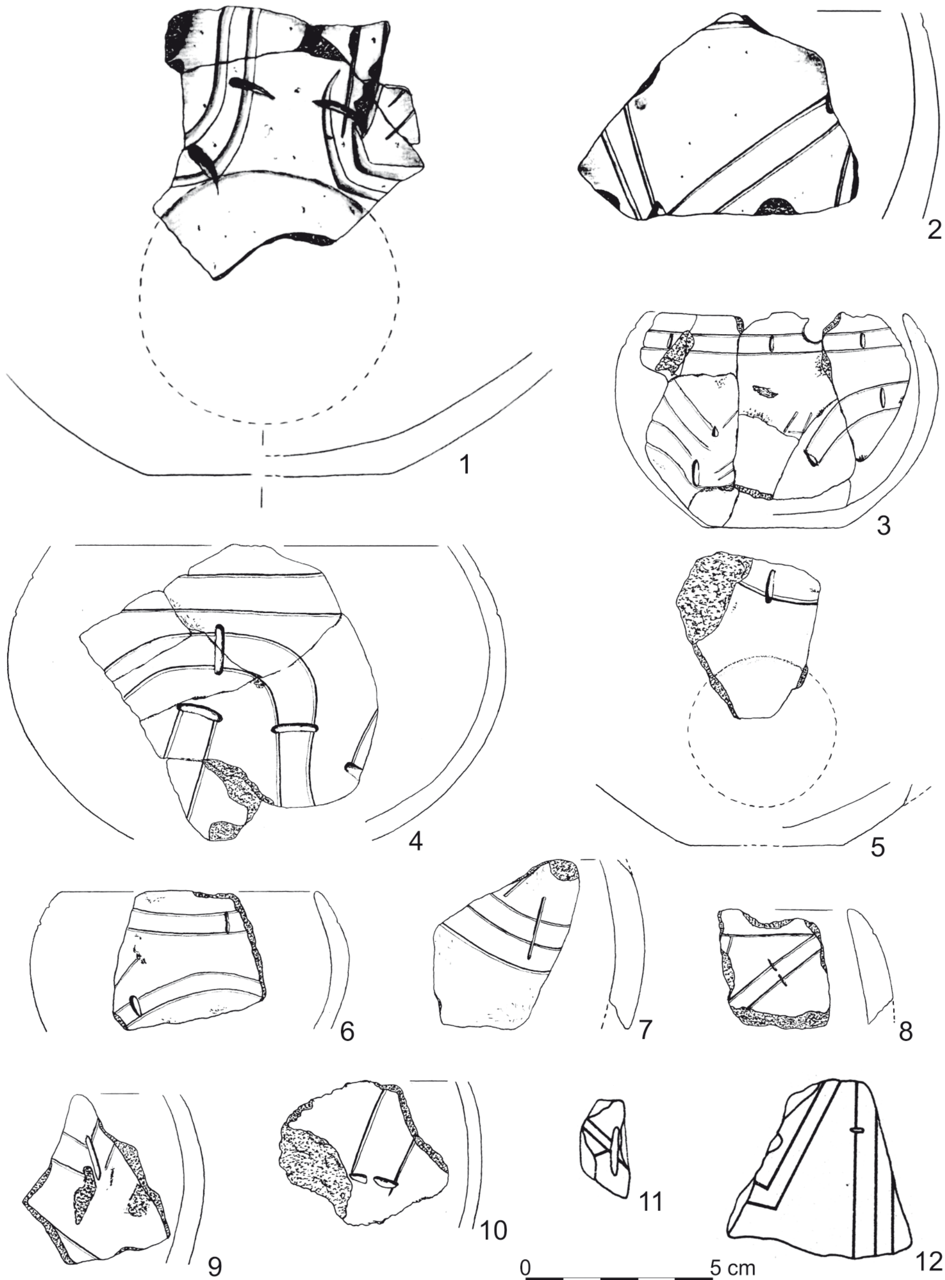

Fig. 4. Selection of LBK pottery from the Lublin region ornamented in the early-*Želiezovce style*: 1-2 – Puławy-Włostowice, site 3 (after Szeliga 2018, tabl. IX: 1-2); 3-10 – Bogucin, site 6 (after Gawryjołek-Szeliga and Szeliga 2012, tabl. VII: 4; IX: 4; XI: 4; XV: 5; XVII: 2; XVIII: 2; XXVIII: 1, 3); 11-12 – Podhorce, site 42 (after Kącki 1982, fig. 1)

The youngest and a somewhat small group of finds is comprised of materials made in the Želiezovce style. Until recently, they were only known from the site of Podhorce 2 and were represented by a modest collection of pottery sherds decorated with patterns that refer to the style of the early Želiezovce phase (Fig. 4: 11, 12). This set was discovered, along with pottery from the music-note phase, during the exploration of non-feature layers (Kącki 1982, 4, fig. 1). A much more numerous group of pottery materials was yielded by the recent rescue research at the site of Bogucin 6, located in the eastern part of the Nałęczów Plateau (Fig. 1: 2). Among the LBK pottery discovered at the mentioned site, the most numerous group was ornamented in the early-Želiezovce style (Gawryjołek-Szeliga and Szeliga 2012, 71). This identification was particularly based on the presence of pseudo-notches impressed on one of more incised lines (Fig. 4: 5, 7, 8, 10) or located between two parallel lines, forming straight, angular or s-shaped ornamental patterns (Fig. 4: 3, 4, 6, 9). Analogous pseudo-notches were also recorded on single vessel sherds from Puławy-Włostowice 3 (Fig. 4: 1, 2). Their presence, as well as their co-occurrences with tear-shaped music-note grooves in both mentioned inventories (sometimes on the same vessel; see Fig. 4: 3) is very characteristic of the early-Želiezovce decorative style (Pavúk 1969, Abb. 13-16; Kadrow 1990, 62, fig. 8; Dębiec 2015, 41-47).

The small number of the early Želiezovce sets and the fact that they always contain pottery ornamented in the late music-note style makes it impossible to distinguish the Želiezovce phase as a completely separate (in respect of its style and chronology) stage of LBK development in the Lublin region. It seems that what is observed in the youngest inventories only reflects the geographically limited adaptation of the early-Želiezovce decorative patterns in the environment of the LBK late-music-note ornamental traditions. This adaptation, discernible especially in the western part of the Lublin region (Puławy-Włostowice 3, Bogucin 6), is a reflection of more general cultural changes initiated in the northern and north-eastern foreland of the Carpathians during the classical phase of the LBK. These changes were a result of the gradual weakening and, as a consequence, complete reduction of the influence exercised by the previously influential centre located in south-western Slovakia. In the discussed territories, this phenomenon was manifest by the termination of the stylistic and typological development of the pottery (Kozłowski 1985, 69). In general terms, these processes, as often mentioned in archaeological literature, generally occurred in stages, first in the drainage basin of the Dniester River and in Volhynia, and somewhat later in the upper Vistula basin (Kadrow and Zakościelna 2000, 190-191, fig. 2, 3; Zakościelna 2007a, 290). The above-mentioned phenomena are reflected by clear differences between the stylistic diversities of inventories from the eastern and western parts of the Lublin region, which attests to the stagnation of two distinct ornamental traditions (the Želiezovce style in the west and the music-note style in the east), lasting until the end of the development of the LBK. The verification of this concept undoubtedly requires further research, which includes obtaining new inventories from various parts of the discussed region.

CHRONOLOGICAL FRAMES OF LBK SETTLEMENT

At present, there are no valid radiocarbon dates of the LBK features from the vast upland territory of the interfluve spreading between the Vistula and Bug Rivers. So far, sporadic attempts to obtain such dates yielded results exceeding the time frame of the discussed culture (Szeliga and Gawryjołek-Szeliga 2021). The only exception is the ^{14}C date of charcoal most probably from the secondary deposit in the feature of the Lublin-Volhynian culture at Bogucin 6. The date indicates a range of 5170-5075 BC (68.2%) and undoubtedly refers to the time when the site was settled by the LBK communities (Gawryjołek-Szeliga and Szeliga 2012, 72).

The lack of radiocarbon dates makes it currently impossible to precisely establish the time frame of the LBK development in the Lublin region. Nevertheless, the temporal ranges obtained at sites from the drainage basin of the upper Vistula and from Volhynia (*cf.* Dębiec and Dzbyński 2007, 56-58; Kotova *et al.* 2007, 415, tab. 2; Kulczycka-Leciejewiczowa 2008, fig. 55; Czekaj-Zastawny 2008, 116, tab. I; Ohrimenko 2009, 82; Szeliga 2017, tab. 1, fig. 6) allow us to infer that the first LBK societies appeared as early as between 5400 and 5300 BC (*cf.* Jakucs *et al.* 2016, fig. 24), whereas the decline of the culture occurred *c.* 4900-4800 BC at the latest. The necessity to verify and specify this general and conventional time frame is without a doubt one of the most important objectives of future research.

RAW MATERIAL MANAGEMENT AND FLINT PROCESSING

Although the available corpus of sources has increased in size during the last dozen years or so, the general findings concerning raw material management among the earliest agricultural societies from the Lublin region made in the 1980s (Zakościelna 1981, 3-9; Balcer 1983, 56-58; Caspar *et al.* 1989, 171, 172) are generally still valid. The available data indicates the clear zonality of the supply of raw materials to the LBK communities inhabiting the interfluve between the Vistula and Bug Rivers, in which its western part was provisioned with raw materials from the Świętokrzyskie Mountains (Holy Cross Mountains) and the east was associated with Volhynia and Podolia.

As to the settlement clusters located by the Huczwa, Solokiya and Bug Rivers, the Cretaceous Volhynian flints yielded by rich outcrops located in the midwestern part of the Volhynian-Podolian Plate were of the greatest economic importance throughout the history of the LBK. Their predominance is indicated by the modest inventory from Świerszczów 3, linked with the pre-music-note phase (Szeliga and Gawryjołek-Szeliga 2021), and by much more numerous sets, associated with the music-note phase, from Tarnoszyn (Zakościelna 1981, tab. 1), Hrubieszów 5 (Gawryjołek *et al.* 2013, 46) and Świerszczów 28 (Gawryjołek-Szeliga 2009, 63, 64). The share of Volhynian flint in the aforementioned inventories exceeded 80% in each case, often representing the totality of the LBK finds (Gawryjołek *et al.* 2013, 46; Szeliga and Gawryjołek-Szeliga 2021). The minimal percentages of other raw materials, including erratic flint, as well as Świeciechów and Chocolate flint (Zakościelna 1981, tab. 1; Gawryjołek-Szeliga 2009, 63, 64) attest to their negligible role in local raw material processing.

Contrary to the inventories from the eastern part of the Lublin region, those from the west (Puławy-Włostowice 3, Bogucin 6) are composed of considerably more diverse raw materials and demonstrate a greater variation in their share within particular sets. Their compositions clearly corroborate the predominance of flint from the north-eastern edge of the Świętokrzyskie Mountains (Świeciechów and Chocolate flint) and the smaller, or even minimal, economic importance of other siliceous raw materials (Zakościelna 1981, tab. 1; 2002, fig. 1; Gawryjołek-Szeliga and Szeliga 2012, 61, 62). The fact that most of the flint materials from Puławy-Włostowice were found outside archaeological features makes it impossible to distinguish all artefacts associated with the early Neolithic settlement horizon (see Szeliga 2018, 189). This, in turn, raises doubts as to the frequencies of certain raw materials, especially the considerable, and at the same different, shares of Chocolate and Volhynian flint (see Zakościelna 1981, tab. 1; 2002, fig. 1; Balcer 1983, tab. 4). Nevertheless, these reservations do not influence the assessment of the general raw material preferences observed among the local LBK communities, which usually processed flint from the Świętokrzyskie Mountains and probably played a considerable role in the redistribution of this material to remote territories (Szeliga 2014, fig. 2, 8; 2018, 191, 192). The rest of the raw materials included in the inventories from Puławy-Włostowice and Bogucin were of much lesser (minimal or even negligible) importance. This mainly applies to materials from the most distant areas (*i.e.* Volhynian and Cracow-Jurassic flint), represented by only a few or even single products. Their occurrences in the western part of the Lublin region and the sporadic discoveries of products made of flint from the Świętokrzyskie mountains in its eastern area (*e.g.* Świerszczów 28; *cf.* Gawryjołek-Szeliga 2009, 64) reflect, above all, intense contacts (of a certainly non-economic character) between particular LBK settlement clusters. They also attest to the active role of the local communities in the general system of long-range distribution and raw material exchange, functioning since the music-note phase across vast areas on both sides of the Carpathians (*e.g.* Kaczanowska 1985, Karte 3; Lech 1979, 130, 131, fig. 1; 2003, fig. 1; Mateiciucová 2008, 142-144).

The situation in the central zone of the analysed area, including the settlement clusters concentrated along the middle Wieprz and its tributaries, is the most unclear. The small number of materials obtained during excavation research and especially the lack of inventories from archaeological features (Łopiennik, Horodysko; *cf.* Zakościelna and Gurba 1991, 13; 1992, 3; Bronicki 2016, 35), or their modest character (Leopoldów; see Jączek and Kubera 2018, 7), seriously hinder the accurate identification of the actual raw material preferences displayed by the local LBK societies. The locations of these territories and data obtained from other zones of the Lublin region allow us only to assume that the raw material structures of the local inventories were heterogeneous and that the share of flint from the Świętokrzyskie Mountains (especially Świeciechów flint) and Volhynia was considerable. The actual importance and scope of local erratic flint processing (which includes the so-called Rejowiec flint, having a considerably good quality and whose numerous and rich outcrops occur across the great part of the Chełm Hills) remains an open question (Libera *et al.* 2014, fig. 1). The current state of research allows us to infer that this raw material was intensively used in the nearest vicinity of the aforementioned outcrops, especially in the settlement clusters of the LBK from the northern part of the Grabowiec Interfluve (Fig. 1: 2). It appears that the results of an analysis performed on flint materials from the site of Horodysko 13 indirectly corroborate this assumption (Libera 2016, 78-94). Unfortunately, the complete absence of LBK materials yielded by features at that site makes it impossible to accurately assess the economic importance of this raw material during the early stage of the Neolithic, but it must have been considerable.

The small number of materials from features (Tab. 1), and the insufficient degree to which they were researched, allows us only to tentatively and generally discuss LBK flint knapping in the Lublin region. The discussion includes only basic information on core exploitation and the production of half-products and tools, which was provided by the available inventories. At the current state of research, this data does not demonstrate any substantial regional differences and corresponds to production trends observed across other territories of LBK settlement. The adequate assessment of these observations will be made possible by comprehensive analyses performed on inventories obtained during earlier research and especially by obtaining new, homogenous sets representative of particular settlement clusters.

In light of the available corpus of sources, we can state that the general trend of flint processing was oriented towards the production of regular blades that usually were not longer than 10 cm. At the same time, the prevailing share of blade segments recorded in particular sets, with a small number of whole specimens (Zakościelna 1981, 8; Gawryjołek-Szeliga 2009, 65; Gawryjołek-Szeliga and Szeliga 2012, 64), indicates that the intentional breaking of blades – in order to make them more slender and to reduce their curvature – was a common phenomenon (*e.g.* Kaczanowska 1971, 11; Dzieduszycka-Machnikowa and Lech 1976, 88, 89; 1979, 128; 1983, 12). Flint half-products were obtained from single-platform cores that, in the initial stage of their exploitation, had narrow striking surfaces (located on the thin side of the nodule and oriented at an acute angle to the striking platform). This characteristic precisely corresponds to the morphological features of the Świeciechów flint pre-core forms discovered in Puławy-Włostowice (Zakościelna 2002, 112-116, fig. 3, 4; Szeliga 2018, 190, 191, fig. 10, tabl. XIII-XVII). Core processing was focused on obtaining blades, which is attested by various repair marks (especially those made to correct the core angle and to change the core orientation) recorded in particular inventories (Gawryjołek-Szeliga 2009, 65; Gawryjołek-Szeliga and Szeliga 2012, 65). In the final stage of exploitation, blade cores were most often transformed into forms used to obtain flakes or were used as hammerstones (*cf*. Szeliga 2018, tabl. XVIII: 1). Blades and flakes were transformed into tools according to general tendencies of LBK tool production. This fact is indicated by the scope of the technological diversity of tool forms and by the frequencies of particular tool types within given inventories, which do not considerably differ from what can be said about inventories discovered across other territories settled by LBK communities. The decidedly most numerous find categories are end-scrapers, retouched blades and flakes (with much lower, often minimal numbers of other tools such as truncations, borers, burins and blades with retouched edges) (*cf*. Zakościelna 1981, 9; Gawryjołek-Szeliga 2009, 66; Gawryjołek-Szeliga and Szeliga 2012, fig. 18; Gawryjołek-Szeliga *et al*. 2013, 46; Szeliga and Gawryjołek-Szeliga 2021).

ECONOMIC BASES

The character and scope of economic activity are among the most poorly understood aspects of LBK colonisation of the Lublin region. This is a result of the insufficient degree to which the source materials were researched and especially from the small number of publications presenting previous specialist examinations, which were limited to zooarchaeological analyses. In light of the current state of research, animal osteological materials were obtained from six sites linked with the earliest (Hrubieszów-Podgórze 5, Świerszczów 3) and the younger phases (Hrubieszów-Kolonia Sławęcin 12, Hrubieszów-Podgórze 5, Świerszczów 28, Tarnoszyn 1, Werbkowice-Kotorów I) of the LBK. They are mainly modest sets of finds encompassing from a few to several dozen specimens (in some cases they are even more numerous) (Tab. 1). The only published results of the previous zooarchaeological analyses concern the vast set of post-consumption remains discovered in pit 6 at the site of Świerszczów 28. Their taxonomic diversity indicates the presence of domesticated (cattle, goat, sheep/goat, pig) and wild animals (roe deer, deer, horse, black grouse, catfish, terrapin, mussels), which attests to the importance of hunting, next to animal husbandry, in the economy of LBK society and, as a result, to the exploitation of diverse ecosystems. Some of the bones bear traces of processing in the form of incisions and burning (Nadachowski and Wolsan 1999, 238). The data obtained in Świerszczów was also supplemented with minimal information on the occurrences of sheep/goat, pig and cattle remains in a small set from Tarnoszyn (Chorostowska 1966, 38; Brzozowski 1986, 146). The majority of the remaining osteological collections have not been analysed, or were examined to a degree that requires verification and complementary research. As to the archaeobotanical data, which has never been subjected to separate analyses in the context of studying LBK settlement in the Lublin region, the situation is even more difficult. In addition to the analysis of recently obtained zooarchaeological materials and the reanalysis of earlier such data, the augmentation of the archaeobotanical data set is a necessary condition to comprehensively characterise the LBK economy in the discussed area.

INTERREGIONAL CONTACTS

This question can be discussed only in a general way due to the still modest number of excavated sites, as well as the fact that only a few homogeneous and abundant sets of artefacts have been yielded by archaeological features, and analysis of these has been minimal. In this context, the disproportionate representation of particular regions and settlement clusters, (which is reflected by the fact that the vast majority of the excavated sites are concentrated in the Hrubieszów Basin and the Horodło Ridge, and sporadically occur across the other zones of the Lublin region) is a serious impediment (Fig. 1: 2). Despite this fact, the general raw material structures of particular inventories clearly attest to the existence of active contacts between the LBK communities inhabiting the south-eastern part of the discussed region and those from its north-western area. This fact is attested by the apparent distribution of Świeciechów and Chocolate flint artefacts to settlement clusters located in the Western Volhynian Upland and by the inflow of Volhynian flint products to settlements occupying the western part of the Lublin region. The communities inhabiting the latter probably also played the leading role in the redistribution of Świeciechów and Volhynian flints to territories located north – that is, to settlement clusters across Kuyavia or even Chełmno Land, where sparse artefacts made of these raw materials occurred at sites representing the classical and late phases of the LBK (*e.g*. Domańska 1988, 83; 2002: 147, 148; Grygiel 2004, tab. XI; Kabaciński 2010, 106, 107, tab. 3, 12; Małecka-Kukawka 2008, tab. 1). This assumption is especially supported by the data yielded by the site of Puławy-Włostowice, including the character of the finds (the deposit of Świeciechów flint pre-core forms), the location of this site (Fig. 1: 2) and the potential role of the Vistula as a communication artery (*cf*. Szeliga 2018, 192). This fact is probably also connected with the inflow of obsidian products to the Polish Lowland, which, besides the geographical premises, may be indirectly indicated by the sporadic occurrences of such artefacts across the Lublin region (Tab. 1). An atypical, ladder-shaped ornament (composed of small arched dashes densely arranged on a single incised vertical line) recorded on a thin-walled vessel fragment from Horodysko 13 might be evidence of these mutual contacts and intercultural influences between the LBK societies inhabiting the Lublin region and Kuyavia (Bronicki 2016, fig. 5: 8). This pattern is decidedly different from the local motifs present on LBK vessels and bears a close similarity to the Šárka style (Bronicki 2016, 49) – especially to the methods of adapting it that are known from the Kuyavian sites (*cf. e.g*., Grygiel 2004, fig. 136: 4; 156: 16, 18; Pyzel 2010, fig. 69: 1-5, 9). It is thus possible that the discussed ornament is one of the manifestations of the previously unknown reception of Kuyavian stylistic patterns in the local LBK zone. The discovery of the Šárka pottery set in Rovantsi (Volhynia) may attest to the much greater scale of this phenomenon (Saile *et al*. 2018, Abb. 5). The discussed question undoubtedly requires further source studies, but the presence of Kuyavian stylistic influences (including the transmission of the Šárka ornamental traditions) in the ornamentation of the LBK pottery from the Lublin region and Volhynia appears to be highly probable.

Another (unfortunately very modest) group of finds includes pottery that demonstrates close analogies to the style of decoration used in the Transcarpatian Eastern Linear cultural circle. They are known from only two sites associated with the younger phase of the LBK and are represented by three bases of thin-walled bowls from Puławy-Włostowice (Szeliga 2018, tabl. I: 8; IX: 4, 5), as well as by an almost complete vessel discovered at Świerszczów 28 (Zakościelna 1988a, fig. 2: b; Gawryjołek-Szeliga 2009, tabl. X). Their ornaments find numerous and close analogies in the inventories of groups inhabiting the northern part of the Carpathian Basin, including the Kapušany-Tiszadob and Szarvas-Érpart groups and the Bükk culture (*cf.* Zakościelna 1988a, 9; Gawryjołek-Szeliga 2009, 62; Szeliga 2018, 189). The character of these finds makes it impossible to conclusively determine if they were imports or only local imitations of the Transcarpathian style. Nevertheless, the presence of a music-note ornament on one of the fragments from Puławy-Włostowice (Szeliga 2018, tabl. IX: 5) indicates that at least some of such vessels were locally made. This assumption is corroborated by finds from other highland areas, which include the northern foreland of the Sandomierz Upland (Szeliga and Zakościelna 2019, fig. 4: 2, 4). Irrespective of this fact, the aforementioned pottery materials from the Lublin region, along with the scarce finds of obsidian products (Tab. 1), suggest the existence of intense influences exercised by the Eastern Linear cultural centre on the vast areas of the upper Vistula and Oder drainage basins (especially in the territories of Podkarpacie and Lesser Poland) during the younger phase of the LBK (*cf. e.g.* Godłowska 1982; Kaczanowska and Godłowska 2009; Kozłowski *et al.* 2014; Kabaciński *et al.* 2015; Szeliga and Zakościelna 2019). Their presence at sites located in the interfluve of the Vistula and Bug, just as the sporadic occurrences of Jurassic-Cracow flint artefacts (Puławy-Włostowice; *cf.* Zakościelna 2002, fig. 1; Szeliga 2018, 192) should be especially linked with the contacts between the local societies and groups inhabiting the above mentioned regions, particularly the LBK clusters from the Rzeszów and Sandomierz regions (*cf.* Szeliga 2014, fig. 8).

SUMMARY

The range of the available sources clearly confirms the constant and intense colonisation of the upland areas located in the interfluvial zone of the Vistula and Bug Rivers by the LBK communities between the Gniechowice phase and the early stage of the Želiezovce phase. The number and dispersion of the diagnostic finds attest to the ephemeral character and limited range (Hrubieszów Basin, Middle Roztocze) of the discussed settlement during the earliest period (Szeliga and Gawryjołek-Szeliga 2021), as well as to its greatest intensification during the music-note phase, which witnessed the colonisation of the whole

analysed region. Unfortunately, the lack of radiocarbon dates makes it impossible, at the moment, to narrow down the chronological framework of the settlement processes and to determine the total time frame of the local LBK development. This problem is essential in the context of the temporal retardation of the classical music-note and late music-note decorative traditions (observed in the materials from the Lublin region), which was, in part, parallel to the geographically limited reception of the early-Želiezovce style.

Similarly to other upland areas, the arrangement of LBK sites across the Lublin region demonstrates the extremely strong connection of the discussed colonisation with the loess zone (*cf*. *e.g*. Modderman 1959, 3-6; Sielmann 1972, Abb. 1, 3, 11; Kruk 1973, 72-74; Kruk *et al*. 1996, 41-48; Lenneis 1982, Karte 4; Czekaj-Zastawny 2008, 96-108). At the same time, the tendency to agglomerate settlements within geographically isolated microregions that usually occupy the high and middle parts of river valleys (especially of small and medium watercourses) is clearly visible. This phenomenon is especially discernable in the central and north-western parts of the Lublin region (Fig. 1: 2) and, to a much smaller extent, in its south-eastern area, which is characterised by a much greater density of settlements (especially along the valley of the Huczwa River). This microregional structure has close analogies in the organisation and character of the settlement network of the LBK in other territories of the upper Vistula drainage basin (*cf*. Kruk 1973, 45-48; Czekaj-Zastawny 2008, 111, 112). The scattered character of the sites located outside the loess zone (Fig. 1: 2) indicates the limited significance of these territories for the settlement of early agricultural societies – they were rather occasionally penetrated for economic reasons. On the other hand, the results of the recent research conducted in the northern foreland of the Sandomierz Upland (*cf*. Szeliga *et al*. 2019, fig. 2; 2020) does not allow us to rule out the possibility that permanent forms of LBK colonisation also existed outside the compact loess cover of the Lublin and Western Volhynian Uplands. This can be indirectly attested by the very location of the Puławy-Włostowice site. This question is one of the most essential issues to be solved during future research.

The development of particular settlement clusters was probably dynamic and based, *e.g*., on intense contacts between the communities that inhabited them. These contacts are mainly manifested by the distribution of various siliceous raw materials via intermediate exchange (both in the upland interfluve between the Vistula and Bug and across much vaster territories). It appears that a special role in this system was played by the societies inhabiting the north-western part of the Lublin region. They were important consumers of southern materials (Chocolate and Jurassic-Cracow flint, obsidian) imported from the LBK settlement clusters occupying the Sandomierz Upland and Podkarpacie. At the same time, they played the key role in redistributing Świeciechów and Volhynian flint artefacts, as well as obsidian products, to the LBK settlement clusters in Kuyavia. The character of the interregional contacts maintained by the communities inhabiting the Lublin region was undoubtedly not limited to the distribution and exchange of raw material. This is indicated by the presence of potential references to the Kuyavian style among the local pottery ornaments. The sporadic occurrences of imports from the Transcarpatian Eastern Linear cultural circle and/or of their imitations also confirm the aforementioned conjecture. Unfortunately, the modest number of diagnostic finds makes it impossible to precisely assess the actual scale and range of these contacts, but their multidirectional and far-reaching character is unquestioned.

The nature and scope of the settlement and economic activities performed by the LBK societies inhabiting particular clusters remain little known. The first reason for this state of affairs is the complete lack of available data, or, where data are available, its small amount and poor representativeness. The second reason is the unsatisfactory degree to which inventories yielded by previous excavation works were researched. As in other territories of the Vistula drainage basin, the settlements consisted of household groups (composed of overground buildings accompanied by construction pits that were secondarily used for economic purposes) (*cf. e.g*. Czekaj-Zastawny 2008, 38, 39; Pyzel 2010, 201, 202; Dębiec 2014, 67-71). Potential remains of such structures were discovered at only a fewl sites from the Lublin region (Bogucin 6, Hrubieszów-Podgórze 5, Puławy-Włostowice 3, Świerszczów 3; *cf.* Gawryjołek-Szeliga and Szeliga 2012, 72, 73; Gawryjołek-Szeliga *et al.* 2013; 50; Szeliga and Gawryjołek-Szeliga 2021, fig. 1: 3; Szeliga 2018, 182). So far, both the degree to which they were researched and the state of their preservation make it impossible to reconstruct particular houses and to assess their numbers or spatial arrangement at particular sites. Information concerning the economic activity of the LBK communities, especially agricultural activities and animal husbandry, is very modest and limited. The fact that only a small portion of the zooarchaeological data was published, as well as the complete lack of archaeobotanical analyses, render it impossible to make any interpretations or perform comparative examinations in this field.

Despite the undoubtedly informative potential of the present corpus of sources, many deficiencies and shortcomings significantly limit interpretative possibilities regarding many vital questions on the presence and development of the LBK society in the upland interfluve between the Vistula and Bug Rivers. In the context of future research, it should be stressed that there is a necessity to thoroughly research and publish the present source materials, as well as to conduct new, interdisciplinary excavation works oriented towards augmenting the archaeological and environmental data that would be representative of particular settlement clusters. It appears that this would help us in complementing and verifying the previous observations and in solving numerous problems concerning the chronological and stylistic range of LBK development, as well as the character and scale of the settlement and the economic activity of this population. Thereby, it would be possible to assess the actual role and importance of the Lublin region, and that of the communities inhabiting it, in the general development of the LBK in the drainage basin of the Vistula.

Table 1. List of LBK sites from the upland interfluvial zone of the Vistula and Bug Rivers. Abbreviation explanations: A – accidental find; S – surface survey; E – excavations; Ft – features; G – graves; P – pottery; F – flint; S – stone; O – obsidian; Ab – animal bones. The numeration of the sites is compatible with fig. 1:2

Lp.	Site		AZP number	The way the finds were obtained			Materials							LBK phase	Director and year of research	Literature (and remarks)
	Locality (community/ district)	No.		A	S	E	Ft	G	P	F	S	O	Ab			
1.	**Alojzów** (Werbkowice/ Hrubieszów)	3	87-93/10		+				11	7				?	W. Koman 1991	Czekaj-Zastawny 2008
2.	**Białki Dolne** (Ułęż/ Ryki)	7	70-76/8		+				2					?	A. Kokowski 1998	-
3.	**Bobowiska** (Markuszów/ Puławy)	2	74-78/48		+						1			?	A. Zakościelna 1981	Brzozowski 1985
4.	**Bodaczów** (Szczebrzeszyn/ Zamość)	34	89-86/35		+				1					?	U. Kurzątkowska, W. Koman 1990	Czekaj-Zastawny 2008
5.	**Bogucin** (Garbów/ Puławy)	6	75-79/6			+	51		504	117	4			II-III	M. Matyaszewski 2011	Gawryjołek-Szeliga and Szeliga 2012
6.	**Brodzica** (Hrubieszów/ Hrubieszów)	23	87-93/38		+				5					?	W. Koman 1991	Czekaj-Zastawny 2008
7.	**Bródek** (Łabunie/ Zamość)	2	89-89/3		+						1			?	J. Kuśnierz 1999	Czekaj-Zastawny 2008
8.	**Busieniec** (Białopole/ Chełm)	7	83-92/26		+				1					?	S. Jastrzębski 1983	Brzozowski 1986; 1988
9.	**Celejów** (Wąwolnica/ Pulawy)	10	75-77/57		+				2		1			?	S. Jastrzębski 1981	-
10.	**Chruślanki Małe** (Józefów by the Vistula river / Opole Lubelskie)	6	82-75/16		+				3	+				?	S. Jastrzębski 1979	Zakościelna 1981; Brzozowski 1986; 1988
11.	**Chruślina Kolonia** (Józefów by the Vistula river / Opole Lubelskie)	5	82-76/36		+				3	7				?	S. Jastrzębski 1979	Brzozowski 1986; 1988; Zakościelna 2002

12.	**Chrzanów Kolonia** (Chrzanów/ Janów Lubelski)	1	88-82/29		+				6					?	Z. Wichrowski 2003	-
13.	**Chrzanów Kolonia** (Chrzanów/ Janów Lubelski)	4	88-82/36		+				9					?	Z. Wichrowski 2003	-
14.	**Chrzanów Kolonia** (Chrzanów/ Janów Lubelski)	7	88-82/48		+				47	+		1		II	Z. Wichrowski 2003	-
15.	**Cichobórz** (Hrubieszów/ Hrubieszów)	32	89-95/79		+				2					?	J. Niedźwiedź 1993	Czekaj-Zastawny 2008 (incorrect name od site: „Lichobórz")
16.	**Ciechanki Krzesimowskie** (Łęczna/ Łęczna)	5	77-84/36		+				+					?	H. Wróbel 1986	Bargieł and Zakościelna 1995a
17.	**Czumów** (Hrubieszów/ Hrubieszów)	?	?		+				2					II	J. Kowalczyk, P. Komorowski, J. Głosik 1956	Głosik 1959-1960 Unknown location of site
18	**Dąbrowica** (Jastków/ Lublin)	12	77-80/37		+				1					?	B. Bargieł 1982	Bargieł and Zakościelna 1995a
19.	**Gliniska** (Tyszowce/ Tomaszów Lubelski)	2	91-92/16		+				1					?	S. Czopek 1979	Brzozowski 1986; 1988
20.	**Głodno Nowe** (Łaziska/ Opole Lubelskie)	4	79-74/18		+				4					?	S. Jastrzębski 1980	-
21.	**Gozdów** (Werbkowice/ Hrubieszów)	?	?	+						1				?	-	Bargieł *et al.* 1994 Unknown location of site
22.	**Góry Rzeczyckie** (Kazimierz Dolny/ Puławy)	1	76-76/36		+				7	+		1		?	A. Kokowski 1980	Bargieł and Zakościelna 1995b; Zakościelna 2002
23.	**Gródek** (Hrubieszów/ Hrubieszów)	1B	87-94/70	+					1					I	-	Buszewicz 1990
24.	**Gródek** (Hrubieszów/ Hrubieszów)	2	86-95/12			+	-	1	+					I	J. Kowalczyk 1953	Kempisty 1962; see also Dzieńkowski 2018, tab. 2
25.	**Gródek** (Hrubieszów/ Hrubieszów)	6 (1D)	87-94/2			+	3		+	+				I-II	T. Dąbrowska, T. Liana, A. Uzarowiczowa 1961-1962	Uzarowiczowa 1964; see also Dzieńkowski 2018, tab. 2

Table 1.

Lp.	Site		AZP number	The way the finds were obtained			Materials							LBK phase	Director and year of research	Literature (and remarks)
	Locality (community/ district)	No.		A	S	E	Ft	G	P	F	S	O	Ab			
26.	**Horodło** (Horodło/ Hrubieszów)	5	85-95/5		+				1					II	?	Gurba 1961
27.	**Horodysko** (Leśniowice/ Chełm)	13	83-90/71			+	-		206	+	+			II	T. Dzieńkowski, S. Gołub 2004-2005	Bronicki 2016; Libera 2016
28.	**Hrubieszów-Podgórze** (Hrubieszów/ Hrubieszów)	1A	86-94/158			+	-		+	+				II?	E. Banasiewicz, A. Kokowski 1983-1985	Banasiewicz and Kokowski 1983, 17; Banasiewicz 1986
29.	**Hrubieszów-Podgórze** (Hrubieszów/ Hrubieszów)	5	86-94/211			+	4		+	+				I	J. Niedźwiedź, W. Panasiewicz 1993	Niedźwiedź and Panasiewicz 1994
30.	**Hrubieszów-Podgórze** (Hrubieszów/ Hrubieszów)	5	87-94/32			+	6		218	16	1		164	II	M. Matyaszewski 2011-2012	Gawryjołek-Szeliga *et al.* 2013
31.	**Hrubieszów – Kolonia Sławęcin** (Hrubieszów/ Hrubieszów)	12	86-93/29			+	2		648	62	+		+	II	A. Hyrchała 2013	Szeliga *et al.* 2017
32.	**Janki Dolne** (Horodło/ Hrubieszów)	7	85-96/54		+				5					?	A. Kokowski 1984	Brzozowski 1986; 1988
33.	**Janki Dolne** (Horodło/ Hrubieszów)	11	85-96/58		+				2					II	A. Kokowski 1984	Brzozowski 1986; 1988
34	**Jaszczów** (Milejów/ Łęczna)	IV	78-85/9		+				+					?	J. Waszkiewicz 1977-1978	Bargieł and Zakościelna 1995a
35.	**Kaliszany** (Józefów by the Vistula river / Opole Lubelskie)	2	81-74/20			+	-		+					?	M. Sułowska 1972	Sułowska 1972
36.	**Kolonia Dobużek** (Łaszczów/ Tomaszów Lubelski)	1	92-92/20		+				1	3				?	J. Maciejczuk 1984	Czekaj-Zastawny 2008
37.	**Kolonia Gozdów** (Werbkowice/ Hrubieszów)	1	87-93/130		+				12					?	W. Koman 1991	Czekaj-Zastawny 2008

38.	**Kolonia Kosmów** (Hrubieszów/ Hrubieszów)	16	88-95/4		+				6	+				?	A. Kokowski 1981	Brzozowski 1986; 1988
39.	**Kolonia Przeorsk** (Tomaszów Lubelski/ Tomaszów Lubelski)	2	94-90/61		+				13	8				?	E. Banasiewicz 1984	Brzozowski 1986; 1988; Czekaj-Zastawny 2008
40.	**Kolonia Rakołupy Duże** (Leśniowce/ Chełm)	13	83-89/18		+							1		?	A. Bronicki 1988	-
41.	**Konstantów** (Dzwola/ Janów Lubelski)	1	89-81/16		+				1					?	J. Libera 1985	-
42.	**Kosin** (Annopol/ Kraśnik)	32	87-75/15		+				1	1				?	B. Bargieł 1985	Czekaj-Zastawny 2008
43.	**Kosmów** (Hrubieszów/ Hrubieszów)	6	88-95/17		+				4					II	A. Kokowski 1978	Brzozowski 1986; 1988
44.	**Kotorów** (Werbkowice/ Hrubieszów)	14	88-92/100		+				1					?	J. Buszewicz 1982	Czekaj-Zastawny 2008
45.	**Krasnystaw** (Krasnystaw/ Krasnystaw)	VI	83-87/6	+					2					II-III	Accidental find	Gurba 1961
46.	**Kraśnik** (Kraśnik/ Kraśnik)	10	83-77/14		+				1					?	Z. Wichrowski 1984	Brzozowski 1986; 1988
47.	**Kraśnik** (Kraśnik/ Kraśnik)	25	84-78/33		+				1					?	Z. Wichrowski 1983	Brzozowski 1986; 1988
48.	**Kraśnik** (Kraśnik/ Kraśnik)	35	84-77/27		+				2					?	Z. Wichrowski 1984	-
49.	**Kryłów** (Mircze/ Hrubieszów)	13	89-95/63		+				11					?	J. Niedźwiedź 1993	Czekaj-Zastawny 2008
50.	**Kulczyn Kolonia** (Hańsk/ Włodawa)	41	74-89/110		+				1					?	T. i W. Mazurkowie 2004	-
51.	**Leopoldów** (Łęczna/ Łęczna)	5	77-84/86			+	2	-	> 350	+	+			II	A. Jączek, M. Kubera 2017	Jączek and Kubera 2018
52.	**Lipowiec** (Tyszowce/ Tomaszów Lubelski)	?	?			+	-	-	?	?	?	?	?	?	J. Gurba 1984	Gurba 1976; Gurba *et al.* 1976 Unknown location of site

Table 1.

Lp.	Site		AZP number	The way the finds were obtained			Materials							LBK phase	Director and year of research	Literature (and remarks)
	Locality (community/ district)	No.		A	S	E	Ft	G	P	F	S	O	Ab			
53.	**Lipsko-Kosobudy** (Zamość/ Zamość)	12	90-88/30		+						1			?	J. Kuśnierz 1997	Czekaj-Zastawny 2008
54.	**Lipsko Polesie** (Zamość/ Zamość)	11	90-87/42		+				2	2				?	A. Urbański 1990	Czekaj-Zastawny 2008
55.	**Łapiguz** (Zamość/ Zamość)	1	88-88/31		+				5					?	A. Urbański 1983	Brzozowski 1986; 1988
56.	**Łapiguz** (Zamość/ Zamość)	5	88-88/33		+				1					?	A. Urbański 1983	Brzozowski 1986; 1988
57.	**Łaziska** (Łaziska/ Opole Lubelskie)	2	79-75/62		+				1	+				?	J. Libera 1980	Brzozowski 1986; 1988
58.	**Łopatki** (Wąwolnica/ Puławy)	3	76-77/180		+				2					?	A. Zakościelna 1980	Bargieł and Zakościelna 1995b
59.	**Łopatki Kolonia** (Wąwolnica/ Puławy)	1	76-77/89		+				2	1				?	A. Zakościelna 1980	Bargieł and Zakościelna 1995b
60.	**Łopiennik Dolny** (Łopiennik Górny/ Krasnystaw)	3	81-86/15			+			+	+				II	A. Zakościelna, J. Gurba 1991	Zakościelna and Gurba 1991; 1993
61.	**Łopiennik Nadrzeczny** (Łopiennik Górny/ Krasnystaw)	1	81-86/57		+				2					?	E. Wołoszyn, W. Mazurek 1988	-
62.	**Łopiennik Podleśny** (Łopiennik Górny/ Krasnystaw)	9	81-86/41		+				2					?	E. Wołoszyn, W. Mazurek 1988	-
63.	**Łopiennik Podleśny** (Łopiennik Górny/ Krasnystaw)	11	81-86/51		+				3					?	E. Wołoszyn, W. Mazurek 1988	-
64.	**Łysa Góra** (Werbkowice/ Hrubieszów)	1	88-93/18		+				7					?	A. Kokowski 1978-1981	-
65.	**Łysa Góra** (Werbkowice/ Hrubieszów)	3	88-93/20		+				1					?	A. Kokowski 1978-1981	Brzozowski 1986; 1988

66.	**Mareczki** (Wąwolnica/ Puławy)	12	76-77/149		+				2					?	A. Zakościelna 1980	Brzozowski 1986; 1988
67.	**Masłomęcz** (Hrubieszów/ Hrubieszów)	14	88-94/79		+				2					?	S. Jastrzębski, A. Kokowski 1984	Brzozowski 1986; 1988
68.	**Mieniany** (Hrubieszów/ Hrubieszów)	7	88-94/65		+				5					?	S. Jastrzębski, A. Kokowski 1984	Czekaj-Zastawny 2008
69.	**Mieniany** (Hrubieszów/ Hrubieszów)	13	88-95/78		+				2					?	A. Kokowski 1978	Brzozowski 1986; 1988
70.	**Miętkie Kolonia** (Mircze/ Hrubieszów)	17	90-93/60		+				6					?	W. Koman 1995	Czekaj-Zastawny 2008
71.	**Modryniec** (Mircze/ Hrubieszów)	2	89-94/44		+				2					?	A. Kokowski 1978	Czekaj-Zastawny 2008
72.	**Modryniec** (Mircze/ Hrubieszów)	5	89-94/14		+				1					?	A. Kokowski 1978	-
73.	**Nawóz** (Nielisz/ Zamość)	XIV	?		+				5					?	E. Mtrus 1976-1977	Brzozowski 1986; 1988 Unknown location of site
74.	**Nawóz** (Nielisz/ Zamość)	XVI	?		+				3					?	E. Mtrus 1976-1977	Brzozowski 1986; 1988 Unknown location of site
75.	**Niedzieliska** (Szczebrzeszyn/ Zamość)	13	89-86/68		+				1					?	U. Kurzątkowska, W. Koman 1990	Czekaj-Zastawny 2008
76.	**Oleśniki** (Trawniki/ Świdnik)	19	80-86/14		+				1					?	H. Taras 2004	-
77.	**Ornatowice** (Grabowiec/ Zamość)	1	86-91/5	+					1					II	1958	Gurba 1961; Gurba and Jasiński 1963
78.	**Ostrów Kolonia** (Wojsławice/ Chełm)	18	84-90/40		+				4					?	S. Gołub 1984	Brzozowski 1986; 1988
79.	**Ośrodek Wyżnica** (Kraśnik/ Kraśnik)	4	84-78/20		+				45	+	+			?	Z. Wichrowski 1983; Z. Wichrowski, Z. Winkler 1994, 1996	Brzozowski 1986; 1988
80.	**Ośrodek Wyżnica** (Kraśnik/ Kraśnik)	5	AZP 84-78/21		+				2	+				?	Z. Wichrowski 1983, 1994	Brzozowski 1986; 1988

Table 1.

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	Locality (community/ district)	No.		A	S	E	Ft	G	P	F	S	O	Ab				
81.	**Panieńszczyzna** (Jastków/ Lublin)	1	76-80/64			+			2						?	S. Sadowski 2006	Sadowski 2006
82.	**Parchatka** (Kazimierz Dolny/ Puławy)	26	75-76/185		+				1						?	J. Nogaj 1987	Bargieł and Zakościelna 1995b
83.	**Pełczyn** (Trawniki/ Świdnik)	I	79-85/5		+				+						?	J. Waszkiewicz 1978-1979	Bargieł and Zakościelna 1995b
84.	**Plisków** (Leśniowce/ Chełm)	4	83-90/62		+				2						?	S. Gołub 1984	Brzozowski 1986; 1988
85.	**Płonka** (Rudnik/ Krasnystaw)	I	?		+				1						II	E. Mitrus 1976	Brzozowski 1986; 1988 Unknown location of site
86.	**Pniówek** (Zamość/ Zamość)	1	89-88/38		+				21						?	J. Buszewicz 1991	Czekaj-Zastawny 2008
87.	**Podhorce** (Werbkowice/ Hrubieszów)	2	87-93/5		+	+	-		>20	+		1			II-III	J. Kącki 1982; W. Koman 1991	Kącki 1982; Czekaj-Zastawny 2008
88.	**Podhorce** (Werbkowice/ Hrubieszów)	11	87-93/83		+				2						?	W. Koman 1991	Czekaj-Zastawny 2008
89.	**Podhorce** (Werbkowice/ Hrubieszów)	33	87-93/105		+				3						?	W. Koman 1991	Czekaj-Zastawny 2008
90.	**Podhorce** (Werbkowice/ Hrubieszów)	36	87-93/108		+				1						?	A. Kokowski 1978-1981 W. Koman 1991	Brzozowski 1986; 1988
91.	**Podhorce** (Werbkowice/ Hrubieszów)	37	87-93/109		+				8						?	A. Kokowski 1978-1981 W. Koman 1991	Czekaj-Zastawny 2008
92.	**Podhorce** (Werbkowice/ Hrubieszów)	38	87-93/110		+				7						?	A. Kokowski 1978-1981 W. Koman 1991	Brzozowski 1986; 1988; Czekaj-Zastawny 2008

93.	**Podhorce** (Werbkowice/ Hrubieszów)	52	87-93/124		+				12					?	A. Kokowski 1978-1981 W. Koman 1991	Czekaj-Zastawny 2008
94.	**Podhorce** (Werbkowice/ Hrubieszów)	53	87-93/125		+				8					?	A. Kokowski 1978-1981 W. Koman 1991	Czekaj-Zastawny 2008
95.	**Polesie** (Tomaszów Lubelski/ Tomaszów Lubelski)	2	94-90/65		+				7	4				?	E. Banasiewicz 1984	Brzozowski 1986; 1988; Czekaj-Zastawny 2008
96.	**Przeorsk** (Tomaszów Lubelski/ Tomaszów Lubelski)		95-90/13		+				3	3				?	E. Banasiewicz 1984	Czekaj-Zastawny 2008
97.	**Puławy-Włostowice** (Puławy/ Puławy)	3	74-76/45			+	4		418	+				II-III	J. Gurba, A. Kutyłowski 1973; J. Gurba, L. Gajewski, I. Kutyłowska 1974; M. Matyaszewski, G. Miliszkiewicz 1977; P. Lis 1988, 1996	Gurba and Kutyłowski 1974; Gajewski *et al.* 1975; Matyaszewski and Miliszkiewicz 1978; Lis 1992; 1997; Zakościelna 1981; 2002; Szeliga 2018
98.	**Putnowice Kolonia** (Wojsławice/ Chełm)	16	83-92/62		+				1					?	S. Jastrzębski 1983	Brzozowski 1986; 1988
99.	**Putnowice Kolonia** (Wojsławice/ Chełm)	23	83-92/77		+				1					?	S. Jastrzębski 1983	Brzozowski 1986; 1988
100.	**Putnowice Kolonia** (Wojsławice/ Chełm)	7	83-92/43		+				2	4				?	S. Jastrzębski 1983	Brzozowski 1986; 1988
101.	**Rąblów Kolonia** (Wąwolnica/ Puławy)	10	76-77/96		+							1		?	A. Kokowski 1980	Brzozowski 1986; 1988
102.	**Rogalin** (Hrubieszów/ Hrubieszów)	8	86-96/6		+				1					?	S. Jastrzębski 1983	Brzozowski 1986; 1988
103.	**Rogalin** (Hrubieszów/ Hrubieszów)	9	86-96/7		+				8					?	S. Jastrzębski 1983	Brzozowski 1986; 1988
104.	**Rudnik Drugi** (Zakrzówek/ Kraśnik)	18	84-80/53		+				2					?	Z. Wichrowski 1999	-
105.	**Sitaniec-Błonie** (Zamość/ Zamość)	5	88-88/11		+				3					?	A. Kutyłowski, A. Urbański 1983	Brzozowski 1986; 1988
106.	**Sitaniec-Błonie** (Zamość/ Zamość)	6	88-88/10		+				1					?	A. Kutyłowski, A. Urbański 1983	Brzozowski 1986; 1988

Table 1.

Lp.	Site		AZP number	The way the finds were obtained			Materials							LBK phase	Director and year of research	Literature (and remarks)
	Locality (community/ district)	No.		A	S	E	Ft	G	P	F	S	O	Ab			
107.	**Sitaniec-Wolica** (Zamość/ Zamość)	1	88-88/12		+				7	+				?	A. Kutyłowski, A. Urbański 1983	Brzozowski 1986; 1988
108.	**Sitaniec-Wolica** (Zamość/ Zamość)	2	88-88/13		+				1					?	A. Kutyłowski, A. Urbański 1983	Brzozowski 1986; 1988
109.	**Skoków** (Opole Lubelskie/ Opole Lubelskie)	2	80-76/20		+				+					?	H. Wróbel 1979	Bargieł and Zakościelna 1995c
110.	**Snopków** (Jastków/ Lublin)	5	76-80/6		+				1					?	W. Zieliński 1982	Brzozowski 1986; 1988
111.	**Snopków** (Jastków/ Lublin)	12	76-80/13		+				1					?	W. Zieliński 1982	Brzozowski 1986; 1988
112.	**Stężyca Łęczyńska** (Krasnystaw/ Krasnystaw)	2	81-86/22		+				1					?	E. Wołoszyn, W. Mazurek 1988	-
113.	**Stężyca Łęczyńska** (Krasnystaw/ Krasnystaw)	9	81-86/48		+				2					?	E. Wołoszyn, W. Mazurek 1988	-
114.	**Strzyżów** (Horodło/ Hrubieszów)	1	86-95/1			+	+		+					II	Z. Podkowińska 1935-37, 1939; J. Głosik, J. Gurba 1961	Podkowińska 1959; 1960; Głosik and Gurba 1963; Brzozowski 1986, 1988
115.	**Strzyżów** (Horodło/ Hrubieszów)	2	86-95/2			+			+					?	Z. Podkowińska 1935-37, 1939; J. Gurba 1961	Podkowińska 1960; Brzozowski 1986, 1988 Bargieł and Zakościelna 1995a
116.	**Strzyżów** (Horodło/ Hrubieszów)	7	86-95/7		+				2					?	S. Jastrzębski 1983	Brzozowski 1986; 1988
117.	**Strzyżów** (Horodło/ Hrubieszów)	10	86-95/10		+				2					?	S. Jastrzębski 1983	Brzozowski 1986; 1988
118.	**Strzyżów** (Horodło/ Hrubieszów)	18	86-95/21		+				1					?	S. Jastrzębski 1983	Brzozowski 1986; 1988

119.	**Sumin** (Tarnawatka/ Tomaszów Lubelski)	1	92-89/19		+				8					I	A. Zakościelna 1984	Brzozowski 1986; 1988; Szeliga and Gawryjołek-Szeliga 2021
120.	**Szczekarków** (Lubartów/ Lubartów)	12	72-82/21		+				+	+				?	M. Florek 1996	-
121.	**Szczepiatyn** (Ulhówek/ Tomaszów Lubelski)	27	95-93/24		+				5					?	A. Urbański 1987	Czekaj-Zastawny 2008
122.	**Szlatyn** (Jarczów/ Tomaszów Lubelski)	10	94-92/184		+				3					?	J. Buszewicz, U. Kurzątkowska, W. Mazurek 1987	Czekaj-Zastawny 2008
123.	**Szopinek Stara Wieś** (Zamość/ Zamość)	5	88-88/43		+				3					?	A. Urbański 1983	Brzozowski 1986; 1988
124.	**Szopinek Stara Wieś** (Zamość/ Zamość)	6	88-88/44		+				4	1				?	A. Urbański 1983	Brzozowski 1986; 1988
125.	**Świeciechów Poduchowny** (Annopol/ Kraśnik)	1	84-75/1		+							1		?	Accidental find	Kind information by J. Libera
126.	**Świerszczów** (Hrubieszów/ Hrubieszów)	3	86-94/90			+	4		229	8			11	I	J. Jóźwiak 2011-2012	Szeliga and Gawryjołek-Szeliga 2021
127.	**Świerszczów /Kolonia/** (Hrubieszów/ Hrubieszów) *	28*	86-94/6*			+	3		1139	60	>15		105	II	A. Zakościelna 1988, 1990	Zakościelna 1988a; 1988b; 1990 Nadachowski and Wolsan 1999; Gawryjołek-Szeliga 2009; Dzieńkowski 2018 The site is known in the archaeological literature under the name Świerszczów Kolonia (no. 28), but it is incorrect. The correct one, compatible with the AZP list, is Świerszczów, site 3A (86-94/6)

Table 1.

Lp.	Site		AZP number	The way the finds were obtained			Materials							LBK phase	Director and year of research	Literature (and remarks)
	Locality (community/ district)	No.		A	S	E	Ft	G	P	F	S	O	Ab			
128.	**Tarnawatka** (Tarnawatka/ Tomaszów Lubelski)	6	92-89/23		+				11	1				II	H. Wróbel 1984	Brzozowski 1986; 1988
129.	**Tarnawatka** (Tarnawatka/ Tomaszów Lubelski)	9	92-89/19		+				18						A. Zakościelna 1984	Czekaj-Zastawny 2008
130.	**Tarnoszyn** (Ulhówek/ Tomaszów Lubelski)	1	95-93/1			+	+		741	136	+		32	II	J. Gurba 1959	Gurba 1961; 1970; Chorostowska 1966; Zakościelna 1981
131.	**Tarnoszyn** (Ulhówek/ Tomaszów Lubelski)	33	95-93/42		+				1	1				?	A. Urbański 1987	Czekaj-Zastawny 2008
132.	**Terebiniec** (Werbkowice/ Hrubieszów)	1	Brak danych		+				+					?	J. Gurba 1977	Bargieł and Zakościelna 1995c
133.	**Teresin** (Białopole/ Chełm)	7	83-92/191		+				1					?	A. Kokowski 1983	Brzozowski 1986; 1988
134.	**Teresin** (Białopole/ Chełm)	19	83-92/203		+				1					?	A. Kokowski 1983	Brzozowski 1986; 1988
135.	**Teresin** (Białopole/ Chełm)	24	83-92/17		+				2					?	A. Kokowski 1983	-
136.	**Turkowice Kolonia** (Werbkowice/ Hrubieszów)	7	90-93/16		+				1					?	W. Koman 1995	Czekaj-Zastawny 2008
137.	**Tyszowce** (Tyszowce/ Tomaszów Lubelski)	4	90-92/21		+				3					?	S. Jastrzębski 1984	Czekaj-Zastawny 2008
138.	**Tyszowce** (Tyszowce/ Tomaszów Lubelski)	6	90-92/23								4			?	S. Jastrzębski 1984	Czekaj-Zastawny 2008
139.	**Tyszowce** (Tyszowce/ Tomaszów Lubelski)	25B	90-92/52			+						1		?	J. Buszewicz 1985	Buszewicz 1986
140.	**Ugory** (Dzierzkowice/ Kraśnik)	9	85-73/5		+						1				A. Kokowski 1979	Brzozowski 1985

141.	**Wąwolnica** (Wąwolnica/ Puławy)	1	76-77/3			+			+	+				?	B. Bargieł, J. Kącki 1980	Bargieł and Kącki 1980; 1981
142.	**Wąwolnica** (Wąwolnica/ Puławy)	7	76-77/24		+				3					?	A. Zakościelna 1980	-
143.	**Werbkowice-Kotorów** (Werbkowice/ Hrubieszów)	1 (I*)	88-92/1			+	5	?	+	+			+	II	T. Liana, T. Dąbrowska 1959- 1960	Liana and Piętka-Dąbrowska 1962; Dąbrowska and Liana 1963; Kurzawska and Sobkowiak-Tabaka 2020 In the light of data provided by the AZP survey, sites I and II appearing in archaeological literature are actually one and the same site marked as no. 1
144.	**Werbkowice-Kotorów** (Werbkowice/ Hrubieszów)	1 (II*)				+								?		
145.	**Werbkowice** (Werbkowice/ Hrubieszów)	4	88-93/3		+				1					?	W. Koman 1991	Czekaj-Zastawny 2008
146.	**Wieniawka** (Horodło/ Hrubieszów)	4	85-96/17		+				2					?	A. Kokowski 1984	Brzozowski 1986; 1988
147.	**Wieniawka** (Horodło/ Hrubieszów)	5	85-96/18		+				1					?	A. Kokowski 1984	Brzozowski 1986; 1988
148.	**Wieniawka** (Horodło/ Hrubieszów)	6	85-96/40			+			+					II	A. Kokowski 1985	Kokowski 1985
149.	**Wierzbica** (Lubycza Królewska/ Tomaszów Lubelski)	7	96-92/7		+				1					?	U. Kurzątkowska, W. Koman 1987	Czekaj-Zastawny 2008
150.	**Wierzbica** (Lubycza Królewska/ Tomaszów Lubelski)	9	96-92/9		+				4					?	U. Kurzątkowska, W. Koman 1987	Czekaj-Zastawny 2008
151.	**Wilków** (Werbkowice/ Hrubieszów)	13	87-93/141		+				2					?	A. Kokowski 1978-1981 W. Koman 1991	Brzozowski 1986; 1988; Czekaj-Zastawny 2008
152.	**Wilków** (Werbkowice/ Hrubieszów)	22	87-93/150		+				1					?	W. Koman 1991	Czekaj-Zastawny 2008

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	Locality (community/ district)	No.		A	S	E	Ft	G	P	F	S	O	Ab			
153.	**Wirkowice** (Izbica/ Krasnystaw)	17	85-86/33		+				1					?	A. Zakościelna 1980	Brzozowski 1986; 1988
154.	**Wólka Pukarzowska** (Łaszczów/ Tomaszów Lubelski)	1	92-92/15		+				4					?	J. Maciejczuk 1984	Czekaj-Zastawny 2008
155.	**Wólka Putnowicka** (Wojsławice/ Chełm)	3	83-92/96		+						1			?	S. Jastrzębski 1983	-
156.	**Wychody** (Zamość/ Zamość)	5	90-87/61		+				1					?	A. Urbański 1990	Czekaj-Zastawny 2008
157.	**Wyżnianka Kolonia** (Dzierzkowice/ Kraśnik)	1	84-77/19		+				5	+				?	Z. Wichrowski 1984	Brzozowski 1986; 1988
158.	**Wyżnianka Kolonia** (Dzierzkowice/ Kraśnik)	2	84-77/20		+				15	13				II	Z. Wichrowski 1984	Brzozowski 1986; 1988
159.	**Zagroda** (Chełm/ Chełm)	5	81-89/28		+					11				?	A. Bronicki 1984	-
160.	**Zagroda** (Chełm/ Chełm)	9	81-89/46		+				2					?	A. Bronicki 1984	Brzozowski 1986; 1988
161.	**Zakłodzie** (gm. Radecznica/ Zamość)	4	88-84/88		+				1					?	A. Urbański, J. Buszewicz, J. Kuśnierz 1989	Czekaj-Zastawny 2008
162.	**Zakrzów** (Łęczna/ Łęczna)	6	77-84/43		+				+	25				?	H. Wróbel 1986	Bargieł and Zakościelna 1995c
163.	**Zamłynie** (Tyszowce/ Tomaszów Lubelski)	3	90-92/40		+				4					?	S. Jastrzębski 1984	Brzozowski 1986; 1988

164.	**Zarzeka** (Wąwolnica/ Puławy)	6	76-77/13		+				1	1				?	A. Zakościelna 1980	Bargieł and Zakościelna 1995c
165.	**Zarzeka** (Wąwolnica/ Puławy)	8	76-77/45		+				13					?	A. Zakościelna 1980	Bargieł and Zakościelna 1995c
166.	**Zarzeka** (Wąwolnica/ Puławy)	17	76-77/54		+				2	5				?	A. Zakościelna 1980	-
167.	**Zgórzyńskie** (Wąwolnica/ Puławy)	5	76-77/55		+				3					?	A. Zakościelna 1980	Bargieł and Zakościelna 1995c
168.	**Zgórzyńskie** (Wąwolnica/ Puławy)	8	76-77/58		+				1					?	A. Zakościelna 1980	Brzozowski 1986; 1988
169.	**Zosin** (Horodło/ Hrubieszów)	15	85-96/83		+				15					II	A. Kokowski 1984	Brzozowski 1986; 1988
170.	**Żuków** (Miączyn/ Zamość)	1	87-91/1			+			1					II	J. Gurba 1960	Gurba 1961
171.	**Żyłka** (Lubycza Królewska/ Tomaszów Lubelski)	1	95-90/2		+						1			?	E. Banasiewicz 1984	Czekaj-Zastawny 2008

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Agnieszka Czekaj-Zastawny[1]

HUMAN BURIALS AND FUNERAL RITES OF THE LINEAR POTTERY CULTURE FROM THE TERRITORY OF POLAND

ABSTRACT

Czekaj-Zastawny A. 2021. Human burials and funeral rites of the Linear Pottery culture from the territory of Poland. *Sprawozdania Archeologiczne* 73/1, 101-117.

Human burials of the Linear Pottery culture in Poland are not common. The recent discovery in Modlniczka of the first – and thus far the only – LBK cemetery in Poland was therefore a significant one. Presently, there are only 17 other known sites with burials. Thirteen sites are in south-eastern Poland, four in Kuyavia, and one in the Odra River valley. In comparison with other burial sites in Central and Western Europe, the graves of the LBK in Poland do not provide many clues about the funerary customs of this culture. Their small number and the very limited proportion of preserved human remains make it impossible to perform many types of analyses. However, despite the small amount of evidence, we can observe general patterns, which are typical of the entire European LBK – in terms of both settlements and burials.

Keywords: Early Neolithic, Linear Pottery culture, funeral rite, human burials, Vistula River basin
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INTRODUCTION

Known burials of the Linear Pottery culture (LBK) in Poland are not common. In comparison with other burial sites in Central and Western Europe (about 100 funerary sites, including vast, separated, burial grounds), the graves of the LBK in Poland do not provide many clues about the funerary customs of this culture. Thirteen (including the cemetery at Modlniczka) are in south-eastern Poland, four in Kuyavia, and one in the Odra River valley (Czekaj-Zastawny 2009a; 2009b; 2017; Czekaj-Zastawny and Przybyła 2012). Despite the small amount of evidence, we can see that Polish finds are typical of the entire European LBK in every analysed element.

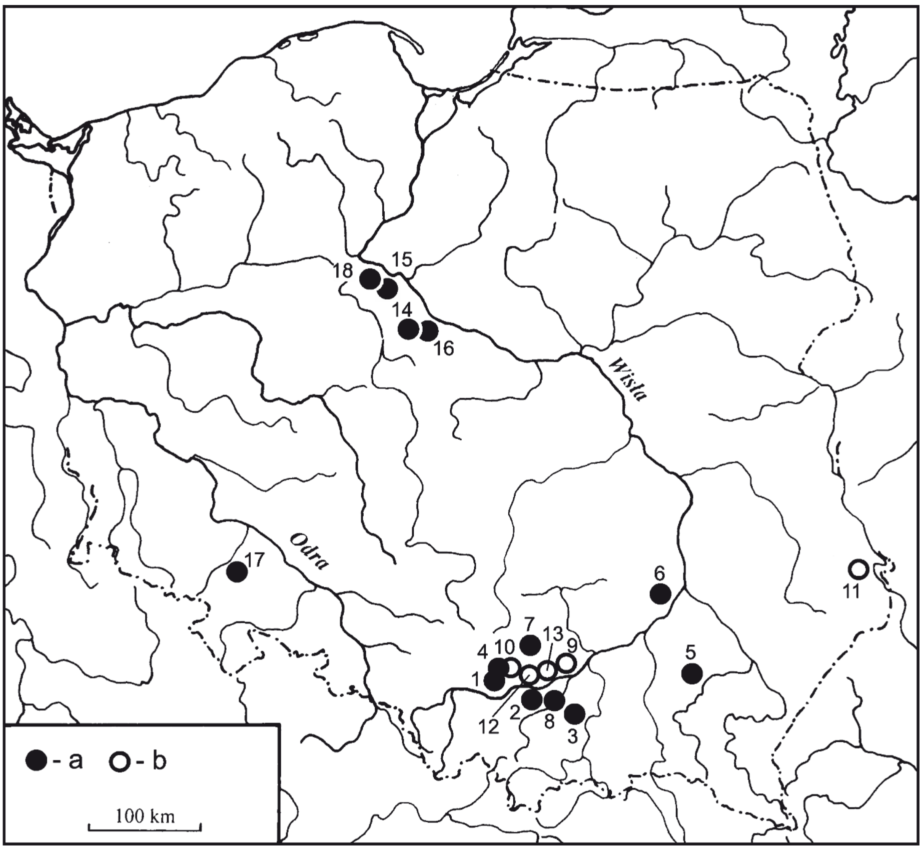

Fig. 1. Sites with LBK burials in Poland: a – burials of the LBK, b – presence of burials probably attributed to the LBK. 1 – Aleksandrowice, 2 – Brzezie, 3 – Łoniowa, 4 – Modlniczka, 5 – Olchowa, 6 – Samborzec, 7 – Szczotkowice, 8 – Targowisko, 9 – Bejce, 10 – Giebułtów, 11 – Gródek, 12 – Igołomia-Zofipole, 13 – Złotniki, 14 – Brześć Kujawski, 15 – Ludwinowo, 16 – Miechowice, 17 – Stary Zamek, 18 – Kruszyn (Czekaj-Zastawny 2009b)

Table 1. LBK burials from south-eastern Poland – list of source materials (Czekaj-Zastawny *et al.* 2009; Czekaj-Zastawny and Przybyła 2012)

Site	type of location	number of burials	burial nr	type of burial	orientation	grave goods	sex/age
Aleksandrowice 2	1 or 3	3	2540	skeletal?	NE-SW	0	?
			2541	skeletal?	W-E	0	?
			2542	skeletal?	NE-SW	fragm. of 2 vessels	?
Bejsce	?	1	pit 3	skeltal	N-S?	2 vessels	childe
Brzezie 17	3	3	1528	skeletal?	N-S	fragm. of 2-3 vessels	?
			1543	skeletal?	N-S	fragm. of 3 vessels	?
			1586	skeletal?	N-S	0	?
Giebułtów 1	1?	7	I	skeletal	W-E	0	
			II	skeletal	W-E	0	
			III	skeletal	W-E	0	
			IV	skeletal	W-E	1 bone tool	
			V	skeletal	W-E	0	
			VI	skeletal	W-E	frgm. of 1 vessel, 1 flint art.	
			VII	skeletal	W-E	0	Male
Gródek nad Bugiem 2	?	1		cremation	?	4 pottery fragm.	?
Igołomia 1	?	1		skeletal	W-E	3 pottery fragm., 12 flint art., 1 obsidian art.	?
Łoniowa 18	2	2	19	skeletal?	N-S	0	?
			23	skeletal?	N-S	1 vessel, deposit of flint artefacts	?
Modlniczka 2	1	39	1040	cremation	?	1 shoe-last tool, 1 flint art.	adult
			1061	cremation	?	5 shoe-last tools, 9 pttery fragm., 5 flint art.	adult
			1087	cremation	?	1 shoe-last tool, 2 flint art.	*adultus/ maturus*
			1109	cremation	?	2 shoe-last tools, 11 pttery fragm.	adult

Table 1.

Site	type of location	number of burials	burial nr	type of burial	orientation	grave goods	sex/age
Modlniczka 2	1	39	1111	cremation	?	0	adult
			1145	cremation	?	1 shoe-last tool, 2 pottery fragm.	?
			1184	cremation	?	0	adult
			1205	cremation	?	0	Male; *maturus*
			1213	cremation	?	0	Male; *maturus*
			1218	cremation	?	1 shoe-last tool, 1 flint art.	adult
			1249	cremation	?	2 shoe-last tools, 1 flint art.	*infans*
			1253	cremation	?	1 shoe-last tool	?
			1354	cremation	?	1 shoe-last tool, 6 pottery fragm., 1 flint art.	adult
			1377	cremation	?	0	adult
			1378	cremation	?	0	adult
			1397	cremation	?	0	?
			1415	cremation	?		
			1423	cremation	?	2 shoe-last tools	*maturus*
			1477	cremation	?	0	?
			3860	cremation	?	2 shoe-last tools	?
			4619	cremation	?	3 shoe-last tools, 7 pottery fragm., 2 flint art.	?
			4688	cremation	?	1 shoe-last tool, 4 pottery fragm., 4 flint art., 1 stone art.	Male; *maturus/ senilis*
			6072	cremation	?	0	?
			6973	cremation	?	0	?
			6074	cremation	?	0	adult
			6075	cremation	?	0	?

Modlniczka 2	1	39	6077	cremation	?	0	?
			6078	cremation	?	0	?
			6128	cremation	?	0	adult
			6129	cremation	?	0	adult
			6130	cremation	?	0	?
			6131	cremation	?	0	?
			6132	cremation	?	0	?
			6133	cremation	?	0	?
			6189	cremation	?	1 shoe-last tool	?
			7422	cremation	?	1 pottery fragm.	adult
			7427	cremation	?	35 pottery fragm.	*adultus*
			7447	cremation	?	0	?
			7496	cremation	?	1 shoe-last tool, 3 pottery fragm.	Male; *adultus/ maturus*
Olchowa 20	2	1	I	skeletal?	N-S	3 vessels	?
Samborzec 1	2	5	41	skeletal	NW-SE	3 pottery fragm.	*Infans I/II*
			42	skeletal	W-E	1 pottery fragm.	Female; *maturus*
			60	skeletal	N-S	1 vessel with powdred ocher, 2 bone tools	Female; *maturus*
			71	skeletal	N-S	1 vessel	*Infans I*
			208	skeletal	W-E	1 shell bead necklace, 1 limestone bead necklace, powdred ocher	Female; *adultus*
Szczotkowice 1	?	1	1	skeletal	?	2 vessels, 36 limestone beads, 3 beeds made of *Spondylus gaedoperus* shell, 1 cylindrical ceramic artifact, 1 fragm. of animal bone (*Bos taurus*)	ca. 60 years
Targowisko 12/13	2	1	1	skeletal?	?	0	?
Złotniki 1	2	3	1	skeletal	NW-SE	0	?
			2	skeletal	N-S	0	?
			3	skeletal	NW-SE	0	?

In common with the settlements, the graves of the Linear Pottery culture from Poland fit with the general model of the funeral rite of the LBK. This is visible in all elements of the funerary rite, such as the context, the location, the construction of the grave, and the grave goods. They have local characteristics (*e.g.* the absence of certain categories of artefacts), but the elements common to the whole LBK milieu prevail (orientation of grave pits, positioning of the dead in the grave pit, main grave goods, *etc.*).

There are 17 other known sites with burials. In the area of south-eastern Poland as many as 13 of them were discovered (Fig. 1; Table 1; Czekaj-Zastawny *et al.* 2009): Aleksandrowice (3 burials), Brzezie 17 (4 burials), Łoniowa (1 burial), Olchowa (1 burial), Samborzec (5 burials), Szczotkowice (1 burial), Modlnica 5 (2 burials), and Targowisko 12/13 (1 burial), (Czekaj-Zastawny 2000; 2008; 2009b; 2014; Valde-Nowak 2008; Mitura and Zych 1999; Kulczycka-Leciejewiczowa 2008; Krauss 1964; Czerniak *et al.* 2006). Graves identified as probably belonging to the LBK came from: Giebułtów (7 burials, Złotniki (3 burials), Bejsce (1 burial), Igołomia-Zofipole (1 burial) and Gródek on the Bug River (cremation burial), (Dzieduszycka 1959; 1964; Sulimirski 1938; Gajewski 1960; Kempisty 1962). In Śląsk, so far, only one site of this type has been encountered – in Stary Zamek (however, considering the recent results of dating, there are doubts regarding the association of these graves with the LBK; Kulczycka-Leciejewiczowa 1988). From the area of the Polish Lowland, within the region of Kujawy, 4 sites have revealed graves, all of which were located in the close vicinity of houses: Brześć Kujawski, Ludwinowo 7, Miechowice, and Kruszyn (Grygiel 2004; Czerniak and Kabaciński 2004; Pyzel 2019).

THE FIRST LBK CEMETERY IN POLAND

Burials are an integral part of many settlements. The identification of the first cemetery of the LBK in Poland – at site 2 in Modlniczka, Kraków area – was the most important discovery of recent years (Czekaj-Zastawny and Przybyła 2012, 31-62).

This cemetery was established in a low, waterlogged part of a valley, and hence within a zone atypical for LBK settlement. Within the excavated area, 39 cremation burials were encountered, covering around 7000 square meters (Fig. 2). They did not create compact clusters, although minor aggregations are perceptible. All the burials are in pits (Fig. 3, Fig. 4) of various shapes (circular, oval, or rectangular), and all have smaller hollows at the bottom, where the remains of funeral pyres were deposited. The fact that the remains of the pyre were moved is testified to by fragmentarily preserved elements of the inventory – both vessels and stone items, among which amphibolite shoe-last tools strongly prevailed (Fig. 5). Only in two graves did the grave goods consist exclusively of pottery. Most commonly, grave goods included an adze and pottery. All the graves are single burials. Out of the 39 discovered burials, the sex of the deceased was determined in 6 cases (1 female and 5 males). Fourteen of the individuals were identified as adults, and one as a child. The

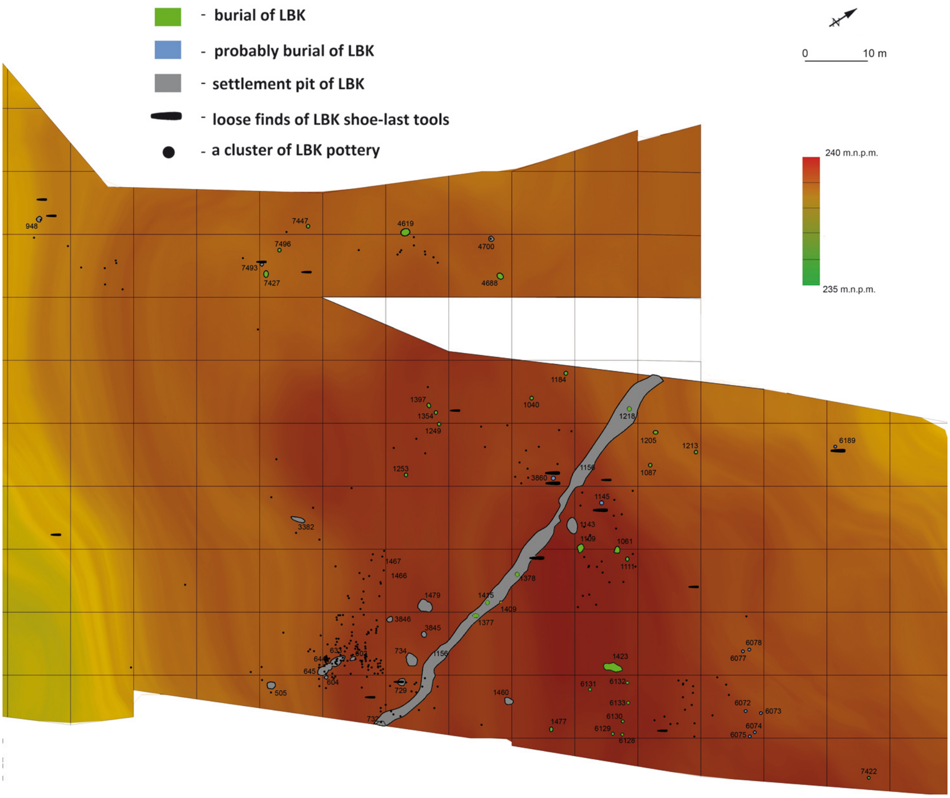

Fig. 2. Modlniczka – plan of the cemetery (Czekaj-Zastawny and Przybyła 2012)

Fig. 3. Modlniczka – cremation burial – feat. No. 1184 (Czekaj-Zastawny and Przybyła 2012)

Fig. 4. Modlniczka – cremation burial – feat. No. 1024 (Czekaj-Zastawny and Przybyła 2012)

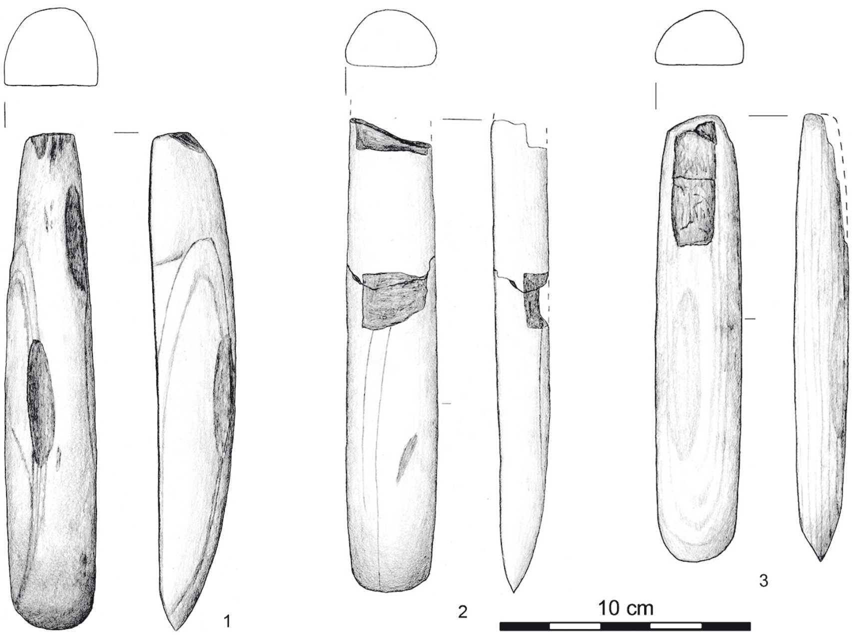

Fig. 5. Modlniczka – examples of shoe-last tools from cremation burials (Czekaj-Zastawny and Przybyła 2012)

entire cemetery was dated to the fully-developed Music Note phase and possibly to the beginnings of the Želiezovce phase of the LBK. It seems likely that the cemetery was associated with the settlement functioning on the nearby elevation (Modlnica, site 5).

PATTERNS OF BURIALS LOCATION IN LBK

There are three basic models of the location of the graves (Jeunesse 1997, 43, 44): designated cemeteries (type 1), individual burials within a settlement (type 2), and small clusters of burials within or on the outskirts of a settlement (type 3). The sites from south-eastern Poland should be ascribed primarily to type 2. Besides the burial ground in Modlniczka, distinguishing sites belonging to types 1 and 3 involves certain difficulties. This mostly stems from the fact that a sufficient area around the burials has yet to be examined. With complete certainty, only the burial ground situated on the outskirts of the settlement in Brzezie 17 can be recognized as type 3. Other burials discovered in clusters can be associated with both type 1 and 3, although the existence of small clusters of graves next to settlements seems more likely. The category of burials located within settlements is represented by features from Olchowa, Łoniowa, Samborzec, Modlnica, and Targowisko 12/13 to name a few.

BI-RITUAL OF BURIALS IN LBK

In the LBK, both inhumations and cremation burials are known. In some regions, both of the rites were followed equally often, but elsewhere the ratio of the two types of burials is different – *e.g.*, at the cemetery in Elsloo, cremations accounted for 42% of all burials, while in Nitra, cremation burials represented 10% of all interments, and in Vedrovice, not a single cremation was found among the total of 96 burials. Cemeteries containing the highest percentage of cremation burials are primarily located in central Germany (Arnstadt – 12 cremations and 10 inhumations; Wandersleben – 132 and 179, respectively), Bavaria (Stephansposching – 31 cremations and 10 inhumations; Aiterhofen – 69 and 159, respectively) and in the Netherlands (47 cremations and 66 inhumations in Elsloo). The burial ground in Modlniczka is unique in this respect, since the cremation burials amount here to 100% of all the graves. Hence, this undermines the opinion that the cremation rite is rare in the eastern range of the LBK (Jeunesse 1997). The closest to Modlniczka, and demonstrating a close similarity to it, is the burial ground in Kralice na Hané (Šmid 2012). There, cremation burials make up the second-highest percentage among the known cemeteries – 89.61%. The grave goods are also analogous to those from Modlniczka.

In Poland, no burial grounds containing both types of burials have been encountered. Moreover, besides the above-mentioned burial ground, the only known cremation burial, in fact regarded as an alleged LBK burial, comes from Gródek on the Bug River. The remaining features are inhumations. There is also a group of burials with no skeletal remains, where either bones did not survive or else these features were cases of symbolic burials – as, for instance, within rectangular features inside tripartite houses (*e.g.*, in Brzezie 17, Brzezie 40, Targowisko 12/13, 14/15). In each case, these features are contemporaneous with the house and always in the same part of it. In the infill of most of them, small artefacts are found in the backfill layer, and in a few, typical inventories of grave goods were discovered (especially in Łoniowa; Valde-Nowak 2008, 51-54). These examples come from sites where bones are extremely poorly preserved; thus, it is hard to assess whether these were actual or symbolic burials.

CONSTRUCTION AND ORIENTATION OF THE GRAVE PIT IN THE LBK

All of the graves contained single burials. Inhumation pits are highly uniform: in most cases they are oval or sub-rectangular, and devoid of any trace of additional structures. This form of burial is the most typical at all European sites. In Aleksandrowice, two graves of rare construction were discovered. In both cases, the pit was either reinforced with a wooden structure or it was roofed (Fig. 6). In other LBK burials in Polish lands, no

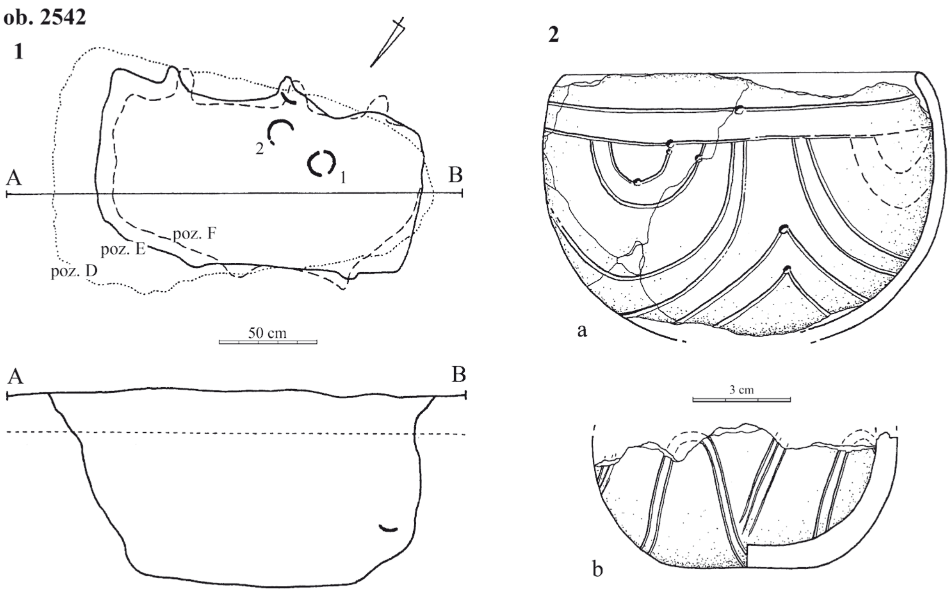

Fig. 6. Aleksandrowice – example grave (Czekaj-Zastawny 2009b)

similar structures have been recorded to date, and outside Poland there are very few of them – *e.g.*, in Mulhouse-Est in the Alsace region (two burials; Jeunesse 1997, 60, 61), in Sondershausen in Bavaria (two graves; Kahlke 1954, 66-68), and in Arnstadt in central Germany (one burial; Kahlke 1954, 66-68). The remains of the construction are perceptible in the form of traces of four vertical posts in a square plan on the inner side of the burial pit's margin, as well as traces of a few posts surrounding the pit (Jeunesse 1997, 60, 61). Placement of the posts on the western, southern and eastern sides is typical. These structures are interpreted as traces of "mortuary houses" with entrances on the north side. Feature 2541 from Aleksandrowice is analogous in this respect (Czekaj-Zastawny 2000; 2008). Traces of posts were recorded here as well, on each of the three aforementioned cardinal directions. Additionally, the direction of the burial pit axis is identical to the analogous features from outside Poland. The burial discussed here is most similar to grave 28 from Sondershausen (Kahlke 1954, 66-68).

Infills of the skeletal burials indicate that the grave pits were backfilled directly after the deposit of the deceased, with dirt from the immediate surroundings of the burial. It seems that no attention was paid to the orientation of the pits with the respect to the cardinal directions, as is also the case in burial grounds outside Poland, where no strict rules regulating this matter were observed. Within the entire range of the LBK, grave orientation is site-specific for each location. At the same time, all the burials are uniform when it comes to the position of the body of the dead: crouched on one side, upper limbs bent at the elbows and directed toward the face, lower limbs bent at the hip and knee joints, feet pulled-up to the pelvis. In seven cases, the deceased was laid on the right-hand side, and in four, on the left-hand side; choice of the side has no apparent connections to sex or age. At LBK grave sites outside Poland, the crouched position on the left-hand side dominates. However, there are sites known where this position does not prevail, as, for instance, at the cemetery in Rutzing in Upper Austria (10 out of 16 deceased were interred there on the right-hand side).

GRAVE GOODS AND TREATMENT OF THE DECEASED IN LBK

In none of the graves were human remains deliberately destroyed or deprived of parts of the skeleton. In three of the graves, the dead were sprinkled with ochre. This practice was fairly common among LBK burials (Jeunesse 1997, 80). Ochre, sprinkled on or around the body, was most often applied on particular parts of the body and in its surroundings. This pigment most often occurs in the vicinity of the skull (as at objects 60 and 208 in Samborzec; Fig. 7). It is not unusual to encounter burials in which there are two concentrations of ochre: in the vicinity of the skull, and between the pelvis and knees (which is possibly the case in the grave in Szczotkowice).

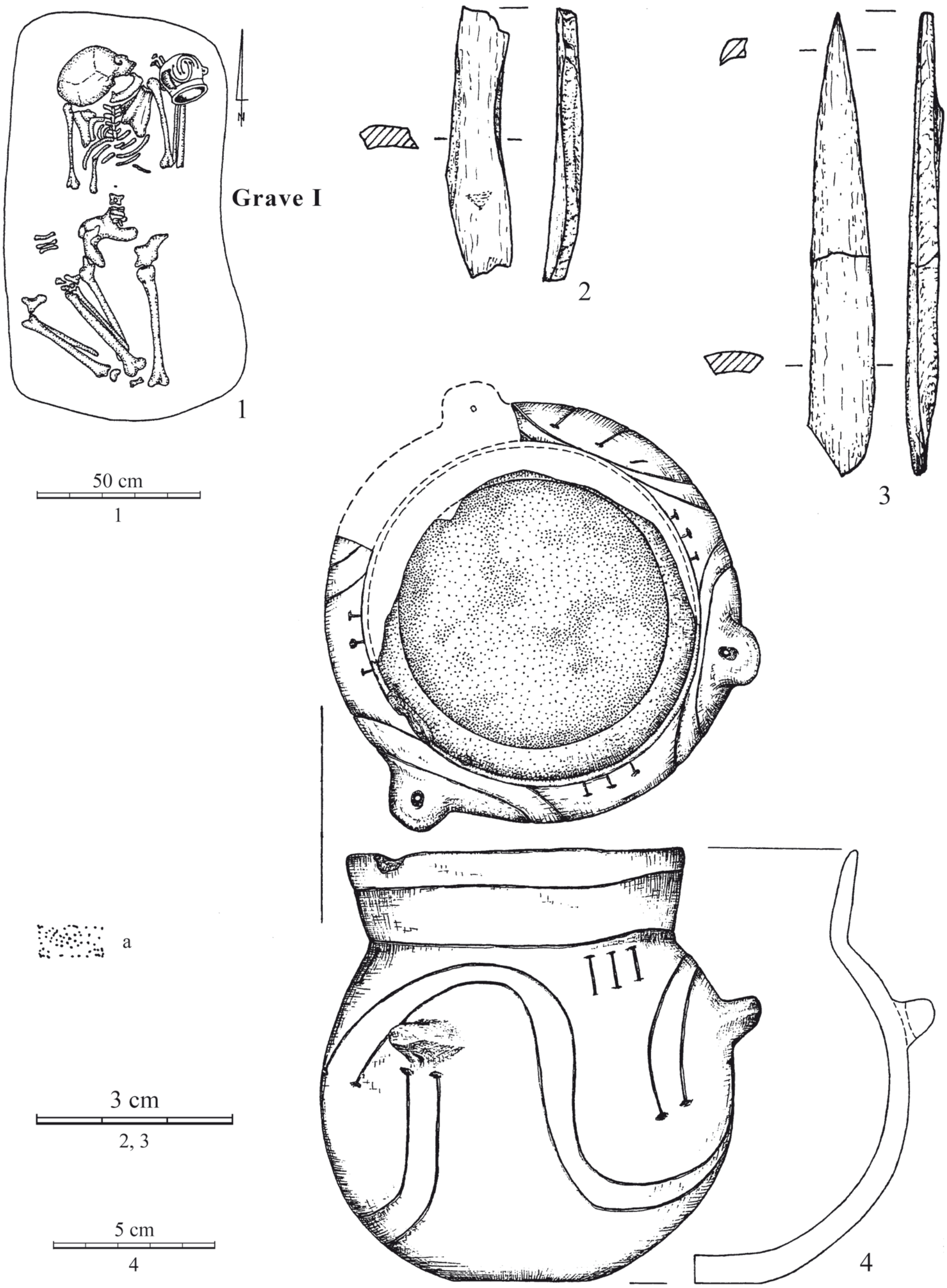

Fig. 7. Samborzec. Grave I (feature 60): 1 – horizontal outline of grave pit with skeleton and grave inventory, 2 – bone tool fragment, 3 – bone tool, 4 – clay vessel with traces of ochre (a); (Czekaj-Zastawny 2009b)

Detailed anthropological analysis was done only for the skeletons from Samborzec (studies by E. Haduch). In total 2 women, 2 men, 2 children and 7 skeletons described as adult individuals were identified. The deceased were of good health, which makes it impossible to determine the cause of their death.

The artefacts found in the graves were those most common in LBK cemeteries. Regarding inhumations, these are mostly pottery vessels, and in cremation burials – stone shoe-last tools. Between 1 and 3 pottery vessels were laid in the graves. Grave goods were placed in the corner of the burial pits (Olchowa), most often close to the head of the deceased (in feature no. 60 from Samborzec, they were in the hands of the deceased lifted toward the head) or next to the outline of the pit, along its longer side (Aleksandrowice). Only in two cases were the vessels accompanied by other items (feature 60 from Samborzec, burial I from Szczotkowice). In three burials, the grave goods contained no vessels. Also found are ornaments, tools, pigments, animal bones, and a polishing slab.

Fig. 8. Szczotkowice – necklace made of *Spondylus gaederopus* shell beads and white marble (Czekaj-Zastawny 2017)

Ornaments are very frequently present in the LBK grave inventories, and they are extremely diverse. Beads are typical of this culture, and ones made of *Spondylus gaederopus* shell are particularly characteristic (Fig. 8). Various tools were found in three graves: in feature 60 from Samborzec – a bone awl, in the grave from Igołomia – a set of flint items, including two sickle insets, and in grave VII from Giebułtów – a tool made of deer antler. Only in one grave (feature 60 from Samborzec) was pigment (specifically, a container filled with powdered ochre) present among the grave goods.

Ochre and graphite are the most widespread pigments. They are found in lumps or powdered (Jeunesse 1997, 80). In most cases, ochre covered the deceased (*cf.* above). Analogously to feature 60 from Samborzec, powdered ochre stored in a container was found in graves 2 and 30 from Essenbach, to name just a few examples.

The feature from Łoniowa is in many ways one of the most interesting burials. Besides the unusual location (within the outline of a contemporaneous house) and traces of organic items, it was also exceptional when it comes to the flint inventory included among the grave goods.

The question of distinguishing inventories typical of female and male burials in the LBK funeral rite is difficult to address. Both men and women were treated similarly regardless of their age. One should rather speak about the categories of artefacts most commonly present in male or female burials, and not about their rigorous division (Jeunesse 1997). The majority of known burials contain "neutral" grave goods that do not indicate the gender of the interred. This is true in the case of inhumations from Poland, where none of the categories more associated with one or the other sex were found. In both the female and male graves, there were items present that are considered to be typical for either sex, *i.e.*, pottery vessels and beads.

This issue renders itself quite differently in the case of cremation burials. At the cemetery in Modlniczka, all the graves identified as male burials were equipped with at least one amphibolite adze (in an extreme case, 4 pieces – grave 1061). This is typical of cremation burial cemeteries, where shoe-last tools, flint artefacts, and pottery vessels or sherds are the most commonly found grave goods. Analyses carried out at the site in Aiterhofen (Nieszery 1995) indicate that, just as in Modlniczka, adzes were the most common elements of grave goods in male burials. Based on this, it is assumed that anthropologically unidentified graves equipped with adzes are male interments; likewise, the only discovered burial of a child was probably the grave of a boy.

GENERAL CHRONOLOGY OF LBK BURIALS IN POLAND AREA

Chronology with respect to the phases of the LBK may be defined only in the case of graves equipped with decorated pottery, and in individual cases – on the basis of stratigraphic relationships. Probably only one burial (feature 208 from Samborzec) may be dated to phase I – the Zofipole phase. Seven graves are dated to the Music Note phase (feature 2542 from Aleksandrowice, features from Brzezie, features 60 and possibly 71 from Samborzec, grave I from Szczotkowice), and two to the Želiezovce phase (from Łoniowa and Olchowa). The cemetery in Modlniczka is dated to the second half of the Music Note phase and the beginning of the Želiezovce phase of the LBK (Czekaj-Zastawny 2009b).

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TECHNOLOGICAL INDICATORS IN THE POTTERY PRODUCTION OF THE LATE LINEAR POTTERY CULTURE AND THE MALICE CULTURE

ABSTRACT

Rauba-Bukowska A. 2021. Technological indicators in the pottery production of the late Linear Pottery culture and the Malice culture. *Sprawozdania Archeologiczne* 73/1, 119-151.

This study aimed to reveal the transformations in pottery production in the Linear Pottery culture. In the course of longstanding analyses of archaeological materials from Lesser Poland, a few technological groups of this pottery were distinguished. A significant change in the preparation of ceramic fabrics was recorded in the late LBK phase, namely the Želiezovce phase. The objective of this study was to gather all data and confront it with the most recent findings from the sites of Targowisko and Brzezie. Based on the investigations, it was established that the major indicators of the late LBK phases were the occurrence of grog admixture, a significantly less common application of chaff admixture, and a smaller contribution of ceramic fabrics tempered with sand. In the light of the chronology of the materials under scrutiny, a distinctive predominance of ceramic fabrics with grog admixture was observed when compared with the set of ceramic bodies previously analysed.

Keywords: Neolithic, south-eastern Poland, ceramic technology, Linear Pottery culture, Malice culture
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1. INTRODUCTION

The earliest farming settlements in the territory of Poland were established by communities of the Linear Pottery culture (from German Linearbandkeramik – LBK). The latest studies on absolute chronology for this culture indicate that it existed from 5350-4900/4800 BC within the territory of modern Poland (Czekaj-Zastawny 2014; 2017; Czekaj-Zastawny *et al.* 2020; Oberc *et al.* in press). The beginnings of the classic phase (Ib) of the Malice culture (MC), which is connected with the Lengel and Tisza cultures was established to between 4650-4550 BC (Kadrow *et al.* 2021). The process of cultural succession between the LBK and MC is the subject of considerations by many researchers – artifacts of MC very often are unearthed at the same sites as those of the LBK. Some claimed that with the end of the LBK and Bükk cultures, contacts between south-eastern Poland and the northern part of the Carpathian Basin ceased (Kozłowski *et al.* 2014 (2015), 41), and settlers, *e.g.*, of the MC, came from the Carpathian Basin (Kaczanowska 1990; Kamieńska and Kozłowski 1990; Kozłowski 2004, 11).

Anna Kulczycka-Leciejewiczowa proposed another direction – a gradual change within the LBK community in its late phase (III) (2004, 21). Sławomir Kadrow maintains that this change caused the transformation of the LBK into the MC (Kadrow 2005, 26, 27; Kadrow 2020a, 96-101).

A characteristic trait of these societies was a farming economy based on agriculture and animal husbandry, which was directly associated with a sedentary lifestyle (Wiślański 1969; Kulczycka Leciejewiczowa 1979; Kozłowski 1998; Pavúk 2004; Czekaj-Zastawny 2008a; Bánffy and Oross 2010; Czekaj-Zastawny 2017). People lived in long, rectangular houses of post construction, concentrated in groups forming farms. Moreover, these societies were the first who produced and utilised ceramic vessels in Lesser Poland. Fragments of these vessels, in addition to flint and stone tools, are the most common artefacts used by the Neolithic farmers that have preserved until today.

Microscopic analyses of ceramic vessels have been used in the elaboration of archaeological ceramic materials for many years. Such analyses of LBK pottery coming from the Upper Vistula River, begun in the early 21st century, have delivered a lot of new findings and detailed knowledge on the matter in question. The basic division of vessels and ceramic fragments of LBK pottery is based on distinguishing thin-, medium- and thick-walled vessels. Thin-walled vessels are characterised by an occurrence of incised ornamentation. Medium- and thick-walled vessels were usually not decorated with this type of ornament. Plastic elements are often encountered on the surfaces of the latter, such as knobs, handles, bands, finger- and nail-tipped decoration, and ornaments of the *barbotino* style (Stadler and Kotova 2019; Czekaj-Zastawny *et al.* 2020, fig. 7: g). Each of the above-mentioned vessel types is also distinctive in terms of the preparation of the ceramic fabric. Generally, the thin-walled vessels were made of fine-grained ceramic fabric, while for the production of medium-walled vessels, medium and coarse-grained fabrics were used.

Table 1. The average content of clay minerals, quartz, and grog in 302 LBK and 48 ALPC ceramic samples (Rauba-Bukowska and Czekaj-Zastawny 2020); values in percent SD (standard deviation)

Cultural affiliation	**Type**	**Average content of**			**All type**	**Average content of**					
		Clay minerals	Quartz	Grog		Clay minerals	SD	Quartz	SD	Grog	SD
LBK phase I	fine ware	64	22	0,27	all type phase I LBK	65	10	19	10	0,35	1
	kitchen ware	66	18	0,27							
	coarse ware	66	17	0,52							
LBK phase II	fine ware	66	19	0,5	all type phase II LBK	63	16	19	11	0,48	2
	kitchen ware	63	21	0,13							
	coarse ware	59	18	0,62							
LBK phase III	fine ware	56	27	1,5	all type phase III LBK	54	13	27	11	4	6
	kitchen ware	56	28	3,7							
	coarse ware	51	25	8,5							
ALPC	*	*	*	*	all type ALPC	52,7	7,9	28,1	8,5	2,1	4,7

Thick-walled vessels were produced using coarse-grained ceramic fabrics. However, these were not rigid rules that would apply to every case study. Instead, they should be considered as strong tendencies or traditions, whether intentional or not. Detailed studies on ceramic fabrics allowed us to specify the preferences of potters in manufacturing ceramic pots, which include their variability over time and between sites. The analysis consisted of several hundred LBK vessels discovered at a few dozen sites from south-eastern Poland (Czekaj-Zastawny and Rauba-Bukowska 2013; Rauba-Bukowska 2014a; Kozłowski *et al.* 2014 (2015); Rauba-Bukowska 2016; Kadrow and Rauba-Bukowska 2017; Czekaj-Zastawny *et al.* 2017; Rauba-Bukowska and Czekaj-Zastawny 2020). The investigated fragments come from pots of various chronologies within the LBK development timeframes, namely the early (from 5350 BC), classical and late (from 5000-4900/4800 BC) phases. These studies, constantly being complemented with the results of new analyses, constitute the basis for the formulation of conclusions on the variability in the technology of ceramic vessel production (Table 1; Fig. 1). Detailed examinations, *i.a.* statistical analyses of data, revealed that with regard to the investigated samples, pottery from the older LBK phases was made of heavy clays/loams with a lower contribution of silt. Thin-walled vessels mainly were produced using ceramic fabrics with only organic admixture (namely chaff). In con-

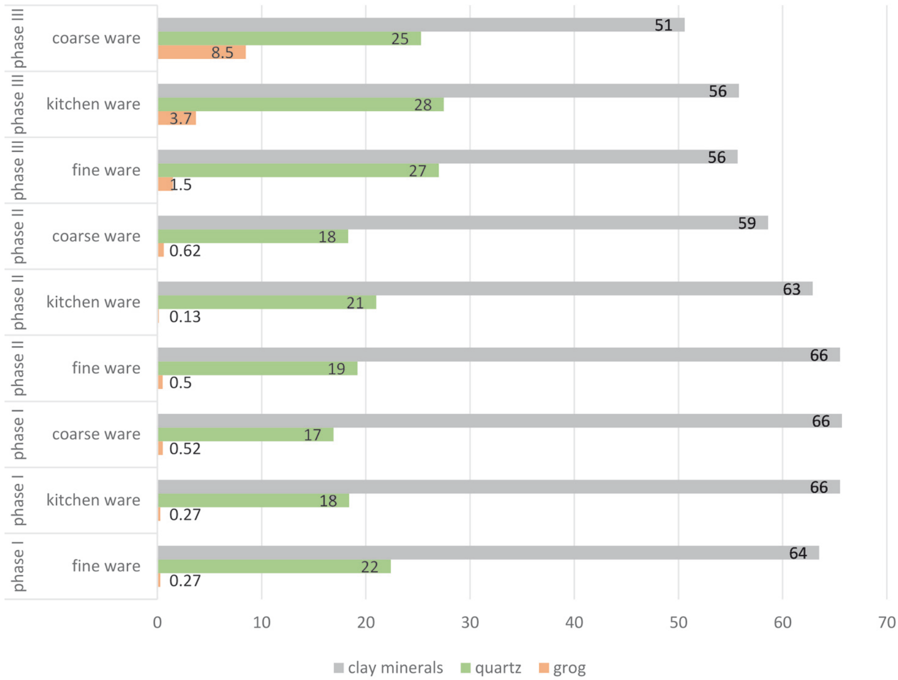

Fig. 1. The average content of clay minerals, quartz, and grog in the LBK sherds (phase I n=99; phase II n=103; phase III n=100) and ALPC (n=48) ceramic samples; value in percent

trast, medium-walled vessels contained sand and plant admixture. Finally, thick-walled vessels were made of ceramic fabrics with chaff admixture and fragments of argillaceous rock fragments, and rarely, with grog (Kadrow and Rauba-Bukowska 2016; Czekaj-Zastawny *et al.* 2017; Rauba-Bukowska and Czekaj-Zastawny 2020). These differences may be due to a few factors: technological, cultural, and aesthetic. In the late LBK phases, silty clays were more commonly used as raw material to produce fine ceramics (Kozłowski *et al.* 2015). Pottery with decorations corresponding to Želiezovce stylistics more often was made of well-prepared ceramic paste. These fabrics usually do not contain organic admixture. Thick-walled vessels were produced using the clay mixtures that previously had been very rarely applied, namely with grog admixture (crushed ceramics). Therefore, distinctive changes had their impact on both the manner of acquisition of raw materials as well as the preparation of ceramic fabrics. These technological changes in the production of pottery most likely resulted from deeper transformations inspired by internal social mechanisms and/or by external influences induced by contacts with societies of different traditions (*i.a.*, technological preferences in the production of pottery).

In this period (late LBK in Poland), contacts with the communities inhabiting the territories of eastern Slovakia have been confirmed (Czekaj-Zastawny 2008a; 2008b; Kaczanowska and Godłowska 2009). They represent the eastern variant of the LBK, namely the Eastern Linear cultural circle or the Alföld Linear Pottery culture (ALPC). ALPC artefacts have been recorded in the territory of Poland at LBK settlements as well. Especially noteworthy are objects (tools) made of obsidian. This raw material is not available in the vicinity of the LBK settlements in Poland, whereas it is a common raw material within the area occupied by ALPC societies (Szeliga 2021; Werra *et al.* 2021). Apart from obsidian, at LBK settlements such as Mogiła 62, Brzezie 17, Tominy 6, Zwięczyca 3, Kosina 62, and Rzeszów 16 (city District Piastów), numerous fragments of vessels were encountered that closely resemble the vessels gathered at ALPC sites in terms of both ornament stylistics and technology (Kadrow 1990; Szeliga and Zakościelna 2007; 2019; Kaczanowska and Godłowska 2009; Czekaj-Zastawny 2014; Dębiec 2014; Sebők 2014; Dębiec *et al.* 2021).

Analyses of the composition of ceramic fabrics applied by these two cultural units (LBK and ALPC) revealed a similarity between the ceramic materials used in the pottery production of the Želiezovce phase in Poland and the ALPC pottery manufacturing tradition (Kozłowski *et al.* 2015; Rauba-Bukowska 2014b; Moskal-del Hoyo *et al.* 2017; Czekaj-Zastawny *et al.* 2018; Rauba-Bukowska and Czekaj-Zastawny 2020). This similarity refers to the technology of preparation of ceramic fabrics, namely the selection of raw material and admixtures. Silty, fine-grained clays were often used as the raw material, and grog admixture became more common. Pottery of the Bükk culture from Hungary corresponds in this respect to the pottery from eastern Slovakia. Thin-walled vessels are generally characterised by a fine-grained, compact, homogeneous fabric. The raw material is assumed to have been carefully selected and prepared; ceramic fabrics were not artificially tempered (Szilágyi *et al.* 2011; 2014).

The Želiezovce phase itself derived from the Želiezovce group formed in the territory of modern western Slovakia (Pavúk 1969; Kadrow 2020b). Ceramic materials of this group were characterized by the use of silty clays and the lack of organic admixture (Pavúk 1969).

The materials of both the Želiezovce phase in south-eastern Poland and the Želiezovce group in Slovakia (*e.g.*, site Štúrovo) often are accompanied by imported artefacts. Within the Želiezovce group, these artefacts come from the Tisza River region and from the area of the Szakálhát group, and numerous imports come from the Bükk culture (Pavúk 1969, 275; Pavúk 1994, 172, 173; Müller-Scheeβel *et al.* 2020, 105). In the Želiezovce phase in Poland, they were imported from the Tiszadob-Kapušany groups and the Bükk culture as well (Kadrow 1990; Kaczanowska and Godłowska 2009; Czekaj-Zastawny 2014; Dębiec 2014; Szeliga and Zakościelna 2007; 2019; Szeliga 2021).

The above remarks may suggest the main directions from which technological innovations (in pottery production) could have emanated: a formative area for ceramics in the Želiezovce style, and areas south of the Carpathians – inhabited by the population of the Eastern Linear cultural circle (Kulczycka-Leciejewiczowa 1979, 63; Rauba-Bukowska and Czekaj-Zastawny 2020).

2. MATERIALS, AIMS, AND AREA OF RESEARCH

The newest microscopic analyses covered 47 fragments of pottery (Table 2). Thirty fragments come from LBK vessels, including 15 pieces from Brzezie 40 and another 15 from Targowisko 16. Almost half of these fragments are the remains of thin-walled vessels; the other half represents thick- and medium-walled vessels. Seventeen fragments were ascribed to the MC and were collected from Targowisko 14-15, including eight thin-walled and nine thick-walled fragments. All of these specimens were gathered during excavations carried out in the years 2018-2019, when the relics of households of the LBK and the MC were discovered. These households were contemporaneous and preserved in an undisturbed condition (Kadrow *et al.* 2021).

The studies on prehistoric pottery were complemented with the results of investigations and analyses of ceramic raw materials. For this purpose, samples from a few locations were taken (Fig. 2; Table 2). These samples were subject to evaluation already at the stage of field research, and based on the results, some of them were not included in further analyses. More promising were the samples taken from the accumulation terraces of the Raba River, to the east of the complex of sites in Targowisko, as well as the samples coming from the area situated to the south of Brzezie 40, nearby an unnamed stream of water.

Table 2. List of analysed samples

No	Symbol	Site	Samples	Cultural affiliation	Phase	Inv. no	Feature	Fine/ middle/ coarse
1	Brz40/1	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/61	10	fine
2	Brz40/2	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/67	10	fine
3	Brz40/3	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/54	10	middle
4	Brz40/4	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/32	8	fine
5	Brz40/5	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/52	10	fine
6	Brz40/6	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/52	10	coarse
7	Brz40/7	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/29	10	fine
8	Brz40/8	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/29	10	coarse
9	Brz40/9	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/30	10	middle

Table 2.

No	Symbol	Site	Samples	Cultural affiliation	Phase	Inv. no	Feature	Fine/ middle/ coarse
10	Brz40/10	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/44	8	coarse
11	Brz40/11	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/39	10	fine
12	Brz40/12	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/39	10	middle
13	Brz40/13	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/28	10	coarse/middle
14	Brz40/14	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/40	8	coarse
15	Brz40/15	Brzezie 40	Neolithic ceramic	LBK	II/III	2018/71	10	coarse
16	Tar16/1	Targowisko 16	Neolithic ceramic	LBK	III	2018/62	44	fine/middle
17	Tar16/2	Targowisko 16	Neolithic ceramic	LBK	III	2018/62	44, 45	coarse
18	Tar16/3	Targowisko 16	Neolithic ceramic	LBK	III	2018/17	31	fine
19	Tar16/4	Targowisko 16	Neolithic ceramic	LBK	III	2018/17	31	fine
20	Tar16/5	Targowisko 16	Neolithic ceramic	LBK	III	2018/60	45	fine
21	Tar16/6	Targowisko 16	Neolithic ceramic	LBK	III	2018/20	31	fine
22	Tar16/7	Targowisko 16	Neolithic ceramic	LBK	III	2018/65	45	fine
23	Tar16/8	Targowisko 16	Neolithic ceramic	LBK	III	2018/13	44	fine
24	Tar16/9	Targowisko 16	Neolithic ceramic	LBK	III	2018/73	44	fine
25	Tar16/10	Targowisko 16	Neolithic ceramic	LBK	III	2018/12	44	coarse
26	Tar16/11	Targowisko 16	Neolithic ceramic	LBK	III	2018/34	31	coarse
27	Tar16/12	Targowisko 16	Neolithic ceramic	LBK	III	2018/34	31	fine/middle
28	Tar16/13	Targowisko 16	Neolithic ceramic	LBK	III	2018/38	31	coarse
29	Tar16/14	Targowisko 16	Neolithic ceramic	LBK	III	2018/14	31	coarse
30	Tar16/15	Targowisko 16	Neolithic ceramic	LBK	III	2018/58	44	coarse
31	Tar14-15/1	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/33	1/A	fine

Table 2.

No	Symbol	Site	Samples	Cultural affiliation	Phase	Inv. no	Feature	Fine/ middle/ coarse
32	Tar14-15/2	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/33	1/A	coarse
33	Tar14-15/3	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/72	1/B	fine
34	Tar14-15/4	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/80	1/B	fine
35	Tar14-15/5	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/114	1/B	coarse
36	Tar14-15/6	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/114	1/B	fine
37	Tar14-15/7	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/39	1/C	coarse
38	Tar14-15/8	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/43	1/C	coarse
39	Tar14-15/9	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/44	1/C	fine
40	Tar14-15/10	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/44	1/C	fine
41	Tar14-15/11	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/44	1/C	coarse
42	Tar14-15/12	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/44	1/C	coarse
43	Tar14-15/13	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/115	1D part B	fine
44	Tar14-15/14	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/55	1/C	fine
45	Tar14-15/15	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/92	1/D	coarse
46	Tar14-15/16	Targowisko 1 4-15	Neolithic ceramic	Malice culture		2019/93	1/D	coarse
47	Tar14-15/17	Targowisko 14-15	Neolithic ceramic	Malice culture		2019/51	2	coarse
48	Sur45	Targowisko	ceramic raw material	clay				
49	Sur46	Targowisko	ceramic raw material	clay				
50	Sur47	Brzezie	ceramic raw material	clay				
51	Sur48	Brzezie	ceramic raw material	clay				

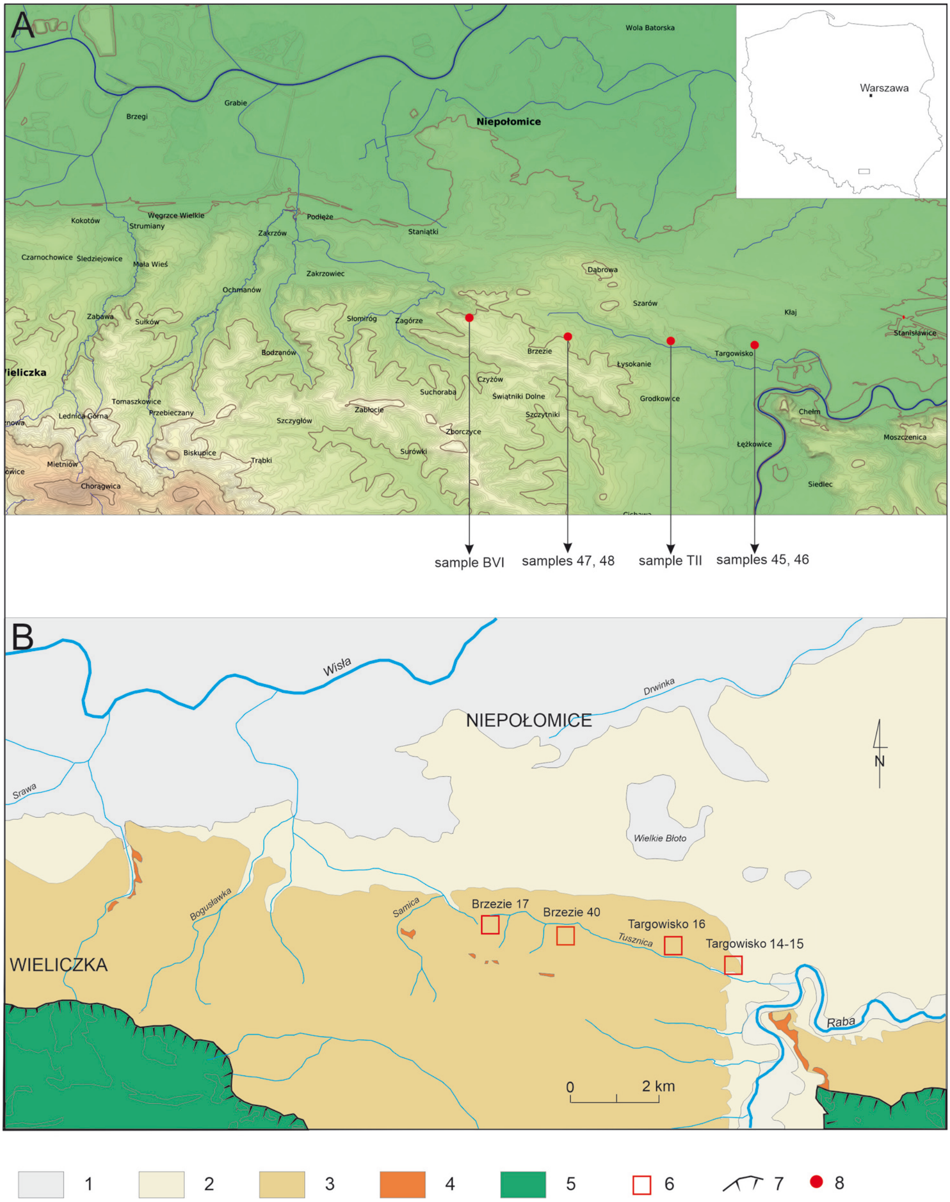

Fig. 2. Location of the archaeological sites and samples of raw material.
A – physical map of south-eastern Poland; B – selection of geological maps (simplified, after Burtan 1954; Skoczylas-Ciszewska and Burtan 1954; Gradziński 1955); 1 – muds, sands and gravels of floodplains of the Vistula and Raba Rivers, Holocene; 2 – sands and gravels above the floodplain terrace of the Vistula and Raba Rivers, Pleistocene; 3 – loess, Pleistocene; 4 – Chodenice and Grabowiec Beds, Miocene; 5 – Carpathian flysch, Paleogene, Cretaceous; 6 – location of the sites; 7 – contemporary margin of the Carpathians; 8 – location of raw material sampling

The analysis aimed to identify the mineral and petrographic composition of ceramic fabrics and the degree of their mixing. In the following stage of the studies, the series of fragments under investigation were compared one to another and confronted with the existing data on the technology of pottery production in the LBK in Lesser Poland.

3. RESEARCH METHODOLOGY

From the ceramic sherds, thin sections were analysed by microscope under polarised light. The raw material samples were mixed by hand and then small bricks of approx. 7 × 5 × 2 cm were shaped. The clay samples prepared in this way were dried for 5 hours at a temperature of 150°C. Then, they were fired in an electric kiln for 24 hours in an oxidizing atmosphere at temperature 700°C. After cooling down, thin sections were made, analogous to those from Neolithic ceramics.

Using the point counting techniques, the percentages of certain compounds were established, including, among others: clay minerals, quartz, potassium feldspars, plagioclase, muscovite, biotite, carbonates, fragments of sedimentary, igneous and metamorphic rocks, fragments of reutilised ceramics (grog) as well as organic material. The description of mineral composition also included silty grains and voids (pores, cavities). The percentage of these elements was established for every sample. The petrographic description also included the degree of mixing of the ceramic fabric, as well as the temperature and conditions of the firing process. An approximate temperature of the original firing was determined based on the thermal transformations of clay minerals, namely the observation of the degree of transformation of ceramic matrix into an amorphous, isotropic substance and the observation of biotite minerals, hornblende, and glauconite (Bolewski and Żabiński 1988; Quinn 2013, 190-203). The division of grain fractions assumed in this paper followed the determinations formulated by the Soil Science Society of Poland (Polskie Towarzystwo Gleboznawcze 2009). The data collected was used for comparative studies.

4. RESULTS

4.1. Raw materials

The research area has thus far delivered a significant collection of ceramic raw materials, including samples of older clays of the Miocene Age, loess (the most common sediment in this area), river sediments, as well as the soils covering the ground. This collection was gathered over the last dozen or so years (Rauba-Bukowska *et al.* 2007; Rauba-Bukowska 2014c; Rauba-Bukowska 2019). The current studies have complemented the collection with new samples (samples 45, 46, 47, 48). All of these raw materials were obtained

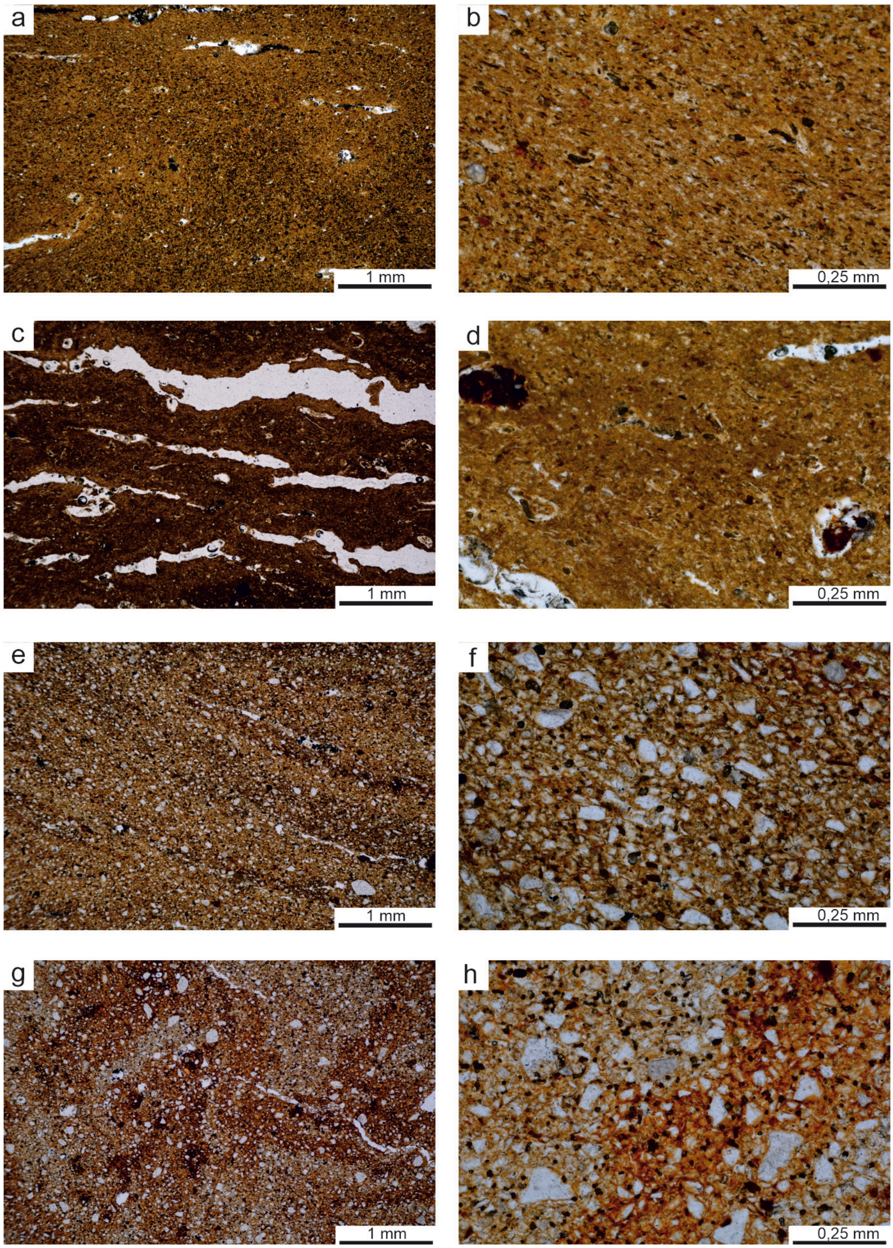

Fig. 3. Photomicrographs of thin sections;
a, b – sample Sur45, homogeneous clay, rare parallel microcracks in the ceramic body; c, d – sample Sur46, homogeneous clay with numerous parallel microcracks; e, f – sample Sur47, silty clay, or loess-like raw material, parallel colorations; g, h – sample Sur48, silty clay or loess-like raw material, uneven colorations; all photos in Plane Polarized Light (PPL)

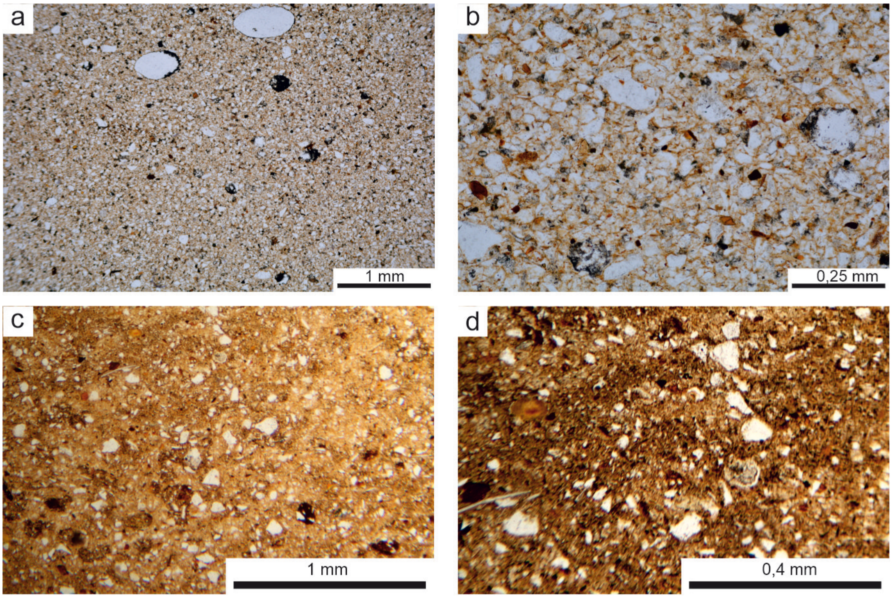

Fig. 4. Photomicrographs of thin sections;
a, b – sample SurTII, loess-like raw material, homogeneous, very fine-grained; c, d – sample SurBVI, heavy clay with a few coarser grains, rare grains of glauconite; all photos in Plane Polarized Light (PPL)

through the Edelman auger used for manual drilling in geological surveys. The locations and descriptions of the samples that could have been used as sources of ceramic raw materials are given below.

Clays and gravels of the lower accumulation terraces, Pleistocene, samples 45, 46 (Fig. 2; 3: a, b, c, d). The samples were taken from the vast valley of the Raba River. This area is adjacent to the silty clays of the Pleistocene Age, extending to the west. The samples were obtained from a depth of *ca.* 1 and 1.7 meters below the ground level. The drilling was performed until it reached the groundwater level. The samples consisted of dark grey, flexible clays containing well-preserved plant remains.

The raw material is fine-grained and homogenous. The sample consisted mainly of clay minerals (*ca.* 70-80%) with a low content of silty grains. There were visible non-transparent compounds, concentrations of iron oxides and hydroxides. The firing process caused an occurrence of longitudinal micro-cracks (Fig. 3: c, d).

River accumulation deposits covering the valleys and the lowest terraces, Holocene, samples 47, 48 (Fig. 2; 3: e, f, g, h).The samples were gathered on the northern slope of a small elevation in Brzezie village, located along the road heading to Dąbrowa. Within the neighbourhood of the sampling spot, there is a small water reservoir. The samples consisted of grey silty clays up to a depth of *ca.* 1 m, and yellow-grey and grey silty clays below

1 m. The drilling was performed until it reached the groundwater level, down to a depth of *ca.* 1.8-2.0 meters. The surroundings of this area are covered with loess-like clays.

The microscopic images of the samples reveal a structure, composition, and granulometry that is typical of loess and loess-like clays. The major compounds of the samples are the binding substance (clay minerals) and silty grains. The latter are represented mainly by quartz and feldspars, non-transparent grains, and mica. There were also distinctive accumulations and concentrations of ferruginous components within the structure, namely iron oxides and hydroxides.

In the course of the former investigations on ceramic raw materials, some samples were taken from the river sediments of the Tusznica Stream, nearby the complex of archaeological sites in Targowisko (sample TII), as well as from the Miocene clays in the vicinity of Brzezie 17 (sample BVI; Fig. 2; Rauba-Bukowska 2007; Rauba-Bukowska 2014c).

Fluvial sediments, Holocene, sample TII (Fig. 2; 4: a, b). The material was sampled from a sounding trench established *ca.* 300 m to the south of the archaeological site Targowisko 16, within a distance of 20 m from the Tusznica Stream, which separates two flattened elevations. The area of the sampling spot belongs to the flood plain. This material is of light grey-brown colour with rusty discolorations.

After firing the clay substance is light orange. It consists of thermally altered clay minerals and a significant amount of silty grains. Within the fine-grained substance, there are sporadic larger, rounded grains of quartz and feldspars. There are also very tiny (0.02 mm) opaque minerals, evenly dispersed. There are also small voids. Rarely, the substance contains concentrations of iron oxides and hydroxides – regular in shape, with distinctive edges (Rauba-Bukowska 2007).

Marine clays of Miocene age, sample BVI (Fig. 2; 4: c, d). The ceramic raw material (clay) was sampled from the northern slope of a small elevation located *ca.* 200 m to the south of the archaeological site Brzezie 17. The samples of flexible grey-to-light-grey clay were taken from a depth of 30 cm.

After firing the clay is orange in colour. It consists mainly of thermally altered clay minerals and a small number of silty grains. Sporadically, there are also larger, rounded grains of quartz and feldspars noted. Within the matrix, concentrations of iron oxides and hydroxides are distinctive. They occur in two types. One of these types is represented by small (up to 0.5 mm) concentrations, regular in shape, with distinct edges. The other occurs in the form of wide, rusty bands. The substance also contains a few thermally altered grains of glauconite. Within the sample, numerous elongated voids were observed, which must have emerged due to the cracking of the material during the process of firing (Rauba-Bukowska 2007).

Based on the above-discussed findings, it may be concluded that both the Miocene clays (sample BVI), as well as the clays from the Raba River (samples 45 and 46), are suitable for the production of ceramic vessels. Due to their poor adhesiveness and elasticity, loess sediments are not very amenable to the shaping of vessel-like forms in the technology of hand-made pottery.

4.2. Pottery

Mineral composition

Ceramic fabrics consist of clay minerals (40-75%), silty grains (approx. 5-20%), tiny mica flakes (muscovite, biotite), iron oxides and hydroxides, opaque minerals and rare heavy minerals (Table 3). Larger grains within the substance are represented by quartz grains, potassium feldspars, and a few chalcedony grains. With regard to the set of samples under analysis, fragments of rocks occur scarcely within the matrix. Amongst them, the most commonly encountered are fragments of sedimentary rocks (mainly claystone and mudstone). Fragments of igneous and metamorphic rocks are very rare, but were found in a greater amount in sample no. 11 from Targowisko 16, for example. Crystal grains are rounded (this concerns both mineral grains and rock fragments). The samples also contained other compounds, the contribution of which was not determined as a percentage. These were grains of glauconite and remains of plankton. Chunks of grog were significant elements of ceramic fabrics, which is discussed in greater detail in the section addressing the issue of intentional admixtures.

4.3. Identification of ceramic raw materials used in production of prehistoric pottery

As a result of the conducted studies upon both ceramic raw materials and prehistoric pottery, it was determined that for the production of ceramic vessels, clays from the Raba River had not been used in their pure form. The analysed clay samples revealed a very homogenous clay substance, with a scarce amount of mineral compounds. None of the vessels under scrutiny shared these characteristics. Moreover, there were no vessels made of purely loess material.

The major indicators used for the determination of the clay were grains of glauconite and the remains of plankton, identified within the ceramic fabrics encountered at the sites Targowisko 16 and 14-15 (Fig. 5: a, b). These compounds indicate that the raw material for the production of ceramic vessels was Miocene clay. The Miocene clay outcrops are situated nearby the archaeological sites on the right bank of the Vistula River, such as Zagórze 2, Brzezie, and Targowisko. Outcrops of Neogene (Miocene) sediments are also commonly encountered on the left bank of the Vistula River, including in the vicinity of Zesławice (there was a brickyard and open-pit mining was carried out). Pottery made of clay containing glauconite and the remains of plankton was identified at a few sites situated on the left bank of the Vistula River, such as Modlnica 5, Mogiła 62, and Pleszów 17-20 (Czekaj-Zastawny and Rauba-Bukowska 2013).

Based on these facts, it should be concluded that ceramic vessels from the sites Targowisko 16 and 14-15 were most likely made of a mixture of the Miocene clays and other sediments, whereas a great majority of the analysed series of 15 fragments of pottery from

Table 3. Mineral composition of the samples; temperature in degrees Celsius; red – reduction, redox – reduction with low airflow; ox – oxidation; values in percent

No	Symbol of the site	Clay minerals	Silt (grains <0,05 mm)	Quartz	Flint/Chalcedony	K-feldspars	Plagioclases	Fragments of sedimentry rocks	Fragments of magmatic rocks	Fragments of metamorphic rocks	Muscovite	Biotite	Opaque minerals	Iron oxides and hydroxides	Grog	Clay clasts	Organic fragments	Heavy minerals	Voids	Fine/middle/coarse	Atmosphere of the firing	Approximately temperature of firing	Ceramic fabric type
1	Brz40/1	58,6	20,5	3,6	0,0	1,3	0,0	0,3	0,0	0,0	5,1	5,4	2,3	0,5	0,0	0,8	0,1	0,0	1,8	fine	redox	700-750	2
2	Brz40/2	52,8	13,6	15,8	0,0	0,7	0,0	0,0	0,2	0,7	0,5	0,0	1,2	0,2	6,6	1,2	1,0	0,2	5,1	fine	redox	700-750	7
3	Brz40/3	67,3	12,3	2,8	0,1	0,6	0,0	0,0	0,0	0,0	0,6	0,0	0,3	1,3	0,0	1,9	4,4	0,0	8,5	middle	red	700-750	4
4	Brz40/4	54,6	14,2	9,9	0,1	1,8	0,0	3,5	0,0	0,0	0,4	1,4	0,7	0,7	7,1	0,7	0,0	0,0	5,0	fine	red	700-750	7
5	Brz40/5	54,3	13,3	6,6	0,0	0,7	0,0	18,9	0,0	0,0	1,7	0,2	0,2	1,5	0,0	0,5	0,0	0,0	2,0	fine	redox	700-750	4
6	Brz40/6	57,9	11,5	5,8	0,0	1,8	0,0	0,0	0,0	0,0	0,9	0,0	0,3	0,0	7,6	0,0	1,2	0,0	13,0	coarse	redox	800	6
7	Brz40/7	45,8	13,2	10,2	0,0	1,4	0,0	1,7	0,0	0,0	0,0	0,3	0,3	0,7	20,3	0,7	0,0	0,0	5,4	fine	redox	700-750	7
8	Brz40/8	60,2	8,8	4,9	0,1	1,5	0,0	3,0	0,0	0,0	0,0	0,0	2,1	2,1	6,1	4,3	0,0	0,0	7,0	coarse	redox	700-750	6
9	Brz40/9	58,7	5,3	16,8	1,4	0,3	0,0	2,2	0,0	0,1	0,0	0,0	0,3	1,1	0,3	1,7	2,8	0,0	9,2	middle	red	700-750	3
10	Brz40/10	62,1	8,6	4,9	0,3	0,0	0,0	4,3	0,0	0,0	0,3	0,0	1,2	3,1	0,0	1,5	1,2	0,0	12,5	coarse	redox	700-750	4
11	Brz40/11	61,9	16,2	10,0	0,1	0,3	0,0	4,1	0,0	0,0	1,4	1,0	0,3	0,3	0,0	0,0	0,0	0,0	4,5	fine	redox	700-750	3
12	Brz40/12	55,9	20,2	6,0	0,3	0,8	0,0	0,0	0,3	0,3	1,0	1,0	0,3	0,8	6,3	4,2	0,1	0,0	2,6	middle	redox	750	7
13	Brz40/13	48,5	10,3	23,5	0,1	2,4	0,0	2,6	0,0	0,1	0,6	0,6	0,9	1,2	1,5	1,2	0,3	0,0	6,5	coarse/middle	redox	700-750	7
14	Brz40/14	44,1	19,0	16,7	0,0	1,5	0,0	0,8	0,0	0,1	1,0	0,8	1,0	0,8	5,6	0,5	2,0	0,0	6,3	coarse	redox	750	7
15	Brz40/15	59,8	16,0	7,6	0,0	0,3	0,0	0,0	0,0	0,0	1,3	0,3	0,3	4,2	0,3	1,3	3,4	0,0	5,2	coarse	redox	700-750	3

Table 3.

No	Symbol of the site	Clay minerals	Silt (grains <0,05 mm)	Quartz	Flint/Chalcedony	K-feldspars	Plagioclases	Fragments of sedimentry rocks	Fragments of magmatic rocks	Fragments of metamorphic rocks	Muscovite	Biotite	Opaque minerals	Iron oxides and hydroxides	Grog	Clay clasts	Organic fragments	Heavy minerals	Voids	Fine/middle/coarse	Atmosphere of the firing	Approximately temperature of firing	Ceramic fabric type
16	Tar16/1	61,7	14,0	2,7	0,0	1,1	0,0	1,9	0,0	0,0	2,7	0,0	0,8	1,9	6,1	2,3	0,0	0,0	4,9	fine/middle	redox	700-750	7
17	Tar16/2	62,6	5,8	2,2	0,0	1,1	0,0	0,8	0,0	0,0	1,6	0,5	0,3	3,3	12,6	2,5	0,0	0,0	6,6	coarse	redox	700-750	4
18	Tar16/3	73,5	14,3	1,1	0,0	0,0	0,0	6,1	0,0	0,0	1,3	0,0	0,8	0,8	0,0	0,0	0,0	0,0	2,1	fine	ox	700-750	1
19	Tar16/4	44,5	13,0	5,7	0,0	1,7	0,0	0,0	0,0	0,0	0,8	0,0	0,0	1,7	20,1	1,7	0,3	0,0	10,5	fine	redox	700-750	7
20	Tar16/5	61,8	17,9	10,1	0,0	1,2	0,0	0,6	0,0	0,0	0,9	0,0	0,6	0,3	3,6	0,3	0,3	0,0	2,4	fine	ox	750	2
21	Tar16/6	73,5	18,5	0,8	0,0	0,3	0,0	0,0	0,0	0,0	1,3	0,0	1,3	0,8	0,0	1,6	0,8	0,0	1,1	fine	red	700-750	2
22	Tar16/7	74,8	11,6	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,3	0,0	0,0	0,0	1,0	3,5	4,2	0,0	4,5	fine	red	750-850	2
23	Tar16/8	74,9	9,0	2,7	0,0	0,0	0,0	2,7	0,0	0,0	1,4	0,0	0,0	1,9	3,0	1,1	1,1	0,0	2,2	fine	redox	700	4
24	Tar16/9	55,4	10,4	6,5	0,0	0,8	0,0	5,9	0,0	0,0	0,6	0,0	0,3	0,8	11,2	0,8	2,8	0,0	4,5	fine	redox	700-750	6
25	Tar16/10	57,1	11,0	13,3	0,1	0,6	0,0	4,9	0,0	0,6	0,0	0,0	0,3	0,0	9,2	0,3	0,0	0,1	2,9	coarse	redox	700-750	3
26	Tar16/11	64,4	8,4	6,2	0,3	1,1	0,0	0,0	0,0	3,1	0,6	0,0	0,0	0,3	5,9	0,0	1,7	0,0	8,1	coarse	redox	700-750	7
27	Tar16/12	59,9	15,5	8,5	0,6	1,9	0,0	1,6	0,0	0,0	0,9	0,3	0,0	1,9	1,3	6,6	0,0	0,0	0,9	fine/middle	redox	700-750	3
28	Tar16/13	63,8	10,0	5,0	0,0	1,8	0,0	0,7	0,0	0,0	1,4	0,0	0,0	1,8	7,2	3,6	0,0	0,0	4,7	coarse	redox	700-750	6
29	Tar16/14	49,4	8,4	5,6	0,1	0,3	0,0	0,0	0,0	0,0	0,3	0,1	0,3	0,0	27,5	0,0	0,1	0,0	8,1	coarse	redox	700-750	7
30	Tar16/15	51,6	15,5	2,9	0,0	0,0	0,0	4,6	0,0	0,0	1,1	0,0	0,3	0,0	20,3	0,0	0,3	0,0	3,4	coarse	redox	700-750	6

31	Tar14-15/1	53,5	16,9	8,0	0,0	1,5	0,0	1,8	0,0	1,8	1,5	0,0	0,3	0,6	7,4	0,0	0,9	0,0	5,5	fine	redox	700-750	7
32	Tar14-15/2	53,7	11,8	8,4	0,0	1,0	0,0	0,0	0,0	0,0	3,1	0,0	0,0	1,0	17,1	0,7	0,0	0,0	3,1	coarse	redox	700-750	7
33	Tar14-15/3	55,9	11,0	2,9	0,0	0,4	0,0	3,3	0,0	0,0	4,4	0,0	0,4	0,0	19,5	0,4	0,4	0,0	1,5	fine	red	700-750	7
34	Tar14-15/4	58,1	9,6	4,2	0,0	0,0	0,0	0,0	0,0	0,0	2,5	0,0	0,6	0,0	21,1	0,3	0,0	0,0	3,7	fine	redox	700-750	6
35	Tar14-15/5	49,4	11,1	2,6	0,0	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	28,9	1,3	0,0	0,0	6,0	coarse	redox	700-750	6
36	Tar14-15/6	69,4	12,6	4,7	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,3	0,3	0,0	7,6	1,7	0,0	0,0	2,3	fine	redox	800-850	6
37	Tar14-15/7	45,7	15,6	4,4	0,0	1,3	0,0	0,0	0,0	0,0	1,3	0,0	0,0	0,3	27,6	0,6	0,3	0,0	2,9	coarse	redox	700-750	6
38	Tar14-15/8	43,1	13,8	1,5	0,0	0,4	0,0	0,0	0,0	0,0	0,0	0,0	1,5	0,0	32,7	0,4	0,0	0,0	6,7	coarse	red	700-750	6
39	Tar14-15/9	52,9	14,7	10,5	0,0	2,1	0,0	0,0	0,0	0,0	3,9	0,0	0,6	0,0	9,9	0,3	0,0	0,0	5,1	fine	red	800-850	6
40	Tar14-15/10	60,6	13,9	6,1	0,2	1,7	0,0	0,0	0,0	0,0	2,2	0,0	0,0	0,0	11,1	0,0	0,2	0,0	4,4	fine	red	750-800	6
41	Tar14-15/11	57,1	14,7	4,3	0,1	0,3	0,0	0,0	0,0	0,0	1,7	0,0	1,2	0,9	15,6	0,0	0,1	0,0	4,3	coarse	redox	700-750	6
42	Tar14-15/12	41,8	13,9	4,8	0,0	0,4	0,0	0,0	1,1	0,0	2,2	0,0	0,0	0,0	30,0	0,7	0,0	0,0	5,1	coarse	redox	700-750	6
43	Tar14-15/13	59,6	16,4	4,7	0,0	0,0	0,0	0,0	0,0	0,0	1,4	0,0	0,0	0,0	10,8	1,9	0,5	0,0	4,7	fine	redox	700-750	7
44	Tar14-15/14	65,0	13,3	2,4	0,0	0,3	0,0	0,0	0,0	0,0	1,4	0,0	0,7	0,3	11,2	1,4	0,1	0,0	4,1	fine	redox	700-750	6
45	Tar14-15/15	50,5	15,1	5,4	0,0	0,3	0,0	0,0	0,0	0,0	4,0	0,0	0,5	0,5	20,2	0,3	0,0	0,3	3,0	coarse	redox	700-750	6
46	Tar14-15/16	47,5	10,7	5,2	0,0	0,6	0,0	0,0	0,0	0,0	2,3	0,0	0,6	1,4	20,6	0,3	0,0	0,3	10,4	coarse	redox	700-750	6
47	Tar14-15/17	39,9	14,2	5,6	0,0	0,0	0,0	0,0	0,0	0,0	4,3	0,0	0,9	5,6	18,5	0,0	0,0	0,0	11,2	coarse	ox	750	6

Brzezie 40 were produced of clays and silty clays, without glauconite or plankton remains (Fig. 5: c, d). However, two fragments, namely samples Brz40/8 and Brz40/9, were made of ceramic fabrics, within which numerous grains of glauconite were detected; moreover, the sample Brz40/9 additionally contained chunks of chalcedony (Fig. 5: e, f). This suggests another source of raw material. Particularly noteworthy within this series of samples is Brz40/1, which contained tiny biotite flakes in a greater amount than was recorded for

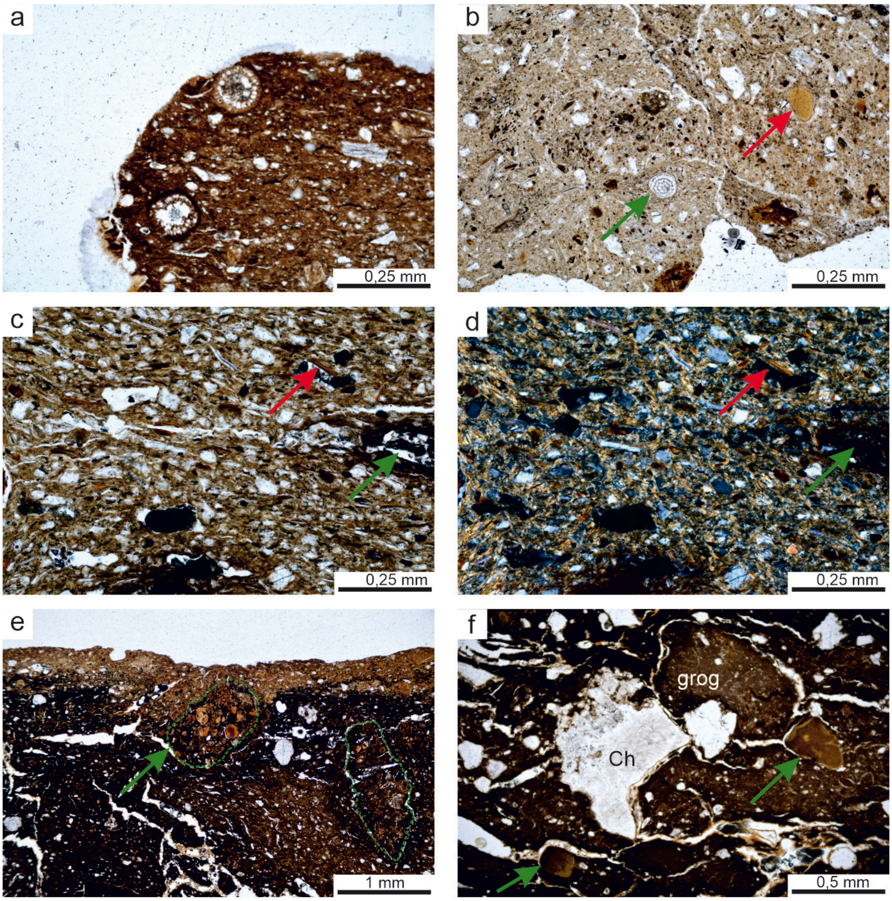

Fig. 5. Photomicrographs of thin sections; a – sample Tar16/1, two microfossils close to the outer surface of vessels (*Diatoms or Radiolaria*?), PPL; b – sample Tar14-15/2, microfossils (green arrow) and grains of glauconite (red arrow), PPL; c, d – sample Brz40/1, fine flakes of biotite (red arrow), organic fragments (green arrow) and opaque components, c-PPL, d-XPL; e – sample Brz40/8, a fragment of sedimentary rock with thermally altered glauconite (green arrow), PPL; f – sample Brz40/9, grains of thermally altered glauconite (green arrows), fragment of chalcedony (Ch) and crumbs of grog, PPL; photos in Plane Polarized Light (PPL) or Crossed Polarized Light (XPL)

other ceramic fabrics. However, the provenance of the raw material of this fabric is difficult to determine (Fig. 5: g, h).

4.4. Technology – intentional admixtures (tempers), ceramic fabrics

A few intentional admixtures were identified within ceramic fabrics, namely organic material, grog, and sand (Fig. 6: a, b, c). Nevertheless, the occurrence of sand within the pottery does not necessarily mean that it was added to the clay substance intentionally. In

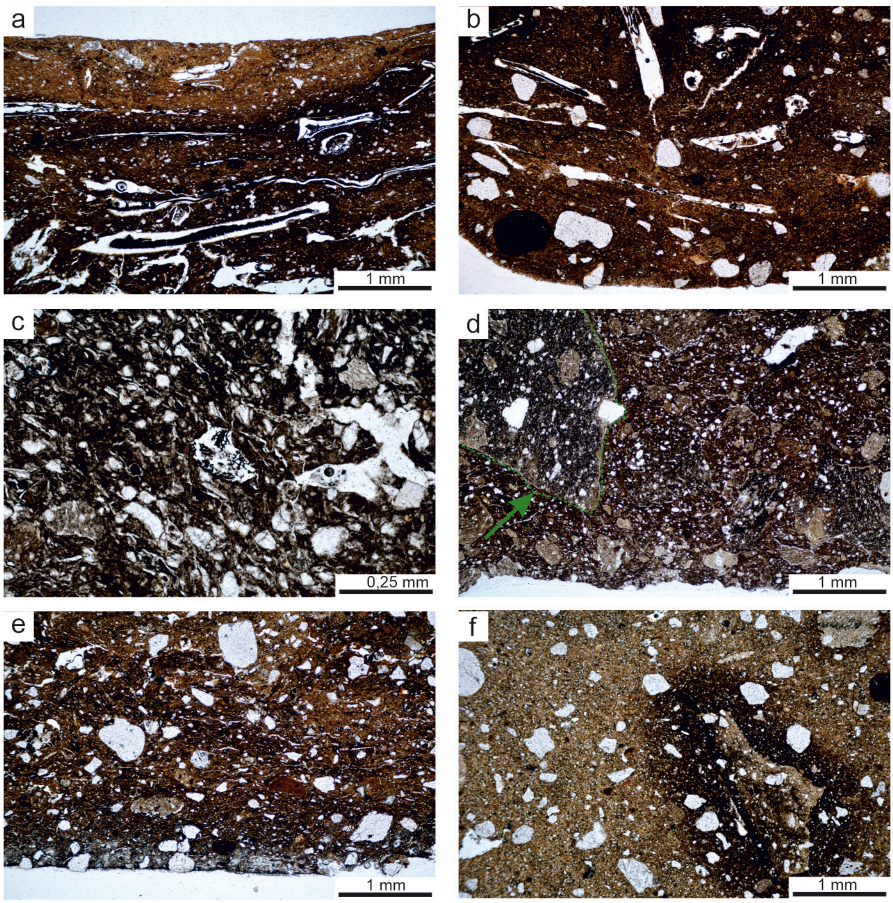

Fig. 6. Photomicrographs of thin sections; a – sample Brz40/3, numerous plant fragments in fine-grained fabric; b – sample Brz40/15, planar voids in ceramic body; c – sample Tar14-15/39, fragments of grog in ceramic paste, plant fragment (in the middle); d – sample Tar14-15/8, fragment with an older generation of grog (arrow); e – sample Tar16/10, sand admixture; f – sample Tar16/5, sand and grog admixture; all photos in Plane Polarized Light (PPL)

this respect, a gathering of locally available raw materials turned out to be useful. A lack of sand within sampled clay samples allows concluding that the sand was added intentionally.

Organic material is usually represented by tiny, elongated fragments of plants. Sometimes the cell structure of these tissues is visible. In the microscopic image, they are black in colour and opaque. Within the zones of vessel walls that became oxidised during the firing process, such fragments preserve extremely rarely. They are more commonly encountered within the core of the vessel wall, where the firing process induced reducing conditions. The analyses revealed that an organic admixture was most frequently used at

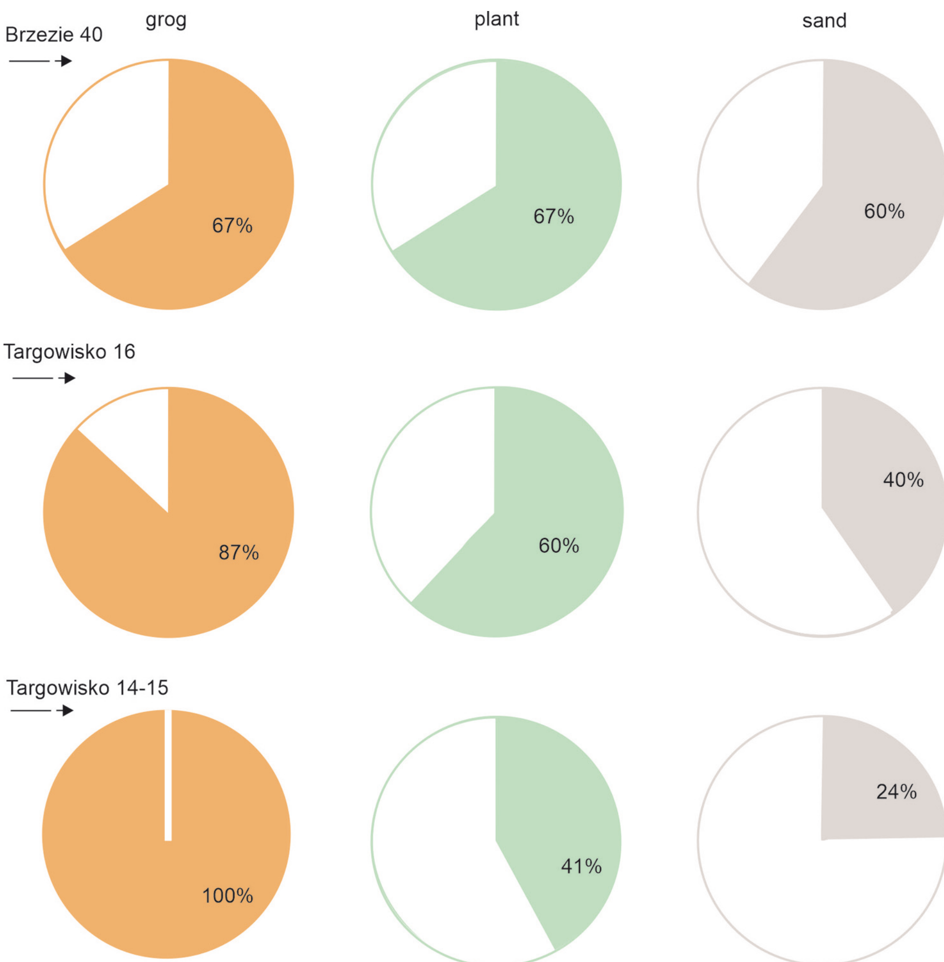

Fig. 7. Percentage share of samples with grog, plant, and sand admixture; sites Brzezie 40 (n=15), Targowisko 16 (n=15), and Targowisko 14-15 (n=17)

Table 4. Percent of ceramic fabrics with particular admixtures: plant, grog, and sand

Site	Type of the vessels	Samples with grog temper	Samples without grog temper	Total	Samples with organic fragments	Samples without organic fragments	Total	Samples with sand admixture	Samples without sand admixture	Total
Brzezie 40	**all type of vessels**	**67**	33	100	**67**	33	100	**60**	40	100
n=15	fine	50	50	100	33	67	100	27	73	100
	medium	67	33	100	100	0	100	13	87	100
	coarse	83	17	100	83	17	100	20	80	100
Targowisko 16	**all type of vessels**	**87**	13	100	**60**	40	100	40	60	100
n=15	fine	78	22	100	67	33	100	27	73	100
	medium	0	100	100	0	100	100	0	100	100
	coarse	100	0	100	50	50	100	13	87	100
Targowisko 14-15	**all type of vessels**	**100**	0	100	**41**	59	100	**24**	76	100
n=17	fine	100	0	100	63	37	100	18	82	100
	coarse	100	0	100	22	78	100	6	94	100

the site of Brzezie 40 (Fig. 7; Table 4). It was recorded within 67% of all fragments under investigation. This admixture was most commonly encountered in thick-walled vessels (in 83% of all thick-walled fragments). With regard to the materials from Targowisko 16, it was less frequent, recorded in 60% of pottery specimens. This indicates a certain tendency to use organic admixture in ceramic fabrics for the production of thin- and medium-walled vessels, with a slight predominance of the former. This type of temper was the rarest in the pottery gathered at Targowisko 14-15 (MC). It was recorded in 41% of all fragments, mostly within ceramic fabrics of thin-walled vessels. At this point, it should be stressed that in their microscopic image, these fragments look slightly different than the "typical" organic fragments encountered in LBK ceramic fabrics; however, in this particular case, specialised analyses of organic remains have not been performed (Fig. 6, c).

The most commonly encountered admixture in the investigated materials was grog. Fragments of older crushed pottery used as a temper have various dimensions (*ca.* 0.1-2.0 mm) and colours. They often resemble the ceramic fabrics to which they were added. The investigations revealed a certain variability in the addition of grog to ceramic vessels at the three sites under studies. With regard to the pottery gathered from Brzezie 40, it was identified within 67% of all fragments. Most of these instances of grog addition occurred within ceramic fabrics used for the production of thick-walled vessels. At the site Targowisko 16, grog was encountered in all thick-walled specimens, which made up 87% of all vessels, but was not found in any other specimens. Whereas, at the site Targowisko 14-15 this type of temper occurred in all ceramic fragments, with no exception.

The sand admixture was recorded within many samples (*ca.* 20) and is represented by rounded grains with a diameter of *ca.* 0.1-0.6 mm. The admixture of sand occurs within 40% of all investigated fragments. With regard to this type of admixture, certain variability is also present. Within the materials from Brzezie 40, sand is the most frequent admixture, encountered in 60% of all fragments. With regard to the series from Targowisko 16, it occurred within 40% of pottery fragments. The smallest number of ceramic fabrics con-

Table 5. Short description of ceramic fabrics, LBK, south-eastern Poland

Fabric type	Description
Fabric type I	heavy clay, fine grained, moderately sorted, admixture of organic fragments
Fabric type II	silty clay, fine grained, well sorted, admixture of organic fragments
Fabric type III	heavy to silty clay, coarse grained, poorly sorted, admixture of organic fragments
Fabric type IV	heavy clay, fine grained, admixture of sedimentary rocks and organic fragments
Fabric type V	heavy to silty clay, coarse grained, poorly sorted, admixture of sand and organic fragments
Fabric type VI	heavy to silty clay, admixture of grog
Fabric type VII	heavy to silty clay, admixture of grog and sand

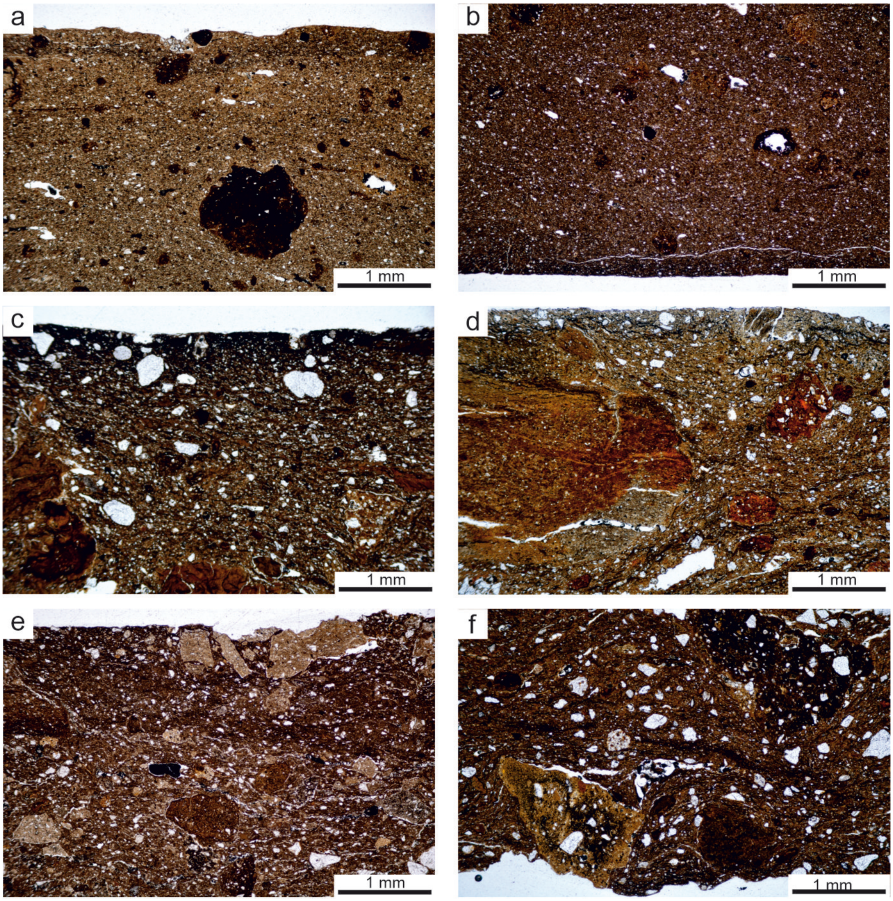

Fig. 8. Ceramic fabric type, photomicrographs of thin sections; a – fabric type I, very fine-grained, heavy clay, without admixture (sample Tar16/3); b – fabric type II, silty clay, fine-grained, very well sorted (sample Tar16/6); c – fabric type III, admixture of sand (sample Brz40/11); d – fabric type IV, admixture of sedimentary rock (sample Brz40/5); e – fabric type VI, admixture of grog (sample Tar14-15/8); f – fabric type VII, admixture of sand and grog (sample Tar16/11); all photos in Plane Polarized Light (PPL)

taining sand was recorded at Targowisko 14-15, making up only 24% of specimens there (Fig. 7; Table 4).

Ceramic fabrics are diversified. Based on the proportions of major mineral compounds (including intentional admixtures), a division into several basic ceramic fabrics was proposed (Rauba-Bukowska *et al.* 2007; Rauba-Bukowska and Czekaj-Zastawny 2020). Each fragment of pottery under analysis was classified to a respective type of ceramic fabric (Table 5; Fig. 8).

4.5. Technology – firing

Most of the vessels were fired in reducing conditions, with a small amount of air-intake at the end of firing or during the cooling process. A great majority of the pottery was fired at a temperature of *ca*. 700-750°C, sporadically exceeding 800-850°C. Conditions and approximate firing temperatures were determined for the investigated fragments of vessels, namely those from which thin sections were taken.

With regard to the material from Brzezie 40, thin- and thick-walled vessels bear traces of reduction firing, with a small amount of air-intake (redox). Only three vessels were fired in a reducing atmosphere. None of the analysed vessels from Brzezie 40 were fired in oxidising conditions.

At the site of Targowisko 16, a great majority of thin- and thick-walled vessels were fired in reducing conditions, with a small amount of air-intake at the end of firing and during the cooling process. Only one thin-walled vessel was fired in reducing conditions; another two thin-walled vessels were produced using the oxidising firing method.

On the other hand thin- and thick-walled vessels from Targowisko 14-15 were fired in reducing conditions, with a small amount of air-intake at the end of firing and during the cooling process. The reducing firing method was applied in the production of four vessels (three thin-walled and one thick-walled). One thick-walled vessel was fired in oxidising conditions.

Based on the above-mentioned observations, a conclusion was formed that the differences in firing technology between the ceramic materials gathered at the three investigated sites were insignificant. Additionally, no transformation in the firing structure of thin- and thick-walled vessels was noted. A great majority of the pottery bears traces of reduction firing with a small amount of air-intake. This means that even if the firing technology had changed, the change was not significant enough to leave any distinctive traces on the ceramic material.

5. DISCUSSION AND CONCLUSIONS

Ceramic vessels gathered at the three archaeological sites under study were made of locally available ceramic raw materials. At the site Brzezie 40, clays and silty clays prevailed. However, the characteristics of three pottery fragments found there vary from the “typical” raw material. This concerns fragments Brz40/8 and Brz40/9, which contain such compounds as chunks of clay with glauconite and grains of chalcedony. One could speculate that these vessels actually come from the left bank of the Vistula River, where such ceramic raw materials are more commonly encountered. The provenance of raw material identified in the sample Brzezie 40-1 is more difficult to establish, however, because it contains a more significant amount of fine biotite flakes. Ceramic fabrics used for the pro-

Table 6. Percentage of samples assigned to each fabric type

Fabric type	Brzezie 40 (LBK)	Targowisko 16 (LBK)	Targowisko 14-15 (Malice Culture)	Samples from III phase LBK in SE Poland (302 samples; Rauba-Bukowska and Czekaj-Zastawny 2020)
I		7		13
II	7	20		35
III	20	13		22
IV	20	13		3
V				2
VI	13	20	76	14
VII	40	27	24	11
total	100	100	100	100

duction of vessels from the sites Targowisko 16 and Targowisko 14-15 were made of heavy clays, and in some of them, glauconite grains and remains of plankton with siliceous skeletons (*Diatoms or Radiolaria*?) were identified. This indicates that these clays originally came from the sea floor. Ceramic raw materials sampled from the surroundings of archaeological sites confirm these observations. Raw materials used as ceramic fabrics most closely resemble Miocene clays, *e.g.*, sample BVI, taken from nearby the sites in Brzezie. In spite of some promising physical properties of clays sampled from accumulation terraces of the Raba River (sufficient elasticity and adhesiveness), they seem not to have been used for the production of the analysed pottery. These clays almost entirely lack any mineral (natural) admixture. At the present stage of research, one can only speculate that these clays could have been used for pottery production, but only after mixing them with loess, sand and other admixtures.

The series from Brzezie 40 discussed in this paper is, in terms of raw material and technology, close to the previously investigated materials from the LBK phase III (Table 6, 7). The properties of the ceramic materials from Targowisko 16, on the other hand, bear more resemblance to ceramic fabrics from Targowisko 14-15. That similar technology was applied in pottery production at these two sites is indicated by the following facts. First a similar source of raw material (Miocene clays) and second a strong representation of ceramic fabrics with an admixture of grog.

Application of Miocene clays instead of silty clays (as commonly recorded in materials of the LBK phase III) is the reason for a relatively low contribution of quartz in these samples, accounting for 17% and 19%, respectively, whereas the average quartz percentage within ceramic fabrics known from the LBK phase III amounts to 27% (Table 7).

The second resemblance is manifested by a significant contribution of grog within the ceramic fabrics. For instance, in pottery from Targowisko 16, on average 9%. This value is

Table 7. The average content of quartz and grog in ceramic fabrics; data after Rauba-Bukowska and Czekaj-Zastawny 2020; Rauba-Bukowska *et al.* 2007; 2011; new data highlighted; n – number of analysed samples

Chronology	Ceramic type	Quartz in %	Grog in %
LBK I, n=99	all type of vessels	19,4	0,35
LBK II, n=101	all type of vessels	19,2	0,48
LBK III, n=100	all type of vessels	26,6	4
Malice culture n=40	all type of vessels	26	8
Brzezie 40 (LBK II/III), n=15	all type of vessels	24	4
Targowisko 16 (LBK III), n=15	all type of vessels	17	9
Targowisko 14-15 (Malice culture), n=17	all type of vessels	18	18

considerably greater than the average percentage recorded for the LBK pottery, even in Želiezovce phase in which the admixture of grog appear (Kadrow and Rauba-Bukowska 2016). While ceramics from Targowisko 14-15 are similarity to those from Targowisko 16, the technology of pottery production definitely varies between the two – in MC grog is a prevailing and organic temper is only marginal and a few plant fragments look different than in the LBK. This technology corresponds well with previous findings and results of studies on this cultural unit (Kozłowski 1996; Rauba-Bukowska *et al.* 2007; Rauba-Bukowska 2011; Rauba-Bukowska 2014a).

6. CONCLUSION

The major indicator of pottery of the late LBK phases is the occurrence of grog admixture and the definitely rarer application of plant temper, as well as a decrease in the contribution of ceramic fabrics containing sand. Neither the manner nor the temperature of firing vary. With regard to the three ceramic series discussed in this paper, the following traits can be listed:

– at Brzezie 40, phase II/III of the LBK, grog and organic material occur mainly within ceramic fabrics used for the production of medium- and thick-walled vessels;

– at Targowisko 16, phase III of the LBK, grog is present in all of the ceramic fabrics used for the production of thick-walled vessels, while organic material was identified mostly in thin-walled specimens;

– at Targowisko 14-15 (MC), grog is present in all of the types of pottery, while organic material occurs mainly within the thin-walled vessels;

– the occurrence of sand admixture decreases from 60% in vessels from Brzezie 40 to 25% in the MC pottery;

– organic fragments identified within the ceramic fabrics of the MC vessels reveal a different structure/morphology; therefore, based on the general microscopic image, they vary from those encountered within the LBK ceramic fabrics.

The LBK series of pottery described in this paper revealed a significant predominance of ceramic fabrics containing grog when compared with the series of previously investigated materials (Table 5, 6; Rauba-Bukowska and Czekaj-Zastawny 2020). In general, in the assemblages of the LBK phase III, ceramic fabrics with grog admixture constituted *ca.* 25% of all specimens, while in Brzezie 40, these fabrics accounted for 67%, and in Targowisko, 16-87%. This surplus, however, could be due to local preferences. Ceramics of the MC show grog-tempered ceramic pastes. Similar results are seen at the Rzeszów-Piastów site. In subsequent stylistic phases of LBK, there is a visible, gradual increase in the technology without admixture (technological group A – after Kadrow 1990) and with grog additives (technological group C – after Kadrow 1990). On the other hand, the ceramics of the MC present the grog technology, and the organic admixture is identified to a negligible extent (Kadrow 1990, 29).

The mechanism of using grog temper can be compared by analogy to the use of an organic admixture, which has been discussed in detail by Kreiter Á., Pető and P. Pánczél: "It has been shown above that there are extensive ceramic technological similarities between Neolithic communities across a large geographical area, and, above all, vegetal tempering seems to be the most consistent pattern in Neolithic ceramic production" (Kreiter *et al.* 2013). Michela Spataro mentions vegetal material in the context of the Starčevo-Criş culture as a main characteristic element of this culture, which distinguishes it from other cultural groups (Spataro 2008; 2019). The process of decreasing the addition of the organic admixture begins in the Middle Neolithic, and vegetal admixture disappeared in the Late Neolithic (Kreiter 2010; Kreiter *et al.* 2011; 2013). Observations confirm this at many Hungarian sites, where the limited use of an organic admixture has been noted, *e.g.*, in ceramics of the Želiezovce group at the site of Szécsény-Ültetés (Kreiter *et al.* 2013). This corresponds well with the results from Polish sites (Rauba-Bukowska and Czekaj-Zastawny 2020). Kreiter and colleagues write: ".. it is suggested that the cross-cultural utilisation of chaff temper cannot only be explained by its ready availability in a particular period of the year, but its social significance must also be sought. A vessel tempered with chaff accumulated events through its manufacture, and its production may have strengthened social and production relations between producers, exchange partners." (2013, 140). These conclusions are consistent with the author's observations from the territory of Poland. The main Neolithic admixtures, namely plant and grog additives, have a cultural rather than a technological meaning. In this context, the disappearance of organic admixture and the beginning of grog technology reflects a socio-cultural transformation. Based on the current and previous analyses, it seems that the stylistic/chronological Želiezovce phase may be a "meeting point" of two technological traditions.

According to the petrographic analysis of the LBK in Lesser Poland, an admixture of grog appears in phase III of the LBK. However, we do not know of grog in the Želiezovce group in Slovakia, but the petrographic analysis of several samples from the Bükk culture in Eastern Slovakia shows that in this culture, grog is known as an admixture (Kozłowski *et al.* 2014 (2015); Czekaj-Zastawny *et al.* 2018; Rauba-Bukowska and Czekaj-Zastawny 2020). The Tisza River region shows an extensive relationship with Poland in the time of the ALPC, and this is confirmed by the imports of raw materials – mostly obsidian (*e.g.* Szeliga 2007, 295-297, fig. 1). Simultaneously with this contact, technological innovation (*e.g.* the usage of grog) approached Lesser Poland (Kozłowski *et al.* 2015; Kadrow and Rauba-Bukowska 2016; Czekaj-Zastawny *et al.* 2017; Rauba-Bukowska and Czekaj-Zastawny 2020). This is a hypothesis which has been studied lately. As there is no data, *e.g.*, from the Slovakian Želiezovce group, the ALPC is our primary suspect, which could have spread grog-tempered ceramics to Lesser Poland in the late LBK. To strengthen or reject this hypothesis, however, requires further studies.

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CULTURE TRANSFORMATION IN THE TARGOWISKO MICROREGION. TRENDS OF CHANGES AMONG DANUBIAN FARMERS

ABSTRACT

Kadrow S., Posselt M., Saile T., Wąs M., Abramów J. and Golański A. 2021. Culture transformation in the Targowisko microregion. Trends of changes among Danubian farmers. *Sprawozdania Archeologiczne* 73/1, 153-176.

The aim of this article is to deepen the discussion on the nature and mechanisms of culture change based on the analysis of newly acquired materials from the Targowisko settlement region. Three groups of materials were acquired (from narrow time horizons) related to the single-phase relics of Linienbandkeramik (Brzezie, site 40 and Targowisko, site 16) and Malice culture houses (Targowisko, site 14-15). The absolute chronology of the beginning of the late phase (III) LBK was established to be 5100-5000 BC, and the classic phase (Ib) of MC was dated to 4650-4550 BC. Selected threads of the cultural tradition (in the field of ceramic-making technology and ornamentation and flint-blade production technology) were passed on among families living in individual houses. Settlement analysis showed the relative instability of microregions, the increased mobility of small groups of people, and risky colonization attempts in Targowisko region. No evidence of direct, contemporaneous contact between the LBK and MC populations was found.

Keywords: LBK, Malice culture, early Neolithic, culture change, Targowisko settlement region
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INTRODUCTION

The *Linienbandkeramik* (hereafter: LBK) spread to the areas located north and north-east of the Carpathians in its pre-music-note phase (I) (the Bíňa and the Milanovce phases in south-western Slovakia; *cf*. Pavúk 2004; Kulczycka-Leciejewiczowa 1983; Czekaj-Zastawny *et al*. 2020; Dębiec 2015; Saile 2020). The earliest Neolithic farmers migrated here from south-western Slovakia and Moravia through the Moravian Gate (Kozłowski *et al*. 2015, 39).

In some regions during the music-note phase (II), the LBK population gradually increased, reaching its peak in the Želiezovce phase (III; *cf*. Kadrow 2020a, 97-98); however, some researchers believe the maximum demographic development occurred in phase II throughout south-eastern Poland (Czekaj-Zastawny 2008, 116). It is assumed that during the evolution of the LBK, the inner rhythm of cultural change was the same throughout almost the entirety of south-eastern Poland and in south-western Slovakia.

However, more and more arguments speak for the simultaneous duration of phases I and II. The recently acquired series of radiocarbon dates from site 2 in Gwoździec suggests a temporal overlap of these phases in the period from 5350/5300 to 5100/5000 BC (Czekaj-Zastawny *et al*. 2020, fig. 16). The ^{14}C dates in Samborzec corroborate this (Kulczycka-Leciejewiczowa 2008). The beginning of the neolithization of south-eastern Poland should also be shifted from 5600/5500 BC to around 5350 BC (Czekaj-Zastawny *et al*. 2020).

There are also reasons to believe that in some regions north of Carpathians, there was not, as it might seem, that they happened in sequential order of phases II (music-note) and III (Želiezovce) Rather, as in Moldova and in the Dniester basin in Ukraine (Kozłowski 1985), phase II continued until the end of the LBK in this region (Kadrow 2020b, 149, 150; fig. 8; Saile 2020, fig. 5).

Some researchers insist that there was no continuation of the LBK in the Malice culture (hereafter: MC). They argue that contacts between south-eastern Poland and the northern part of the Carpathian Basin ceased abruptly with the end of the LBK and the Bükk culture (Kozłowski *et al*. 2014, 41). Post-Linear settlers, *i.e.,* MC communities, presumably came from the Carpathian Basin, across the mountains (Kaczanowska 1990; Kamieńska and Kozłowski 1990; Kozłowski 2004, 11).

Other archaeologists prefer the model of a gradual but profound process of change within the LBK community in its late phase (III) (Kulczycka-Leciejewiczowa 2004, 21). They maintain that this change caused the transformation of the LBK into the MC (Kadrow 2005, 26-27; Kadrow 2020a, 96-101).

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The aim of this article is to deepen the discussion on the nature and mechanisms of culture change based on the analysis of newly acquired materials from the vicinity of Targowisko.

SPATIAL AND CHRONOLOGICAL RANGE OF THE STUDY

Research on the early Neolithic culture transformation is conducted in the area of one of a few early Neolithic settlement regions of south-eastern Poland. It is located south-east of Kraków, between the Vistula and Raba rivers (the so-called "Targowisko" region – *cf.* Czerniak 2013; or "Brzezie" region, *cf.* Czekaj-Zastawny 2017, fig. 12).

The areas densely inhabited by the LBK and MC populations stretched from site 2 in Zagórze in the west to site 10-11 in Targowisko in the east (Fig. 1). The distance between both sites is approx. 8 km in a straight line. There were 6 more sites between them. This entire settlement agglomeration was discovered thanks to rescue excavations on the A-4 motorway (Czekaj-Zastawny 2014; Czerniak *et al.* 2007; Czerniak 2013; Grabowska and Zastawny 2014; Kadrow *et al.* 2020; Zastawny and Grabowska 2014). Therefore, we do not know how far north and south from its course this settlement cluster reached.

The studied agglomeration is located in southern Poland, on the border of the Western Carpathinas and the Outer Western Carpathians (Kondracki 2002). Its western part (sites:

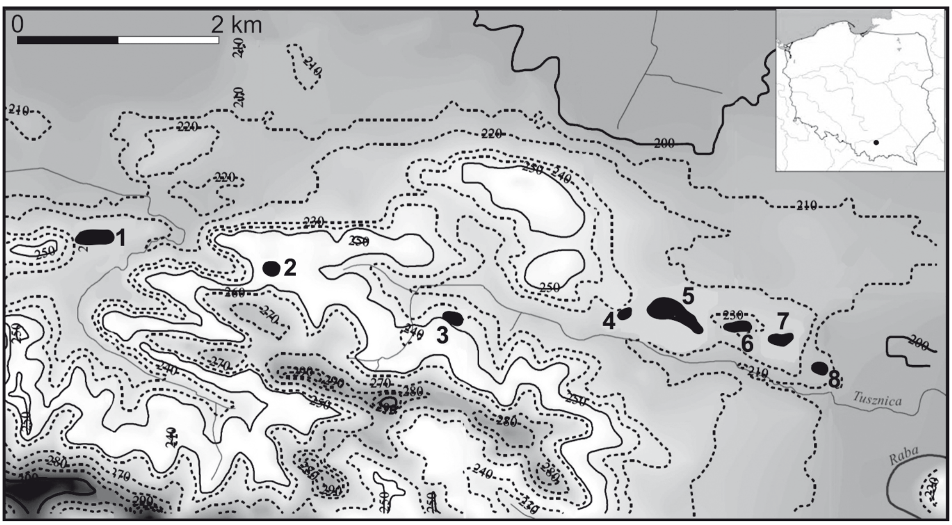

Fig. 1. Targowisko settlement region. Early Neolithic sites with relics of houses: 1 –Zagórze 2, 2 – Brzezie 17, 3 – Brzezie 40, 4 – Szarów 9, 5 – Targowisko 16, 6 – Targowisko 14-15, 7 – Targowisko 12-13, 8 – Targowisko 10-11 (in part acc. to Czekaj-Zastawny 2014)

Zagórze 2, Brzezie 17 and 40) belongs to the macroregion of the Western Beskids Foothills and the mesoregion of the Wieliczka Foothills, while the lower sites in the eastern part (sites: Szarów 9 and Targowisko 10-11, 12-13, 14-15 and 16) are located in the macroregion of the Sandomierz Basin and the Bochnia Foothills mesoregion (*cf*. Forysiak *et al*. 2021).

In the zone described above, traces of LBK settlement from the oldest (I) to the youngest (III) phases have been documented (*cf*. Czerniak *et al*. 2006; Czerniak 2013; Kadrow and Okoński 2008; Kadrow *et al*. 2020; Włodarczak 2006; Zastawny and Grabowska 2014). Moreover, relics of the early and classical MC phases have been discovered there (Czekaj-Zastawny *et al*. 2002; Czekaj-Zastawny *et al*. 2007; Czerniak *et al*. 2007; Grabowska and Zastawny 2014; Kadrow *et al*. 2020). Despite the insufficient and unclear results of radiocarbon dating of LBK relics (Milisauskas 1986; Czekaj-Zastawny 2008; Kadrow *et al*. 2020), this culture has been dated, until recently, from 5600/5000 to 4800 BC. Now its beginning is set at 5350 BC (Czekaj-Zastawny *et al*. 2020). The MC, deprived of ^{14}C dates, has been dated from 4800 to 4500 BC (*cf*. Kadrow 2020a, 89, 90).

GEOMAGNETIC PROSPECTION

Geomagnetic survey on the investigated area (30 ha; Fig. 2) was made by Posselt & Zickgraf – Archäologisch-geophysikalische Prospektionen GbR from Germany. Magnetometer survey, the most common geophysical method for archaeological purposes, was used. The survey was done with the Fluxgate-Gradiometer Förster Ferex 4.032.01, 4 chan-

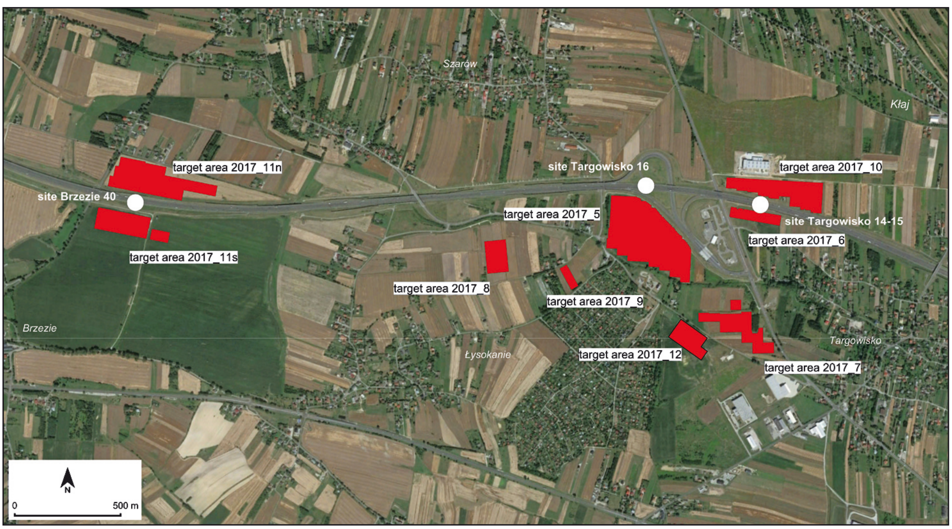

Fig. 2. Targowisko settlement region. Map of geomagnetic survey divided into target areas (red) with locations of excavated houses (white circles); (prepared by M. Posselt, cf. Golański *et al*. 2019)

nels (each pair of Fluxgate probes was used in a gradiometer array, with a vertical distance of 0.65 m between each channel), maximum resolution 0.1 nT. (Golański *et al.* 2019, 9-11).

The purpose of the surveying programme, including geomagnetic prospection, was to obtain assemblages of artefacts and ecofacts related to a period of time that would be as short as possible, *i.e.*, to the existence of a single family living in one house, representing a single cultural tradition, without any older or younger materials (Golański *et al.* 2019, 7, 8). It was assumed that this objective could only be achieved on the boundaries of settlements inhabited over longer periods of time (*cf.* Grygiel 1986, 273, fig. 3).

Thus, the geomagnetic prospection was carried out in selected target areas covering the northern or southern edges of large settlements of the LBK and MC, which had already been thoroughly surveyed as part of rescue excavations at the early-Neolithic settlement complex of the Targowisko region, in connection with the construction of highway A-4 (Fig. 2).

The results of the geomagnetic survey made it possible to demarcate zones (each having an area of 1 are) at three sites for the purpose of confirming the validity of the planned research strategy. The test excavations at sites 16 and 14-15 in Targowisko and at site 40 in Brzezie (Fig. 2) met the expectations, yielding assemblages of artefacts from narrow time horizons (Golański *et al.* 2019, 12-18).

RESULTS OF EXCAVATIONS

Brzezie 40

At the northern edge of site 40 in Brzezie, geomagnetic prospecting revealed the relics of one long LBK house, clearly separated from other traces of building structures (*cf.* Golański *et al.* 2019, fig. 12-15). In an excavation unit with an area of one are, the remains of long building pits with no traces of post-holes have been discovered (Fig. 3). The absence of post-holes was not the result of destructive post-depositional processes. Rather, it is a peculiarity of the construction of this house. Similar houses were discovered in the central part of the site in question (*e.g.*, houses No. 14 and 16; *cf.* Czerniak 2019, fig. 2). However, some researchers continue to assert that the absence of post-holes in this case is an effect of erosion processes.

In pits near the house and in the so-called cultural layer, 604 pieces of LBK pottery were discovered. The vast majority of these were very small sherds. Only 15% of them represent characteristic fragments, *i.e.*, ornamented fragments or parts of the upper rims or bottoms of pottery. The ceramics are divided into delicate vessels, ornamented by engraved lines (Fig. 4: 2, 4, 5, 8, 9), and kitchen vessels, composed of hemispherical cups and vessels with a neck, decorated with plastic elements and fingernail imprints (Fig. 4: 1, 3, 6, 7). The presence of notches crossing the engraved lines (Fig. 4: 2, 5) enables this set of pottery to be dated to the beginning of the Želiezovce (III) phase (Kadrow 1990, 72, 73, fig. 28;

2020b, fig. 7). A characteristic feature of this set of material is the relatively high proportion of parallel, closely-spaced engraved lines in the ornamentation (Fig. 4: 4, 5, 8, 9).

The collection of flint artifacts includes 122 relics and comes almost exclusively from the fill of features. As many as 96% of the specimens (including the burned ones) were made of Jurassic Cracovian flint. The rest, *i.e.*, 5 items (4%), were made of obsidian. The most numerous group in the inventory includes products related to flake exploitation (78 items in total). Products related to blade exploitation (26 items; Fig. 5: 1, 5-7) are less numerous. The remaining part of the inventory consists of specimens identified as flint crumbs(9 items). Microdebitage in the form of 8 chips was also identified. A total of 29 tools were documented (approximately 24% of the flint inventory). In total, 22 retouched specimens were distinguished, among which blade forms predominate: end-scrapers (7 pieces; Fig. 5: 7), truncated blades (2 pieces; Fig. 5: 5), micro-retouched blades (4 pieces; Fig. 5: 6) and a perforator (1 piece). Flake forms are represented by 7 amorphous retouched specimens. The second group of tools are the so-called utility forms, *i.e.*, flakes and blades with traces of use-wear in the form of so-called utility retouch and utility refinishing (7 items in total).

The inventory from Brzezie 40 contains mostly elements typical for many other LBK sites in Małopolska.

Fig. 3. Brzezie, site 40. Remains of the LBK house
(photo by A. Golański)

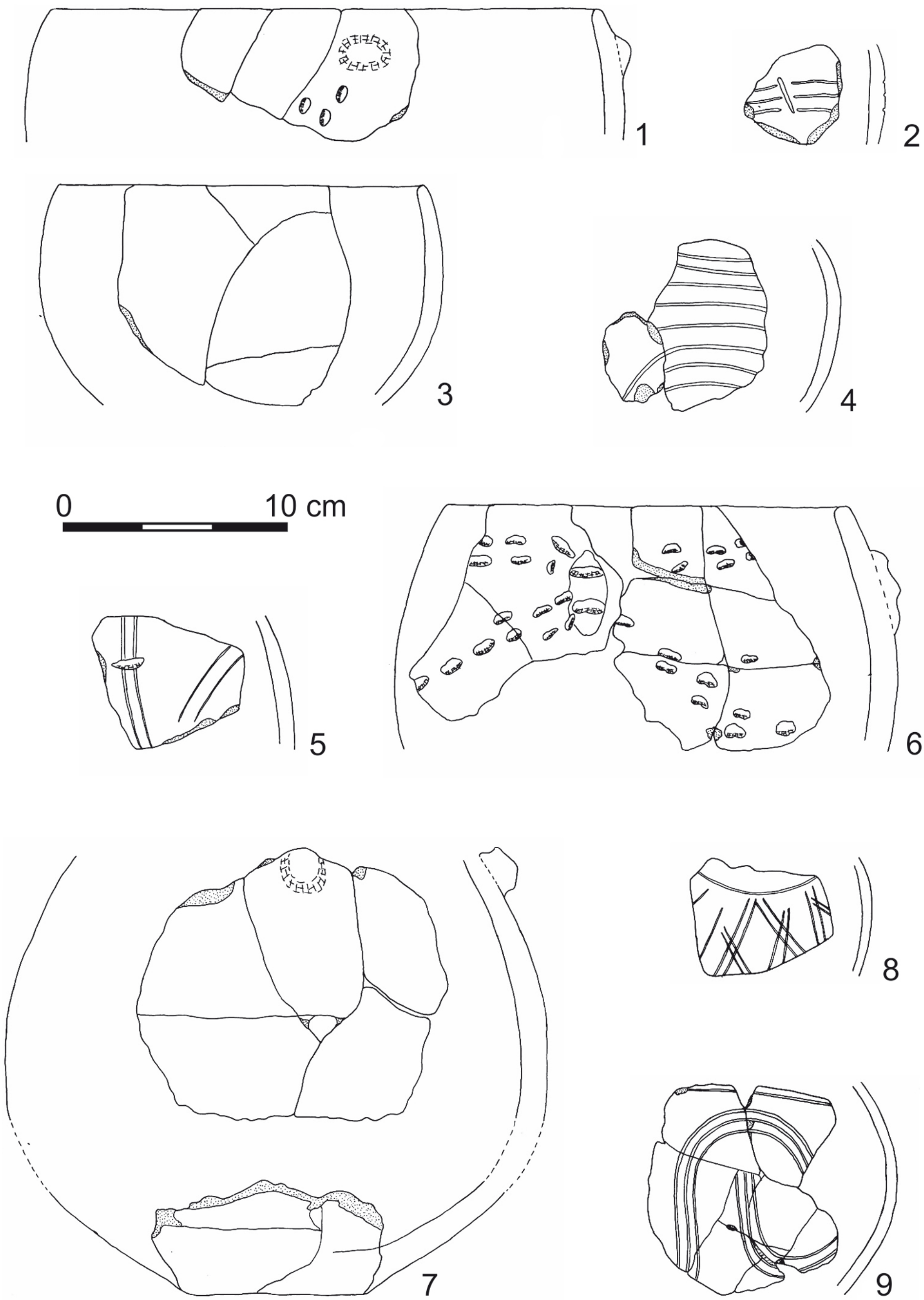

Fig. 4. Brzezie, site 40. Selection of LBK pottery (1-7) from excavated house
(illustration by M. Golańska and A. Krzywda)

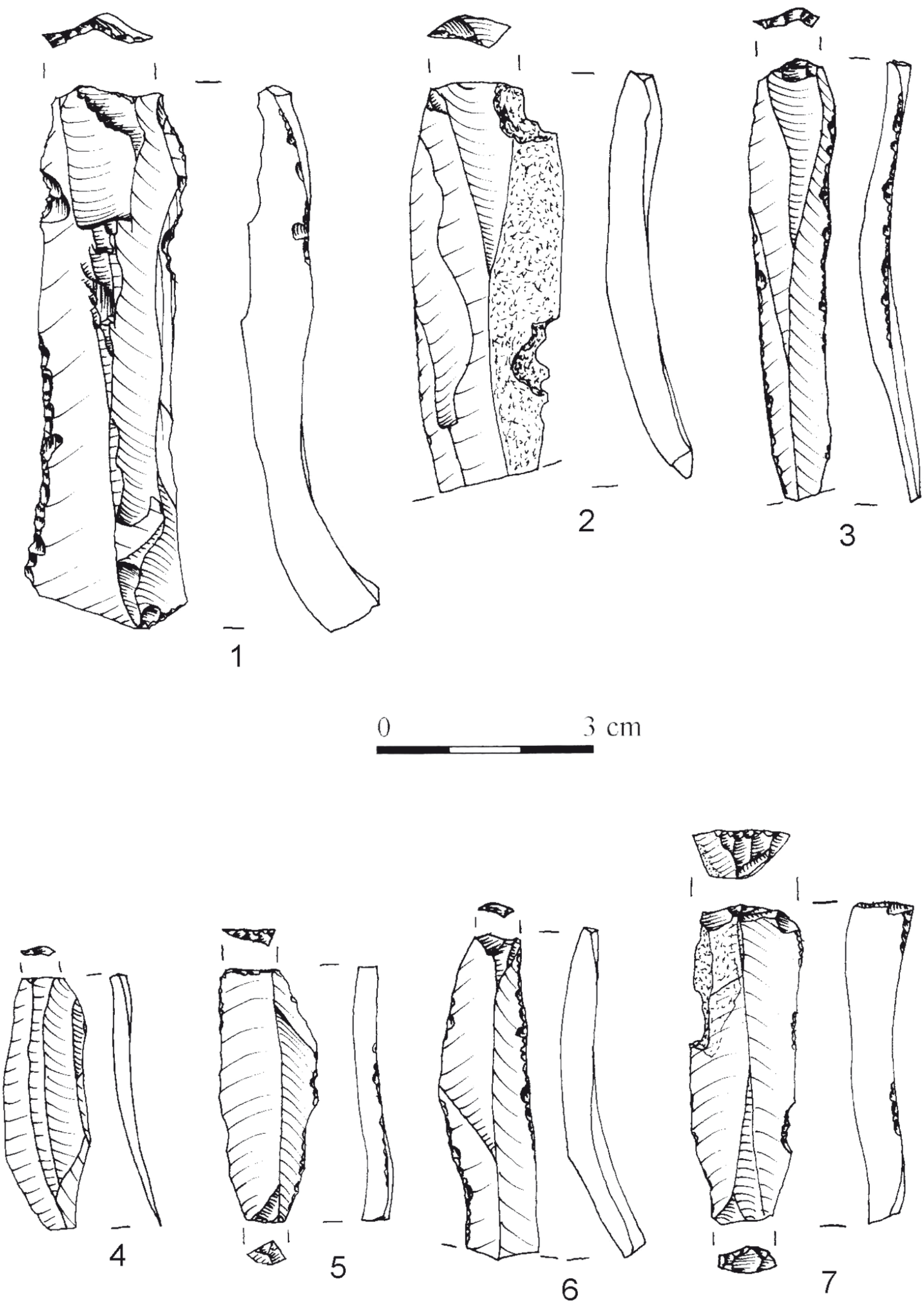

Fig. 5. Stone artefacts from excavated LBK houses at Brzezie, site 40 (1, 5-7), and Targowisko, site 16 (2-4), made of Jurassic flint (1-3, 5-7) and obsidian (4) (illustration by M. Wąs)

Targowisko 16

On the western edge of site 16 in Targowisko, thanks to the geomagnetic prospection, traces of three long LBK houses, located at fairly large distances from each other, were recorded (Golański *et al.* 2019, fig. 4-7). It was decided to excavate the northernmost house (Fig. 6).

A house consisting of 5 rows of post-holes was unveiled. Long pits have been explored on both sides of the house (Fig. 6).

In domestic pits and in the so-called cultural layer, 618 pieces of LBK pottery were discovered, mostly of small size. Only 14% of the pottery sherds represent the category of characteristic ceramics, *i.e.*, they have an ornament or are part of a rim or bottom.

Among the delicate ceramics, cups decorated with engraved lines, which are sometimes cut with notches, predominate (Fig. 7: 1-3, 6). Kitchen ceramics, including hemispherical and necked dishes, are decorated with plastic ornaments and fingerprints (Fig. 7: 7, 9-13). The large share of notches in engraved ornamentation suggests a slightly younger position in the Želiezovce (III) phase (Kadrow 2020b, fig. 7) than the pottery set from Brzezie 40.

The entire flint inventory (64 specimens) from this site comes from the fill of 4 domestic features. Most of the artifacts (including the burned ones) were made of local Jurassic Cracovian flint (83%). As much as 17% (11 products) were made of obsidian (Fig. 5: 4). In the technological and typological structure of the inventory, the most numerous group includes products related to the exploitation of flakes (30 items in total). Flakes (19 items), the technologically related flake core (1 specimen), and tools made of flakes (10 items) constitute nearly half of the entire inventory. Products related to blade exploitation (26 items; Fig. 5: 2-4) are slightly less numerous. The most numerous objects in this group are blades (10 items), but the group also includes a blade core (1 piece) and 15 tools made of blades. In addition, there were 3 flint crumbs and one chip.

As many as 25 tools have been identified. The typological tools include truncated blades (7 items), micro-retouched blades (3 items; Fig. 5: 3) and a perforator (1 item). Five amorphous retouched flakes were also recorded. The utility tools include flakes and blades with traces of use-wear in the form of the utility retouch and utility displays (9 items in total).

While the inventory from Targowisko 16 has many analogies in other LBK sites from western Małopolska in terms of raw materials and tool structure, some differences are visible in the aspect of production. Blade technology production is relatively difficult to ascertain here. Of note is not only the lack of cores, but most of all the lack of characteristic production waste, such as crested blades, platform rejuvenation flakes, etc.

Targowisko 14-15

In the northern part of site 14-15 in Targowisko, traces of five MC houses were documented thanks to geomagnetic prospection (Golański *et al.* 2019, fig. 8-11). House no. 3 was selected for excavation (see Golański *et al.* 2019, fig. 11). Relics of a 12-meter-long MC house, typical for western Małopolska, were discovered. These consisted of a single row of post-holes on the perimeter of a rectangular structure and one row of post-holes separating the vestibule (see Kadrow 2015, fig. 2-4). The house is accompanied by a construction (clay) pit (Fig. 8) to the north-west.

A total of 653 fragments of MC ceramics were discovered, of which only 92 were characteristic sherds (14%). These include pear-shaped vessels decorated with a stroked ornament in the form of horizontal lines below the rim and sliding triangles on the upper part of the belly (Fig. 9: 11), along with small cups (Fig. 9: 8), bowls (Fig. 9: 1), bowls on hollow pedestals (Fig. 9: 5), other vessels on feet (Fig. 9: 9), amphorae with anthropomorphic images (Fig. 9: 6; *cf*. Grabowska and Zastawny 2007, fig. 4, 5), pouch-like vessels (Fig. 8: 3, 4) and large biconical vessels. The forms of these vessels and their ornamentation are typical for the classic MC phase (Kadrow 2006, 63-69).

The stone inventory consists of 97 products, 42 of which are made of chocolate flint, 41 of the Jurassic Cracovian flint and 3 of obsidian. The degree of charring of 11 artifacts prevents their raw material identification. In the technological and typological structure, the most numerous group includes products related to flake exploitation (55 items in total).

Fig. 6. Targowisko, site 16. Remains of the LBK house (photo by A. Golański)

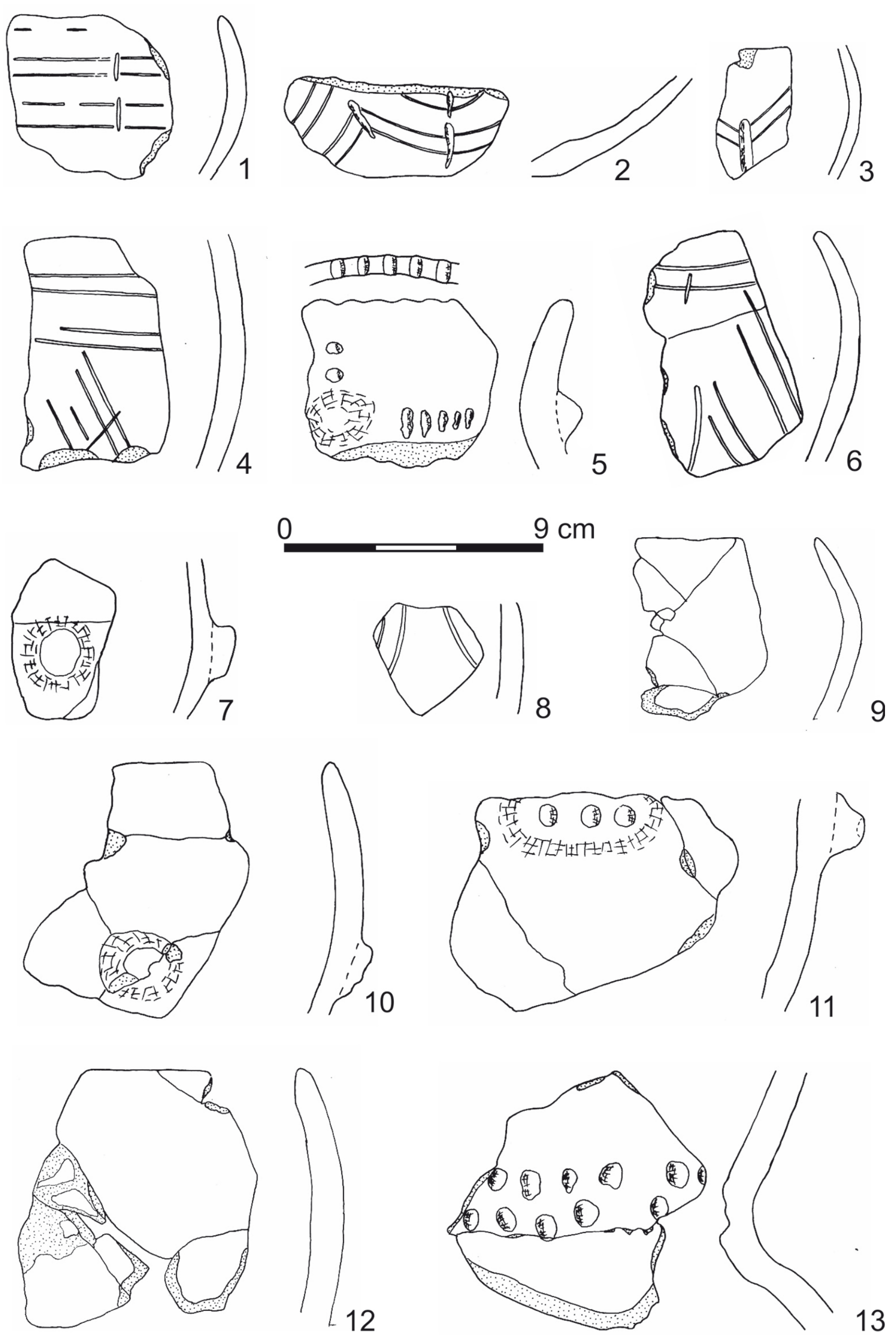

Fig. 7. Targowisko, site 16. Selection of LBK pottery (1-13) from excavated house (illustration by M. Golańska and A. Krzywda)

The products associated with blade exploitation (35 items; Fig. 10: 1, 2) are slightly less numerous. The rest of the inventory consists of specimens identified as flint crumbs (5 items) and microdebitage in the form of two chips. As many as 31 tools were identified, accounting for over 30% of the total inventory. Sixteen retouched specimens were identified, among which blade forms predominate: truncated blades (6 items, including 2 single and 4 double; Fig. 10: 4, 7, 8), end-scrapers (2 items), micro-retouched blades (6 items; Fig. 10: 3, 5, 6) and 2 retouched flakes. Moreover, utility tools (15 items) with retouching or utility displays were distinguished

CHRONOLOGY AND SETTLEMENT PROCESS DYNAMICS OF THE TARGOWISKO REGION

In addition to the results of the excavations described above, a series of radiocarbon dates were also obtained, precisely defining the absolute age of the beginning of the late (III) LBK phase and the classic (Ib) MC phase (Fig. 11; Table 1). As samples for age determination, macroremains of plants were used, which were collected from the bottom levels of construction pits accompanying the excavated houses at the sites of Brzezie 40 and Tar-

Fig. 8. Targowisko, site 14-15. Remains of MC house (photo by A. Golański)

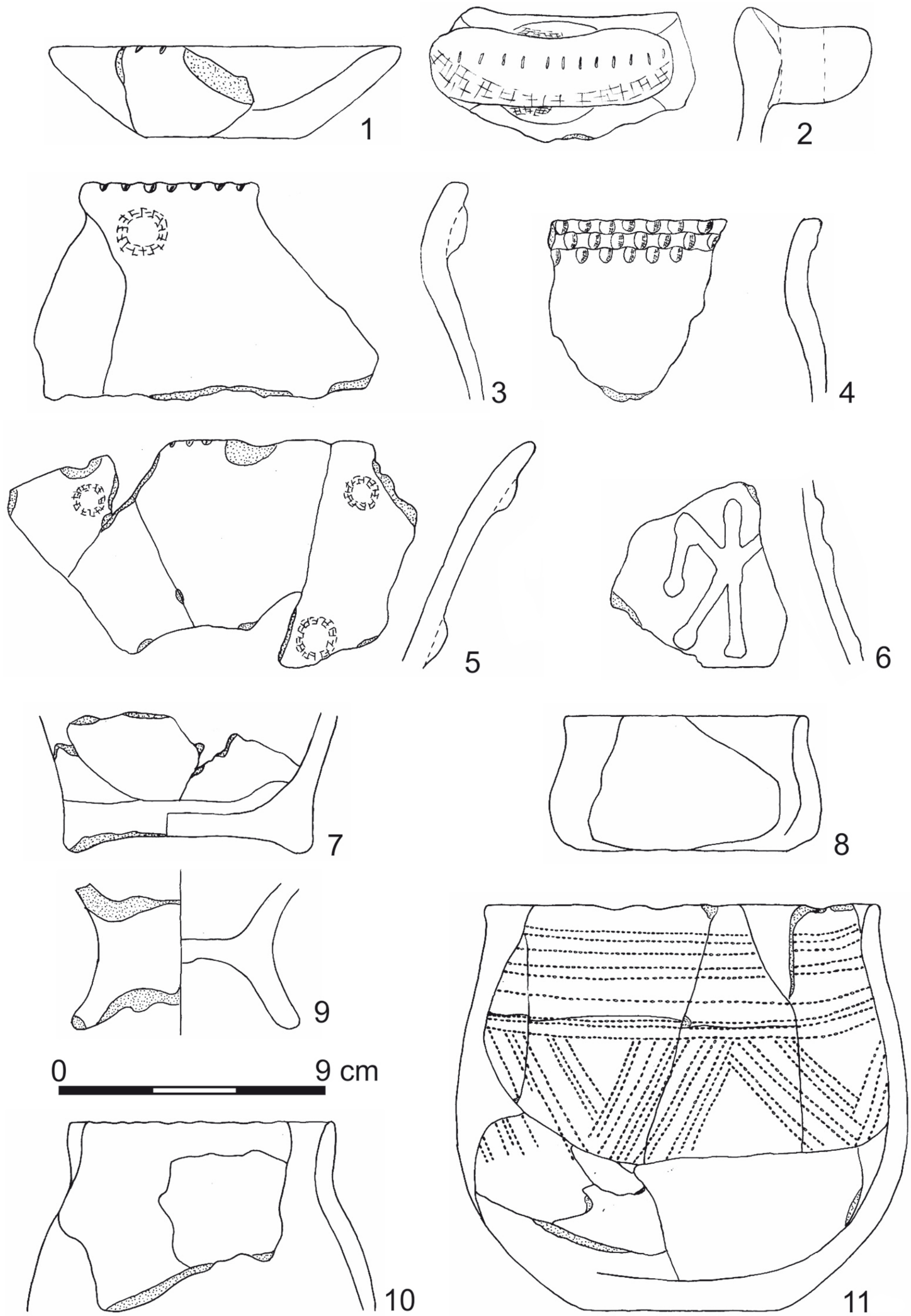

Fig. 9. Targowisko, site 14-15. Selection of MC pottery (1-11) from excavated house (illustration by M. Golańska and A. Krzywda)

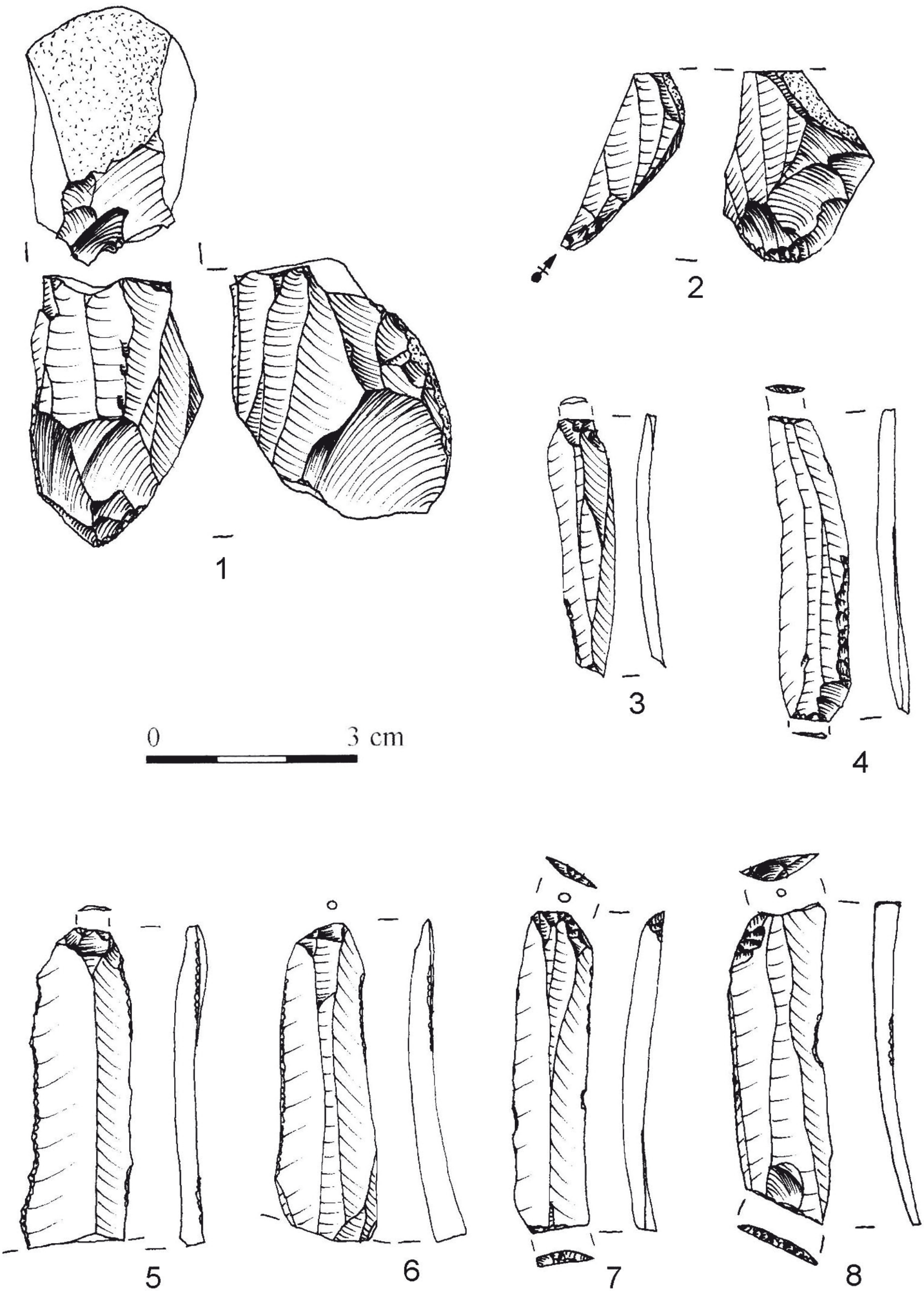

Fig. 10. Targowisko, site 14-15. Selection of stone artefacts from excavated MC house, made of Jurassic (1, 4, 5) and chocolate (2, 3, 6-8) flint (illustration by M. Wąs)

gowisko 14-15 and 16 (Abramów 2021). At the same time, the assumption about the single-phase nature of the explored parts of the sites, as well as the origins of all artifacts and ecofacts obtained from narrow time intervals therein, were confirmed.

The sigma 1 intervals of the probability distributions of six ^{14}C dates from Brzezie 40 and Targowisko 16, whose ceramics stylistically and typologically related to the beginning of the late LBK phase, take maximum values from 5200 to 4950 BC (Table 1). A concentration of probabilities is associated with a narrower time period, *i.e.*, 5100-5000 BC. The probability distributions of the seven ^{14}C dates in the sigma 1 range associated with the classic phase MC house relics are located between 4700 and 4450 BC. The concentration of probabilities is limited to a narrower range of 4650-4550 BC (Table 1).

In the opinion of Agnieszka Czekaj-Zastawny, researcher of site 17 in Brzezie – which is dominated by relics from the music-note phase (II) of the LBK – this phase should be dated to the period between 5300-5100 BC (Czekaj-Zastawny 2014, 94). As it turned out recently, the traces of the early phase (I) of the LBK in Gwoździec are dated to the same period (*cf.* Czekaj-Zastawny *et al.* 2020, fig. 16). The presence of the settlement of the older (I) LBK phase at site 10-11 in Targowisko, and the dating of the impact of its inhabitants on the environment to the period 5300-5100 (MKL-4491 6270 ± 80 BP), readable in the TRG core at a depth of 280 cm and slightly higher (Forysiak *et al.* 2021, table 1), confirms this diagnosis. The sequence of stages, beginning with a large settlement from the older (I) phase of the LBK, followed by subsequent settlement phases at site 2 in Zagórze (Kadrow *et al.* 2020), does not contradict this.

There are still no radiocarbon dates for the older (Ia) MC phase. However, thanks to the dates published in this article and the definition of the chronology of the younger (III) LBK phase and the classical (Ib) MC phase (Fig. 11; Table 1), we know that this phase should fall between them, *i.e.*, between 4950 and 4700 BC. Confirming such dating is the chronology of the environmental impact of the inhabitants of the settlement at site 10-11 in Targowisko, visible in the layers of the TRG core at a depth of 257-256 cm (MKL-4183 5960 ±80 BP, *i.e.*, 4950-4800 BC; *cf.* Forysiak *et al.* 2021).

The new arrangements of the absolute chronology presented above and the reanalysis of the chronology of the settlement phases at the site of Zagórze 2 (Kadrow *et al.* 2020) allow for some modifications of the model of the chronology of settlement in the Targowisko region, reconstructed by Czekaj-Zastawny (2014, 97-100, fig. 58). Now, we can also attempt to reconstruct the dynamics of settlement processes in this region (Fig. 1, 12).

At about 5300 BC at the western end of the region, at the Zagórze 2 site, a group of prospectors with ceramics from the older phase (I) of the LBK in the Gniechowice style appeared. The action of permanent settlement (construction of long houses) began a little later, but still during the older phase of the LBK (Zofipole style ceramics) on the western (Zagórze 2; see Kadrow *et al.* 2020) and eastern edges of the region (Targowisko 10-11; see Zastawny and Grabowska 2014). In the former, there were at least 13 houses from that time, while at Targowisko there were 8 houses spanning two building phases.

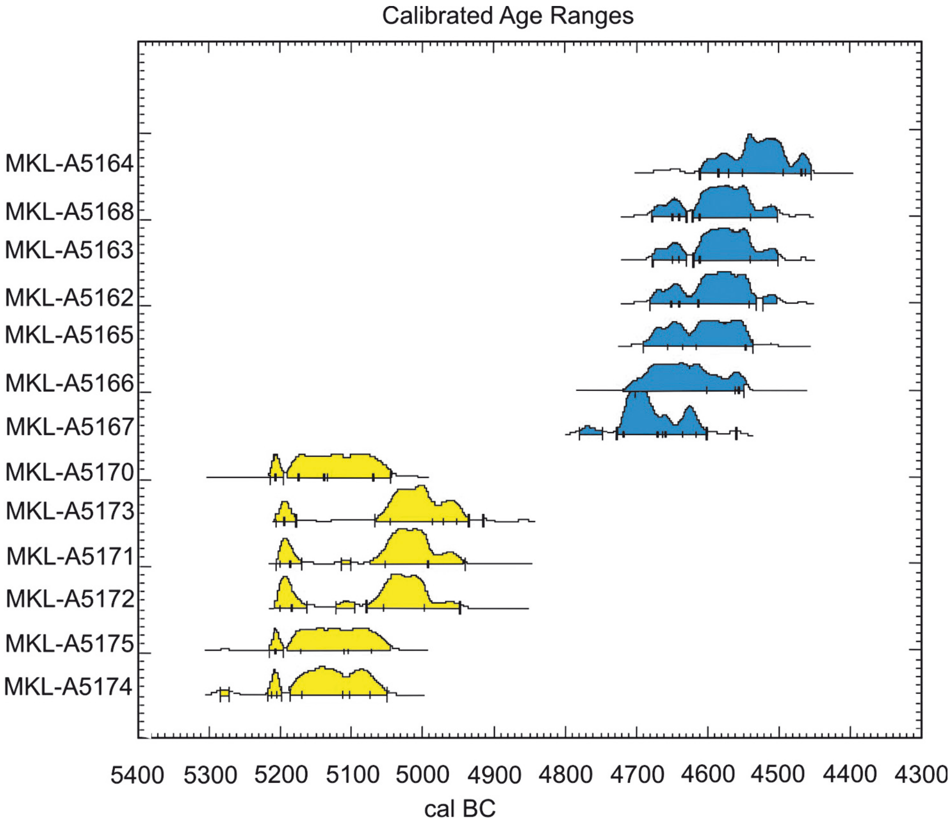

Fig. 11. Radiocarbon chronology of LBK (Brzezie 40 and Targowisko 16) and MC (Targowisko 14-15) houses (calibration after Calib Rev 8.1.0)

In the next, music-note phase (II) of the LBK, permanent settlement from the above-mentioned locations moves to the sites located in the interior of the region, *i.e.*, to the Brzezie 17 site (east of Zagórze 2) and to the complex of sites 12-16 in Targowisko (west of Targowisko 10-11). Twenty-six long houses from that period were discovered in Brzezie, and 30 houses in Targowisko (Czekaj-Zastawny 2014, 98).

In the late phase (III) of the LBK, the settlers showed an even greater tendency to colonize the central parts of the region. At that time, settlements were established at the site of Brzezie 40 and Szarów 9. The settlement of sites 12-13 and 16 in Targowisko was continued. From that time, 52 long houses were documented in the above-mentioned sites (Czekaj-Zastawny 2914, 98), *i.e.*, slightly less than in the previous phase.

So far, there is no evidence of contemporaneous contact between the population of this phase of LBK and the inhabitants representing the oldest MC phase in the region. Research on the question of contact is possible thanks to site 12-13 in Targowisko, where the

Table 1. List of radiocarbon dates from LBK settlements at Brzezie site 40 and Targowisko site 16 and from MC settlement at Targowisko site 14-15. Calibration after Calib Rev 8.1.0

L.p.	Site	Lab	BP	BC – 68,3% probability	BC – 95,4% probability
1	Targowisko 14-15, ob. 10	MKL-A5164	5705±24	4585 (8,9%) 4569 4553 (56,6%) 4493 4469 (2,7%) 4464	4611 (95,4%) 4456
2	Targowisko 14-15, ob. 1	MKL-A5168	5737±23	4650 (4,7%) 4641 4613 (63,6%) 4540	4678 (18,0%) 4631 4621 (77,5%) 4501
3	Targowisko 14-15, ob. 1c	MKL-A5163	5737±23	4650 (4,7%) 4641 4613 (63,6%) 4540	4678 (18,0%) 4631 4621 (77,5%) 4501
4	Targowisko 14-15, ob. 1	MKL-A5162	5741±23	4652 (6,5%) 4640 4613 (61,8%) 4542	4681 (90,2%) 4531 4526 (5,2%) 4502
5	Targowisko 14-15, ob. 1	MKL-A5165	5755±23	4658 (15,0%) 4636 4616 (53,3%) 4548	4691 (95,4%) 4536
6	Targowisko 14-15, ob. 1A	MKL-A5166	5779±24	4686 (65,0%) 4602 4562 (3,3%) 4556	4703 (95,4%) 4549
7	Targowisko 14-15, ob. 1	MKL-A5167	5821±23	4604 (57,0%) 4534 4520 (11,3%) 4504	4674 (7,6%) 4636 4616 (85,9%) 4492 4472 (1,9%) 4461
8	Targowisko 16, ob. 44b	MKL-A5170	6182±23	5176 (24,4%) 5140 5132 (43,9%) 5071	5214 (95,4%) 5046
9	Brzezie 40, ob. 7	MKL-A5173	6096±24	5197 (2,0%) 5193 5046 (55,5%) 4986 4971 (10,7) 4954	5206 (9,9%) 5176 5069 (85,3%) 4935 4917 (0,3%) 4913
10	Brzezie 40, ob. 10A	MKL-A5171	6108±24	5201 (11,1%) 5185 5054 (57,2%) 4992	5207 (16,2%) 5168 5116 (1,6%) 5100 5073 (77,6%) 4941
11	Brzezie 40, ob. 7	MKL-A5172	6118±23	5202 (14,5%) 5184 5056 (53,5%) 4998	5208 (21,9%) 5162 5121 (3,7%) 5096 5079 (69,8%) 4949
12	Brzezie 40, ob. 10A	MKL-A5175	6187±24	5173 (68,3%) 5073	5215 (95,4%) 5046
13	Brzezie 40, ob. 7	MKL-A5174	6200±23	5212 (4,1%) 5206 5171 (43,2%) 5114 5103 (21,0%) 5074	5283 (1,3%) 5274 5218 (8,5%) 5199 5187 (85,7%) 5051

youngest phase (III) LBK ceramics with red painting were registered (Czerniak *et al.* 2006, fig. 6), as well as ceramics with anthropomorphic representations from the older (Ia) MC phase (Czerniak *et al.* 2006, fig. 17).

The settlement strategy seen in this region during the beginning of the LBK is partially repeated in the early stages of MC settlement The oldest settlements of this culture reappear at extreme locations: Zagórze 2 in the west, and Targowisko 10-11 in the east (Fig. 1, 12). At both sites, the presence of 4 houses was documented, with a structure similar to the house recently discovered at site 14-15 in Targowisko (Fig. 8, *cf.* also Kadrow 2015, 299-

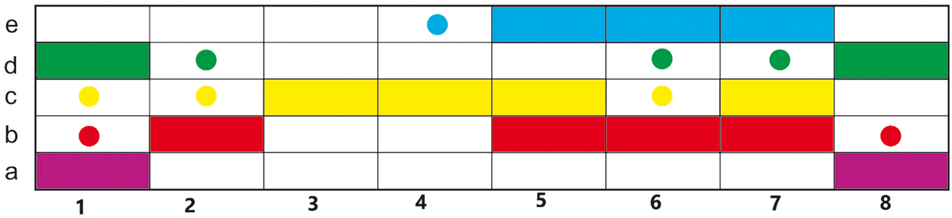

Fig. 12. Targowisko settlement region.
A graphic model of the sequence of settlement phases of LBK and MC settlements at the sites:
1 – Zagórze 2, 2 – Brzezie 17, 3 – Brzezie 40, 4 – Szarów 9, 5 – Targowisko 16, 6 – Targowisko 14-15, 7 – Targowisko 12-13, 8 – Targowisko 10-11 (colored rectangles – stable settlements with house remains; colored rings – settlement without the remains of houses; a – LBK phase I (Zofipole style), b – LBK phase II, c – LBK phase III, d – MC phase Ia, e – MC phase Ib; in part acc. to Czekaj-Zastawny 2014)

301; fig. 2, 4). It is not yet known whether some of the remains of houses, including those of larger sizes, and the circular cult construction ("pseudo-ditch" enclosure) at site 12-13 in Targowisko (Czerniak *et al.* 2007, fig. 7) are related to this period. At the site of this cult construction, imported ceramics from the Oborin II culture of eastern Slovakia and from the Stroked Ornamented Pottery culture of Bohemia were discovered (Czerniak *et al.* 2007, fig. 4, 6). It is known, however, that stable forms of settlement in the classical phase (Ib) of the MC are less frequent at the sites on the edge of the region (Zagórze 2 and Targowisko 10-11) and are concentrated in the interior at other sites in Targowisko (12-16; Fig. 1, 12).

While in the times of the LBK it is difficult to identify the central settlement for the entire region or for some part of it, in the MC period this function was most likely played by site 12-13 in Targowisko for the eastern part of the region (Fig. 12). The central settlement for the western part – but only in the early phase (Ia) – was probably site 2 in Zagórze. For some reason – perhaps the arrival of settlers of the Lengyel culture (hereafter: LC – Pleszów-Modlnica group; *cf.* Kadrow *et al.* 2020) – this microregion did not undergo further development in later phases.

During the LBK and MC period (5300-4500 BC) in the Targowisko settlement region (Fig. 1, 12), the population did not form typical, stable settlement microregions with one founding central settlement (*e.g.*, Pyzel 2019, 338), inhabited continuously from the beginning until the end of the LBK or even until the end of the classic phase of the MC classic (*e.g.,* Rzeszów, site 16; see Kadrow 2020a). As in many newly analyzed regions, *e.g.*, on the upper Danube, the relative instability of microregions is visible, along with increased mobility of small groups of people and attempts at risky colonization of other locations (*e.g.,* Pechtl 2020).

CULTURE CHANGE

The most visible evidence of cultural transformation was the change in the style (ornamentation and forms) of the ceramics at the transition between the LBK and the MC. A radical stylistic breakthrough was marked on this level of ceramics analysis. The stylistics of the beginning of the Želiezovce phase (ŻI) from the Brzezie 40 site (Fig. 4) and the turn of the early and middle section of this phase (ŻI/ŻIIa) from site 16 in Targowisko (Fig. 7) do not have any continuation in the ceramics of the classic MC phase (Fig. 9) from site 14-15 in Targowisko. Nor are any elements of the LBK style to be found in the rich collections of the early MC phase from the Targowisko 10-11 site (Grabowska and Zastawny 2014) or from the Zagórze 2 site (Kadrow *et al.* 2020) from the same settlement region (Fig. 1). The high proportion of decorative themes in the form of a meander in the pottery of the older phase of MC could indicate the participation of the Sandomierz-Opatów group of the LC in the genesis of the MC.

The issue of technological activities during the production of ceramics is somewhat different. LBK ceramics from Targowisko 16 are similar in terms of ceramic mass to MC materials from Targowisko 14-15. Similar technology is indicated by similar raw material sources (Miocene clays) and a a significant proportion of ceramic material that includes grog. The LBK ceramics from the Brzezie 40 site show a different character in terms of raw materials and admixtures (*cf.* Rauba-Bukowska 2021).

The LBK flint inventories from the Brzezie 40 and Targowisko 16 sites contain typological and technological elements typical of this culture in south-eastern Poland. They are dominated by Jurassic Cracovian flint with a small share of obsidian. The MC inventory from site 14-15 in Targowisko has a different raw material structure, where chocolate flint plays a significant part. Part of the MC blade material from Targowisko 14-15, made of chocolate flint, is associated with a different technology of exploitation and perhaps also with the use of different blade production techniques than in the LBK. On the other hand, some MC blades from Jurassic Cracovian flint have features analogous to forms known from the LBK inventories (*cf.* Wąs 2021). The share of chocolate flint in the raw material structure of the MC flint inventory, as well as certain peculiarities of the blade exploitation technology from site 14-15 in Targowisko, confirm the participation of the Sandomierz-Opatów group in the genesis of the MC.

In terms of the basic means of subsistence of the LBK and MC populations in the Targowisko region, evidence of the continuation of agricultural activities prevails. At all three sites, remains of grain crops were recorded. Two sites (Targowisko 14-15 and Targowisko 16) contained the remains of emmer wheat (T. *dicoccum*), and in the case of the MC site Targowisko 14-15, also einkorn (T. *monococcum*). At the LBK site of Brzezie 40, one grain fragment identified as wheat (*Triticum* sp.) and several other fragments of cereal grains (*Cerealia* indet.) were recorded. The presence of emmer wheat grains and a small share of einkorn wheat reflect the known picture of Neolithic crops thus far. Emmer heat was not grown as an independent crop. It always appeared in the company of an einkorn which is much better represented in archaeobotanical materials (*cf.* Abramów 2021).

The information collected as a result of the analysis of the TRG core indicates that in its section, which was formed at the time of the settlement of the older LBK phase in Targowisko 10/11, a weak change (split between two episodes) in the composition of pollen was recorded. A slight increase in the share of plant species associated with arable farming is contemporary with the settlement of the older MC phase. The low impact of the early Neolithic population on the environment could have been due to the nature of farming at that time. People were using small mid-forest clearings. Differences in the degree of human impact on the environment are not recorded at the time when site 10-11 in the Targowisko site was inhabited by the populations of the LBK and MC phases (see Forysiak *et al.* 2021).

CONCLUSIONS

Thanks to the series of new ^{14}C dates (Fig. 11), the absolute chronology of the beginnings of the late phase (III) of the LBK and the classical phase (Ib) of the MC was established. Indirectly, thanks to the synchronization of the dated layers in the TRG core with the impacts on the natural environment of the inhabitants of settlements at site 10-11 in Targowisko (*cf.* Forysiak *et al.* 2011), we also know the absolute chronology of the older phase (I) of the LBK and the older MC phase (Ia) in the analyzed region.

The exact chronology of the sequence of settlement episodes (Fig. 12) at all sites in the Targowisko settlement region (Fig. 1), along with the settlement analysis, enabled us to establish that the population did not form typical, stable settlement microregions with one central founding settlement. Conversely, the relative instability of microregions is visible, along with the increased mobility of small groups of people, settling various sites inside the Targowisko region (Fig. 1, 12).

At the turn of the LBK and MC, there are signs of continuity at the level of settlement strategies and basics of subsistance, and no continuity in terms of symbolic products, *e.g.* the form and ornamentation of ceramics, nor in the construction and size of houses.

Impulses from various cultural environments contributed to the formation of the MC, which proves its heterogeneous character and the complicated course of its genesis.

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THE ENVIRONMENTAL CONTEXT OF EARLY NEOLITHIC CULTURAL TRANSFORMATION IN THE TARGOWISKO SETTLEMENT REGION (SOUTHERN POLAND)

ABSTRACT

Forysiak J., Kadrow S., Noryśkiewicz A. M., Okupny D., Saile T., Twardy J. and Zawiska I. 2021. The environmental context of Early Neolithic cultural transformation in the Targowisko settlement region (Southern Poland). *Sprawozdania Archeologiczne* 73/1, 177-201.

The aim of this article is to provide information on environmental changes in the Targowisko region in the Early Neolithic as a natural response to settlement and economic activity of the human population in that area. The discussion is based on lithological, geochemical, and palynological analyses, as well as the analysis of Cladocera within strata inside the TRG (Targowisko) core, located in a small wetland in the immediate vicinity of the eastern edge of the Neolithic settlement in the Targowisko region. Settlement analysis points to the absence of stable microregions and to the mobility of human groups. This is confirmed by the sequence of settlement episodes and economic activity, reflected in the stratigraphy of the core sediments, where episodes of significant human interference are followed by phases of almost complete regeneration of the environment. No differences have been noticed between the *Linienbandkeramik* and Malice culture communities as regards their impact on the environment.

Key words: environmental conditions, Early Neolithic, LBK culture, Malice culture, Targowisko region, biogenic sediments, multi-proxy environmental reconstruction
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INTRODUCTION

The Targowisko settelment region is a unique archeological area, where numerous remnants of Early Neolithic cultural activity have been found (Czerniak 2013; Czekaj-Zastawny 2014; Grabowska and Zastawny 2014; Zastawny and Grabowska 2014a, b; Kadrow *et al.* 2020). The settlement of the eastern Targowisko region in the *Linienband-keramik* (hereafter: LBK) and Malice culture (hereafter: MC) periods (5300-4500 BC) did not form a typical, stable microregion with one central founding settlement (*e.g.* Pyzel 2019), inhabited continuously throughout the LBK or even until the end of the MC classic phase (*e.g.* site 16 in Rzeszów; see Kadrow 2020a). The examined material points to the relative instability of the microregions, the increased mobility of small human groups, and to risky decisions about settlement (Kadrow *et al.* 2021), noted also in many recently analysed regions, *e.g.* on the upper Danube (*e.g.* Pechtl 2020).

The environmental changes resulting from settlement and economic activity have already been investigated (Kalicki, 2014). However, due to the properties of the biogenic material, it was not possible to conduct a palynological investigation for the material falling within the timespan of the LBK and MC in this region. As it has been widely acknowledged that reconstruction of the environmental context is a very important part of archeological studies, we aimed to find new biogenic material that sedimented in water bodies or swamps, and that would be more suitable for environmental analysis. During the detailed geomorphological investigation, several swamps were recognized in the region, but only a few layers of strongly decomposed biogenic sediments were found, which turned out not to be suitable for palaeoecological analysis. Therefore, material was taken from the swamp that was previously investigated (Kalicki 2014). In the collected sediment core, the lithology was described and several analyses were performed: geochemical and palynological, as well as an analysis of subfossil Cladocera.

The main aim of the study was to provide information on environmental changes in the Targowisko region in the Early Neolithic as a response to settlement and economic activity of the human population in that area.

Geochemical composition of the sediment is more and more often used in the reconstruction of palaeoenvironmental conditions (*e.g.* Wojciechowski 2000; Borówka 2007,

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Ratajczak-Szczerba *et al.* 2014, Pleskot *et al.* 2018; Kittel *et al.* 2020). The assumption of these interpretations is that the main chemical components of biogenic sediments derive from different sources and that they accumulate in deposits in different physical-chemical conditions. In order to recognize the extent of denudation, whether generated by natural factors or induced by human activity – and especially relative changes in these types of processes – elemental contents can be used (Fe, Mn, K, Mg), as well as the sums of these elements relative to a normalisation element such as Ca. Paleoenvironmental conditions responsible for the sedimentation of the biogenic material were interpreted by determining the quantitative ratios of the elements and by classifying the deposits geochemically (Borówka 2007).

Pollen analysis is widely used in archeological studies to reconstruct not only general vegetation history, but past human impact on vegetation and past cultural landscapes as well (Gaillard 2007). This allows for the estimation of changes in vegetation under the influence of human activities, and provides some indication of the type of agriculture in the study area (Behre 1981, Gaillard 2007). Palynological studies contribute important data to environmental reconstructions and cultural and economic practices. The low representation of pollen and the high degree of sporomorph damage, which are characteristic of the so-called dry sites and old glacial areas, could significantly affect the interpretive capabilities and limitations of the method. However, even in this case, palynological data can provide useful qualitative data.

Subfossil Cladocera analysis is often used in paleolimnology in order to reconstruct environmental conditions in the past (Korhola and Rautio 2001). Cladocera are an important zooplankton component of freshwater lacustrine environments. Their remains, preserved in the sediment, clearly indicate the presence of a body of water – even a shallow one. Cladocerans are very sensitive to water depth (Nevalainen *et al.* 2011), temperature (Lotter *et al.* 1997; Zawiska *et al.* 2015) and pH changes (Locke and Sprules 2000; Zawiska *et al.* 2013). For this reason, they are useful in archaeology, because they help trace environmental changes resulting from human activity.

This article reports the results of environmental analyses as part of the project "Great culture transformation in microregional perspective. Trends of changes inside Danubian farmers an interdisciplinary study". Other aspects of the investigations carried out within the project are presented in two articles published in this volume (Kadrow *et al.* 2021; Rauba-Bukowska 2021). When combined with data concerning material culture, technology and economy (see Kadrow *et al.* 2021; Rauba-Bukowska 2021), the information may contribute to resolving the question of whether the cultural transformation resulted from internal changes in the local Early Neolithic communities (*e.g.* Kadrow 2020a) or from the disappearance of the local LBK population and the arrival of new settlers from beyond the Carpathians, who developed the MC (*e.g.* Kozłowski *et al.* 2014). Considerations about the mechanisms of transformation, taking into account the results of environmental – nalyses, are contained in one of the two related articles (Kadrow *et al.* 2021).

THE LOCATION

The Targowisko settlement region lies in the borderland between the Carpathian Foothills (Wieliczka and Bochnia Foothills) and the Sandomierz Basin (Kondracki 2002; *e.g.* Kadrow *et al.* 2021, fig. 1), mostly in the valley of the Tusznica river, which flows into the Raba river, a tributary of the Vistula. The western part of this settlement region lies in the Podłężanka river basin, also a tributary of the Vistula. The area was glaciated during the

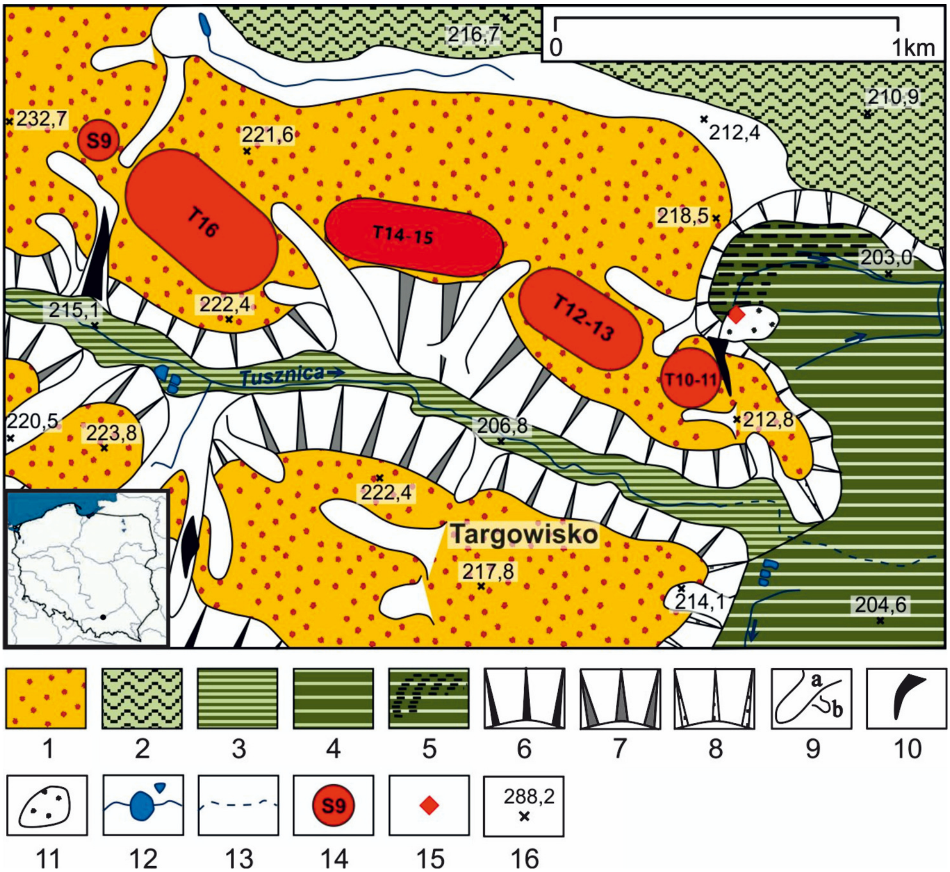

Fig. 1. Geomorphological map with the locations of the studied sites; 1 – morainic upland, denudated with loess mantle, 2 – alluvial plain (fluvial terrace), 3 – Tusznica River valley floor, 4 – high terrace (Raba river valley), 5 – mire (in paleochannel), 6 – slopes of foothill ridges, 7 – slopes of Tusznica River valley, 8 – slopes of Raba River valley, 9 – denudational dry valleys (a) and trough (b), 10 – gullies and other erosional cuttings, 11 – deluvial fan, 12 – river channels and artificial reservoirs, 13 – sewered and underground river channel, 14 – early Neolithic settlements (T10-11 – Targowisko site 10-11; T12-13 – Targowisko site 12-13; T14-15 – Targowisko site 14-15; T16 – Targowisko site 16; S9 – Szarów site 9), 15 – location of TRG core, 16 – hight-point m a.s.l.

Southern Polish (Elsterian) Glaciations (Mojski 2005), but its tills and glaciofluvial sand with gravel are covered by a loess mantle, approx. 10 m thick, accumulated during the Saalian and Vistulian cold stages (Maruszczak 1980).

The borderland between the Sandomierz Basin and the Wieliczka and Bochnia Foothills is poor in biogenic sediment, which could be used to track environmental changes in that area. Although several wetlands have been selected and identified there, biogenic sediments deposited in them have survived only as thin layers of highly decomposed material, with very limited usefulness for palaeoecological analysis.

The studied archaeological sites in Targowisko are located within near-valley strips of morainic upland covered by loess, or on slope flatness descending towards the bottom of the Tusznica river valley (Fig. 1). Biogenic sediments for palaeoenvironmental analyzes were collected from the wetland located directly north of the site of Targowisko 10-11. The wetland takes up a part of the Raba paleochannel shaped during the Late Vistulian (Kalicki 2014; 2015), bordered by a steepish slope more than 10 m high to the west, and by a flat alluvial plain to the east. The south-western part of the paleochannel is covered with a diluvial fan (Fig. 1). It formed during the Neoholocene, when mineral matter from the denuded slope and the surrounding upland was deposited there through a small gully (Fig. 1).

After identifying the thickness of organic sediments in the paleochannel and the diluvial series of the fan, a profile was selected for detailed palaeoecological examination. The profile, marked as TRG, was located in the western part of the fan (Fig. 1; φ = 49°59'17,7" N; λ = 20°17'54,7"E), approx. 30 m to the northwest of the TP3 core examined by Kalicki (2014). The earlier palaeogeographical and palynological analyses carried out in that place traced the development of that area from the Late Glacial to the historical periods. However, because the deposits analysed by Kalicki (2014) representing a significant part of the Atlantic period (synchronous with the Early Neolithic settlements) contained no pollen and showed discontinuities in sedimentation, the decision was made to resume exploration of the wetland.

MATERIALS AND RESEARCH METHODS

The TRG core was collected with a 50-cm-long Instorf sampler with double coring separated by 50 cm. Three general layers were documented within the core profile: 0-150 cm: a silt layer – mineral deposit with organic debris and peaty interbeddings (diluvial fan series); 150-510 cm: gyttja series (lacustrine deposits) – carbonate-detritus or carbonate-mud gyttja (Fig. 2); 510-550 cm: sandy series.

Detailed tests covered the material collected from a depth of 160-360 cm. Basic physical and chemical parameters, including organic matter content (LOI – loss on ignition), calcium carbonate content ($CaCO_3$), reactivity (pH) and conductivity of matter (Fig. 2), were measured for 64 samples in a 3-cm resolution, according to the procedure by Bengtsson

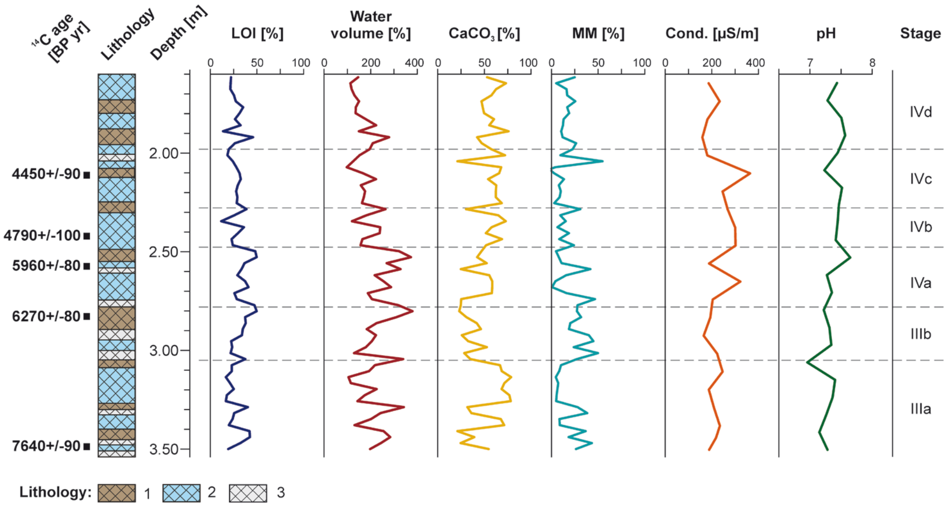

Fig. 2. Targowisko TRG-core. Basic physico-chemical parameters. Lithology: 1 – detrital-calcareous gyttja, 2 – calcareous-silty gyttja, 3 – clay gyttja

and Enell (1986). The calcium carbonate content was calculated by the Scheibler method, the reaction (pH) and conductivity were estimated by the conductimetry method, and the loss on ignition was obtained at 550°C (Myślińska 2010). Ash with no organic matter was dissolved with concentrated HNO_3, 10% HCl and H_2O_2 in a Berghof Speedwave microwave mineralizer. Elements with palaeogeographical significance (Na, K, Ca, Mg, Fe, Mn, Cu and Zn) identified in the resulting solution were marked by the atomic absorption spectroscopy method (AAS Solar Unicam).

Statistical analysis of the chemical composition included several indicators of the type and relative intensity of denudation processes (LOI/$CaCO_3$, Na/K, Ca/Mg, Na+K+Mg/Ca) (Fig. 3), as well as water table changes (Fe/Mn, Cu/Zn, Fe/Ca), with the use of Triplot and PAST (Hammer *et al.* 2001). After the solution was made in accordance with Clift *et al.* (2019), the grain size composition of the samples was determined with a Mastersizer 3000 laser particle size analyser (Malvern).

Five samples of the TRG core were radiocarbon dated (Table 1; Fig. 4) by the conventional method with the scintillation technique. This test was performed on the samples with approx. 2-cm-long intervals.

The palynological analysis covered sediment collected from a depth of 190-300 cm, from which 31 samples, each with a volume of 1 cm³, were submitted for standard laboratory processing. In order to prepare the material for microscopic analysis, the samples were treated with 10% HCl, 10% KOH, 40% HF and Erdtman acetolysis (Berglund and Ralska-Jasiewiczowa 1986). First, *Lycopodium* spores were added to each sample as an

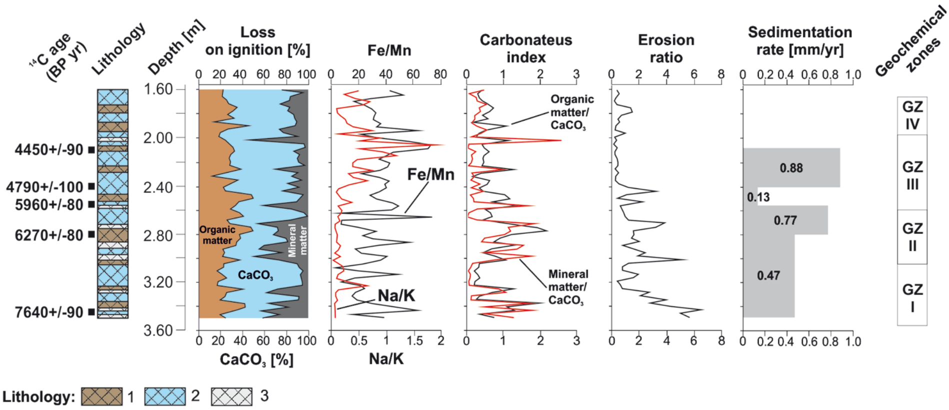

Fig. 3. Targowisko TRG-core. Variability of the conditions of sedimentation in the TRG profile, estimated on the basis of the geochemical ratios (Fe/Mn, Na/K, LOI/CaCO3, MM/CaCO3, catchment erosion) against the lithology, content of the basis lithogeochemical components and sedimentation rate. Lithology: 1 – detrital-calcareous gyttja, 2 – calcareous-silty gyttja, 3 – clay gyttja.

indicator (Stockmarr 1971) to calculate the absolute concentration of sporomorphs. Pollen and spore identification was based on the pollen key by Beug (2004) and the Northwest European Pollen Flora I-VIII (Punt *et al.* 2003). Depending on the quality of the sample, not less than 200 (from 215 to 498) pollen grains of trees, shrubs and terrestrial herbaceous plants (excluding Cyperaceae) were counted each time (AP + NAP-Cyperaceae = 100%; AP – Arboreal Pollen, NAP – Non Arboreal Pollen). Cyperaceae were excluded from

Table 1. Results of radiocarbon dating of the deposits from the TRG core (calibration after Calib Rev 8.1.0)

Depth of sample cm	Lab code	BP	BC - One Sigma Ranges	BC - Two Sigma Ranges
210	MKL-4489	4450±90	**[3334 - 3213] 0,421675** [3191 - 3147] 0,144471 **[3140 - 3012] 0,433854**	**[3360 - 2912] 1,000000**
240	MKL-4490	4790±100	**[3649 - 3500] 0,793679** [3433 - 3379] 0,206321	**[3778 - 3363] 1,000000**
255-257	MKL-4183	5960±80	**[4940 - 4776] 0,862974** [4759 - 4726] 0,137026	[5198 - 5189] 0,004598 **[5049 - 4672] 0,985704** [4662 - 4660] 0,000816 [4635 - 4617] 0,008882
280	MKL-4491	6270±80	**[5322 - 5206] 0,668432** [5170 - 5114] 0,223516 [5103 - 5073] 0,108052	[5467 - 5446] 0,016685 **[5380 - 5008] 0,983315**
344-346	MKL-4184	7640±90	[6587 - 6579] 0,046197 **[6574 - 6426] 0,953803**	**[6650 - 6353] 0,959546** [6312 - 6259] 0,040454

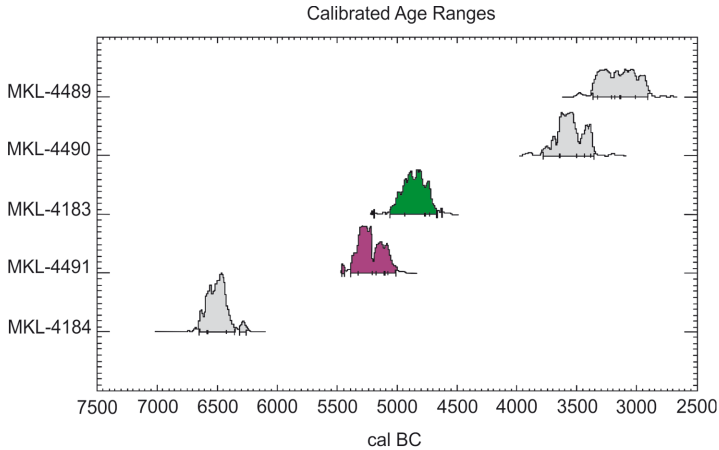

Fig. 4. Targowisko TRG-core. Radiocarbon dating of selected deposits from different core depths; the purple color of the probability distribution – existence of a settlement from the older phase of LBK; the green color of the probability distribution – existence of a settlement from the older phase of MC at site 11 in Targowisko (calibration after Calib Rev 8.1.0)

the basesum due to their typically local presence in the peatland, and their percentage was calculated in the same way as that of aquatic and spore plants. Finally, for palynological interpretation, 31 samples were used and 70 taxa were determined. The system of basic pollen curves and the CONISS analysis from the PolPal program package (Walanus and Nalepka 1999) made it possible to separate one pollen zone (TRG -1 L PAZ; L PAZ – Local Pollen Assemblage Zones) containing four sub-zones (TRG -1a – TRG -1d L PASZ – Local Pollen Assemblage SubZones). The selected curves of pollen taxa indicated the main environmental changes, and the beginning of agricultural activities were chosen for the diagram (Fig. 5).

Samples for the analysis of Cladocera (Crustacea: Branchiopoda) remains were likewise collected from a depth of 190-300 cm, but only some of them have been examined thus far. One cubic centimeter taken from each fresh sample was subjected to the standard laboratory procedure described by Frey (1986). Microscope slides were prepared from 0.1 ml of each sample and examined under a light microscope with magnifications of x100, x200 and x400. For each sample, 2-4 slides were scanned, and all skeletal remains, including head shields, shells and postabdomens, were counted. The identification of the Cladocera remains was based on the identification key by Szeroczyńska and Sarmaja-Korjonen (2007). Stratigraphic diagrams presenting the percentage of each species (Fig. 6) were prepared with C2 freeware (Juggins 2007). Subfossil Cladocera analysis is often used in paleolimnology in order to reconstruct environmental conditions in the past (Korhola and Rautio 2001). Cladocerans are very sensitive to water depth (Nevalainen *et al.* 2011),

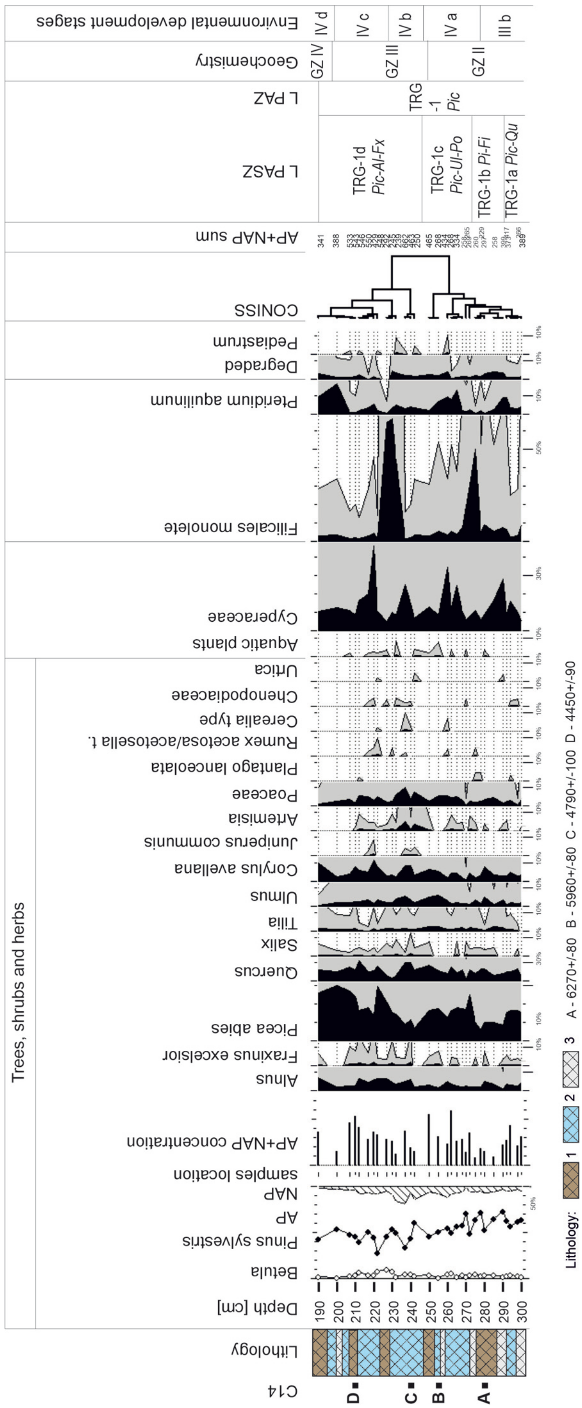

Fig. 5. Targowisko TRG-core. Percentage pollen diagram of the selected taxa

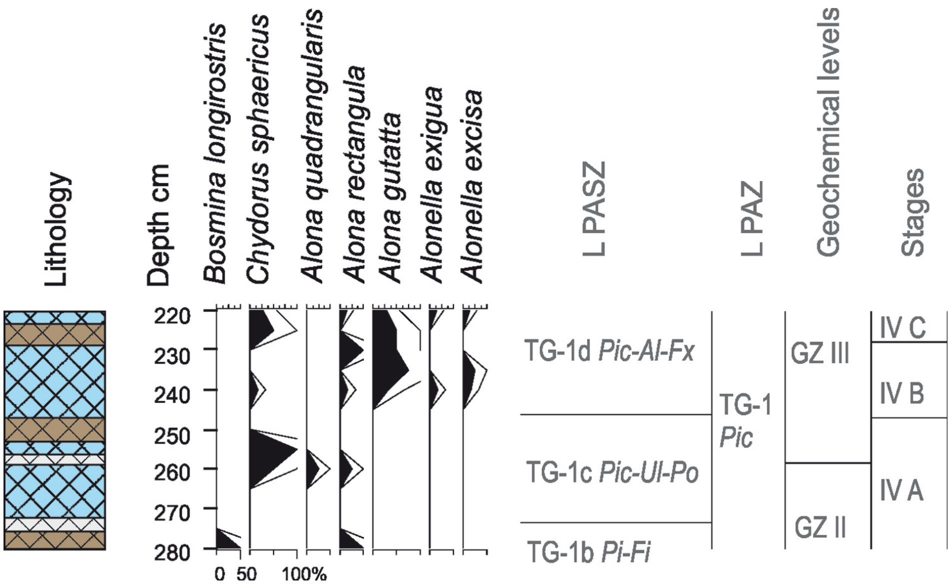

Fig. 6. Targowisko TRG-core. Percentage Cladocera diagram

temperature (Lotter *et al.* 1997; Zawiska *et al.* 2015) and pH changes (Locke and Sprules 2000; Zawiska *et al.* 2013). For this reason, they are useful in archaeology, because they help trace environmental changes resulting from human activity.

RESULTS OF PALAEOENVIRONMENTAL STUDY

The research covered the middle section of the TRG core, between a depth of 160 cm and 360 cm (Table 2), deposited during the Middle and Upper Holocene. The lower section of the paleochannel fill, accumulated during the Late Vistulian and the Early Holocene, does not reflect any human influence (Kalicki 2014). Radiocarbon dating allowed for the indication of the presumptive section of lake deposits that developed contemporaneously with the presence of the Neolithic communities in this area. They thus coincided in time with the research project mentioned in the introduction. Therefore, palynological and Cladocera analyses were performed for the section between 190 cm and 300 cm (Table 2). The identified parameters of the sediments from the TRG core are described below in the chronological order of their accumulation.

The analysed sediments were described as lake deposits – gyttjas, with a high content of calcium carbonate and a variable content of mineral and organic material, allowing for the determination of the type of sediment (Stasiak 1971; Markowski 1980). They were deposited in a shallow reservoir, probably periodically, even with a disappearing water surface. However, the lack of peat inserts in the sediments excludes the pool being occupied by peatland. The mineral matter in the gyttja may come from denudation of the surrounding slopes that washed into the reservoir, and from microelements in the composition of organisms. Its increasing share in the Holocene deposits is interpreted as an effect of the unnatural exposure of the terrain surface and its exposure to denudation (Tobolski 2000, Myślińska 2010).

The chemical composition of analysed deposits allows for the calculation of some indicators: the type of denudation indicator Na/K, the erosion index of the catchment area

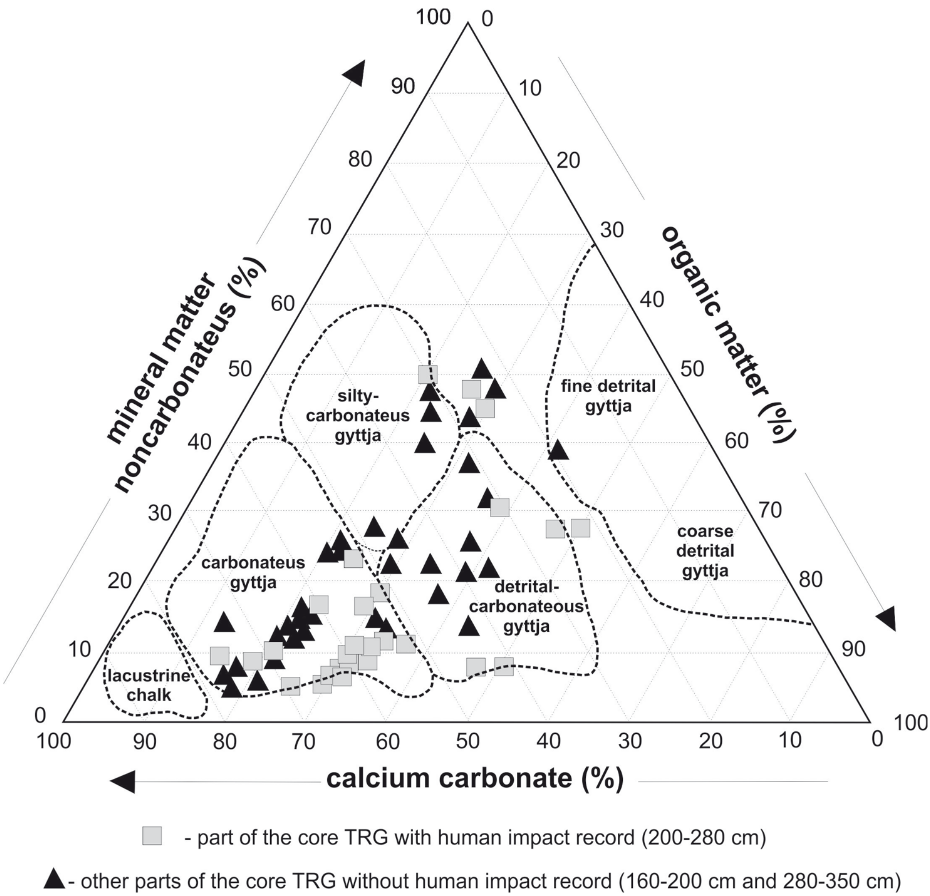

Fig. 7. Targowisko TRG-core. Relationship between the content of lithogeochemical elements in the sediments of the TRG profile against the classification type of biogenic deposits (after Markowski 1980)

Table 2. Selected results of TRG core analyses in stratigraphic order

Sedimentary stages	Geochemistry	Pollen	Cladocera
Calcareous-silty gyttja (160-216 cm); High content of calcium carbonate (to 75%), two specific episodes: low content of mineral matter - 2,6% (209-212 cm), and its rapid increase to 54% in 203 cm; 211-210 cm dated to 4450±90 BP (Table 1; Fig. 4).	**GZ IV (160-198 cm);** distinct changes in the ratio of redox conditions: an increase in Fe/Mn and a decrease in Ce/Fe, in the ratios of the type denudation processes: a decrease in Na/K. **GZ III (198-250 cm);** In top part (up 216 cm) increase in Fe/Mn and Ce/Fe are observed, an erosion ratio is low.	**TRG-1 *Picea* (190-300 cm);** High *Picea* (7-27%; av. 14%) with tends to rise. Relatively high participation of *Pinus* with a gradual decline (from 60 to 30%). All other trees oscillating. Numerical analysis (CONISS) suggests the similarity and confirms this division to one LPAZ and three L PASZ.	**TRG-1** Seven Cladocera species were found: *Bosmina longirostris, Alona rectangula, Alona quadrangularis*, *Chydorus sphaericus, Alonella excisa*, *Alonella exigua* and *Alona guttata.*
Calcareous-detrital gyttja (216-228 cm); A relatively high content of $CaCO_3$ (about 60%), and a stable content of organic matter. **Calcareous gyttja (228-248 cm);** high content of $CaCO_3$ and several fluctuations in the mineral matter, content of organic matter also oscillates but increase to top; 240-239 cm dated to 4790±100 BP, (Table 1; Fig. 4).	In lower part the erosion index of the catchment area decreases from 3.2 to 0.2, while the Fe/Mn index remains stable (21-42), and chemical denudation processes intensify (the Na/K ratio increases from 0.07 to 0.74).	**TRG-1d *Picea-Alnus-Fraxinus* (190-250 cm);** Gradual increase of *Picea* (7-26%). Relatively high and variable participation of *Quercus*, *Corylus* and *Alnus*. Higher frequency of NAP at the beginning of the phase (mainly *Artemisia*, Brassicaceae, Poaceae and *Rumex*). Frequency and variety of anthropogenic indicators grows. Variable frequency of Cyperaceae (7-46%) and Filicales monolete (1-64%). Aquatic plants and Pediastrum appeared. Changeable concentration of sporomorphs.	**TRG-1d** 5 Cladocera species were found, those living among the plants dominated *Alona guttata (50%), Alonella excisa and Alonella* *exigua.* At depth 245-250 cm no remains were found.
Detrital-calcareous gyttja (248-284 cm); The content of organic matter in relatively high there, its average value being the highest in the entire profile. The content of mineral matter decreases sharply from the depth of 272 cm	**GZ II (250-305 cm);** Two clear peaks of an erosion ratio (275-278 cm and 300 cm); Rapid changes of the Fe/Mn index between 260 and 275 cm, but at a stable level of Na/K index. In lower part the variability of Fe/Mn index is less intense,	**TRG-1c *Picea-Ulmus*-Poacea (250-275 cm).** The upper limit: Decrease of *Picea* and increase of NAP; High frequency of *Picea* (50-67%) and *Pinus* (8-23%, av. 14%) and rising *Ulmus* (form1 to 5,5%) and *Corylus* (from 1 to 5%). Higher frequency of NAP (mainly Poaceae, *Artemisia*, Brassicaceae). Single pollen grains of Cerealia appeared. High participations of	**TRG-1c** Three species were uncontinously present *Chydorus sphaericus, Alona quadrangularis*, and *Alona rectangula.*

upwards, while $CaCO_3$ increases rapidly; at the depth of 266 cm, the content of mineral matter does not reach 1% and the content of organic matter is high. 281-280 cm dated to 6270±80 BP (Table 1; Fig. 4).	likewise the erosion ratio. The carbonaceous ratio is between 0,5 and 1,5; the values of the grain-size ratio, especially GS11, rise gradually from 1.66 to 3.26.	Cyperaceae and *Pteridium aquilinum*. Lower values of degraded sporomorphs. Aquatic plants and Pediastrum appeared. Relatively high concentration of sporomorphs.	
Calcareous-silty gyttja (284-326 cm); The percentage of $CaCO_3$ and mineral matter is more characteristic there: in samples taken from the lower part, $CaCO_3$ quite consistently has the frequency of up to 80%, while the content of mineral matter is very low.		**TRG-1b *Picea*-Filicales (275-290 cm)**. The upper limit: increase of *Picea* and decrease of Filicales; High frequency of *Pinus* (50-67%) and lower *Picea* (5-9%). The other of mesophilous trees still in lower, more or less the same as earlier, participations. Filicales monolete frequency is rising (from 5 to 47%) but *Pteridium aquilinum* decreasing (7-0.7%). NAP still low. Single pollen grains of *Artemisia* and *Urtica* appeared. Higher values of degraded sporomorphs. Relatively low concentration of sporomorphs. Numerical analysis (CONISS) confirms joining the spectra into one L PASZ. **TRG-1a *Picea-Quercus* (290-300 cm)**. The upper limit: decrease of *Picea* and *Quercus*; High frequency of *Picea* (14-15%), *Pinus* (50-60%) and *Quercus* (3-6%). Lower participation the other of mesophilous trees: *Alnus*, *Fraxinus*, *Tilia*, *Ulmus* and *Corylus*. Poaceae, Filicales monoete and *Pteridium aqulinum* are continuously present. Cyperaaceae frequency is rising. Degraded sporomorphs are at lower values. Relatively high concentration of sporomorphs.	**TRG-1b** Two Cladocera species present at depth 280 cm, *Bosmina longirostris* and *Alona rectangula.*
Detrital-calcareous gyttja (326-360 cm); Varying content of $CaCO_3$ (Fig. 2) and of organic matter (20%-45%) Mineral matter is mostly very coarse or coarse in structure, with a slight admixture of sand and clay. 346–344 cm dated to 7640±90 BP (Table 1; Fig. 4).	**GZ I (305-360 cm);** This section shows low values of oxidizing conditions (the Fe/Mn ratio below 40) and low values of the type of denudation indicator Na/K (0.06 on the average).		

(showing the size and type of denudation) and values of oxidizing conditions (the Fe/Mn), the carbonaceous ratio, coefficient of the Fe/Mn with other geochemical ratios, and redox (showing the chemical state in the reservoir). The values of the analyzed parameters and indicators are shown in the table and figures (Table 2, Fig. 2; 3; 6).

Palynological analyses of the deposit from the Targowisko mire made it possible to describe the changes in the natural environment, but only to a limited extent. The examined sediment formed in a reservoir with an unstable groundwater level, which had a decisive impact on the condition of sporomorphs. Periodic desiccation, recorded both in the structure and the physical and chemical analysis of the material, was detrimental to the preservation of pollen. The palynological results and the radiocarbon dating show that the analysed section of the profile records plant succession from the mid-Atlantic to the beginning of the Subboreal period. Pollen records show that in the general scheme of vegetation development in the TRG, the profile has a very similar character to the other described sites from the vicinity (Wasylikowa *et al.* 1985; Kalicki 2014). During the analysed period, the area surrounding the Targowisko sites was overgrown by forests. They were dominated by pine (*Pinus sylvestris*) and spruce (*Picea abies*), with an admixture of oak (*Quercus*), elm (*Ulmus*), lime (*Tilia*), ash (*Fraxinus*) and hazel (*Corylus*). Wetlands in the Tusznica river valley were covered by alder (*Alnus*) and riparian forest, as is evidenced by the presence of alder but also elm and ash. An important issue is the high participation of spruce in the diagram (7-27%). This could indicate that it was an important component in the forests of that time. Although it is a wind-pollinating species, its relatively large and heavy pollen grains are not carried by the wind over long distances (Obidowicz *et al.* 2004). From contemporary analogies, it appears that as little as a 5% participation of spruce in the diagram may indicate regional expansion of this species (Obidowicz *et al.* 2004). Comparing this with the data summarized in the isopolen maps (Obidowicz *et al.* 2004), we can observe a higher proportion of it in the corresponding periods. A similar situation was noted in the TG profile (Kalicki 2014). This may indicate that it was locally more widespread in the forest communities in the Targowisko region. However, it should not be forgotten that spruce pollen grains are relatively easy to recognize even when the material is severely damaged, and their higher occurrence may be over-represented. Throughout the analysed period, the presence of open areas that could bear traces of human activity was relatively small. The NAP curve ranges from 5% to 15% (Fig. 5), and the dominant plants were grasses (Poaceae), which, like sedges (Cyperaceae), may largely have come from wetlands and peatbogs in the valley. The high and fluctuating proportion of grasses, sedges and ferns (Filicales monolete) suggests an unstable groundwater level resulting in the alternate flooding and drying out of the peat bog. Brief descriptions of local pollen zones and subzones and their basis of delimitation are presented in Table 2.

Cladocera are an important zooplankton component of freshwater lacustrine environments. Their remains preserved in the sediment clearly indicate the presence of a body of water – even a shallow one. Individual Cladocera species differ in their ecological requirements; therefore, Cladocera assemblages provide valuable information about the water habitat in the past. Analysis of the species composition for the Targowisko region has been carried out on the middle section of the TRG core (depth of 280-220 cm) with a resolution of 5 cm (Fig. 2). The results are presented within the palynological subzones (Table 2).

INTERPRETATION AND DISCUSSION

The features and thickness of mineral and organic deposits accumulated in basins of the reservoir depend on the environmental conditions in the surrounding area. Those changes, as well as human activity, have an influence on the type of sediments (Tobolski 2000). The results of lithological, geochemical and palinological analyses supplemented by the radiocarbon dating have served as the basis for a preliminary reconstruction of environmental conditions recorded within the paleochannel in Targowisko. The compilation of the TRG core analysis results made it possible to distinguish the environmental development stages. The first and second stages are not presented in this work, as they fall in the Late Glacial and Early Holocene, when no human activity was recorded in the study area. The description begins with stage IIIa, correlated with the Middle Holocene.

However, there are several factors that complicate the tracking of the environmental changes. The results of the analysis of the lithology and geochemistry of sediments, as well as of Cladocera, indicate changes taking place in the immediate vicinity of the reservoir, in the area from which water flows with soil material. The examined area had a fluctuating water level, and the basin was periodically without surface water. Comparison of the preliminary results of the Cladocera analysis with the geochemical data shows that the Cladocera remains were present in sediments with a large content of organic matter (approx. 50%) and absent from sediments with a high content of $CaCO_3$ (approx. 70%). This may suggest that only the organic sediments are of a lacustrine origin in the studied site. The pollen analysis records changes in both the local and regional environment (Nalepka 1994; Tobolski 2000), which is beyond the Tusznica catchment in the study site. As a result, it cannot be ruled out that the environmental changes in nearby sites (such as Targowisko 12-13, 14-15 and 16), situated 200-1500 m to the west of the TRG core (Fig. 1), are also reflected in the pollen spectra of the studied core. Therefore, the palynological record of human influence is not synonymous with lithological and geochemical indications of enhanced human activity in the immediate vicinity of the TRG, *i.e.* mainly at site 10-11 in Targowisko (Fig. 5). Filicales and Cyperaceae show a clear dependence on habitat conditions in the Targowisko catchment. Fluctuations of the Filicales curve show a negative correlation with the curve of the sum of Cyperaceae and Cladocera. This would support the earlier thesis that, as a result of lowering water levels, the basin is being drained and wetland plants and aquatic organisms are disappearing, and vegetation, including ferns, is invading the mire. However, if ^{14}C dates are correct, the palynological diagram presents the entire sequence of Early Neolithic settlement phases from LBK I to MC Ib, already reported from this region (Kadrow *et al.* 2021).

The comprehensive field study in the Targowisko region previously conducted by Zastawny (Zastawny 2014) made it possible to correlate the sequence of settlement phases distinguished in the above-mentioned publication with the sequence of environmental changes recorded in the studied core (Kadrow *et al.* 2021). The situation is further complicated by the fact that, according to the recently published new ^{14}C date series (Czekaj-Zastawny *et al.* 2020; Kadrow *et al.* 2021) and stylistic analyses (*e.g.* Kadrow 2020b), the chronological phases may have overlapped one another on the regional scale.

Stage IIIa (360-305 cm), according to the radiocarbon dating, can be correlated with the Middle Holocene (Table 1; Fig. 4, 5). Detrital-calcareous gyttja with a significant content of $CaCO_3$ resulting from a supply of dissolved carbonate was deposited in the lower part of that section (IIIa) by migrating groundwater (Fig. 3). This origin of the water in the lake is confirmed by the high (slightly alkaline) pH of the sediments. The contents of organic matter and mineral matter exceed the content of $CaCO_3$ in two episodes, which may indicate a low water level (Wojciechowski 2000; Ratajczak-Szczerba *et al.* 2014). The analysis of grain size shows the dominance of silty fractions and low variability, possibly linked to the moderate accessibility and proximity to the sources of the material subjected to denudation. The dating of the gyttja sample from a depth of 346-344 cm (Table 1; Fig. 4) suggests that this section should be correlated with the Atlantic period of the Holocene (Starkel *et al.* 2013). The examined samples of stage IIIa bear no traces of human activity influencing the environmental disturbances, although the region seems to have been penetrated by a Mesolithic population at that time (Wilczyński 2014).

In **stage IIIb (305-278 cm)**, the content of $CaCO_3$ is very high and fairly stable at first, while the content of mineral matter is very low, which must have resulted from a very limited supply of silty material provided by mechanical denudation processes, as confirmed further by the changing Na/K ratio: a sharp decrease from 0.66 to 0.02. The section at a depth of 326-308 cm, therefore, corresponds probably to the period of stabilization in environmental conditions, rather without human interference. Conversely, the decrease in the content of mineral matter and in pH, along with the simultaneous increase in conductivity at a depth of 308 cm, seem to have been a response to a strong environmental impulse in the catchment area. The high content of mineral matter may have been caused by the thinning of vegetation on the slopes, which intensified mechanical denudation and the leaching of minerals from the soil cover, as evidenced by the increase in the erosion index from 0.42 to 5.2 (Fig. 3). The geochemical and lithological parameters at a depth of approx. 300-284 cm, vary in their values, with two distinct fluctuations. This suggests that the pressure on the habitat was not so much constant and homogenous as episodic, though periodically strong.

This stage includes two subzones distinguished in the pollen diagram (TRG 1a-1b L PAZ; Fig 5). The pollen results show scarce vestiges of human activity. There are single grains of ruderal plants: *Artemisia*, *Urtica* and Chenopodiaceae, and one sample containing pollen of *Plantago lanceolate*, a ribwort plantain typical of meadows (Behre 1981). This may point to animal husbandry in that period. However, the high percentage of *Pteridium aquilinum* – bracken fern characteristic of burnt-out places (Latałowa 2007) – may suggest that the area was penetrated by small groups of people. There are no traces of cultivation, but crops could have been grown in small forest clearings, in more favourable habitats or at a distance from the small lake in Targowisko. These plants are entomophilous or autogamous, and so produced a low quantity of pollen. And, the relatively high degree of afforestation could have prevented pollen migration from these places.The afforestation rate remains high – the forests being dominated by spruce (*Picea*), pine (*Pinus*) and oak (*Quercus*) and with an admixture of hazel (*Corylus*) in the lower layers. One should also note the high proportion of degraded grains (Fig. 5) and the apparently selective distribution of sporomorphs.

In stage IIIb, two Cladocera species, *Bosmina longirostris* and *Alona rectangula*, were present, which suggests the high trophic state of water (Whiteside 1970; Duigan 1992) at a depth of 280 cm. However, the poor species diversification may also suggest unfavourable environmental conditions such as the periodical drying of the reservoir. At a depth of 275 cm, no Cladocera remains were found, which further evidenced a lack of appropriate water conditions.

This section may correspond to the older (I) phase of the LBK, the Zofipole phase, the most intensive one in the entire settlement sequence identified at Site 10-11 in Targowisko. The archaeological finds from that phase include traces of eight longhouses built in two construction stages and forming a medium-sized settlement (Zastawny and Grabowska 2014a, 104-108, fig. 18, 41). At that time, agriculture consisted of the intensive cultivation of small forest clearings (Kruk and Milisauskas 1999, 44-46; Nowak 2009, 204-210), which is confirmed by research carried out in Targowisko and its vicinity (Nalepka 2015, 346-349).

The next stage – **IVa (278-248 cm)** – shows the varying environmental influence on the wetland. From a depth of 278 cm upwards, there is a noticeable increase in the mineral content after a short episode of stabilisation and perhaps regeneration of the surrounding area. The upper part of that section records a sharp drop in the mineral content to a mere 1% at a depth of 266 cm, as well as a significant increase in $CaCO_3$ and in organic matter (Fig. 2). For these reasons, the stratum seems to have been formed when denudation of the surrounding slopes stopped for a short time (as shown by the decrease in the Na+K+Mg/Ca ratio from 3.8 to 0.58 and by the stable Na/K ratio) and when vegetation cover developed in the catchment area and the wetland. These data point to the diminishing rate of denudation and possibly to the transformation of the reservoir into a periodic wetland, which would have made it difficult to supply material from the slopes to the centre of the mire.

This stage includes one subzone distinguished in the pollen diagram (TRG-1c L PAZ; Fig. 5). During the analysed stages, the surroundings of the Targowisko sites were overgrown by forests dominated by spruce (*Picea abies*) and pine (*Pinus sylvestris*). The record of human activity in this part of the sediment is still low. However, a greater presence of herbaceous plants (NAP curve in the graph), including taxa from the synanthropic plant group, may indicate human influence on the environment. The pollen diagram shows an almost continuous curve of *Artemisia* and occasionally *Rumex*. The single reappearance of *Plantago lanceolata* suggests that the surrounding area could still be used for grazing. The first crop indicators (cereals – type Cerealia) appeared in the diagram for the first time. The rapidly increasing percentage of ferns (Filicales monolete) at a depth of 275 cm may have resulted from a falling water level. Human activity could also be reflected in the fluctuating water level shown by the varying percentages of ferns and sedges. Deforestation of even small, mid-forest clearings may have disrupted water management in this small basin, but we cannot exclude that a hiatus appeared here.

However, in general, the pollen diagram shows that the impact of the human economy on the natural environment was still relatively small.

A sample taken from a depth of 257-255 cm has been radiocarbon dated to 5960±80 BP, which gives a calibrated timeframe of 4950-4800 BC (Table 1; Fig 4). Thus, the episode dated to *ca*. 5100 BC may have been related to the late (III) phase of the LBK, which has left no settlement traces at Site 10-11, but which has been recorded at sites located a little more to the west (Targowisko 12-13, 16; *cf*. Kadrow *et al*. 2021). These sites (12-13 and 16) also lie in the studied wetland catchment, and the effects of human impact could be recorded in the biogenic sediments, even if there was no settlement at site 10-11.

The remains of three Cladocera species – *Alona quadrangularis*, *Chydorus sphaericus* and *Alona rectangula* – documented at a depth of 260 cm, suggest that the reservoir was rather shallow during their accumulation (Fig. 6). Those taxa may also indicate the high water trophic status (Whiteside 1970), possibly caused by human activity nearby. This is accompanied by an increase in the mineral content up to 50% and a simultaneous increase in the concentration of all elements, particularly Zn and Cu. Conversely, the erosion index for the catchment area rises only slightly despite the increasing concentration of K, Na and Mg. These data may suggest that nutrients were delivered to the wetland due to fires, documented at many sites with a confirmed geochemical record of human activity (*e.g*. Pleskot *et al*. 2018; Kittel *et al*. 2020). The changes coincide with the transition from clay gyttja to calcareous gyttja. In the pollen diagram, plant species linked to human activity (*Artemisia*, *Rumex*, Cerealia, Chenopodiaceae) have been recorded at a depth of 260-275cm (Fig. 5).

The evidence of intensifying human activity might be related to the settlement consisting of four buildings at site 10-11 in Targowisko in the older (Ia) phase of the MC (Grabowska and Zastawny 2014, 255-261, fig. 1, 4-6). Since there were no major changes in the recorded environmental sources, it can be assumed that there were also no major changes in subsistence strategies as compared to the preceding LBK period (Kadrow 2020a, 101; Kadrow *et al*. 2021).

During stage **IVb (248-228 cm)**, calcareous-silty gyttja reappears in the core. Despite the varying content of $CaCO_3$ and of mineral matter, the lithological and geochemical composition remains stable. The poor geochemical record may have resulted from a decrease in the average rate of biogenic accumulation, and those two phenomena would point to low human activity.

This stage includes the older part of subzone TRG-1d, characterised by the strongest human impact on the natural environment. In the pollen diagram, the proportion and the variety of light-loving plants increase, and both the composition and the acreage of the forests change. The percentage of pine declines, while the percentage of trees with edible fruits rises, such *Quercus* and *Corylus* (Fig. 5). Acorns and hazelnuts could be used for both human and animal food. There were mixed forests nearby the Targowisko basin. At this time in the diagram, the proportion of herbaceous plants increases significantly, and the concentration of pollen decreases (Fig. 5). This may indicate an increase in the area of deforested land. From among herbaceous plants, species typical of wet meadows (*Plantago lanceolate*, *Rumex*), dry pastures (*Junipers*) and crops (Cerealia), but also of ruderal areas (*Artemisia*, *Rumex*, *Urtica*) are present, which suggests that the vicinity was used in various ways by humans. The general palynological pattern would indicate that settlements or small groups of people were some distance from the study reservoir. This stronger human impact resulted in greater changes to the landscape, which may have increased erosion. Afterwards, the groundwater level probably decreased allowing ferns to spread.

The Cladocera species identified at a depth of 240 cm are typically linked to the aquatic vegetation *Alonella excisa*, *Alonella exigua* and *Alona guttata* (Flössner 2000); no species characteristic of an open water zone has been recorded in that layer. The reservoir, therefore, must have been very shallow and overgrown with aquatic plants at that time (Duigan 1992; Zawiska *et al.* 2019). In the pollen spectra of that section (242 cm), single grains of *Sparganium*, *Comarum palustre* and algae from the Chlorophyta group (Pediastrum) appeared. At the same time, the proportion of sedges in the diagram increases, which may also indicate the wetland character of the described reservoir.

The excavated part of site 10-11 in Targowisko has yielded only modest vestiges of the Lublin-Volhynia culture (*cf.* Zastawny and Grabowska 2014b, 417-419, fig. 1, 2). The stronger human influence discernible in the pollen diagram, therefore, must have been related to a larger Lublin-Volhynia group inhabiting probably the northern part of the site, which has not been explored as yet. Ample traces of settlement from that period have been found at site 2 in Zagórze, over 8 km to the west of the TRG core (Kadrow *et al.* 2021, fig. 1). The inhabitants there belonged to the Lengyel culture (the Pleszów-Modlnica group; *cf.* Kadrow *et al.* 2020).

Stage **IVc (228-198 cm)** is connected with calcareous-detrital gyttja deposition, indicating a certain stabilisation in the supply of material to the basin. The proportion of mineral matter does not exceed 2%, which results from low physical denudation, while chemical denudation is more noticeable. This stratum presents the poorest geochemical record of human activity due to the diminished concentration of trace elements (Cu, Zn) and lithophilic elements (Fig. 3). This is also confirmed by the pollen analysis. The younger part of the pollen subzone TGR1-d is again characterised by an increase in the representation of trees and the pollen concentration in the sediment. The pollen diagram reflects the regeneration of forests on wet and dry locations. Among the trees, spruce shows the greatest increase in representation. The share of pine, oak and hazel is also relatively high, which testifies to the significant presence of these taxa in the forest stand at that time. Although, in the pollen diagram, some traces of human activity reappear after the decrease of the fern curve at a depth of 222 cm (Fig. 5). However, the extent of deforestation remains small in that part of the Neolithic, as noted in previous publications (Kalicki 2014).

Small human groups representing the Funnel Beaker culture or the Baden culture left modest traces in that period (Zastawny and Grabowska 2014b, 421, fig. 2).

Stage **IVd (198-160 cm)** occupies the upper part of the TRG profile, representing the final developmental phase of the basin, consistingof calcareous-silty gyttja. Two episodes can be identified within it on the basis of physiochemical parameters (Fig. 2), denoting an increase of denudation intensity in the reservoir catchment area.

Only one pollen sample is included in this stage. A higher proportion of alder and hazel is recorded; however, in the basin in Targowisko, spruce and pine still dominate the forest communities, with the participation of oak, elm linden and hazel.

This stage can be dated to younger than 2900 BC, and thus goes far beyond the age range of the analyzed problems of human activity.

CONCLUSIONS

Pollen results indicate that the surroundings of the study site were covered mainly by pine and spruce forests, with an admixture of deciduous forests with oak, elm, lime, ash and hazel.

However, in general, the pollen diagram shows that the impact of the human economy on the natural environment was still relatively small. On the basis of single occurrences of anthropogenic pollen indicators, periods of human activity can be described. Based on the palynological data, human activity was mainly pasture and to a lesser extent, the cultivation of cereal plants. Rapid changes of Cyperaceae and Filicales monolete indicate water level fluctuations and possible sediment hiatuses.

Preliminary Cladocera results indicate that biogenic sediments from the Targowisko site were of lacustrine origin in some periods, and therefore have potential for further Cladocera-based reconstructions. The results obtained so far suggest water-level fluctuation and lake productivity changes, which were probably due to human impact.

The lithological and chemical composition of the sections of the analysed core characterize subsequent periods of human influence on habitat conditions. The carbonate sediments of wetlands, with a modest amount of allochthonous elements, represent the Mesolithic (6500 BC), while sections consisting of carbonate gyttja, contemporaneous with phase I of the LBK (5300-5200 BC), bear distinct traces of chemical and mechanical denudation. Distinct changes took place in the catchment area of the marshland *ca*. 5100 BC.

Samples of biogenic core sediments dated to 4950-4800 BC show geochemical properties related to human activity, which indicates further changes in the environment, possibly caused by population from the older (Ia) phase of the MC.

The next section of the analysed core, dated to *ca*. 3700 BC, shows the relatively small impact of human activity on the chemical and lithological properties of the sediments. This marks the beginning of the Eneolithic, with the more intensive occupation of the Lengyel culture (Pleszów-Modlnica group) in the western outskirts of the region in Zagórze, site 2.

The analysis of the lake sediments of the studied core from Targowisko revealed changes in the characteristics of sediments and the composition of pollen and fossil remains of aquatic organisms, correlated with the phases of settlement and economic activity. It can be assumed that human activity influenced the habitat conditions in the reservoir, leaving a permanent record in its sediments.

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ON THE BANDKERAMIK ON THE LOWER VISTULA RIVER

ABSTRACT

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The Vistula River is the most important river in Polish history and culture. This paper discusses whether this could influence the hypothesis regarding the crucial role of this river for the Early Neolithic colonization of the Polish lowlands. It presents an overview of the Linear Pottery culture settlement on the lower Vistula River. The main sources of information are broad-scale survey programmes, which provide an impressive number of sites, while the extent of large-scale excavations is very limited. This is an important caveat with respect to statements on similarities and differences in occupation between the lowlands and other regions. Nevertheless, according to the present state of research, the lower Vistula region can be regarded as a remote, but important settlement area of the LBK.

Keywords: LBK, Polish lowlands, early farming occupation
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INTRODUCTION

The title of this volume implies the existence of two distinct parts of the Neolithic world: those to the west and to the east of the Vistula River. As a person who grew up on the right bank of this river, in Warsaw Praga, which has by no means been as a fashionable district as it is nowadays, I learned from an early age about the symbolic power of rivers to

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separate worlds and people. The Vistula River is one of the few European rivers representing a symbolic boundary separating the supreme western civilization from the under-developed, barbarian east (the location of this boundary depends strongly on the place of birth and residence of the person involved). However, in the history of Poland, the Vistula River was an important waterway running almost without exception through purely Polish territories. Thus, it played a uniting role, connecting the west with the east and the south with the north – not only literally, but also metaphorically, thereby contributing to the sense of common national identity. This modern integrating role of the river influences archaeological interpretations (Kostrzewski 1933). In this paper, I focus on the first farming communities of the Linear Pottery culture (LBK) living on the Vistula River in the Polish lowlands, especially in the lower course of this river. I present an overview of their occupation and pay special attention to the issue of the Vistula River as a potential south-north communication route for different groups of the LBK.

REGIONAL SETTING

The Vistula River flows through the territory of modern Poland, from the western Carpathians in the south to the Gdańsk Bay in the north. The approximately 1000-kilometer-long river can be divided into three parts: the upper Vistula to the confluence with the San River (or to Zawichost), the middle Vistula to the confluence of the Narew River, and the lower Vistula to its estuary in the Baltic Sea. The upper Vistula River flows mainly through loess areas of western Lesser Poland, which were a key region of LBK settlement in Poland and were extensively studied by A. Czekaj-Zastawny (2008). Loess uplands extend slightly over the middle Vistula boundary and LBK settlement is registered there even in marginal areas, previously regarded as uninhabited (Szeliga *et al.* 2020).

Further to the north stretches the vast area of the Polish lowlands. The strong relationship between loess and the settlement of the LBK has been emphasized up until now (*e.g.* Hofmann 2020), and this heavily influences the interpretation of any traces of occupation outside this area – a perfect example of which being the Polish lowlands stretching along the middle and lower Vistula River. Up until now, opinions regarding the special function of lowland sites, diminishing new discoveries and stressing any hint of a temporary and ephemeral character, have been prominent in the discussion (Grygiel 2004; Bogucki 2020), which leads to the necessity of emphasizing the opposite – the similarity of these sites with the LBK loess norm (Pyzel 2010a; Płaza and Papiernik 2020). Similar discussions take place regarding the LBK further west, for example in Brandenburg (Cziesla 2008; Ismail-Weber 2017).

STATE OF RESEARCH ON THE LBK IN THE POLISH LOWLANDS ON THE VISTULA RIVER

Slightly more than 50 years ago, A. Kulczycka-Leciejewiczowa published a map with a catalogue of all known LBK sites from the territory of Poland (Kulczycka-Leciejewiczowa 1968). It included 150 sites, 28 of them located in the lowlands on the Vistula River: six in different parts of Mazovia, 20 in Kuyavia and Pałuki, two in Chełmno Land. Since that time, an impressive increase in data has taken place: in Lesser Poland itself, the number of sites has increased by more than 11-fold (Czekaj-Zastawny 2008). Lowland sites are depicted in Fig. 1, and they will be briefly presented to the following regions:

Mazovia

In this region, the growth in data is very limited. There are no new sites in the south of the region, in the vicinity of old discoveries from Śniadków Górny and Świdry Małe (these sites are not considered on the map (Fig. 1), as they belong to the middle Vistula area) nor in the north, near Lubiejewo. However, surveys of the Polish Archaeological Record (AZP) and later field surveys by M. Bednarz from the University of Warsaw confirmed the existence of a settlement micro-region between the Vistula River and the Kampinos Forest, in the Warsaw Basin meso-region, within the flood plain of the river. A. Kulczycka-Leciejewiczowa mentioned three sites from this area, all registered in the early 20th century (Kulczycka-Leciejewiczowa 1968, 117, pt 68-70). Surveys in the last two decades of that century revealed the existence of 10 new sites located within a total area of 70 km^2. It is an agricultural region of diverse conditions, mainly covered by poor, sandy soils, but also heavy alluvial and till soils. On two sites, small rescue excavations have recently been conducted (Cząstków Polski, Comm. Czosnów, site. 12, excavations by M. Czarnecki; Łomna Las, Comm. Czosnów, site 4, excavations by M. Hrynczyszyn Archaios Sp. z o.o.), which revealed the existence of typical LBK settlement pits and artefacts such as pottery and chipped and ground stones, which can be dated to the middle LBK with some archaic elements (LBK IIA according to Pyzel 2010a; LBK pottery analysed by author, publication in preparation). These data argue for a relatively stable and quite early LBK occupation in this region, which definitely deserves more attention in the future.

Kuyavia

Intensive archaeological research in this showcase region of the lowlands confirmed the existence of a compact settlement group extending throughout Kuyavia to Pałuki and eastern Greater Poland. It consists of at least 453 sites: apart from the 388 published in my Ph.D. catalogue (Pyzel 2010a), 46 sites discovered around Wietrzychowice (Papiernik *et al.* 2017; Papiernik *et al.* 2020) and 19 new sites registered during excavations on the A1 motorway route (Pyzel 2017; catalogue by Pyzel 2010a includes only sites on this route discovered during previous surveys) were considered on the map (Fig. 1) as well. Sites are clustered along water courses, glacial tunnel valleys and kettle lakes. Most of them are lo-

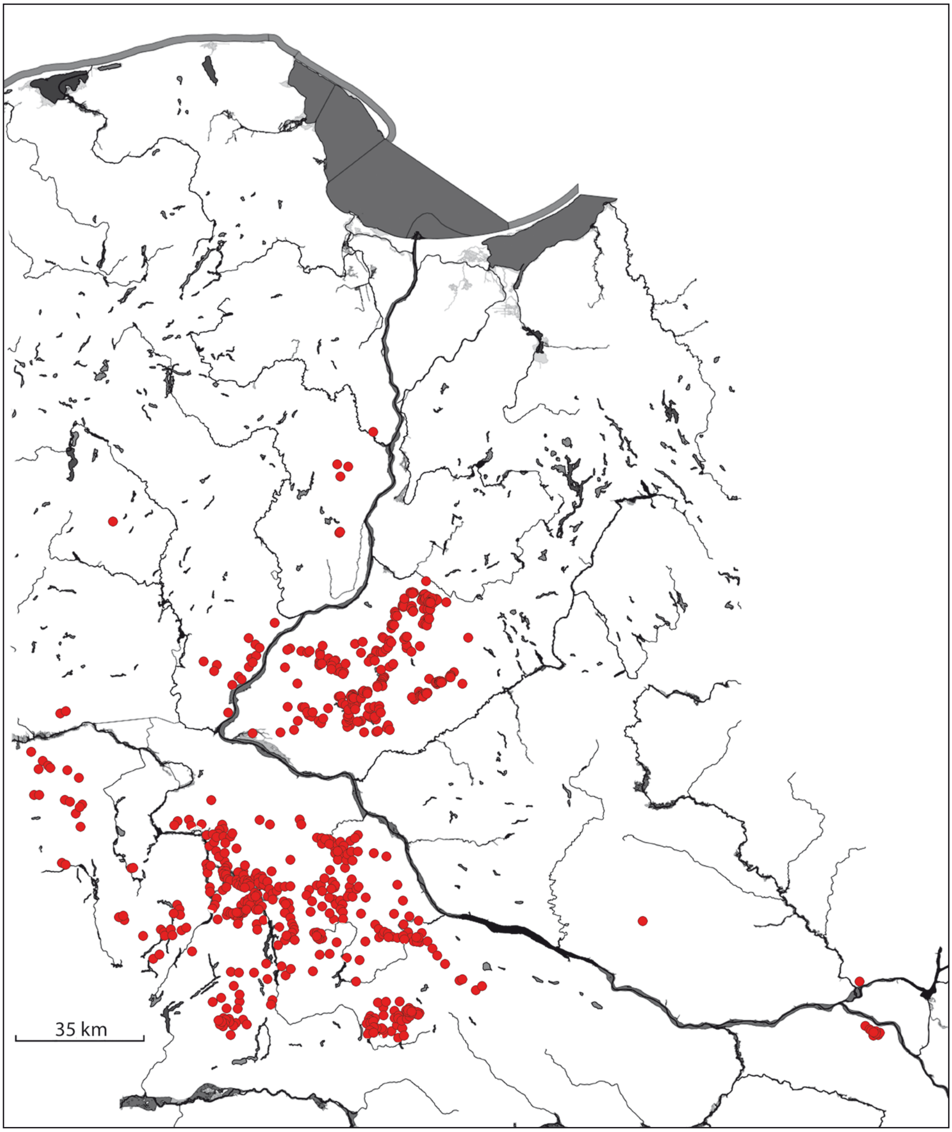

Fig. 1. LBK sites on the lower Vistula river. According to: Kulczycka-Leciejewiczowa 1968; Pyzel 2010; Werra 2013; Gackowski and Białowarczuk 2014; Czerniak *et al.* 2016; Papiernik *et al.* 2017, modified

cated on or in the vicinity of fertile soils developed on ground clay moraine: famous Kuyavian mollic gleysoils, but also cambisols and others (Pyzel 2010a; 2010b; Jankowski and Sykuła 2020).

Pomerania

The map published by Kulczycka-Leciejewiczowa includes only two sites from this region, both in Chełmno Land (Kulczycka-Leciejewiczowa 1968, 117, pt 79, 84). In this area, the greatest increase in the number of LBK sites within the lowlands can be observed. A recent catalogue by D. Werra (2013) lists 279 sites, which confirms previous conclusions by R. Kirkowski that Chełmno Land belongs to one of the key regions of the LBK in modern Poland (Kirkowski 1994). Most of the sites cluster in small valleys and on lakes, and the majority of them are located on moraine upland covered by fertile cambisols.

On the other side of the Vistula River, some hitherto unknown enclaves have been discovered recently in the Kociewie region. The first one is a group of 15 sites from the Świecie Plateau (Gackowski and Białowarczuk 2014). I excluded the site Gądecz listed by Gackowski and Białowarczuk (2014) from this figure, as the dating was based only on stone artefacts. Sites of this kind (loose stone artefacts), known, for example, from Mazovia (Sałacińska and Sałaciński 2010), were also not considered in this paper. These 15 sites belong to two separate clusters located on small tributaries of the Vistula River. About 30 km further to the north, on the eastern edge of the Tuchola Forest, two traces of occupation were discovered at Warlubie, Comm. loco. Both sites are from rescue excavations on the A1 motorway route: Warlubie site 3 – two pieces of pottery, Warlubie site 4 – one piece of pottery (Gackowski and Białowarczuk 2014). Another three sites – Kościelna Jania site 13, Barłożno site 15, Bobrowiec-Kornatka site 5, are located *ca.* 40 km to the north (Czerniak *et al.* 2016). A small campsite at Brody Pomorskie, site 20, Comm. Gniew, situated at a distance of 20 km from this cluster, remains the northernmost undoubted LBK settlement (Felczak 1987). In the case of Bielawki, site 32, Comm. Pelplin, which is sometimes mentioned as belonging to the LBK (Ratajczak and Ostasz 2010; Kozłowski and Nowak 2019, 48), the very few Early Neolithic pottery fragments found there represent post-LBK communities (personal communication L. Czerniak 2020. According to it, Brzeźno, site13 was also excluded from the map in Fig. 1). A similarly misleading attribution to the LBK (even in the title of the publication Przybył 2011), unfortunately even more broadly repeated (*e.g.* Czerniak *et al.* 2016, 194 fig. 1), occured in the case of Juszkowo-Rusocin, site 28, Comm. Pruszcz Gdański, located 20 km further to the north of Brody Pomorskie, on the boundary of the Vistula fens (Żuławy Wiślane) and the Kashubian Lake District. A single Neolithic potsherd, found during a rescue excavation on the A1 motorway, dates to the post-LBK cultures (Przybył 2011).

In the case of the whole region of the Vistula fens, suggestions about the existence of LBK sites have been repeated for many years (*e.g.* Kulczycka-Leciejewiczowa 1993, 44 footnote 15). The AZP data mention one site at Giemlice, site 2, Comm. Cedry Wielkie, dated according to a single potsherd (personal communication A. Gackowski 2020). Taking into account its location in a peatland not suitable for a stable occupation during the Atlantic period (Rosa 2000), it needs a re-examination, and thus it was not considered on the map (Fig. 1). However, the AZP data also include a newly discovered LBK site at Ostrowite, site 2, Comm. Chojnice, in the north-eastern part of the Krajna Lake District, where traces of a stable settlement were excavated (Sikora *et al.* 2018), raising hopes of further finds in the future in this hitherto unexplored region.

Most of the sites illustrated in Fig. 1 are known only from surveys, mainly (but not solely) conducted as part of the AZP project. So far, it has covered ca. 90% of the Polish territory, but the state of research is not uniform. Unfortunately, Pomerania, excluding Chełmno Land, has most of the blank spots on its maps, although the regions close to the Vistula River can be regarded as the best studied (Niedziółka 2018). Without a doubt, the AZP project was the largest contributor to the increase in the data, and thus to the changes in prehistoric settlement maps, even if the research was far from ideal, which has been discussed many times (*e.g.* Barford *et al.* 2000). The results are influenced not only by the experience of the archaeologists who conducted the surveys themselves, but also those estimating the chronology of the finds. It can be concluded that LBK sites are more likely to be discovered in regions where they had been expected because of the existing knowledge of the LBK settlement patterns. But even there the results may not necessarily have been very representative. For example, thanks to an intensive systematic survey conducted recently in southern Kuyavia near Wietrzychowice, 45 LBK sites were discovered in an area where, according to the AZP data from the 1980s, only two sites had existed (Papiernik *et al.* 2017; Papiernik *et al.* 2020). Similar observations could be made for eastern Kuyavia on the A1 motorway route: here also, the repeated survey conducted as a part of the rescue excavation programme added 11 new sites to the four known from the AZP. Subsequent rescue excavations additionally verified these estimations. The dating of 14 sites could be confirmed, but 19 new ones were discovered as well. It is also worth mentioning that the number of surface finds does not necessarily correlate with the size of a site (Pyzel 2017). Recent research results clearly demonstrate that although the number of LBK sites known from the AZP survey is astonishingly high, it is clearly lower than the true number of settlements.

SETTLEMENT

Summing up all of the regions presented above, one obtains the number of 767 LBK sites on the lower Vistula River, which is very impressive. It is almost as many as for the whole of Lesser Poland (Czekaj-Zastawny 2008). Seven hundred thirty-two of them concentrate in the two core areas of Kuyavia and Chełmno Land, and 35 are scattered outside of them. This total number of LBK sites on the lower Vistula River indicates that this was a remote, peripheral but nevertheless important region, which cannot be regarded as an ephemeral, failed occupational experiment of the first farmers.

It needs to be stressed that on both the lower and upper Vistula River, similar research methods (mainly the AZP survey) were applied. However, in the case of lowland peripheries such as Pomerania (excluding Chełmno Land) or Mazovia, one can expect that some small and undiagnostic find assemblages could not be classified properly, which was due to the fact that not all local archaeologists were familiar with LBK material there. The state of research is thus not always comparable, and conclusions from the core areas of Kuyavia and Chełmno Land influence the interpretation of the whole lower Vistula region.

The LBK settlement there follows patterns known from other regions of this culture. Its insular character is striking: the first farmers settled selected enclaves, preferring moraine uplands with fertile soils developed on tills. It did not necessarily have to be the most fertile mollic gleysols, characteristic especially for Kuyavia, which were traditionally regarded as a crucial factor attracting the farmers (Pyzel 2010a; 2010b). Their origin and age are controversial, and it is not clear if they were readily developed in the Early Neolithic (*e.g.* Szmyt 1996, 92, 93, further references therein). There is also a correlation of LBK settlement with cambisols and albeluvisols, and in the case of young glacial landscapes of the lowlands with a great variability of soils, it is sometimes difficult to estimate such a relationship, as demonstrated by debates about LBK sites located on sandy soil (called Podgaj-type sites: Domańska and Rzepecki 2009; Rzepecki 2013).

Not all suitable enclaves were occupied by LBK communities (Kukawka 1997), as was evidenced by a linear project running through Kuyavia, which did not reveal the existence of LBK sites there (Pyzel 2010a, 172-173). Certainly not all enclaves have been discovered so far, as the example of an incidental discovery of an LBK site at Ostrowite, site 2, perfectly indicates.

LBK sites cluster, not only in a linear order along water courses, but also in the lowland landscape around kettle valleys and lakes. Not in every case could such clusters be detected: on peripheries at Brody Pomorskie and Ostrowite, single sites were detected, and further intensive surveys are required in their vicinities to trace potential neighbouring sites. For example, the cluster south of Brody Pomorskie, excavated due to the construction of the A1 motorway, consists of three sites: a stable settlement at Kościelna Jania 13 (Czerniak *et al.* 2016) and two other sites – Borowiec-Kornatka 5 and Barłożno 15, where loose finds of LBK provenance were found, indicating that activity in this area was not restricted solely to Kościelna Jania. In general, as far as location of settlements is concerned, patterns from other regions were also followed in the lowlands.

Character of settlement

The A1 motorway running from the north to the south, to a large extent close to the Vistula River, forced rescue excavations of many sites, and their large scale brought new information on settlement structures of LBK communities in the lowlands.

In the case of Kuyavia, the motorway route cut through numerous micro-regions located directly on the edge of the upland, on its boundary with the Vistula River valley, which was a very favourable location. Large settlements (Ludwinowo, site 7, Kruszyn, site 10, Wieniec, site 10: Pyzel (ed.) 2019; Płaza 2016, Maciszewski 2015) occupied continuously during the whole Kuyavian LBK could be detected for the first time. In the case of Smólsk, site 2/10, a shift of occupation took place in the late LBK (Muzolf *et al.* 2012). Areas of more scattered settlement with many individual houses could be identified as well.

On the A1 route further to the north, similar, smaller settlements consisting of a few houses were registered in Chełmno Land (Bocień, site 5: Małecka-Kukawka 2012; Werra 2013) and in Kociewie (Kościelna Jania, site 13: Czerniak *et al.* 2016).

No large settlements were detected there, and it is not clear if they existed there at all. For Chełmno Land, it has been suggested that one settlement could be located on some neighbouring hills. This hypothesis was connected with the concept of a shifting occupation (Gurtowski and Kirkowski 1994) and needs to be re-examined. In general, more detailed research can reveal some occupational changes within and among micro-regions. Probably not all micro-regions were inhabited during the whole LBK. The existence of some clusters with such stability has so far been demonstrated only for Kuyavia (Grygiel 2004; Pyzel 2010a) and Chełmno Land (Kirkowski 1994).

On all sites excavated to a large enough extent to enable any kind of spatial analysis, evidence of stable LBK settlement features was registered: large, clay extraction pits, typical lateral pits, sometimes with remains of houses among them, etc. For the most part, these are poorly preserved, which makes their typological classification difficult, but the fact that lowland houses follow the general patterns of iconic LBK longhouses is unquestionable. Definitive examples of sunken-floor buildings are very seldom found (*e.g.* Werra 2010b), and it is not clear if they occur on typical or atypical sites. There are very few certain sites of other functions, such as temporary camp sites (*e.g.* Domańska and Rzepecki 2010), although new data from the intensive survey near Wietrzychowice suggest a relative high percentage of this type among all LBK sites (Papiernik *et al.* 2020). Macrobotanical and faunal remains indicate a farming economy (*e.g.* Mueller-Bieniek *et al.* 2016) with an emphasis on cattle (Gillis *et al.* 2017; Marciniak 2020).

CHRONOLOGY

The lowlands as a whole were settled from the early to the late LBK. This whole chronological sequence can be seen in Kuyavia and Chełmno Land. The situation in other regions is not clear, as such continuity is not self-evident (*e.g.* Pechtl 2020).

The earliest assemblages dated to the Kuyavian phase I (typologically, with elements of the oldest LBK associated with some early music note, *i.e.*, LBK IIA, traits) occur close to the Vistula River valley, and the occupation later spreads to other regions, especially to the west (Pyzel 2010a; 2014).

All these estimations are based on pottery typology, which is key for the relative chronology. The uniformity of the music note stylistics makes such divisions difficult, and the issue of potential stylistic stagnation must be also considered (Werra 2013).

The absolute time span for the LBK occupation in Kuyavia lies between 5300 and 5050-5000 calBC according to recent estimations (Marciniak *et al.* in preparation), which is much shorter than previously assumed for the lowlands, especially for the end date, formerly thought to be even as late as 4850 calBC (Czerniak 1994). Nonetheless, this chronology definitely needs to be studied more extensively, as in general, there are very few absolute dates for the LBK in the lowlands.

ORIGIN AND CONTACTS

There are two potential origin areas for the lowland LBK. An origin in Lesser Poland has been the dominant hypothesis since the beginning (*e.g.* Kostrzewski 1933), but the role of Lower Silesia has been stressed for at least 50 years now (Kulczycka-Leciejewiczowa 1979). The oldest lowland LBK assemblages, known since the 1980s, are distinguished by a high proportion of Cracow Jurassic flint, which was interpreted as an indication of the importance of the Warta River as a route of the first farming migration (Kozłowski 1988; Czerniak 1994; Kirkowski 1994). In general, a hypothesis of many migrations from different regions, lasting through the whole lowland LBK, has prevailed in the scientific discourse for many years. This polygenesis should be visible on a large, regional level (Czerniak 1994; Kirkowski 1994), but even within small micro-regions as well (Grygiel 2004). My settlement analysis demonstrates that the colonization was quite rapid and in fact completed during the early music note phase (LBK IIA: Pyzel 2010a). I also argue that the very first settlers came from western Lesser Poland, where local communities cultivated intensive contacts with Moravia, as indicated by the characteristic Zofipole style of pottery (Pyzel 2014). In the case of some sites from Chełmno Land, D. Werra suggests some relations with Lower Silesia on the basis of mineral pottery temper (Werra 2013), and this hypothesis definitely deserves more thorough studies.

Although there are almost no human remains of the LBK farmers and local hunter-gatherers, which makes DNA and other analyses impossible, one can assume on the basis of estimations for other regions that lowland LBK communities were also of migrant origin. There are very few indications of relations with the local Mesolithic communities (Płaza 2015) still inhabiting the lowlands during this time. From the middle LBK, lowland communities become more autonomous, and traditional connections with their areas of origin grow weaker. Instead, east-west relations become more and more important, which can be connected with migrations towards Western Pomerania.

Lowland communities on the lower Vistula River maintained diverse contacts with other groups, which are exemplified, for example, by items made of rare and exotic raw materials such as obsidian, Volhynian flint or more common Cracow Jurassic flint (Kabaciński *et al.* 2015; Pyzel and Wąs 2018). The first farmers belonged to a very broad LBK circle of exchange, visible through stone artefacts made from amphibolite (Szydłowski 2017). There are also foreign elements in the pottery, even from the Eastern Linear cultures (Pyzel 2009; Werra and Sobkowiak-Tabaka 2017). Apart from connections with the south, which used to be favoured in the archaeological discourse on the lowland LBK, there are close links with western Pomerania and even with the Elster-Saale region (Kirkowski 1993; Czerniak 1994; Grygiel 2004). Western influences can also be seen in house architecture (Werra 2010a).

DISCUSSION: THE ROLE OF THE VISTULA RIVER IN THE LIFE OF LBK LOWLAND COMMUNITIES

Rivers were important communication routes in prehistory (Haughey 2016). The Vistula River has always been regarded as a major connection between Lesser Poland and the lowlands, and this perspective has influenced interpretations of the first farming communities (*e.g.* Kostrzewski 1933). South-north contacts were crucial not only for the original movement of LBK communities into the lowlands, but also later for the supply with flint raw materials. Chocolate flint played a major role for the communities on the lower Vistula River: its outcrops are located not far from the western bank of the river, at the beginning of its middle course. Irrespective of the unresolved issue of exactly how it was obtained – through exchange or directly from the source (*e.g.* Pyzel and Wąs 2018) – the interesting question is whether it occurred along the Vistula River or not. K. Adamczak, S. Kukawka and J. Małecka-Kukawka raised doubts about this possibility for the time of the Funnel Beaker culture. In their opinion, this assumption is based on the mythos about the special role of the Vistula River in Polish history and culture. In reality, the banks of the river were swampy and overgrown with shrubs and weeds, and thus difficult to access and to follow (Adamczak *et al.* 2017). Historical sources inform that conditions on the banks of the Vistula varied through time; for example, between the 10th and 13th century AD, floodplains were broadly used for cultivation, but afterwards they became swamped and partially flooded (Gieysztor 1982). The distribution of LBK sites, with a significant concentration of the earliest ones close to the Vistula River, indicates, however, that the river must have played an important role in the original colonization of the lowlands by LBK communities. This correlation is even more striking if one compares two linear projects cutting through the region of Kuyavia, which offered a random sample of excavated sites. On the Jamal and PKN Orlen gas pipelines, which ran from the east to the west, there were no sites of LBK I; on the A1 motorway cutting through eastern Kuyavia from the north to the south, finds from this phase were registered in almost every micro-region (Pyzel 2010a, 172-173; 2014).

Sites located in the peripheries – Kościelna Jania in Pomerania and Cząstków Polski in Mazovia – yield material quite early within the LBK II, and in both cases the excavations confirmed the existence of regular occupation with settlement pits and ground stone finds such as grinders, which is an argument against their interpretation as a kind of way station on the way to major settlement areas. However, these remote peripheries definitely deserve more attention in future research, which may help to estimate their relationships with core settlement regions such as Kuyavia or Chełmno Land (and others in the south).

LBK people could have travelled over long distances without leaving any archaeological traces, and colonization may not necessarily have taken the form of a regular wave of advance, in which one region is settled after another. It could have been much more of a leapfrog colonization, such as in Bavaria, where sites located more in the west (thus further from the origin) are older. Interestingly, the migrants did not always follow the Danube, sometimes taking inland routes (Pechtl 2009). However, there are no inland sites in Central Poland, on the Pilica or Warta rivers. S. K. Kozłowski and M. Nowak have recently suggested that the so called “Wrocław-Poznań corridor” was important for the LBK migration from Lower Silesia (Kozłowski and Nowak 2019). This connection actually played a crucial role in the post-LBK time, and with regard to the majority of sites dated to this period (Jankowska 1999). For the LBK, most of the sites lie close to the Vistula River, which is an argument for the role of this river as a route of colonization as well as later communication, even if contacts with the south grow weaker with time as the lowland communities became more and more independent.

LBK sites cluster around traditional fords across the Vistula River known from historical sources, such as Włocławek, Nieszawa, Toruń, Fordon and Chełmno (Gieysztor 1982). This supports the argument that the river was not an impenetrable barrier in the Neolithic.

The distribution of flint raw materials confirms this view and indicates the role of the river as a communication route. J. Kabaciński distinguished three zones of supply with chocolate flint in Kuyavia. Only in zone I, stretching some dozen kilometres along the Vistula River, was the full technological process from natural nodules to ready tools carried out, and some specialized flint workshops could be found there (Kabaciński 2010; 2018).

It is not clear how the LBK people travelled. There are no dugout canoes or raft finds from the LBK milieu, but wells, for example, showcase the skills of craftsmen, which were advanced enough to produce them. Apart from the waterway, travel along the well-developed valley was also possible. Recent investigations reveal that the landscape in the Early Neolithic could have been more open than previously assumed (Moskal del-Hoyo *et al.* 2016; Marciniak 2020), which made orientation easy. The whole colonization process strongly indicates that LBK communities had an astonishingly deep knowledge of the landscape, and that the Vistula River was an important element on their mental map.

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FIELD SURVEY AND MATERIALS

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THE FIRST FIND OF LBK GRAPHITE-COATED POTTERY IN LESSER POLAND: WIĘCKOWICE, SITE 4, KRAKÓW DISTRICT

ABSTRACT

Brzeska-Zastawna A., Borowski M. P. and Zastawny A. 2021. The first find of LBK graphite-coated pottery in Lesser Poland: Więckowice, site 4, Kraków district. *Sprawozdania Archeologiczne* 73/1, 221-249.

In the years 2006-2011, at the site Więckowice 4, rescue excavations were carried out in the eastern part of an extensive (over 15 ha) multicultural zone. The most numerous are the remains of the LBK settlement from the "music note" phase. The south-eastern part of the settlement was explored, discovering lines of building pits and post holes belonging to 3-4 longhouses. A particularly unique discovery was a fragment of a LBK vessel with powdered graphite preserved on the outer surface. In addition to the LBK ornament of engraved lines, it is decorated in a manner referring to the ornamentation of the Eastern Linear circle (Tiszadob-Kapušany group). The presence of graphite on the vessel wall has been confirmed by the results of SEM-EDS analyses. This is the first such find in Lesser Poland. To comprehensively address the cultural significance of this find we provide an up-to-date overview of graphite usage in a wide range of LBK contexts.

Keywords: Linear Pottery culture, Lesser Poland, graphite-coated pottery, Eastern Linear circle ornamentation
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INTRODUCTION

In the years 2006-2011 at the site Więckowice 4, Kraków district (Fig. 1), archaeological excavations were carried out related to the intensively developing residential buildings in the eastern part of the site (Fig. 2). These were not wide-ranging, but spot tests, organized in places where new single-family houses, internal access roads to the property and technical infrastructure were built. Within a few years, research work was carried out at the construction sites of 10 buildings, two internal roads with a total length of 251 meters and a 60-meter-long water line. A total area of 31 ares was examined. The type and scope of the research was varied and depended on the implementation of several stages of investment works. The research excavations had different dimensions: *e.g.* 134.0 × 5.5 m; 117.0 × 4.0 m; 18.0 × 20.0 m; 25.0 × 12.0 m; 12.0 × 13.0 m; 60.0 × 0.6 m (Fig. 3). They were located at a distance of several dozen meters from each other in an area of approx. 1 ha. In this context, the nature of the research and the degree of exploration of the area should be considered probative. In the years 2006-2011, the excavations were conducted by A. Zastawny (trenches I-XIV). In 2011, additional works were managed by I. Mianowska (trench XV). The result of the research was the identification of a portion of a settlement with longhouses of the Linear Pottery culture (LBK) and a settlement of the Lusatian culture from the Bronze Age, as well as traces of a settlement of the Funnel Beaker culture and the Lengyel culture (several features).

Site no. 4 in Więckowice is located on the southern edge of the Kraków-Częstochowa Upland, 14 km north-west of the center of Kraków (Fig. 1). It has an area of over 15 ha and occupies a well-exposed, wide terrain elevation, separating the valley of the Jurassic stream called Kobylanka from the wide floodplain valley of the Rudawa river (Fig. 2). Particularly favorable for prehistoric settlement, the topographic location of the described place and its soil (loess formations) and water conditions, as well as the close proximity of Jurassic flint outcrops should be emphasized. Prior to the excavation, the site was known only from a surface survey carried out in 1987 (AZP 101-55/13).

During the excavation work in 2009 (Zastawny 2009), a complex of LBK construction pits, adjacent to dwelling structures was discovered (features no. 45, 46, 47, trench III.9). A fragment of the vessel with a graphite-coated surface come from one of them (feature no. 45). The use of this mineral in the preparation of the surfaces of the ceramics from Więckowice has been additionally confirmed by the results of archaeometric analyses discussed in this article. This is the first time that LBK ceramic materials in Lesser Poland have been diagnosed with graphite powder on the vessel wall. This was the impetus for this article and its discussion of the aforementioned vessel and the pottery and lithic inventory of accompanying feature no. 45. The materials from the research on site 4 in Więckowice have not been published so far.

In 2012, a fragment of the vessel with graphite was made available for petrographic research, conducted as part of a project led by A. Czekaj-Zastawny (see Rauba-Bukowska

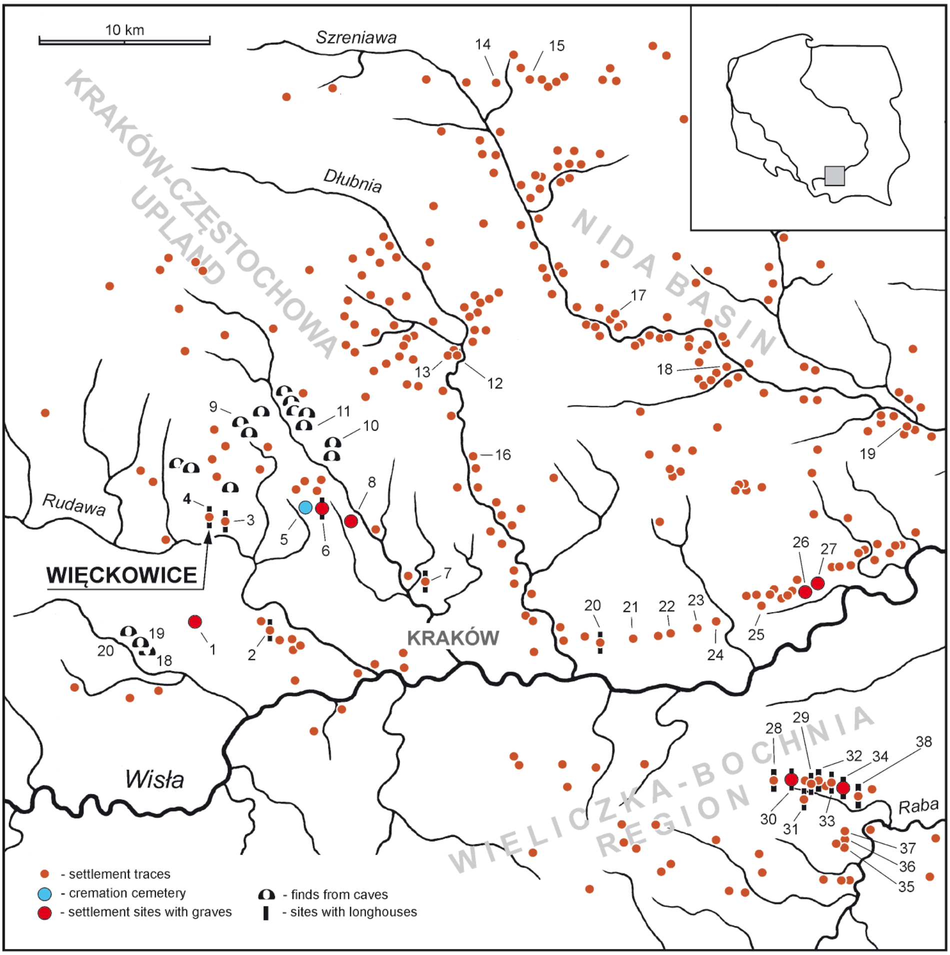

Fig. 1. Location of site 4 at Więckowice in the LBK settlement area near Kraków (acc. to Zastawny and Grabowska 2014).

Main sites: 1 – Aleksandrowice site 2; 2 – Kraków Olszanica, site 4; 3 – Bolechowice, site 9; 4 – **Więckowice, site 4**; 5 – Modlniczka, site 2; 6 – Modlnica, site 5; 7 – Kraków Górka Narodowa, site 9; 8 – Giebułtów, site 1; 9 – Wierzchowie, site 2 (Wierzchowska Górna cave); 10 – Maszyce, site 1 (Maszycka cave); 11 – Ojców, site 3 (W Okopach Wielka Górna cave); 12 – Iwanowice Dworskie, site 1 (Babia Góra I, II); 13 – Iwanowice Włościańskie, site 1 (Góra Klin); 14 –Pstroszyce; 15 – Miechów, site 65; 16 – Michałowice, site 27; 17 – Brończyce, site 1; 18 – Przesławice, site 8; 19 – Kowala, site 1; 20 – Kraków Mogiła, site 62; 21 – Kraków Pleszów, site 17-20; 22 – Kraków Branice, site 76; 23 – Kraków Wyciąże, site 5; 24 – Kraków Cło, site 7; 25 – Zofipole, site 1; 26 – Igołomia, site 1; 27 – Złotniki, site 1; 28 – Zagórze, site 2; 29 – Szarów, site 9; 30 – Brzezie, site 17; 31 – Brzezie, site 40; 32 – Targowisko, site 16; 33 –Targowisko, site 14,15; 34 – Targowisko, site 12,13; 35 – Łężkowice, site 1; 36 – Targowisko, site 1; 37 – Targowisko, site 2; 38 – Targowisko, site 10,11

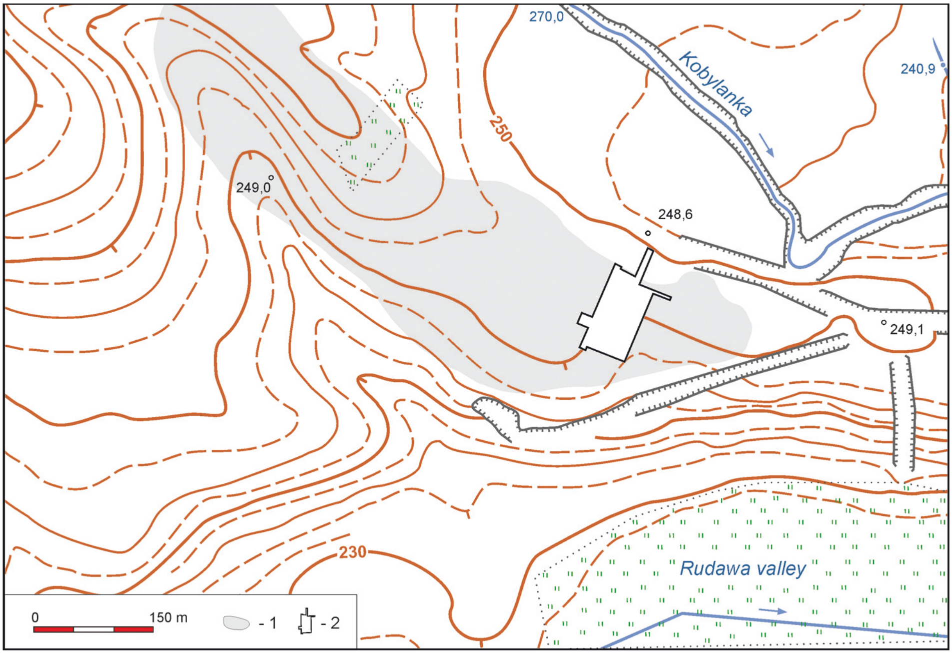

Fig. 2. Więckowice, site 4, Kraków district. Range of the site (1) with research area in 2006-2011 (2). Illustration by A. Zastawny

and Czekaj-Zastawny 2020, tab. 1). The results of the analyzes performed at that time were not made available to the authors of this article.

LBK SETTLEMENT AT WIĘCKOWICE

Most numerous at site no. 4 in Więckowice are the remains of an LBK settlement from the "music note" phase of this culture, with traces of residential buildings and flint workshops. The south-eastern part of the settlement was explored, in which lines of building pits were discovered, along with post holes belonging to 3-4 above-ground pole-structure buildings (Fig. 3). Apart from ceramic and flint products, obsidian and amphibolite artifacts were obtained. A total of 35 features were discovered and examined, including post holes, construction pits, adjacent to dwelling structures and utility pits with ceramic materials – uniform in terms of style and chronology.

Despite the fact that the excavation covers a fairly large area (approx. 1 ha), the relatively large distances between the archaeological trenches prevents us from recreating a complete picture of the settlement layout. In one trench with an area of 12.0 × 13.0 m

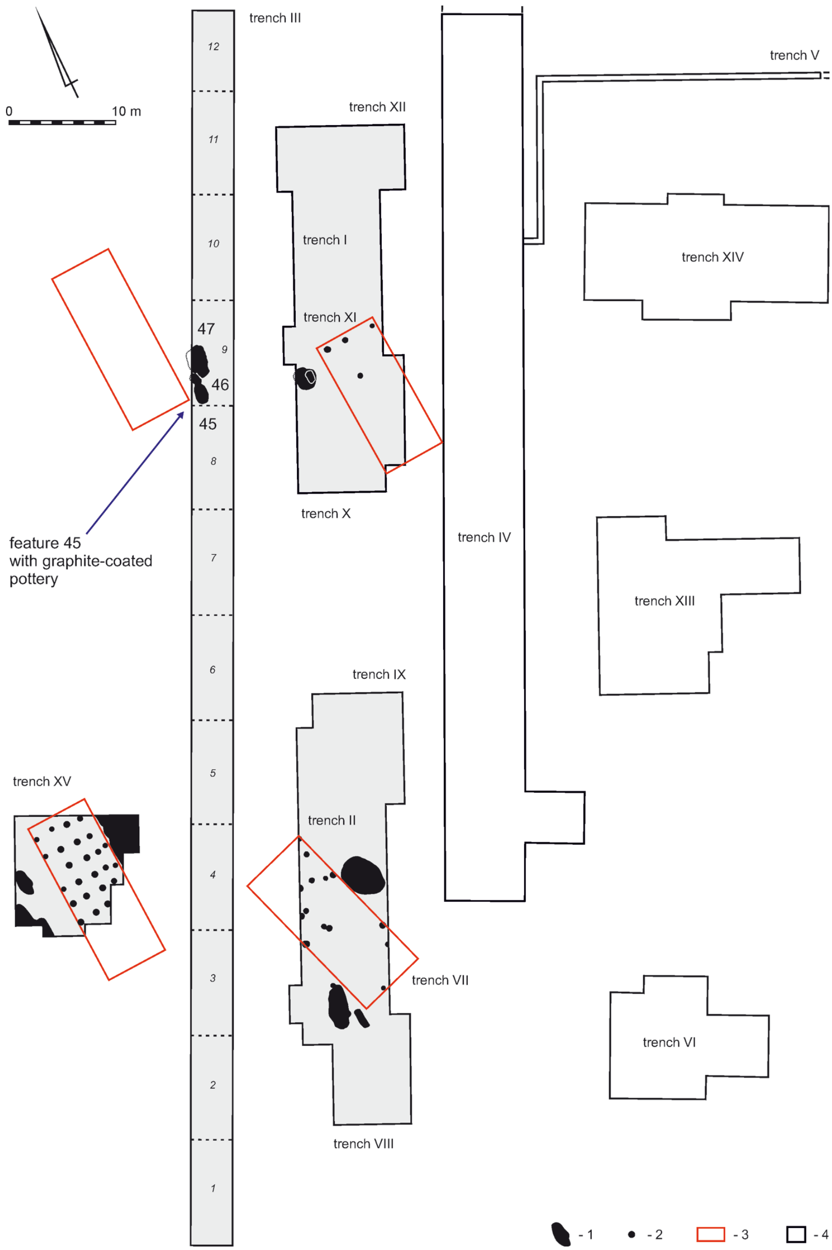

Fig. 3. Więckowice, site 4, Kraków district.
Trenches with LBK features: 1 – pits, 2 – postholes, 3 – reconstructed outlines of longhouses, 4 – trenches without LBK features. Illustration by A. Zastawny

(trench XV), a nearly complete structure of a longhouse was captured, consisting of 5 rows of postholes and lines of construction pits at both long sides of the building (Fig. 3). In other parts of the study area, construction pits with a partially preserved arrangement of posthole pits, as well as those without rows of postholes (trench III; features 45, 46, 47; Fig. 3). Thus, at the site in question, traces of four LBK longhouses were discovered: one documented almost in its entirety (trench XV), two fragmentarily preserved (trench II, XI) and one possible longhouse (trench III).

An important distinguishing feature of the settlement character is the abundance of flint artifacts, which confirms the existence of flint workshops in which the preliminary stages of processing took place, including initial trimming of nodules. Materials of this kind come from the pits surrounding longhouses, including pit no. 45, in which a vessel with an admixture of graphite was discovered.

LBK pottery from the settlement in Więckowice represents a uniform ornamental style, characteristic of the "music note" phase of this culture in Lesser Poland. Older and younger materials, typical of the Želiezovce phase, have not been discovered in any of the features. We associate the entire settlement with the "music note" phase and thus verify the incorrectly defined relationship with the Želiezovce phase, which, on the basis of an incomplete assessment of materials, was previously attributed to the settlement in Więckowice (see Zastawny and Grabowska 2014, fig. 43; Rauba-Bukowska and Czekaj-Zastawny 2020, tab. 1).

Więckowice belongs to the group of the most western LBK sites in the region near Kraków, associated with the Rudawa River basin and the area of flint outcrops in the southern part of the Kraków-Częstochowa Upland (Fig. 1). Sites with stray finds and cave materials prevail here. There are also settlements with graves (Aleksandrowice site 2, Giebułtów site 1; Czekaj-Zastawny 2009) and a unique cremation cemetery, the only one in Lesser Poland (Modlniczka, site 2; Czekaj-Zastawny and Przybyła 2012). Settlements with longhouses are characteristic of the area in question. Such settlements include Bolechowice, site 9 (Breitenfellner and Rook 1991), Kraków-Olszanica, site 4 (Milisauskas 1986), Kraków-Górka Narodowa, site 9, and Modlnica, site 5 (Czerniak 2010). On the map of the entire region near Kraków, they can be described as the western cluster (Fig. 1), which is less numerous compared to the eastern grouping, including the settlements in the Tusznica valley in the Wieliczka-Bochnia loess. Against this background, and according to the current state of research, the settlement from Więckowice presents itself as the farthest west LBK settlement with longhouses in Lesser Poland (Fig. 1). The aforementioned site of Bolechowice 9 is the one closest to our settlement, just 1.1 km to the east and located just like Więckowice on the right bank of Kobylanka stream; it also has traces of longhouses from the same ("music note") chronological phase (Breitenfellner and Rook 1991).

FEATURE NO. 45. MATERIALS AND ANALYSIS

Feature no. 45 belongs to the complex of 3 construction pits (features 45, 46, 47), discovered in trench III.9 (Fig. 4). The outlines of these features partly extend beyond the boundary of the excavation on the west side, where the part with postholes of the long-

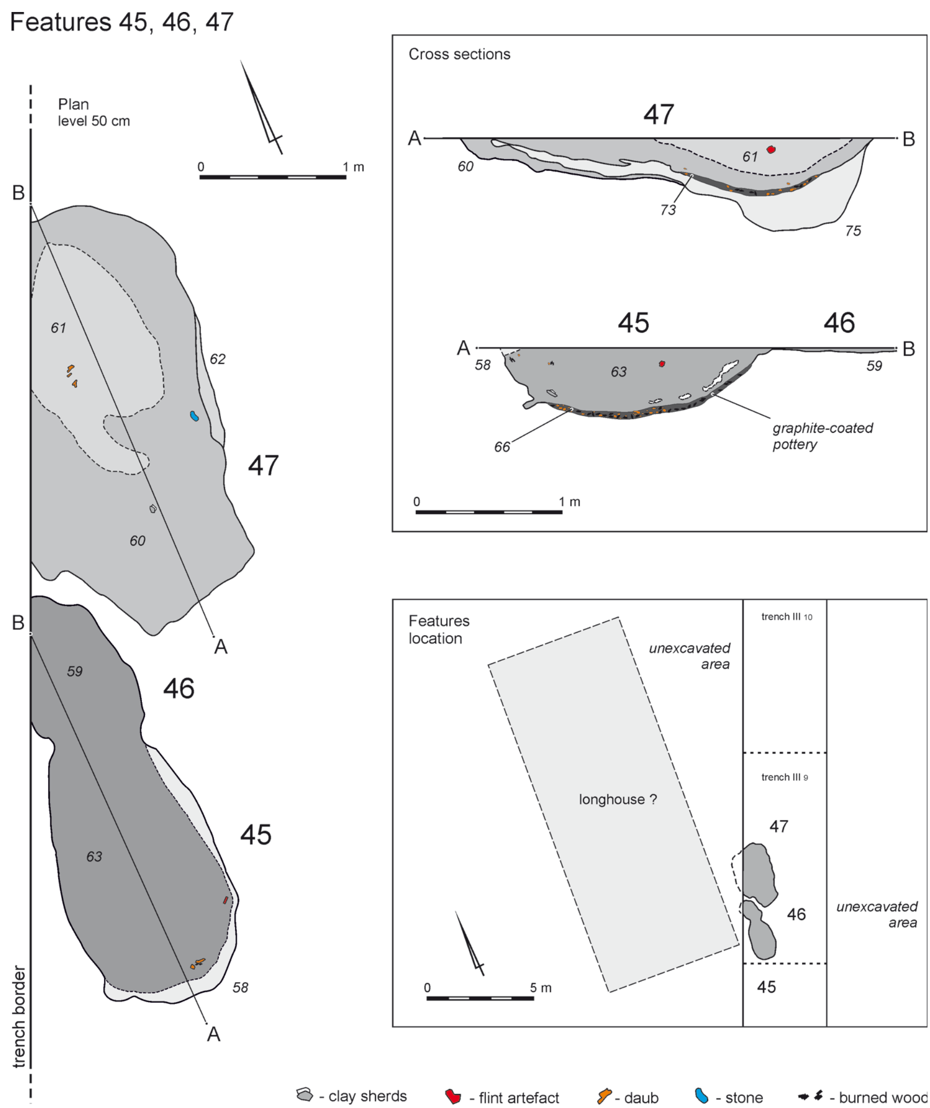

Fig. 4. Więckowice, site 4, Kraków district. Plan with the arrangement of LBK features Nos. 45, 46, 47. Illustration by A. Zastawny

house structure is probably located (the zone outside the research area). Features 45 and 46 have a partially common outline, while pit 47 is located several dozen cm north of them. The longitudinal axes of all features are oriented on a N-S axis. They have a layout typical for construction pits, and with high probability they mark the south-eastern “corner” of the LBK longhouse.

Pit no. 45 was preserved as an oval silhouette with an elongated outline and dimensions of 188 × 108 cm (Fig. 4). From the north, it connects to a small pit (no. 46), which is actually a shallower part of the described feature. At the level of discovery (approx. 50 cm below the present ground level), the pit was filled with brown-black earth, mixed only on its circumference with yellow loess. In its vertical section, the fill had a regular, trough-shaped outline, with a thin layer of intensely black earth with daub lumps and charcoals clearly distinguished at the bottom. From feature 45, a large amount of lithic material was obtained (257 items), along with a less abundant collection of potsherds (46 fragments), coming from at least 7 vessels of the LBK. A small, flat amphibolite adze was also discovered. The fragments of the vessel with the graphite-coated surface were in the intensely black layer of soil filling the bottom of the feature, at a depth of 40 cm below the level of discovery of the pit (Fig. 4).

Pottery

1. Clay vessel preserved in twelve fragments (reconstructed belly diameter: 19.2 cm; vessel height: 17.5 cm). Spherical belly merging into a clearly distinguished conical neck with a slightly everted lip (Fig. 5: 2). On the belly, at the point of its maximum protrusion, there is a small, vertically pierced handle (Fig. 5: 4). The vessel is richly ornamented with engraved lines in various arrangements. There are 4-5 circular lines on the belly, enclosing the space with smaller bands composed of 3 parallel lines in an arched arrangement (Fig. 5: 1). It cannot be determined whether these strands are separate, closed patterns of decorations or whether they connect with each other in parts of the belly that are not preserved. The ornament was made carelessly. The lines are discontinuous, uneven and repeatedly corrected (Fig. 5: 4). There are traces of accidental indentation in many places (Fig. 5: 1). In the ornamental zone, traces of graphite powder with a granulation of up to 2 mm, “scattered” on a surface of 3.8 × 4.0 cm, were visible to the naked eye (Fig. 5: 1; 6: A, B). There is an additional decorative field above the handle, connecting the belly with the conical neck (Fig. 7). It is composed of vertical rows of zigzags, enclosed with diagonal lines engraved on both sides, and a horizontal line from above (Fig. 5: 2; 6: C). Above this line, the neck becomes a short spout with a slightly bent outward edge. The field with the zigzag ornament placed above the handle is also fragmentarily preserved in another part of the vessel, where graphite is also present, proving that the described vessel had at least 2 handles with zigzag ornaments placed above them. The described bowl is a thin-walled vessel made of dusty, loess-like clay. Very fine grains of sand are present in the ceramic mass. A crumbled

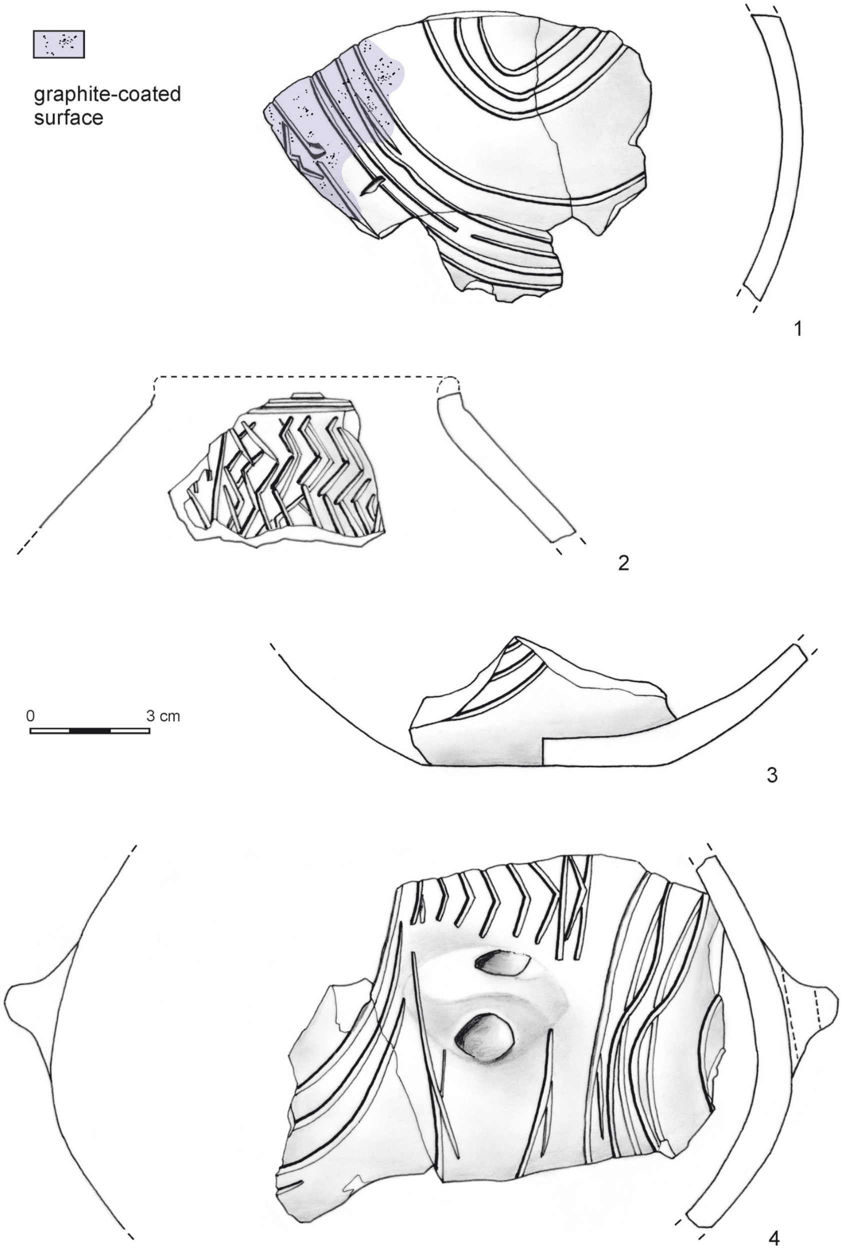

Fig. 5. Więckowice, site 4, Kraków district.
LBK vessel with graphite-coating from feature No. 45.
Illustration by A. Zastawny

fragment of pottery is visible on the outer surface. The cross-section shows the colour zoning: light beige core, dark gray to beige-brown outer surface, brown-orange inner surface.

2. The upper part of a thin-walled hemispherical bowl, preserved in seven fragments, with a mouth diameter of 17.5 cm (Fig. 8: 1). The vessel is decorated with an ornament of engraved lines, with "note" points placed on and between the lines. Below the edge of the rim, there is an horizontal line with an engraving around the vessel, under which fragmentary, single, arched lines have been preserved, arranged in three U-shaped motifs, closed

Fig. 6. Więckowice, site 4, Kraków district. LBK vessel with graphite-coated surface from feature No. 45: graphite powder on the outer wall (A, B); the upper part of the vessel, decorated with an engraving in the style of the Tiszadob-Kapušany group (C). Photo by A. Susuł and A. Zastawny

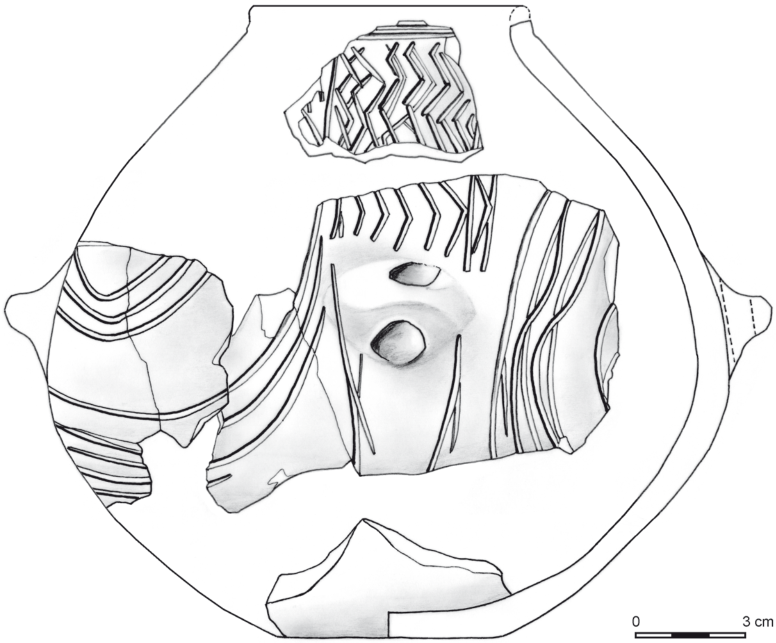

Fig. 7. Więckowice, site 4, Kraków district.
Reconstruction of the LBK vessel with graphite-coated surface. Illustration by A. Zastawny

at the top. The walls of the vessel are badly damaged and the outer surfaces are completely worn (no admixture).

3. Upper and middle parts (3 pieces) of a thick-walled hemispherical bowl with a mouth diameter of 14 cm (Fig. 8: 2). The outer surface is uneven and rough with visible traces of various admixtures in the pottery mass: ceramic and stone rubble, sand, plant ingredients. There are three short, parallel lines on the belly.

4. The upper part of a thin-walled hemispherical bowl without ornament (4 pieces), with a mouth diameter of 10.5 cm (Fig. 8: 4). Numerous traces of organic admixture are visible on the partially preserved outer surface.

5. Top part of a thin-walled bowl with a conical neck (Fig. 8: 3). Reconstructed diameter of the mouth – 20 cm. The outer surface is completely destroyed, the ornament is missing, and the clearly visible composition of the pottery is grog and plant material. The vessel is preserved in five fragments.

6. Two fragments of the belly of a thin-walled bowl with an ornament of engraved lines in an arched pattern and "note" points on and between the lines (Fig. 8: 5). External surfaces worn down.

7. The belly of a thin-walled vessel (8 fragments) with a very poorly preserved "note" ornament. External surfaces worn down.

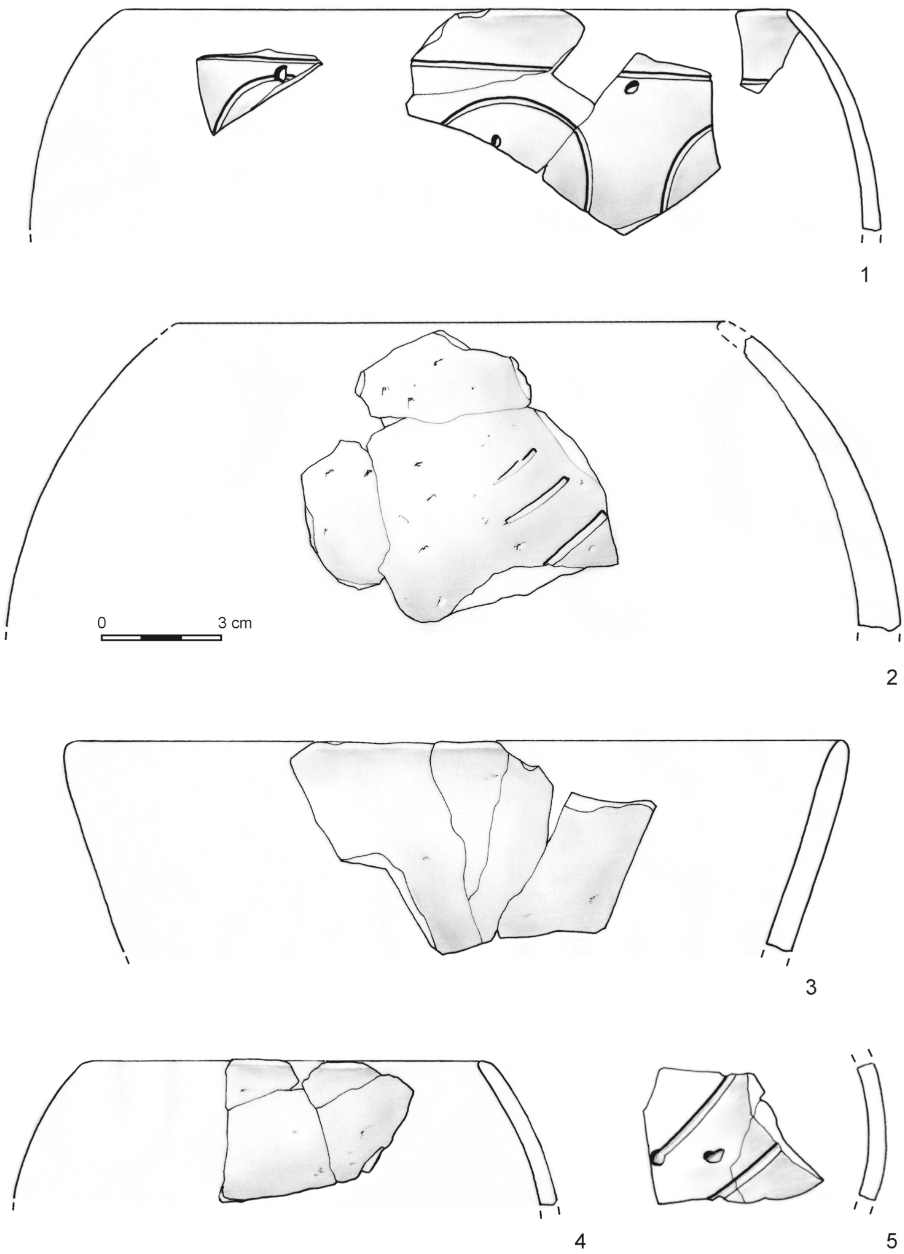

Fig. 8. Więckowice, site 4, Kraków district.
Fragments of the LBK pottery from feature No. 45.
Illustration by A. Zastawny

8. Five small fragments of thin-walled vessels without ornament.

The pottery from feature no. 45, numbering 46 fragments from at least 7 vessels, is a standard for the "music note" phase of the LBK in western Lesser Poland. It is represented by both the predominantly smooth, thin-walled pottery (Fig. 8: 1, 3-5) and thick-walled ceramics (Fig. 8: 2). Reconstructable fragments came from hemispherical bowls of various sizes and proportions. In one case, the upper part of a conical bowl was distinguished (Fig. 8: 5). The decoration has been preserved on several fragments, mainly in the upper parts of the vessels. The engraved lines and the "note" points create simple compositions, consisting of U-shaped motifs in the middle of the belly and horizontal lines below the edge of the rim. The "note" points appear on and between the engraved lines (Fig. 8: 1). On the belly of the thick-walled cup, three short, parallel lines are placed (Fig. 8: 2).

With the exception of the last fragment, where the original surface has been preserved (rough, with traces of ceramic, stone, sand and plant admixture), the thin-walled ceramics survived in a very poor condition (without external surfaces). The thin-walled pottery contained fine-grained sand and organic material. Analogies to the pottery fragments discussed above can be found at many LBK sites near Kraków. The most important are Bolechowice, site 9 (Breitenfellner and Rook 1991), and Brzezie, site 17 (Czekaj-Zastawny and Zastawny 2011; Czekaj-Zastawny 2014). The latter is a settlement with longhouses from the "music note" phase, at which the graphite pendant and imported pottery (from the Eastern Linear circle) come. Compared to the materials from Bolechowice, arched motifs predominate in the systems of engraved lines from Więckowice (Fig. 8: 1, 5), while in Bolechowice, angular motifs are the most common (Breitenfellner and Rook 1991, fig. 6: r-t). The same decoration, on the other hand, occurs on thick-walled ceramics (Fig. 8: 2) (Breitenfellner and Rook 1991, fig. 6: u). In the construction pit of longhouse no. III (feature no. 90) at Brzezie 17, where a graphite pendant was discovered, the engraved ornamentation with "note" points occurs in both arched and angular arrangements (Czekaj-Zastawny 2014, pl. 27: d-i). The inventory of this pit includes a fragment of a conical bowl (Czekaj-Zastawny 2014, pl. 27: c), similar to the one from feature 45 from Więckowice (Fig. 8: 3).

In the materials from feature 45, the fragments of the vessel with graphite powder stand out in all respects (Fig. 5; 6). Compared to the ceramics discussed so far, their technical condition is better, the preserved fragments are larger, and the ornamentation is more varied and covers the entire surface of the vessel. Its shape is also a bit different. The spherical belly, as in the case of typical bowls, turns into a conical neck with a slightly everted lip (Fig. 5). Crushed pottery sherds of various sizes are present in the admixture in the clay mass. (Fig. 6: A). The most important element (apart from the presence of crushed graphite) is the decoration. The typical ornament of multiple engraved lines with U-shaped motifs (Fig. 6: A) is accompanied by fields covered with vertical rows of zigzags, closed with diagonally engraved lines on both sides and a horizontal line from above, located above the handle (Fig. 5; 6: C). It is an ornament referring directly to the style of the Eastern Linear group of Tiszadob-Kapušany (here we thank Dr. R. Hreha from the Slovak Academy of Sciences in Košice for his consultation). Vessels with such an ornament are known from the Eastern Slovak sites of Šarišské Michaľany and Zemplínske Kopčany (Hreha and Šiška 2015, pl. 129: 7, 131: 4, 134: 1). The decoration in the form of arched engraved lines and vertical zigzag lines, appearing (as in Więckowice) as a composition on one vessel, appeared on a pear-shaped vase in Zemplínske Kopčany (Hreha and Šiška 2015, pl. 134: 1). We also know of arrangements of vertical zigzags on ceramics of foreign origin from Lesser Poland. From the above-mentioned site in Brzezie 17 comes a bowl with an everted lip, imported from the environment of the Tiszadob-Kapušany group (Czekaj-Zastawny 2014, fig. 45: A; pl. 186: e). This is another element connecting the settlement of Więckowice and Brzezie ("music note" phase, longhouses, ornamentation of the Eastern Linear circle, graphite). The technological difference of the discussed bowl with the graphite surface from Więckowice, and its ornamentation, which refers to the Eastern Linear style, seem to indicate its status as an import. However, the carelessness of the ornamentation (imitation?) and the presence of graphite raw material (probably put on the spot on the surface of the vessel) suggest that it may rather be a local product.

The use of graphite powder, identified on the outer surface of the vessel discussed here, represents the most common use of graphite in the LBK in Europe. Examples are known from sites in Moravia, southern Bavaria, the Bohemia and Silesia (see the rest of the article). An analogy from the Bavarian site of Mangolding (Pechtl and Eibl 2011, Abb. 86) deserves attention here. There, a graphite bowl was discovered with grains of crushed graphite on the surface that most closely (except the mouth diameter) resembles the vessel from Więckowice (Fig. 13: 6).

Lithic artefacts

The few ceramic fragments were accompanied by numerous (257 specimens) lithic artefacts, including a small amphibolite adze (*Flachhacke*) with dimensions of 51 × 27 × 9 mm (Fig. 10: 1) and 256 flint products made of the local brown Jurassic-Kraków flint. The vast majority (58%) are flakes (149 specimens). Apart from that, there were 3 pre-core irregular forms and 4 single-platform flake cores, including a carinated initial core (Fig. 9: 4) with dimensions of 61-77 mm in length, 36-69 mm in width and 38-90 mm in thickness (the others represent similar types of boat-shaped cores, most often with crests, and with trimmed sides and platforms), along with 1 splintered piece, 5 scaled flakes, 25 technical flakes and blades, 8 tools, 12 blades, 37 chips and 12 chunks.

The so-called "technical" forms are represented predominantly by forms related to core trimming – mainly by crested flakes (Fig. 9: 2; 13 specimens). Their average dimensions are 51 × 49 × 16 mm. Crested blades are less numerous (Fig. 9: 3; 7 specimens), and have average dimensions of 77 × 28 × 16 mm. Most were removed by hard-hammer percussion. The exception is a very regular, partially crested *débordant* blade (Fig. 10: 4) with a dihedral butt and a straight longitudinal section. The next group consists of secondary

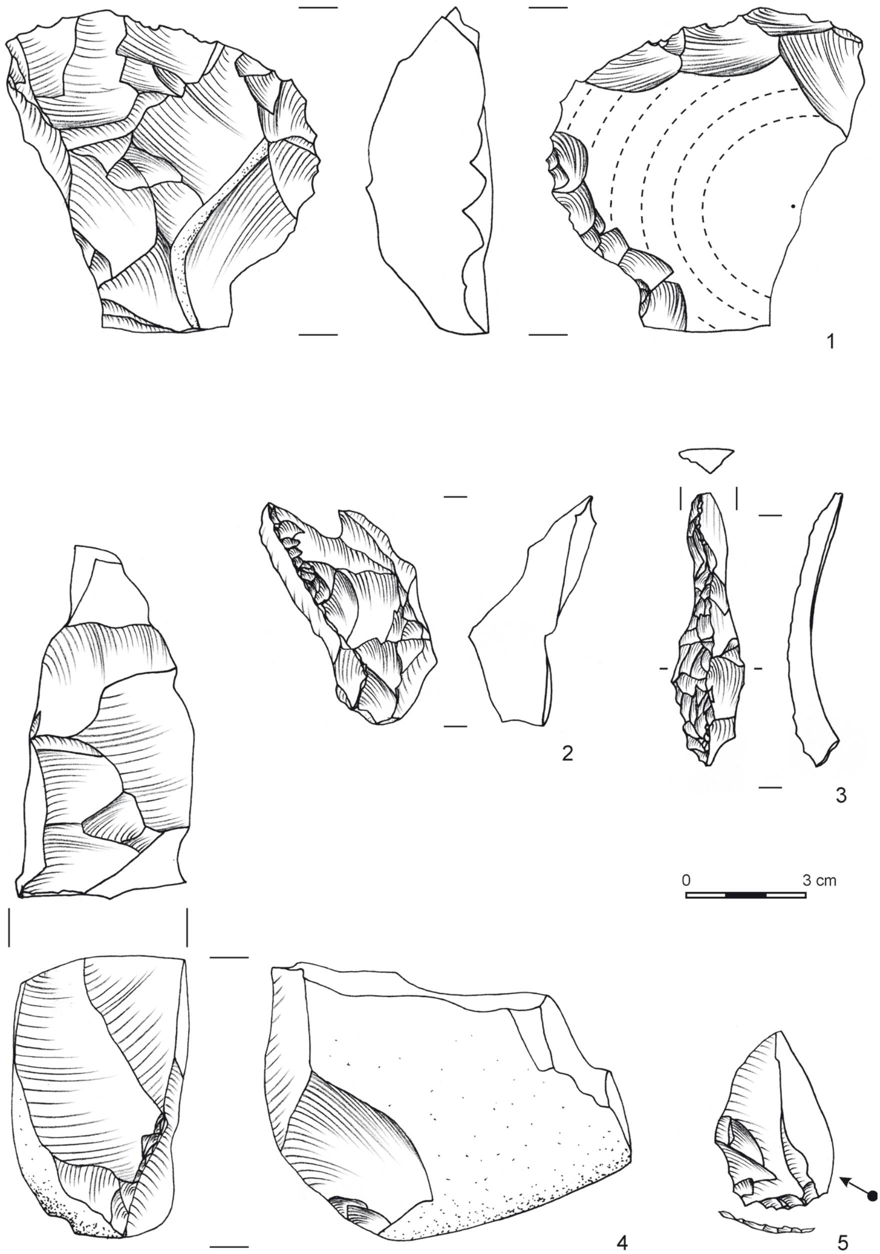

Fig. 9. Więckowice, site 4, Kraków district.
Selected LBK flint artefacts from feature No. 45.
Illustration by A. Brzeska-Zastawna

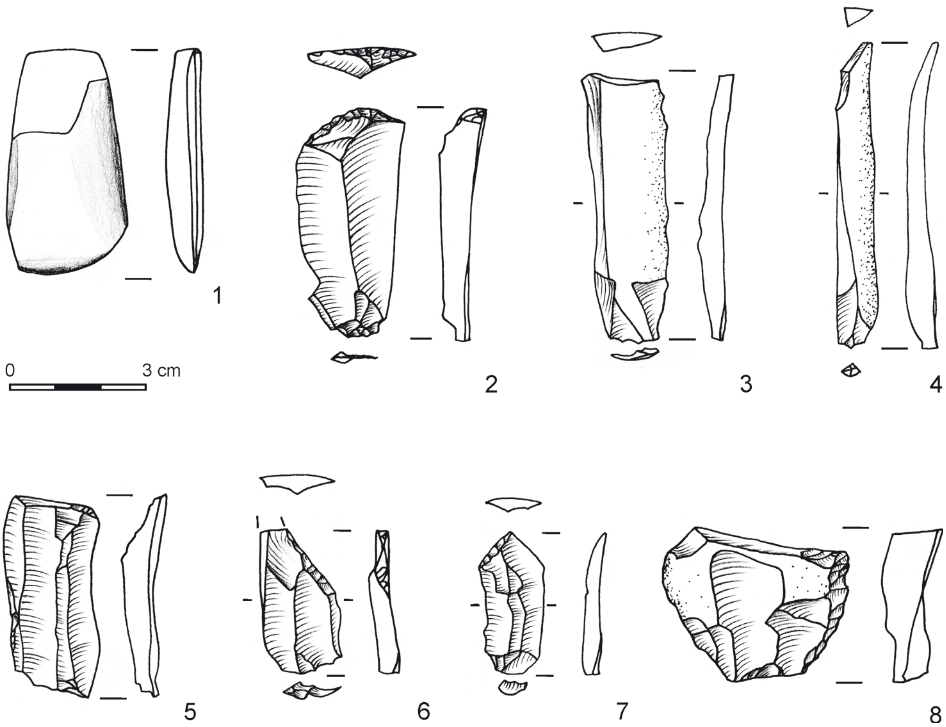

Fig. 10. Więckowice, site 4, Kraków district.
Selected LBK flint and amphibolite artefacts from feature No. 45. Illustration by A. Brzeska-Zastawna

crested blades and flakes (2 specimens each). Moreover, a repair flake appeared in the form of a core tablet (Fig. 9: 5).

Tools are represented by a modest group of 8 artefacts, including: 1 endscraper on a secondary crested blade (Fig. 10: 2) with dimensions of 52 × 23 × 8 mm, 2 truncated blades (Fig. 10: 6, 7) with dimensions of 33 × 18 × 5 and 32 × 15 × 4 mm, 1 retouched blade (Fig. 10: 5) 21 mm wide and 6 mm thick, 2 retouched flakes, 1 flake perforator (Fig. 10: 8) with dimensions of 34 × 42 × 11 mm, and a massive bifacial denticulate-notched tool of the mining type on a chunk (Fig. 9: 1) with dimensions of 68 × 89 × 29 mm.

Among the flakes (149 specimens), there is a distinct group of specimens from the decortication and initial core-trimming stages. Flakes with cortex constitute 72.5% of all flakes. Fifteen are completely cortical, and 41 are specimens with more than 50% cortex (37.6% of flakes in total). Fifty-two specimens are covered with cortex up to 50% (34.9% of flakes in total). In addition, they have negatives of a trimming character. They have strongly convex bulbs, sometimes double or dispersed bulbs with obtuse angles, depending on the angle of impact. They are often accompanied by Hertzian cones as well as bruises and crumbles. These features prove that all trimming treatments are carried out by direct hitting with a hard hammer.

Most of the blades are associated with the early stage of exploitation. All blades on which tools were not made are covered to a varying extent with cortex, most often to a degree exceeding 50% (Fig. 10: 3). Almost all of them are defragmented. Their average dimensions are 19 mm wide × 5 mm thick. Butts are usually multi-negative, and less often single-negative. Most of them were obtained by indirect percussion with an antler punch (striking angle approx. 90 degrees, eraillure scars, convex bulbs, protruding lateral edge in the butt part, flat butts, lip). Two of them could have been obtained by the pressure technique (an angle of about 95 degrees, diffuse bulb, uniform thickness, a straight longitudinal section with a slight bend in the distal part).

The only forms from the later stages of exploitation in this pit are represented by a modest set of tools in the form of two truncated blades made on regular blades, 15 and 18 mm wide. The blades on which the tools were made were obtained by antler punch. They have a multi-negative and a single-negative butt, respectively, one prominent and one diffuse bulbs, lips, and a right angle of striking. One has an eraillure scar. The secondary crested blade on which the endscraper was made was detached by direct percussion. There are no regular blades from advanced exploitation in the pit, but there are a few broken fragments of such blades, along with unsuccessful blades or flakes on which fragments of the striking surface were removed with traces of regular blade exploitation. This proves that the group of regular blade blanks were taken out of the pit.

The inventory of the pit is dominated by the remains of flint-making activities related to the decortication of raw material nodules, initial trimming and early exploitation. Moreover, the inventory shows a typical form of a massive, mining-type tool. All the described elements indicate the typical production character of the inventory of pit 45, which is well-known from the Lesser Poland LBK flint-production settlements located near outcrops of flint (Lech 1981; Caspar *et al.* 1989), such as Kraków-Olszanica 4, Modlnica 5 (Wąs 2010) Spytkowice 26 or the closest sister site to Więckowice in Bolechowice 9 (Milisauskas 1986; Breitenfellner and Rook 1991; Brzeska-Pasek *et al.* 2018). Site 4 in Więckowice is therefore another settlement point of the LBK in the area near Kraków related to the production of flint products. The presence of graphite at the site in Więckowice is particularly important for research on the potential model of contacts and distribution of flint products from Jurassic-Kraków flint from the areas near Kraków to the Silesian-Moravian environments. A collection from one characterized feature does not entitle us to further conclusions in this regard. A completely study of archaeological materials from Więckowice 4 will probably provide an answer to the question of the general structure of the inventories, as well as whether the settlement produced blades for export and whether this settlement could have played a role in the flint-product distribution network.

ARCHAEOMETRIC ANALYSIS OF GRAPHITE-COATED POTTERY

The scanning electron microscope examination was performed – without the application of any conductive layers – on a small ceramic flake (several millimetres in diameter) broken off from the exterior of the vessel. The observations were carried out by means of a Hitachi S-3400 N device with tungsten cathode (low vacuum mode, air pressure 30 Pa) in the Laboratory of Electron Microscopy, Faculty of Chemistry, University of Wrocław.

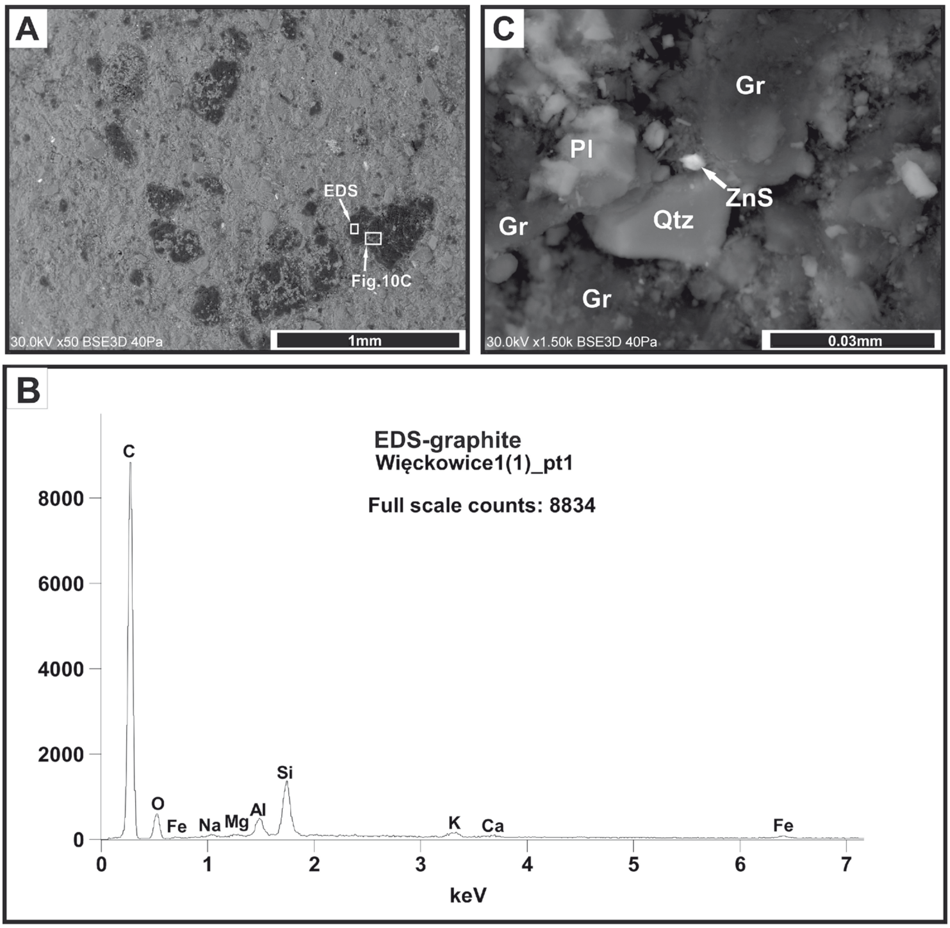

Fig. 11. Results of SEM-EDS examination of graphite-coated pottery from Więckowice, site 4: A – low magnification BSE image showing general view of the investigated ceramic surface. The two small rectangular features indicate the area shown in detailed view (Fig. 11: C) and the area used for EDS analysis (Fig. 11: B); B – Representative EDS spectrum of graphite; C – detailed view of graphite-rich rock fragment. Identification of particular minerals is based on interpretation of EDS spectra: Gr – graphite, Pl – plagioclase, Qtz – quartz, ZnS – zinc sulfide (sphalerite or wurtzite)

EDS spectra of particular mineral phases observed on the studied surface were acquired using a Thermo Scientific Ultra Dry detector (resolution 129 eV), and were analysed by Noran System 7.

In the low magnification BSE images, the analysed sample reveals a characteristic spotty pattern composed of dark-grey angular particles (up to *ca.* 0.5 mm across) scattered on the moderate-grey background of clay groundmass (Fig. 11: A). The spotty appearance is considered typical of ceramic surfaces covered with intentionally applied graphite coatings (*cf.* Kreiter *et al.* 2014; Borowski 2017; Łaciak *et al.* 2019). At higher magnifications, the dark grey objects embedded in the groundmass can be recognised as strongly flattened rock fragments with lepidoblastic or lepido-granoblastic structures and well-developed foliation. EDS spectra indicate the extremely high carbon content of these particles (Fig. 11: B). The rock fragments tend to be monomineralic or nearly monomineralic. Besides the predominant carbon-rich phase, showing a distinctive platy appearance, subordinate intergrowths of other rock-forming minerals can be observed. These are mostly represented by quartz, feldspars and micas. Sporadically, individual isometric sulfide grains (typically up to ca. 5 μm across) also occur (Fig. 11: C). On the basis of the results obtained, it may be assumed that the vessel's exterior was deliberately covered with pulverized graphite-rich metamorphic rock, such as graphite schist or graphite-muscovite schist. The coating may be classified as poorly preserved (in places moderately well preserved). This is indicated by its rather irregular distribution and the low amount of graphite-rich particles (up to *ca.* 15% of the surface area).

A small polished thin section (*ca.* 1 × 1 cm) was prepared from the graphite-coated sherd. The limited size of the preparation was dictated by concern for the preservation of this unique artefact. The thin section was analysed in both transmitted and reflected light by means of a Nikon LV100POL microscope equipped with an LV-UEPI attachment. For the purpose of petrographic characterisation, the descriptive system proposed by Quinn (2013) was followed. The Udden-Wentworth classification was used for grain size description.

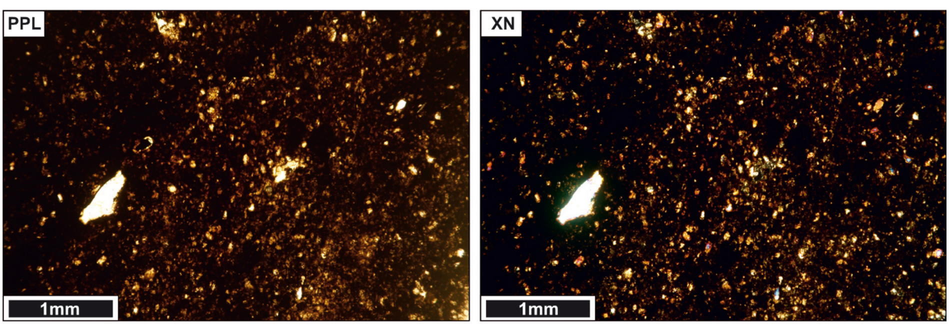

Fig. 12. Photomicrographs showing general view of ceramic thin section produced from the graphite coated pottery fragment from Więckowice, site 4 (PPL – plane polarised light; XN – crossed polarisers)

The fabric (Fig. 12) is characterised by a very weakly bimodal grain-size distribution. The predominant fine fraction (*ca.* 20-25 vol. % of ceramic body) is very well-sorted and largely represented by medium silt to very fine sand grains (mode: 0.05 mm). The inclusions of fine fraction are very angular to subrounded (mostly angular to subrounded) and composed of predominant quartz; abundant feldspars; uncommon mica (mostly muscovite); rare opaque phases; and rare to very rare accessory minerals (including zircon and tourmaline). The poorly-represented coarse fraction consists of a few angular quartz grains of medium-to-coarse sand (up to *ca.* 0.6 mm; mode: 0.45 mm). The colour of groundmass is brown to dark brown in both PPL and XN. In XN, the matrix is characterised by high optical activity and stipple-speckled b-fabric. The voids are mainly represented by scarce meso- to macro-vughs. Some of them show characteristics typical of organic-related porosity, such as slightly blackened margins and enclosed charred plant remnants (see Quinn 2013, 97). No graphite flakes can be observed in the marginal part of the sherd in the reflected light observation. This, however, should most likely be attributed to delamination of the coating, which tends to split off easily during thin section preparation, especially when dealing with poorly preserved surfaces (Łaciak *et al.* 2019).

The predominant grain-size range of mineral inclusions in the analysed pottery fragment can be considered indicative of ceramics produced from ubiquitous loess-derived silty clays, which are widely available throughout southern Poland. These ubiquitous raw materials were eagerly used by LBK potters in Central Europe (*e.g.* Rauba-Bukowska 2019, 13; Borowski *et al.* 2021). The individual sand-sized mineral inclusions could have been present as either intrinsic components of the clay raw material or deliberately added during ceramic paste preparation. The former possibility appears more likely, since the presence of larger grains belonging to a psammitic fraction has been previously reported from loess-like clays in Lesser Poland (Rauba-Bukowska 2019, 10). The scarce organic-related voids should most likely be attributed to naturally or artificially incorporated impurities of the paste rather than intentionally added vegetal temper. The presence of grog, tentatively indicated by macroscopic observations of the sherd, has not been confirmed by petrographic results. It cannot be ruled out, however, that this discrepancy is due to the relatively small size of the studied thin-section and the inhomogeneous distribution of grog fragments within the ceramic body.

GRAPHITE-COATED POTTERY FROM WIĘCKOWICE IN TERRITORIAL AND CHRONOLOGICAL CONTEXT

Graphite was used in several ways in the LBK in Europe (Tichý 1961; Pavúk 1972; Podborský 1993; Nieszery 1995; Hložek and Kazdová 2007; Pechtl and Eibl 2011; Lička 2011). It was most commonly used in a powdered form, as a component of clays covering the outer and inner surfaces of vessels (pottery with a graphite-coated surface) and as an admixture of pottery masses from which whole vessels were produced (graphite pottery). In pottery, graphite powder is most often present on smooth pottery, and less often on thick-walled ceramics. Ornaments in the form of circular, perforated pendants are examples of prestigious manifestations of graphite processing, and are discovered almost exclusively in funerary contexts. The role of graphite as a valuable and rare raw material is emphasized by finds of lumps and blocks of raw graphite (often with traces of attrition), placed in graves and discovered in settlements.

The discovery of a vessel covered with graphite powder at the site in Więckowice is the first documented example of the use of graphite in the production of LBK clay vessels in Lesser Poland. It is also only the second recognized case of graphite use in any of the materials of this culture at sites in Lesser Poland. For the first time, an artefact made of this raw material was discovered at a settlement from the "music note" phase of the LBK in Brzezie, site 17, Wieliczka district. It is a circular graphite pendant with a hole for hanging (Fig. 13: 1), found in a construction pit (feature no. 90) of one of the longhouses (Rodak and Zastawny 2011, 20; Czekaj-Zastawny 2014, 86-87; Trąbska and Wesełuchy-Birczyńska 2014). It is the only decoration of this type known from any part of Poland. An admixture of graphite powder was also found in a sherd of Neolithic pottery from feature no. 44 in Stanisławice, site 10, Bochnia district (Nowak 2015, 64-68; Borowski 2015, 330-333). It was pottery with the addition of crumbled fragments of graphite pottery (individual graphite grains lying loose in the ceramic mass). The cultural affiliation of this feature has not been clearly established, although its relationship with the LBK has not been ruled out (Nowak 2015, 66).

In south-western Poland, the occurrences of graphite-coated pottery are largely confined to LBK sites located in the northern foreland of the Moravian Gate (the Głubczyce Plateau and its immediate surroundings). In Lower Silesia, an individual graphite-coated sherd has been recognised only at the Skoroszowice site, in the Niemcza Strzelin-Hills (see Łaciak *et al.* 2019, fig. 1). It can be stated that graphite used in Neolithic ceramic production in Upper Silesia was not of a local origin, since the area is dominated by sedimentary rocks and, therefore, lacks natural deposits of graphite (as is also the case in Lesser Poland). The nearest sources of this particular raw material are attributed to metamorphic rocks of the eastern part of the Bohemian Massif, with outcrops in the area of western Moravia. It remains an open question, however, whether these were lumps of raw graphite or rather graphite-coated vessels themselves that were transported. The results of an extensive archaeometric study on the late LBK ceramic assemblage from the Dzielnica site indicate that at least one of the graphite-coated vessels was probably produced elsewhere, as evidenced by its assignment to the non-local fabric group (Borowski *et al.* 2021). The Dzielnica site has also provided several graphite-tempered pottery fragments. The presence of these coarse-ware sherds, hitherto unrecognised at any other LBK site in Poland, is assumed to have resulted from the occasional trans-Sudetic importation of vessels from northern Moravia (Borowski 2018; Borowski *et al.* 2021).

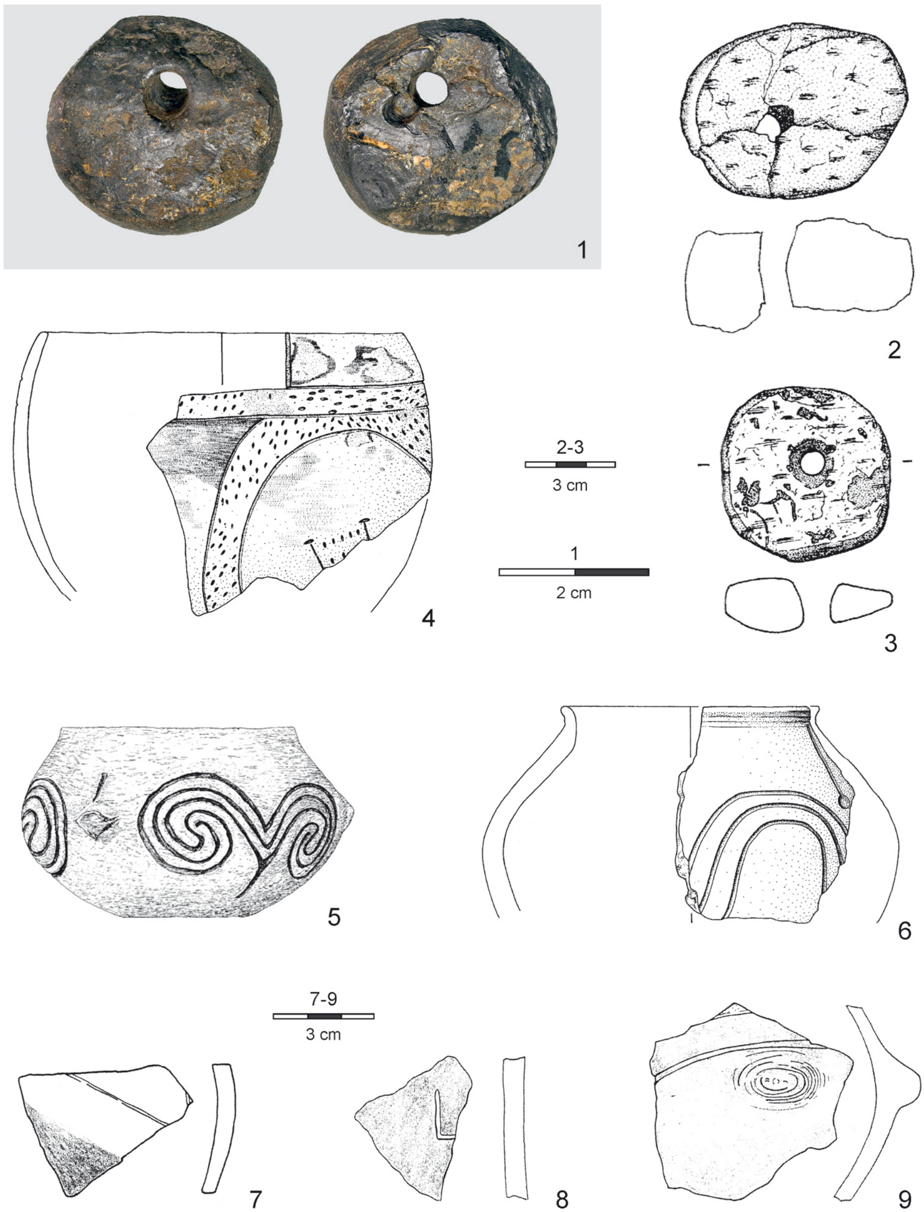

Fig. 13. Examples of graphite pendants (1-3) and the use of graphite in the production of pottery as an ingredient of pottery mass (5) and as powder on vessel surfaces (4, 6-9) in various chronological LBK stages: 1 – Brzezie 17, Lesser Poland, "music-note", settlement pit; 2, 3 – Aiterhofen-Odmuhle, Bavaria, LBK, graves; 4 – Haimbuch, Bavaria, ältere LBK, pit near grave; 5 – Niederhummel, Bavaria, ältesten LBK, settlement pit; 6 – Mangolding, Bavaria, ältesten LBK, 7 – Kosoř, Bohemia, Lnk II, pit; 8, 9 – Kosoř, Bohemia, Lnk I, pits (1 – collection of Archaeological Museum in Kraków, photo A. Susuł; 2-6 /without scale/after Pechtl and Eibl 2011; 7-9 after Lička 2011)

Graphite finds associated with the LBK are much more numerous in the areas of graphite deposits, mainly in Moravia and southern Bavaria (Tichý 1961; Pechtl and Eibl 2011; Hložek 2012). In Moravia, already by the 1960s, there were 60 known sites with graphite and graphite ceramics (Tichý 1961). The use of graphite in the production of pottery in Moravia is most fully discussed in relation to the finds from the Těšetice-Kyjovice settlement, where pottery with traces of graphite powder occurred in 5 settlement pits (mostly related to longhouses) as well as in one of the grave pits (Hložek and Kazdová 2007, 24; Vostrovská 2018, 115, 119). Lumps of raw graphite and fragments of vessels with graphite on the surfaces of the walls were discovered in the Moravian settlements of Vedrovice (Ondruš 1975-76; Hložek 2012) and Svinov (Hložek and Kazdová 2007).

Southern Bavaria clearly stands out on the map of LBK sites with graphite in Europe as the only area where all uses of graphite by the LBK communities have been recorded (Nieszery 1995; Pechtl and Eibl 2011). It is also the only area that has been thoroughly discussed and cataloged in the materials of the LBK /33 sites/ (Pechtl and Eibl 2011). Graphite appears here as a raw material used in the production of pottery (graphite powder), both as an admixture in pottery masses (graphite pottery) and as a raw material for covering the surface of dishes (pottery with graphite-coated surfaces). Examples of the use of graphite in pottery are the most abundant (Fig. 13: 4-6). Finds of raw pieces of graphite, often with signs of surface attrition, are numerous. Pottery with graphite, as well as raw graphite lumps, are finds that have been discovered in Bavaria in both settlement and burial contexts (Pechtl and Eibl 2011, 373-379). The most effective form of graphite use is seen in ornaments in the form of circular and oval pendants with a hole (Fig. 13: 2, 3). These prestigious items are known from Bavarian sites as stray finds and, above all, as pieces of grave equipment. The most numerous series comes from the well-known cemetery in Aiterhofen-Ödmühle (Nieszery 1995; Pechtl and Eibl 2011). An individual find of a similar graphite pendant was also reported from northern Moravia (Davidová 2007, fig. 17, 30: 9).

The areas with graphite finds also include the Bohemia and Slovakia, although there are definitely fewer such discoveries there. Pottery with traces of graphite is known from the settlement in Kosoř, Prague-West district (Lička 2011, 71). Eight pottery sherds were found there, with graphite used both as a component of ceramic mass and in the form of graphite powder applied to the outer and inner walls (Fig. 13: 7-9). Interesting finds come from Nitra in Slovakia, where at the LBK cemetery, similarly to Bavaria, pieces of raw graphite were found in a male grave and in a child's grave (Pavúk 1972, 63, tab. 1). Interestingly, the presence of graphite in LBK ceramic pastes was also recently reported from the Kamyane-Zavallia site (southern Ukraine), situated in close proximity to a large graphite deposit (Kiosak 2014, 124; Gaskevych 2017; Kiosak 2017, 258).

Graphite products and traces of graphite use in pottery production are known from all developmental stages of the LBK in Central Europe. It is most clearly observed in areas where examples of the use of graphite are the most numerous. In Bavaria, raw graphite –

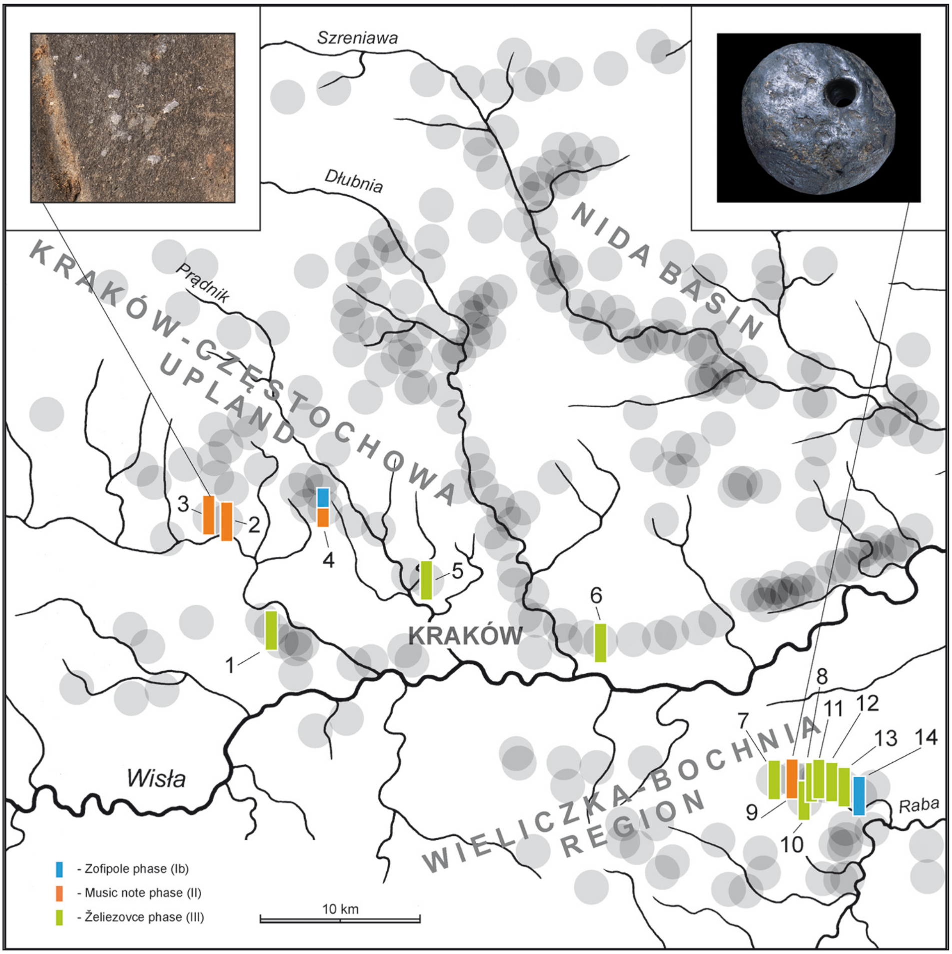

Fig. 14. Distribution and chronology of sites with longhouses on the background of the LBK settlement zones in the Kraków region (acc. to Zastawny and Grabowska 2014, modified) with marked sites at Więckowice, site 4 (vessel with graphite-coated surface, photo by A. Susuł) and Brzezie, site 17 (graphite pendant, after Rodak and Zastawny 2011). Main sites: 1 – Kraków Olszanica, site 4; 2 – Bolechowice, site 9; **3 – Więckowice, site 4**; 4 – Modlnica, site 5; 5 – Kraków Górka Narodowa, site 9; 6 – Kraków Mogiła, site 62; 7 – Zagórze, site 2; 8 – Szarów, site 9; 9 – Brzezie, site 17; 10 – Brzezie, site 40; 11 – Targowisko, site 16; 12 -Targowisko, site 14,15; 13 – Targowisko, site 12,13; 14 – Targowisko, site 10, 11

in the form of untreated pieces and lumps with traces of attrition – is found in all LBK phases (Pechtl and Eibl 2011, Abb. 2). Graphite on vessel surfaces (the most common) and graphite in ceramic mass dominate in the older phases (*ÄLBK, ältere LBK*), while pendants with a hole come from the middle and younger phases (*mittlere, jüngere LBK*). The chronological range is also characteristic for the finds in Moravia, where pottery with graphite was found in the context of all LBK phases, except phase Ia (Podborský 1993, 91). On a multiphase settlement in Kosoř in the Bohemia, graphite pottery and pottery with graphite-coated surfaces were discovered in features dated to phase Ic and, above all, to the II Lnk phase (Lička 2011, 71). In Nitra, Slovakia, the pottery of one of the graves in which a graphite lump was deposited shows transitional features between the youngest LBK phase and the oldest stage of the Želiezovce group (Pavúk 1972, 76-87). Both settlements from Lesser Poland (Brzezie 17 and Więckowice 4), from which the graphite pendant and the graphite vessel originate, represent the middle, "music note," phase of the LBK (Fig. 14).

It is estimated that the use of graphite in the production of pottery had both practical and aesthetic reasons (Podborský 1993, 91; Hložek and Kazdová 2007, 29; Lička 2011, 71). Graphite added to the pottery mass (eng. *graphite-tempered pottery*; pol. *ceramika grafitowa*; cz. *tuhová keramika*; ger. *Graphittonkeramik*) increased the technical quality of the vessel (thermal properties), while at the same time serving as an attractive ornament (yielding black and shiny surfaces on the vessel walls). Graphite powder on the surface of a vessel (eng. *graphite-coated pottery*; pol. *ceramika grafitowana*; cz. *tuhovaná keramika;* ger. *Oberflächengraphitierung*), the most common use of graphite in pottery, probably already had an aesthetic function, and could be perceived as a rare and original ingredient for finishing vessels. Moreover, it seems likely that this kind of surface treatment could have served some symbolic or emblematic functions. For the above reasons, graphite was a valuable raw material for exchange and could end up in areas remote from graphite deposits, including Lesser Poland, along with other raw materials or finished products, *e.g*. amphibolite tools.

FINAL REMARKS

The presented article discusses the materials from an LBK settlement pit (feature no. 45) at site 4 in Więckowice, which was dated to the "music-note" phase. The site is situated on the southern edge of the Kraków-Częstochowa Upland (Fig. 1). This location makes the settlement discovered here stand out from the LBK settlement cluster near Kraków. According to the current state of research, it is the westernmost LBK settlement with longhouses (Fig. 14). An additional distinguishing feature is its location in the immediate vicinity of sources of Jurassic flint, which is reflected in the nature and number of flint inventories.

Fragments of an ornamented vessel with powdered graphite preserved on the outer surface of its wall were discovered in feature no. 45 and constituted a very unique find. This is the first such discovery confirmed in Lesser Poland. The presented results of an SEM-EDS examination prove that the investigated ceramic surface was coated with pulverised graphite originating from remote metamorphic deposits. Unfortunately, in this case, ceramic petrography does not provide any clear indications of the vessel's provenance, since the ubiquitous loess-like clays tend to be very uniform throughout Central Europe, in both textural and mineralogical terms. It seems likely, however, that this vessel was produced locally and coated with imported graphite. This interpretation is consistent with the results of ethnoarchaeological studies of Arnold (1985, tab. 2.3), indicating that raw materials used for surface finishing, such as slips or paints, are often obtained from relatively distant resources.

Not only is the presence of graphite noteworthy, but also, the use of this material on a vessel decorated in a style reminiscent of the ornamentation of the Eastern Linear group of Tiszadob-Kapušany. As stated above, this vessel was probably made on the spot, using imported graphite and foreign ornamental motifs. For this reason, the discussed artefacts constitute an interesting source in the research on interregional contacts of the LBK settlement cluster on the Vistula: Moravian graphite and Sudeten amphibolite (miniature adze from feature no. 45) and references to the ornamentation of the Eastern Linear circle.

The discovery of graphite ceramics in Więckowice has become an opportunity to recall the issues of graphite use in the LBK in Central Europe and to present the position of finds from Lesser Poland in this context. It can be assumed that there are many more finds of graphite-coated or graphite-tempered pottery in the LBK of Lesser Poland (*e.g.* at the settlement in Brzezie 17, from which the graphite pendant comes). The problem seems to be the identification of graphite admixture on poorly preserved surfaces. The reach of graphite over the upper Vistula may be confirmed by the relationship with the Silesian-Moravian borderlands (lithic raw materials). An unquestionable distinguishing feature of the LBK settlement near Kraków is the coexistence of traces of interregional contacts with both the western (Silesia, Moravia) and eastern areas, from the Eastern Linear circle (eastern Slovakia, north-eastern Hungary). In this regard, the graphite-coated vessel itself may be considered unique in its stylistic syncretism, as expressed by the application of non-local ornamentation patterns and the use of exotic raw material in surface finishing.

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EASTERN LBK POTTERY: SOME OBSERVATIONS ON PRODUCTION TECHNIQUES AND THE SYMMETRICAL STRUCTURE OF ORNAMENTS (FLOREŞTI AND NIEZWISKA)

ABSTRACT

Palaguta I. and Starkova E. 2021. Eastern LBK pottery: some observations on production techniques and the symmetrical structure of ornaments (Floreşti and Niezwiska). *Sprawozdania Archeologiczne* 73/1, 251-267.

There are two collections that are stored in Saint Petersburg originating from the first LBK sites (Floreşti I and Niezwiska) investigated in the USSR during the 1950-60s by Tatiana Passek and Katerina Chernysh. Despite the incompleteness of this material, it allows us to make several observations regarding technical aspects of pottery production and its ornamentation. The production of LBK vessels is based on a coiling with subsequent forming by the "paddle-and-anvil" technique. Principal distinctions between production techniques make it possible to exclude the idea of links between the LBK and the subsequent Precucuteni-Tripolye A culture. The specifics of the forms and techniques of LBK ornamentation allows to propose that such ornamentation originates from non-ceramic prototypes. Additionally, the symmetrical analysis of Eastern LBK ornamentation indicates differences in symmetry preferences between the LBK and Cucuteni-Tripolye populations. According to the hypothesis of D. K. Washburn (2018), such a difference may indicate distinctions in the social structures of these cultures.

Keywords: LBK pottery, pottery technology, ornament, symmetrical analysis
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INTRODUCTION: EASTERN LBK AND COLLECTIONS FROM FLOREŞTI AND NIEZWISKA IN SAINT PETERSBURG

The beginning of the study of the "Eastern" Linear Pottery culture (Linearbandkeramische Kultur, LBK) in the former USSR (specifically, what are now the Republic of Moldova and Ukraine) dates back to the second half of the 20th century. It is rightly associated with the name of Tatiana S. Passek (1908-1968), one of the largest figures in the history of studies on the Neolithic and Eneolithic of Eastern Europe, as well as with her student Ekaterina K. Chernysh (1924-2006).

The first Eastern LBK sites that were investigated since the 1950s were Floreşti in Moldova and Niezwiska in Ukraine. Interest in them was primarily due to the fact that, at these sites, a consistent pattern of LBK layers overlain with layers from the Tripolye culture was found, which may exemplify the stratigraphic column for the Neolithic in these territories. The question of the origin of the Tripolye culture was also actively discussed in post-war historiography. From the point of view of N. Ya. Marr's "stadial theory", which had dominated in the USSR since the 1930s, "new" archaeological cultures in a region were likely to have evolved through changes undergone by the previous ones that occupied the same territory (Klejn 1993, 21-22). According to Tatiana Passek, the "Tripolye culture is generally autochthonous in its origin and is associated with the early Neolithic LBK culture" (Passek 1949, 235). This intensive discussion was inspired by Sergey N. Bibikov's suggestion that the Tripolye-Cucuteni culture originated in the Balkan-Danubian area and spread through migrations of its carriers from this region (Passek 1954; Bibikov 1955). Echoes of these discussions continue to reverberate in the assertions of researchers regarding the "influences" of LBK traditions on Precucuteni-Tripolye ceramics – for example, in the idea that the Early Tripolye population that assimilated the "descendants of LBK tribes" might have "take[n] over the technology of tableware" (Zbenovich 1989, 177, 197), or other "certain characteristics" both of table and kitchen-ware (Burdo 2004, 111).

The materials from these settlements can be found in various museums, including the one in Saint Petersburg. The collection of ceramics from Floreşti is kept in the Peter the Great Museum of Anthropology and Ethnography (the Kunstkamera) RAS. This is a selection of ceramics from the excavations of different years: 1956-1958 and 1960 (Inventory 6484). The majority of the materials are in The National Museum of History of Moldova in Chişinău. The examples from these collections have been repeatedly published in special and generalizing works (Passek and Chernysh 1963; Chernysh 1996; Larina and Dergachev 2017), but it is not clear which collection was used for statistics (Larina 1999, 58, fig. 48-55, 58).

The settlement of Floreşti I was situated on the bank of Răut River in Northern Moldova. The stratigraphic horizon of the LBK is "poor of finds," and covered by the Tripolye A – Precucuteni II level. During excavations of more than 2000 m^2 that took place there in

1955-58 and 1960-61, "the remains of eight big cellar dwellings" and eight "consumer pits" were found. As noted by the authors of the excavations, "almost all dwellings are arranged in rows, from east to west, forming a street," and the whole square of the village is around 120×120 meters (Passek and Chernysh 1963, 23).

As can be seen in the published drawing, the pits were arranged linearly, stretching from north to south, with a distance of 6-8 m between them. Based on analogies with the LBK settlements in Central Europe, we may be dealing with not only with pit-huts, but also with elongated pits, usually located along the edges of the frame-and-pole "long houses" that were typical of this culture. The fills of the pits, which included layers of ash and coal, saturated with animal bones and fragments of ceramics, does not contradict this. It is quite difficult to trace the pillars of the house frames in the "yellowish loams" that underly the chernozem soil. Various authors (Lenneis 2005, 57, fig. 5; Saile *et al.* 2016, 9-11, Abb. 6) have already proposed reconstructions of the locations of these houses.

The total size of the collection stored in the MAE RAS is relatively small, consisting of about 1150 fragments. Calculations show a predominance of coarse pottery (kitchenware) with rough surfaces (80%), as well as the almost absolute dominance of spherical vessels in both categories of fine (tableware) and coarse ware.

The majority of materials from the site at Niezwiska, which were excavated between 1951 and 1957, are stored in the Ivano-Frankivsk local history museum. There are only 18 vessels from a burial found in 1953, that storied in State Hermitage museum, St. Petersburg (Inventory 2171). The materials were published by E. Chernysh (Chernysh 1962). It is obvious here that the pit near the longitudinal edge of the LBK "long-house" was interpreted as a "pit-hut". The mentioned burial was near its edge.

Thus, the material available to the authors is fragmentary, and in both cases, it does not constitute a complete archaeological assemblage. There is no sense in republishing it; however, these ceramics are excellent material for making observations on the technique of pottery manufacture and ornamentation, as well as for the study of the principles of organization of ornamental compositions.

LBK POTTERY TECHNIQUES

Based on the ceramics from Floreşti and Niezwiska, several observations on the technologies of the vessels' manufacture and decoration were made (Kozhin and Palaguta 2016). Recent studies allow us to supplement some of the conclusions.

The study of the composition of the raw materials of LBK ceramics has been greatly expanded in recent years thanks to the research of A. Rauba-Bukowska and S. Kadrow (Czekaj-Zastawny *et al.* 2017; Kadrow and Rauba-Bukowska 2017a; Kadrow and Rauba-Bukowska 2017b; Kadrow *et al.* 2017; Kadrow *et al.* 2018). Without questioning the conclusions of the authors, who revealed the differences in ceramic materials and re-

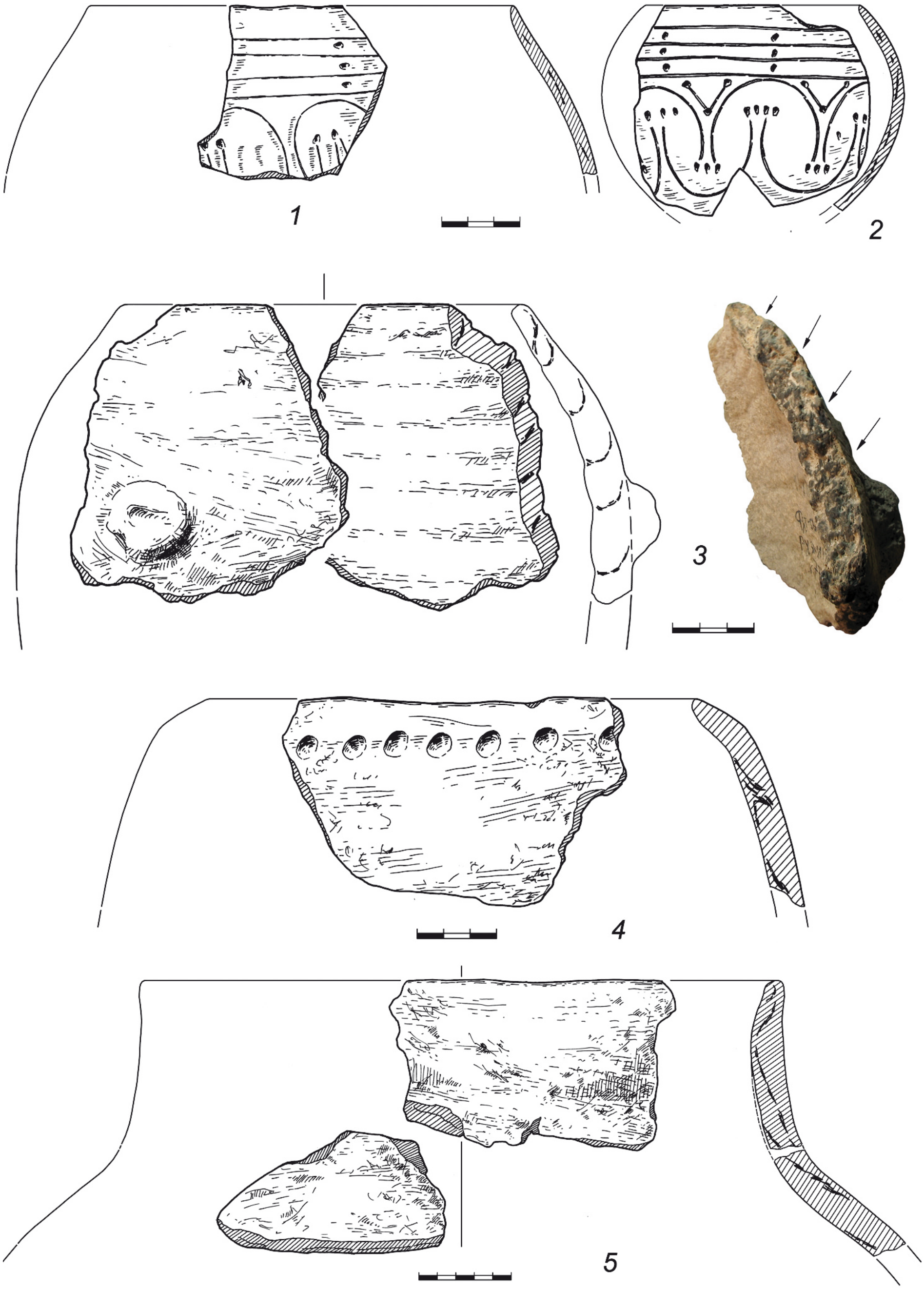

Fig. 1. Floreşti I: LBK pottery from excavations by T. Passek. Peter the Great Museum of Anthropology and Ethnography (the Kunstkamera) RAS, St. Petersburg

constructed the possible paths of migration of LBK groups, it should be noted that the particular selection of ceramic raw materials is also influenced by the properties of local clays, to which the population needed to adapt when occupying new territories.

The general characteristics of the raw materials of LBK ceramics are largely determined by the entire technological chain, where the "paddle-and-anvil" technique is used as the main *modus operandi* in the formation of the vessels in both the Western and in the Eastern areas of this archaeological culture (Gomart 2011; Gomart 2014; Kozhin and Palaguta 2016). This necessitates the exclusion of large solid impurities (crushed screes or fireclay) in the material, which would damage the vessel walls during the use of this technique. Therefore, in the manufacture of Linear Pottery, finely crushed non-organic impurities, such as sand and powdered chamotte, or organic substances (chaff, or perhaps dried manure) were used. When moving to new territories, the choice of admixtures to the raw clay material was determined both by the already established skills (as indicated by the differences in impurities), and by the characteristics of local raw materials.

Vessels' blanks were assembled from coils or narrow strips. There is an example of a "kitchen" vessel in Floreşti, the walls of which, after coiling, were not hardly modified by secondary forming operations. The oval coils can be clearly seen at fractures (Fig. 1: 3). The walls of the vessel turned out to be thick, but its surface was smoothed out, so that the irregularities are visible only from the inside. However, this is an exception to the rule. Most of the vessel walls bear the traces of extensive transformations as a result of beating (Fig. 1: 4). The walls of the tableware vessels made of fine-structured clay are especially transformed by the "paddle-and-anvil" technique (Fig. 1: 1-2). The use of coils rather than strips in several cases is indicated by the disorder of their joints (Fig. 1: 1, 5).

Indicators of the use of the paddle-and-anvil technique are:

– coils are largely strained, joints between coils or strips are also stretched and deformed (Fig. 2: 1);

– the structure of sherds is layered; the orientation of inclusions that are visible in the cross-sections of sherds is preferably along the surface (Fig. 2: 4);

– use of paddle-and-anvil technique requires the use of finely granulated impurities that do not damaged the walls of the vessels: sand (crushed, powdered gruss or chamotte) or organics (chaff or, perhaps, dried manure) (Kozhin 1964; Rye 1981);

– flat traces of a paddle on the upper surfaces, and corresponding traces of an anvil on the inner surfaces of vessels;

– these features are consistent with the predominantly spheroidal shapes of vessels that usually do not have explicit ribs (This quite eloquently demonstrates the closeness of the LBK forms to the spherical amphoras of the Corded Ware cultures of Europe, the Karasuk culture of Southern Siberia, and the ceramics of Melanesia, where the paddle-and-anvil technique was also used (Kozhin 1964; Kozhin and Ivanova 1974). It is obvious that there is no need to talk about any genetic continuity between these cultures; the morphological similarity of their ceramics is due only to the use of similar techniques).

Fig. 2. Floreşti I: LBK pottery from excavations by T. Passek. Peter the Great Museum of Anthropology and Ethnography (the Kunstkamera) RAS, St. Petersburg

The unity of the ceramic assemblage of the LBK, despite the differences in the ceramic raw materials between "kitchen" and "table" ware, confirms the use of the paddle-and-anvil technique for both categories of pottery. "Kitchen" vessels can be quite large: the diameter of the rim of one sample from Floreşti, which is represented in numerous, loosely connected fragments, is over 34 cm, and the height of the vessel height could exceed 70 cm (Fig. 1: 5). There is a typical admixture of chaff in the paste of this vessel. Both the walls and the rim are formed by beating, which is visible in the traces of the paddle on the upper surface, and by the strained joints between the coils or strips. The surface is smoothed after beating. The bottom of this vessel is rounded. The firing is uneven: the upper part of the vessel is yellowish, but there are also large, gray-colored spots on the walls that occurred because of an inability to form a homogeneous firing environment.

LBK pottery belongs to the round-bottom tradition that is based on the use of blanks shaped as semi-spherical bowls, which are flattened later on in the pot-making process. The body/bottom passage is smooth. As can be seen in several fragments, the line between the walls and the bottom is formed by a series of paddle blows (Fig. 2: 2), and only one case in the Floreşti collection demonstrates the use of scraping for modification after beating (Fig. 2: 5).

There is a completely different set of technological operations in the Tripolye-Cucuteni ware, which formed another "operational chain". The paddle-and-anvil technique is not used either in the early period Precucuteni-Tripolye A or later, even when a number of vessels of "Steppe" origin created by this technique appeared in the Tripolye assemblages (Palaguta 2007, 67-72). Tripolye vessels are constructed from wide clay bands with subsequent scraping and trimming. These techniques allow the use of large fractions of chamotte as admixture.

The only evidence of possible connections between the LBK and Precucuteni-Tripolye A ceramics are the finds from the LBK level at the site of Tîrpeşti, located in Subcarpathian Moldova, where some LBK vessels were decorated with carved decorations like the earliest Precucuteni pottery (Marinescu-Bîlcu 1971). These fragments obviously represent an attempt to decorate an LBK vessel with an ornament inherent to another tradition, but the same ornamental techniques are more typical for the pottery of the Boian-Giuleşti culture, which predates the Precucuteni culture, and is conventionally synchronous to the LBK. That is why the role of LBK culture in the genesis of the Precucuteni-Tripolye culture can be excluded.

The lines of pottery decoration in Floreşti, just as in Niezwiska, are mostly cut with a sharp instrument on clay that is in the nearly 'leather-hard' condition. The depth of the lines is 1.5-2 mm, cutting the wall by almost half of its thickness (Fig. 2: 6). The 'dots' were made after the lines, and their inner surface is rough, as can be expected when working with a dried preform (Fig. 2: 1-3, 5).

The smoothing and polishing of the surface of the tableware was made after the completion of its ornamentation. There are some cases in Floreşti in which the ornamental lines were erased during the polishing process (Fig. 2: 3). Thus, the use of the paddle-and-anvil technique and surface polishing obviated the need to use engobe for surface smoothing, unlike the ceramic processes of the most Balkan cultures, included the Cucuteni-Tripolye culture.

The manner of decoration, which resembles a woodcarving, as well as the "free" manner of early LBK ornaments, which are not related to the tectonic of the vessel's shape, may provide evidence of the influence of the processing of non-ceramic items (Schuchhardt 1909; Kozhin and Palaguta 2016, 248).

In Floreşti, traces of red paint are revealed on separate fragments of the "table" ware, and one of the "kitchen" vessels is painted with broad black lines (Fig. 2: 7). LBK paints have not been analyzed. It can be only assumed that the paint was applied after firing, as in the Tripolye and other Balkan cultures (Podvigina *et al.* 1999).

The question of LBK origins remains an important problem. One of the keys to answering this question is the genesis of the LBK ceramic complex and its connection with the traditions of the earliest Balkan-Carpathian Neolithic Starčevo-Körös-Criş culture. This problem has been the subject of a recent collective work that is devoted to comparing the pottery techniques of the LBK, the Alföld Linear Pottery culture and the Körös culture (Gomart *et al.* 2020). However, the question of whether a complete technological chain was borrowed, or of whether a more or less independent development of techniques by the LBK complex took shape with only the idea of ceramic production borrowed – further developing independently via inspirations from the treatment of other materials – requires further study, taking into account not only the manufacturing technique, but also the decoration of the vessels.

The second problem is the influence of the LBK on the formation process of subsequent cultures of the Late Neolithic and Eneolithic that emerged on the same territories. This includes the question of the role of the LBK in the genesis of the Cucuteni-Tripolye ceramic complex that was mentioned above. In this case, we believe, the symmetrical analysis of ornaments is quite productive, allowing for the comparison of large 'layers' of material at the level of archaeological cultures through the principles of symmetry used in ceramic ornaments.

LBK ORNAMENTS: SYMMETRICAL ANALYSIS

Studies on the decoration of LBK pottery have an extensive historiography that includes the description and analysis of ornamental compositions and their elements in multiple local groups and separate sites, which allows local and chronological characteristics and the directions of influences and migrations to be distinguished.

The method that is based on the analysis of the principles of symmetry, which were used for the compounding of ornamental compositions, is relatively rarely applied for studies on pottery ornaments. It is based on work on the symmetry of crystals and its mathematical theoretical background (Shubnikov and Kopcik 1974; Jablan 2002). The principles of symmetry have been taken into consideration in the description of ethnographic materials, objects of applied art of the Scythian-Siberian "animal style," and pottery of the Turkmen Copper Age and the Andronovo culture of the Steppe Bronze Age (Kircho 1999; Rudkovskiy 2013 *etc.*). The analysis of symmetry has also been tested on the materials of the Tripolye culture (Starkova 2020).

The starting point for using symmetry analysis to study ornaments of prehistoric ceramics is the work of Anne O. Shepard (Shepard 1948), and the most fruitful developments in this direction are seen in research on the decoration of ceramics and textiles of Native American cultures. Dorothy K. Washburn and Donald W. Crowe found that a change in the ratio of symmetry types is associated with the movement of population groups, and, accordingly, with a change in the social, economic, and cultural structures of societies. Thus, the choice of definite types of symmetry is an important element of cultural identity (Crowe 2004; Washburn 2018).

From a formal point of view, any ornamental composition is a curvilinear/rectilinear geometric pattern consisting of repeating elements and motifs. The focal point of a composition may be either the patterns themselves or the background spaces between them. This phenomenon is referred to as the "reversibility" of the ornament (Kozhin 1981, 136; Palaguta 2009). The motif is repeated in the composition according to certain rules of symmetry, and the number of repetitions is limited. This makes it possible to consider any ornament within a rigid, limited framework of a set of symmetry methods.

The main types of symmetry are:

– mirror reflection (the simplest), in which elements are mirrored about an axis or plane;

– rotation, in which the figure (element or motif) can be rotated several times about the rotational center. Particular cases of rotation symmetry are central when elements or motifs rotate 180 degrees relative to the center; glide reflection refers to when the rotation is made relative to an infinitely remote center;

– similarity, in which all figures of the same shape are considered equal, regardless of their size;

All planar symmetry constructions are limited by four options: movement, double rotation, mirror reflection, and glide reflection. On this basis, only 7 types of one-dimensional ornaments (borders) can be created. The ornament on LBK ceramics is located mainly in the horizontal zones, so we restrict ourselves to considering exclusively linear patterns. A border is a linear pattern obtained by the parallel translation of a motif or element of an ornament. A motif is a repeating set of elements in the composition. Symmetries of borders are usually denoted by alphanumeric indices originally adopted in crystallography: pm11, pmm2, p112, pmg2, p111, p1g1, p1m1,1 (fig. 1, *1*) where:

– p – primitive (or elementary) cell in crystallography, which is an equivalent of a motif in ornamental composition;

– 1 – no changes;
– m – mirror reflection;
– g – glide reflection, which is an offset of the repeating region relative to the axis;
– 2 – rotation around the center of rotation by 180 degrees

This system of symbols for borders was developed by the German crystallographer Carl Hermann in 1928 and modified by the French mineralogist Charles Victor Mauguin in 1931. Hermann-Mauguin symbols are also called international symbols because they are used in the International Tables for Crystallography. The international system is different from the A.V. Shubnikov system (Shubnikov and Koptsik 1974); however, as experience has shown, it is more suitable for describing the symmetry of ornaments.

With regard to the analysis of the symmetry of ornaments on LBK ceramics, we are faced with certain difficulties associated with the extreme fragmentation of the ceramic material, which complicates the reconstruction of the patterns and the full ornamental compositions, which is required for this study.

The Eastern LBK materials used for this study come from the sites of the Prut-Dniester interfluve (the territory of the contemporary Republic of Moldova), and were published in a monograph by Dr. Olga Larina (Larina and Dergachev 2017): Floreşti I, Gura Camencii IV, Dănceni, Sîngerei I, Rogojeni II. The examples belong to a group of sites that are close in time and territory, and that are relatively well represented and illustrated, which allows us not only to distinguish separate elements, but also to reconstruct the complete ornamental compositions.

Resettlement of the LBK population to these Eastern territories took place at an early "note" phase, and later, the contacts between the periphery and the central part of the area were interrupted, which is evidenced by the absence of ceramics of the later Želiezovce phase (Kadrow and Zakościelna 1999, 190, 191). Thus, on this territory, we find only the pottery of the "note" phase, which developed independently without any influences from the western region. Besides the Moldavian sites, some compositions on pots from the contemporaneous Niezwiska burial, where complete vessels are preserved, are also included in the analysis (Passek and Chernysh 1963, fig. 25, 12, 15, 16, 23).

As has been observed (Starkova 2020), it is more expedient to carry out a symmetric analysis on the materials from a group of relatively synchronous sites of the same region, since this obscures the local characteristics of individual settlements. In addition, the information from any one site is not enough to obtain informative results.

Obviously, any irregularities in the lines, which often break the symmetry of elements and motifs, are a direct product of the skills of a particular master, so here we are employing an "ideal" scheme, without consideration of such errors. Many ornamental schemes were initially created with a violation of symmetry, and it was the basic structure that was violated, although the basis of the composition of the border followed the rules of symmetry. This can be compared with Tripolye-Cucuteni ornaments, where the symmetry of the main construction was often broken by additional details (Starkova 2020). Also, symmetry was generally absent in some of the LBK decorations, but because of the small size of the fragments, and the inability to determine the amount of such decorations, this category of ornaments is not included in the statistics of the study.

Five out of seven possible types of border symmetry were identified in Eastern LBK ornaments: pm11, pmm2, p112, pmg2, p111.

The simplest compositions, both visually and in terms of their production, are those of the pm11 type, formed by the parallel transfer of the motif and its reflection about the vertical axis (Fig. 3: 1-3). Such compositions are formed by rows of horseshoe-shaped figures, arched lines, or triangles. The majority of pm11 schemes were produced without distortion or any additional elements breaking the symmetry.

The next type of symmetry, known as pmm2, presents a vertical and horizontal reflection of the motif, as well as a 180-degree rotation. There are significantly fewer borders with vertical and horizontal symmetry. These can be parallel lines separated by paired or single depressions or compositions of rows of broken lines forming rhombuses (Fig. 3: 4, 5). In some cases, geometric figures are rather sloppily executed, with uneven lines, which breaks the pmm2 symmetry (Fig. 3: 6).

A more complicated type of p112 symmetry is formed by a parallel translation and rotation of the motif by 180 degrees. These are ornaments in the form of rows of horizontal, S-shaped figures, formed by one to three parallel lines or a continuous S-shaped spiral (Fig. 3: 7, 8, 11). Compositions based on the p112 type of symmetry can also consist of inclined semicircles, formed by 1-3 parallel lines, or by oblique parallel lines (Fig. 3: 9, 10). In ornaments formed by this type of symmetry, violations often occur, such as different numbers of lines forming the semicircles, or even a significant deformation of the basic structure, such as when parts of the spirals overlap and are not drawn completely (Fig. 3: 11).

Compositions of the pmg2 type are formed by a parallel translation, a mirror reflection of the motif and its gliding about the horizontal axis with rotation by 180 degrees. Ornaments with this type of symmetry are most common on Eastern LBK ceramics. Such borders are formed by wave-like or broken bands, rounded depressions, or rows of semicircles, which consist of one to four lines (Fig. 3: 13-16). Variants with additional elements that differ in the upper and lower parts of the border, and which therefore break the symmetry of the final composition, are quite common among this type of ornamental scheme (Fig. 3: 16, 17, 19). Sometimes the number of lines forming the motives can be different between the upper and lower rows, but the basic structure of the border is not broken in this case (Fig. 3, 18).

However, there are compositions where the pmg2 symmetry is clearly visible, but the basic structure is strongly distorted – for example, a broken line with discontinuities, a different number of lines in a band, or additional elements with significantly different locations (Fig. 3: 20). In another example, the center line of the border is an element of both the lower and upper parts of the composition, thereby violating the basic structure formed by the rows of sliding semicircles (Fig. 3: 21).

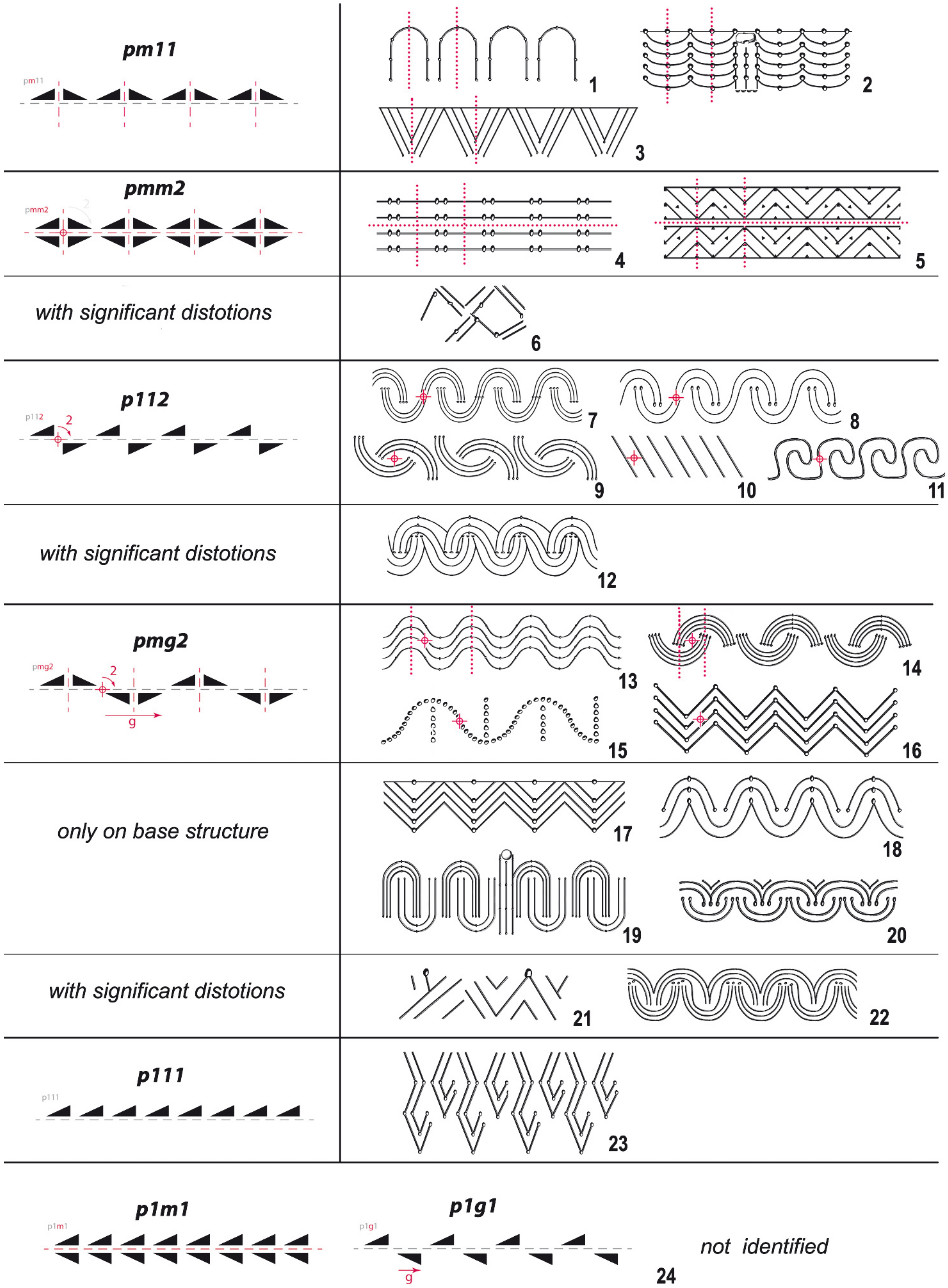

Fig. 3. Symmetry types of Eastern LBK ceramic ornaments

The p111 symmetry is a simple parallel translation of the motif in the horizontal direction. It would seem that compositions with repeating motifs without horizontal and vertical symmetry are the most simple, but such schemes are quite rare in LBK ceramic ornaments. This type, which is composed of vertical rows of broken lines, is present on one vessel from Niezwiska (Fig. 3: 23). On the other hand, compositions following a basic p112 symmetry are common in Tripolye ornaments; however, they are broken by additional asymmetrically located elements, thus, in the final scheme, they turn into compositions with a simple p111 repetition of the motif. In LBK ceramics, additional details are absent from p112 compositions as a rule, and all distortions follow the basic structure.

Compositions of the p1m1 type, which denotes a parallel transfer of the motif with its reflection relative to the horizontal axis, and the p1g1 type, which is formed by the reflection and gliding along the horizontal axis, are not identified in the decoration of Eastern LBK ceramics (Fig. 3: 24).

The above example of symmetry analysis, due to practical constraints, was conducted on an extremely small amount of material from the peripheral sites. However, even in this case study, we can find some regularities. In particular, the greatest number of compositions with broken symmetry was found among the ceramics of the Floreşti I settlement. So far, due to the lack of information, it is not entirely clear how to interpret this. The p1g1 symmetry type, which is absent among ceramics of the Eastern LBK sites considered here, is found on ceramics of the same phase in the central part of the area, for example, in the LBK burial ground in Nitra (Pavúk 1972, Abb. 29, 7, 11). This can be explained, as noted above, by the long-term isolation of the Eastern region of the LBK area, and, accordingly, by the differences in the composition and structure of the population compared to its central part.

The calculations of the percentage of symmetry types can be carried out in a very approximate manner using a small amount of data from the above-mentioned sites of the Middle Dniester region using summary tables by Olga Larina (Larina and Dergachev 2017, fig. 51-54), in which the different types of ornaments are presented. Estimating from the total number of published varieties, the most common types of ornaments in the Eastern LBK are those with pmg2 symmetry (38%), followed by pm11 (28.2%), p112 (19.7%), and pmm2 symmetry (12.7%), with the least common being the p111 type (1.4%) (Fig. 4).

For comparison, the symmetries of ornaments of the BII-CI stage of the Tripolye culture (Popudnya, Shipintsi), as well as those of its finale stage from the cemetery at Vykhvatintsy, are presented in Figure 4, alongside the LBK data (regrettably, the data for the Tripolye A and BI periods are not sufficiently presented in publications, but this does not affect the general comparison between the cultures). There is a significant difference in the ratio of symmetry types between the chronological stages, which confirms the dramatic changes in Tripolye-Cucuteni society just before its decline (Starkova 2020). Thus, with such a comparison, it can be seen that completely different ideas about symmetry are embodied in the ceramic ornaments of three different cultures: the LBK, the Tripolye BII-CI and the later Tripolye CII (which, in fact, is a separate culture of the Early Bronze Age).

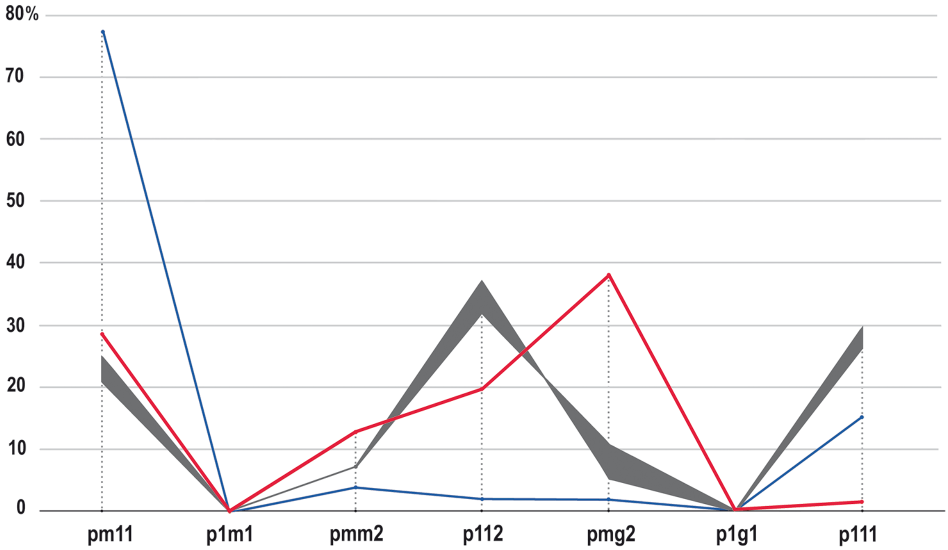

Fig. 4. The frequency of symmetry types: Eastern LBK (red), Tripolye BII-CI (gray), and in the Vykhvatintsy cemetery of the Tripolye CII period (blue)

The possibility of developing this topic at the level of one culture is still limited by the fact that the analysis of symmetry has not been carried out for individual sites. As for the symmetries in LBK ornaments, it would be appropriate to compare their ratio in the center of the territory to the periphery, as well as in different phases of culture development, when the difference in the set of symmetries, in contrast to the style of ornamental compositions, may not be so significant.

CONCLUSIONS

The analysis of pottery forming and ornamentation techniques shows the basic differences between the ceramics of the Late Neolithic and Early Eneolithic cultures of the Carpathian-Balkan circle – in particular, the Tripolye-Cucuteni culture, which replaces the LBK in the territories East of the Carpathians. The analysis of the symmetric structure of LBK ornaments yields the same results. The use of this method is needed for more detailed studies of the series of reconstructed pottery, but even an approximate comparison revealed the different types of symmetries that were chosen by different populations. It can be assumed that the change of the population in this region took place without any visible contacts between the archaeological cultures.

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THE EARLIEST PHASE OF THE LBK IN THE LUBLIN REGION: NEW EVIDENCE FROM THE HRUBIESZÓW BASIN

ABSTRACT

Szeliga M., Gawryjołek-Szeliga K. 2021. The Earliest Phase of the LBK in the Lublin region: New Evidence from the Hrubieszów Basin. *Sprawozdania Archeologiczne* 73/1, 269-301.

This article is an attempt to initially characterize the oldest phase of the LBK in the Lublin region, or more precisely – within its eastern part, where all related discoveries are concentrated. The main point of reference is the inventory discovered in 2011-2012 in Świerszczów (Hrubieszów Basin), which is currently the largest homogenous collection originating from this region, related to the early phase of the LBK. The artefacts described herein, as well as the stylistic differentiation of other similarly dated ceramic inventories from the eastern Lublin region (and from neighbouring Volhynia) currently allow us to distinguish two essential stages of the colonisation of this area in the oldest phase of the Neolithic. The older stage corresponds to the Gniechowice-Milanovce horizon (moderte and ephemeral settlement), and younger (Zofipole style), should be correlated with the Moravian phase Ib, including at least the younger section of its development (sub-phase Ib2).

Keywords: Early LBK, Gniechowice and Zofipole style, eastern Lublin region, Volhynia, settlement, colonization

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INTRODUCTION

The oldest horizon of LBK settlement is undoubtedly the most enigmatic stage of its development in the Lublin region. It results, on the one hand, from the small amount and specific nature of the existing source materials, and on the other, from the incomplete degree of their development and publication. Until recently, the remnants of the pre-music-note phase of the LBK in the discussed area come almost exclusively from the discoveries from Gródek, Hrubieszów municipality. These are represented by a single cremation grave from the site No. 2 (Kempisty 1962, Fig. 1-2), a few features and collection of diagnostic ceramic finds from site No. 6 (Uzarowiczowa 1964, 431, Fig. 3; Kulczycka-Leciejewiczowa 1983a, 88) and a single vessel discovered accidentally at site No. 1B (Buszewicz 1990, Fig. 3: 4). General reports on materials from the Zofipole phase obtained during excavations on site 5 in Hrubieszów-Podgórze (Niedźwiedź and Panasiewicz 1994, 52, fig. 2) and on the surface of site 1 in Sumin, Tarnawatka municipality (Brzozowski 1988, 2), supplemented these data.

These discoveries have never been the subject of a dedicated study, but were only superficially discussed in the literature, limited only to materials from Gródek and Sumin. Information on the finds most often was presented collectively (*i.e.* without taking into account particular sites in Gródek), and often also incorrectly (Kulczycka-Leciejewiczowa 1979, 51; 1983a, 88-89; 2000, 200; Czekaj-Zastawny 2008, 138; Kadrow and Okoński 2008, fig. 16; Zakościelna 2007, 38-39, fig. 1-2; Dębiec and Saile 2015, Abb. 1; Saile 2020, fig. 1). Although many times attention was paid to their remote location and great importance in context of the spread of the early LBK (*e.g.* Gurba 1970, 178; Kulczycka-Leciejewiczowa 1968, 62-63; 1979, 51; 1987, 299), the small number of sites and the ambiguous nature of the finds precluded the possibility of undertaking wider studies on the oldest LBK phase in the Lublin region. New, very important data in this regard was provided by the latest discoveries from the Hrubieszów Basin, or more precisely from site 3 in Świerszczów. Currently this is the richest collection related to the pre-music-note phase of the LBK in the eastern Lublin region, providing a basis for undertaking wider studies on the beginnings of Neolithic settlement both in this area, as well as within the entire Lublin-Volhynian loess upland zone. Those issues, along with the presentation of this extremely important collection, constitute the main subject of considerations undertaken in this study.

LBK SITE IN ŚWIERSZCZÓW

The site of Świerszczów 3 (AZP 86-94/90), Hrubieszów municipality, Lublin voivodeship, is situated about 1.5 km NE of Hrubieszów, within the edge zone of the broad and wet lower Huczwa valley, occupying part of a distinct elevation at the base of a loess headland with south-western exposure (Fig. 1: 1). Geographically, it is situated within the Hrubieszów

Fig. 1. Świerszczów, site 3: location of site (1) and features of the early LBK discovered during the rescue excavations proceeding construction of the Hrubieszów bypass (2), along with a partial reconstruction of a potential longhouse outline (1 – fragment of map at a scale of 1: 10 000 used on the basis of licence No. DGK-I.7522.7.2021.JKO_06_CL1; 2-3 – *cf.* Jóźwiak and Wilczyński 2012, modified)

Basin microregion, which is part of the Polish share of the Volhynian Upland, *i.e.* the Western Volhynian Upland (Kondracki 1998, 295-296, fig. 43). It was discovered during AZP surface surveys in 1986 by Sławomir Jastrzębski, who obtained 23 pottery fragments and 2 flint flakes related to the LBK, Trzciniec, Lusatian and Przeworsk cultures. In the years 2011-2012, in relation to the plans of the Hrubieszów bypass construction, rescue excavations were carried out on the site. Their executor was the *Pracownia Badań i Nadzorów Archeologicznych* [Laboratory of Archaeological Research and Custody] in Lublin, and the manager of the excavations was Jadwiga Jóźwiak. These studies led to the recognition of a total area of 53.13 ares and the discovery of 185 features, confirming the long-term and multicultural nature of the site, from the oldest phase of the Neolithic (Jóźwiak and Wilczyński 2012, 3). The LBK materials obtained in this research constitute the main and initial focus of considerations undertaken in this study.

FEATURES

During the research in 2011-2012, four LBK features (Nos. 11, 19, 174 and 176) were discovered and explored. They were located in the central part of the studied area, creating an irregular concentration in a relatively small space (Fig. 1: 2). Two features (11 and 19) were fully explored, while the other two (174 and 176) were only partially investigated, *i.e.* within the strip of the planned road construction. The largest and best-preserved feature (No. 19) consisted of a vast and elongated pit with an irregular vertical outline and dimensions of 10.26 × 3.42 m, oriented approximately on the N-S axis (Fig. 1: 2-3). In the longitudinal section, the pit appeared to be trough-shaped. Its fill was characterized by a non-uniform thickness, oscillating between 10 and 30 cm, exceeding 90 cm only in the central part (Fig. 2: 1), as well as a uniform structure and consistency and a dark grey-brown co-lour. The remaining features were much smaller in size and depth, and were characterized by oval or irregular vertical outlines and sections similar to the trough-shaped ones (Fig. 2: 2-4).

The size, morphological properties and orientation of feature 19 justify its interpretation as a construction pit, related to the creation and functioning of an above-ground long-house-type residential structure. Other, much smaller and shallower features, should probably be interpreted in a similar way. They may be the bottom parts of objects originating from the construction and functioning of the same household. In addition to morphological characteristics, this may also be indicated by their location and orientation, and in the case of features 174 and 176 also by the distance from pit 19 (Fig. 1: 3). The conducted research did not reveal the clear layout of post-holes, which are typical for this type of construction, reflecting their original outline and orientation. The lack of evidence of post-holes, however, may simply be a result of the general stratigraphic situation recorded within the site (a layer of black soil thick enough to make it difficult, and very often even

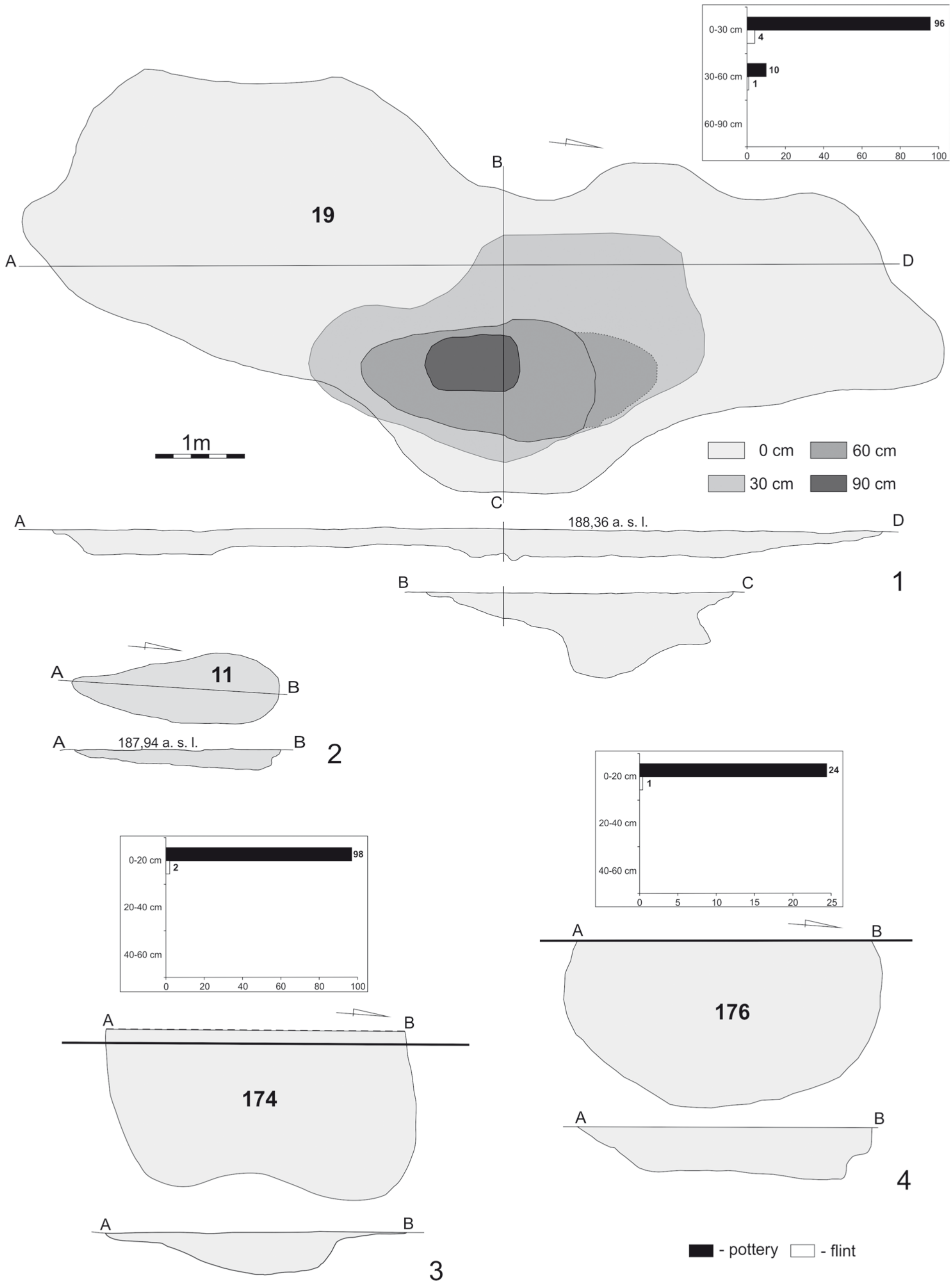

Fig. 2. Świerszczów, site 3: horizontal plans and sections of the early LBK features along with the amounts of artefacts at particular depths: 1 – feature no. 19; 2 – feature no. 11; 3 – feature no. 174; 4 – feature no. 176. Illustration by W. Kozieł and M. Szeliga

impossible, to record the outlines of the features). In this context, a very important role is also played by the serious degree of destruction of Early Neolithic settlement remnants during later settlement episodes (Jóźwiak and Wilczyński 2012, 3), which is recorded especially in the zone directly adjacent to the north (Fig. 1: 2-3). Thus, the site in Świerszczów, along with a hypothetical residential structure with a width of approx. 8-9 m and with an undefined length (probably more than 20 m), would be the first in Lublin region, and the fourth in the entire area of the upper Vistula and Odra River basins – an early LBK settlement with remnants of permanent, above-ground residential architecture. The only current unquestioned remains of houses are known from Stary Zamek (Kulczycka-Leciejewiczowa and Romanow 1985, fig. 14; Kulczycka-Leciejewiczowa 1987, fig. 6), Targowisko 10-11 (Zastawny and Grabowska 2014, fig. 1) and Gwoździec (Czekaj-Zastawny *et al.* 2020, fig. 3).

ARTEFACTS

In total, 237 artefacts were obtained from the LBK features, forming inventories that are diverse in terms of quantity and represented predominantly by fragments of vessels, and only to a minimal extent by flint products (Tab. 1). These were complemented by a large group of daub fragments of various sizes, almost exclusively in the fill of feature 19, as well as a modest collection of animal bones. Only a few LBK ceramic materials were obtained during the exploration of off-feature layers and fills of younger features.

The analysis of the quantitative distribution of flint and ceramic artefacts within the fills of particular features reveals their clear concentration within current top layers, and occasionally also in the middle parts, with their complete absence at deeper levels (Fig. 2: 1, 3-4). This situation corresponds with the data obtained for many other LBK sites in the upper Vistula basin (*e.g.* Kadrow 1990, fig. 5b; 6b; 7b; 8b; 9b; 12b; 13b; Szeliga and Zakościelna 2007, fig. 13-14), indirectly indicating the considerable degree of destruction of features in Świerszczów.

Pottery

The collection of ceramics from LBK features includes a total of 229 vessel fragments (Tab. 1). These are characterized by a considerable degree of fragmentation, with the domination of fragments of bodies, making up as much as 72.93% of the entire collection and significantly exceeding the frequency of parts of rims (18.34%), and especially of bases (8.73%). No vessel has been entirely preserved, and only a few have been refitted to a degree that allows for the reconstruction of their forms, sizes and ornamental motifs. Among the ceramics, non-ornamented specimens have a decisive advantage, constituting a total of approximately 84.38% of the entire collection (Tab. 2). Sherds that were able to be refit represent *ca.* 20% of the whole collection. These data, as well as the differentiation and

Table. 1. Świerszczów, site 3, Hrubieszów municipality: qualitative and quantitative comparison of artefacts originating from the LBK features.

Feature No.	Pottery	Flint	Daub	Animal bones	Total
11	1	-	-	-	**1**
19	106	5	79	7	**197**
174	98	2	1	1	**102**
176	24	1	-	3	**28**
Total	**229**	**8**	**80**	**11**	**328**

Table. 2. Świerszczów, site. 3, Hrubieszów municipality: condition of the ceramics in the LBK features: O – ornamented fragments; NO – non-ornamented fragments

Feature No.	Rims		Bodies		Bases		Total	
	O	NO	O	NO	O	NO	O	NO
11	-	-	-	-	-	1	-	**1**
19	3	9	10	73	1	10	**14**	**92**
174	8	18	11	56	-	5	**19**	**79**
176	-	4	3	14	-	3	**3**	**21**
Total	**11**	**31**	**24**	**143**	**1**	**19**	**36**	**193**
	42		**167**		**20**		**229**	

presence of diagnostic fragments (*e.g.* rims, bases and ornamented sherds) allow us to estimate that the whole collection covers the remains of at least 25 vessels.

VESSEL SHAPES

The sherds that were able to be refit and the presence of rims for which the vessel shape could be reconstructed indicate the low diversity of vessel types. Without a doubt, bowls form the dominant group, along with globular pots (ger. *Kümpfte*; see also Pyzel 2019, 48) Among the bowls, the most common are wide-open conical forms, both thin-walled and thick-walled, with rims that were most often straight (Fig. 7: 1, 3, 4-5, 7, 10-12; 9: 1), and only occasionally slightly bent inward (Fig. 7: 3, 8). There are very few hemispherical bowls. In fact, the only reliable form of this type – with an undefined height and a diameter of about 25 cm at the opening – occurred in feature 174 (Fig. 5: 2). Globular pots are represented by forms with rims curved inward both slightly (Fig. 4: 1, 3, 5, 7; 6: 2, 4; 8: 2, 5, 7) and strongly (Fig. 6: 1; 8: 1). These are supplemented by a relatively few tall forms with ovoid profiles (Fig. 8: 3-4, 6), as well as at least one biconical form (Fig. 5: 1). The remaining vessels in the collection had a more complex morphology. These include a vessel (flask or amphora) with a short neck and an outwardly curved rim (Fig. 3: 1), as well as two pedestalled vessels, probably bowls, but possibly beakers (Fig. 9: 4-5). This collection is

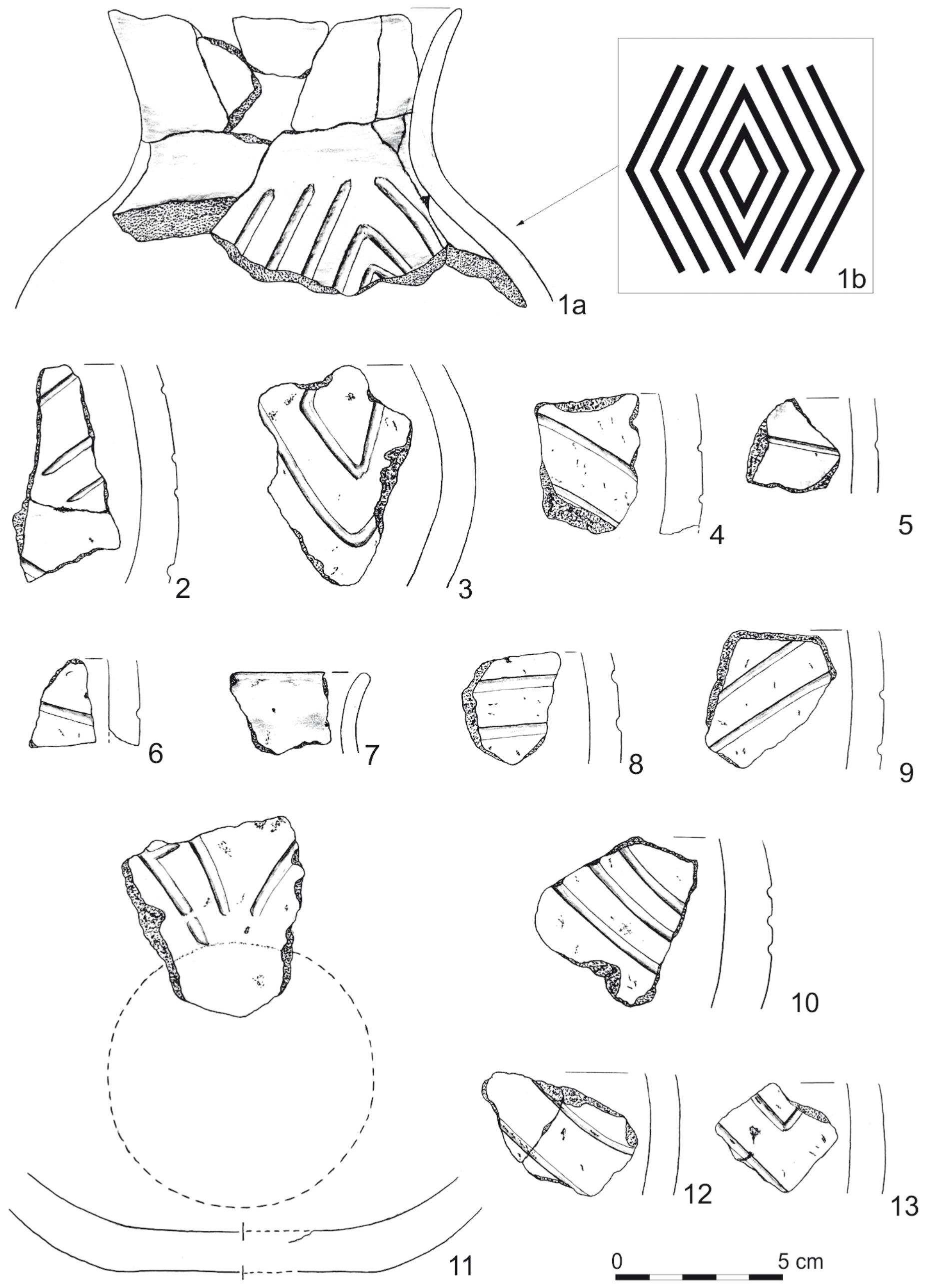

Fig. 3. Świerszczów, site 3: 1-13 – ceramics decorated with the incised ornament: 1a (along with the reconstruction of the ornament – 1b), 3, 5, 7, 10-11 – feature No. 19; 2 – feature No. 176; 4, 6, 8-9, 12-13 – feature No. 174. Illustration by K. Gawryjołek-Szeliga

supplemented by a small fragment of an undefined, thin-walled vessel with an outturned rim (Fig. 3: 7), possibly in the form of a flask.

MORPHOMETRIC AND TECHNOLOGICAL PROPERTIES

The analysis of the basic morphological and metric properties – including wall thickness, properties of the ceramic mass, ornamentation techniques and methods of vessel surface finishing, reveals a very weak and ambiguous division into fine and coarse pottery.

Fine ware is represented by fragments of bowls of various sizes (*e.g*. Fig. 5: 2; 7: 1, 3-5) and globular pots, most often with slightly incurved rims (*e.g*. Fig. 8: 1-4, 6), and – definitely less frequently – by vessels with a more extensive and diversified morphology (Fig. 3: 1; 9: 4-5). These vessels were made of greasy clay, containing mostly fine and very fine sand and an organic addition, occurring within particular fragments in various compositions and intensities. In a few cases, the presence of crushed stone and grog (chamotte) of various degrees of granulation, as well as ochre, was also recorded. The walls of the vessels are usually even, smooth, and matte – smooth or rough – depending on the state of their preservation, as well as the amount and type of temper. The wall thickness ranges from 4 to 9 mm, and only sporadically larger (Fig. 3: 2-4; 5: 1). The colour of the surface reveals a fairly large degree of differentiation, with a predominance of grey and dark grey forms with uniform fractures, indicating firing in a reducing atmosphere. Some of the vessels were engobed, as evidenced by exfoliated external surfaces observed on a few fragments.

Coarse ware is represented only by globular pots with rims that were most often slightly inclined inwards (*e.g*. Fig. 4: 1, 3, 5; 5: 1; 6: 1-2, 4; 8: 5, 7). Their wall thicknesses ranged between 9 and 17 mm. Among the decorative motifs are plastic ornaments, represented by nodules (Fig. 9: 3), fingernail impressions (Fig. 4: 1, 3-7) and plastic strips (Fig. 4: 8). In two cases, the surface of the vessel was decorated with longitudinal and shallow, horizontal "pseudo-cuts" (Fig. 9: 2). In the ceramic mass in this category of pottery, there is a significant amount of organic additions, as well as sand and occasionally also gravel, crushed stone, grog and ochre. The granulation of the additions is quite varied, ranging from fine (0.5-1 mm – mainly sand) to very coarse (5-10 mm – mainly gravel). The surfaces of the vessels are usually rough, porous and even rugged, and are yellow-orange-grey in light shades. They are most often characterized by poor firing in oxidative conditions.

DECORATION

The total share of ornamented ceramic fragments originating from LBK features was estimated at only about 15.72% (36 pieces; *cf*. Tab. 2). An incised ornament was observed on a small number of fragments of fine pottery, most probably originating only from a few vessels. This ornament occured in various compositional arrangements, consisting of

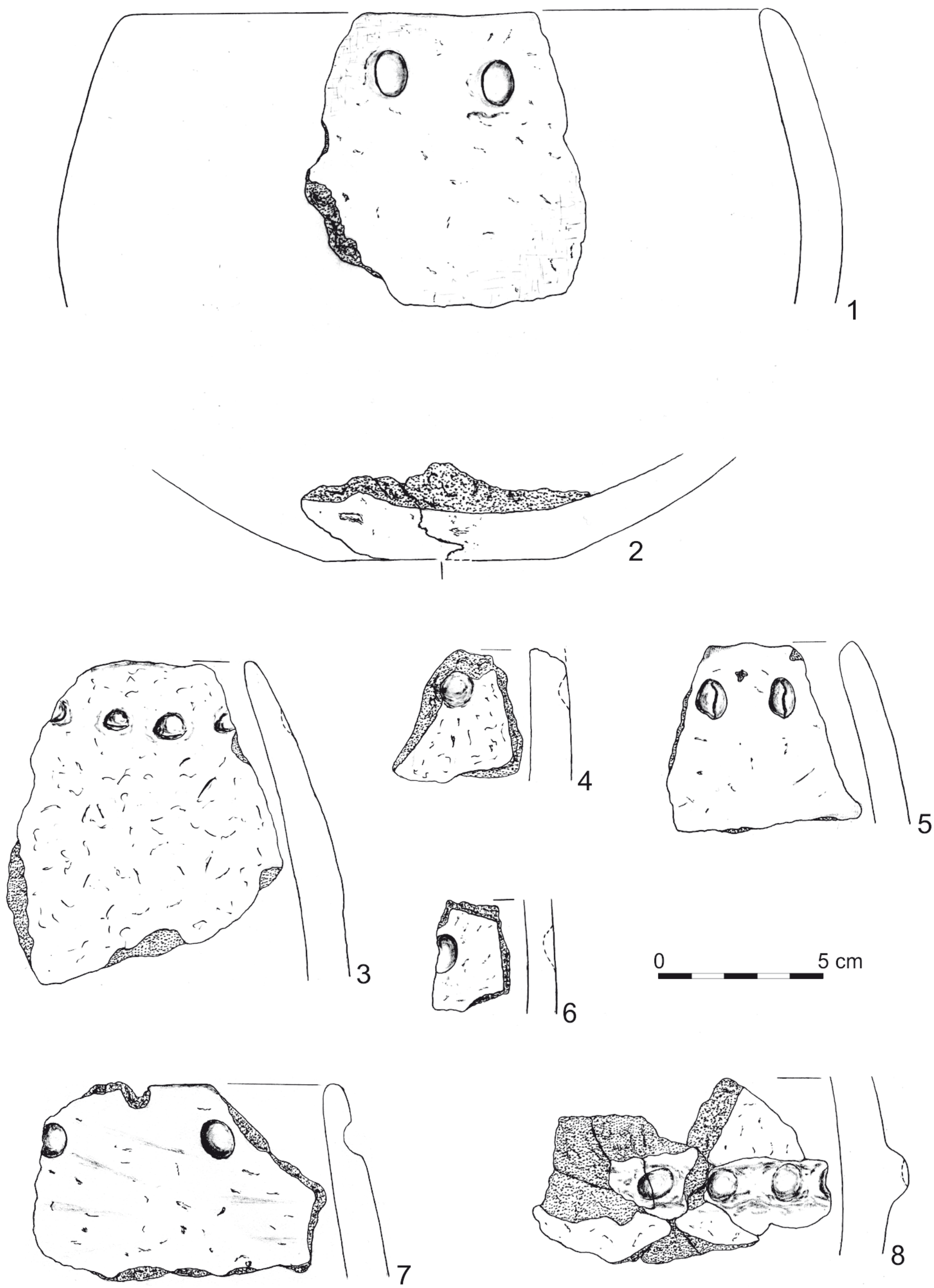

Fig. 4. Świerszczów, site 3: 1-8 – ceramics decorated with fingerprints:
1-4, 6 – feature No. 19; 5, 7 – feature No. 174; 8 – on the secondary bed in the fill of the Malice culture feature. Illustration by K. Gawryjołek-Szeliga

rectilinear (Fig. 3: 1, 3, 13; 8: 1, 3) and curvilinear (Fig. 3: 4, 9-10, 12; 5: 1) motifs, made with single or multiple lines and arranged vertically, horizontally or obliquely to the vertical axis of symmetry of the vessels. The width of the incised lines ranges from 2 to 4 mm, with a clear quantitative predominance of lines varying between 3-3.5 mm. All of them are characterized by a relatively large depth and a U-shaped profile in cross-section.

Referring to the classification system of J. Pyzel (2010a; 2019), main motifs are the most common ornamentations among the analyzed vessels (*ca.* 58,33% of all incised decorative motifs), which are represented mainly by simple horizontal arched and/or wavy

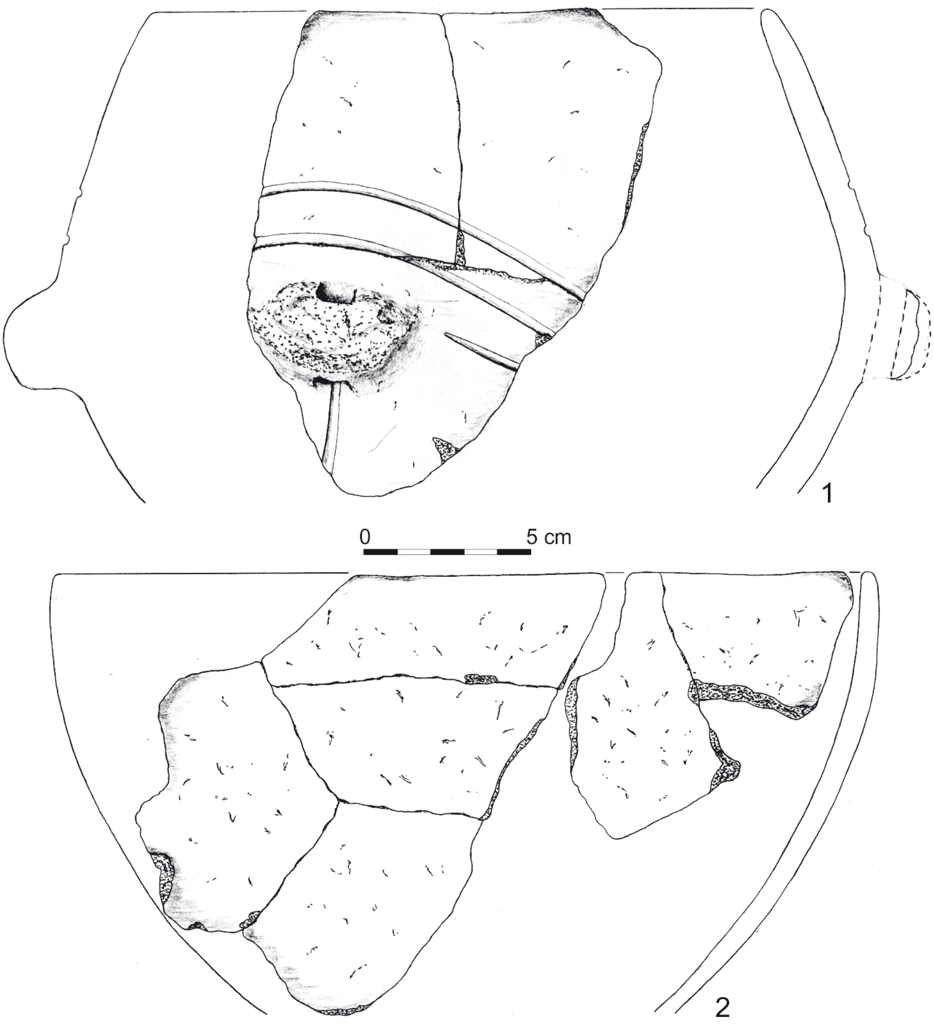

Fig. 5. Świerszczów, site 3: 1-2 – ceramics from feature 174. Illustration by K. Gawryjołek-Szeliga

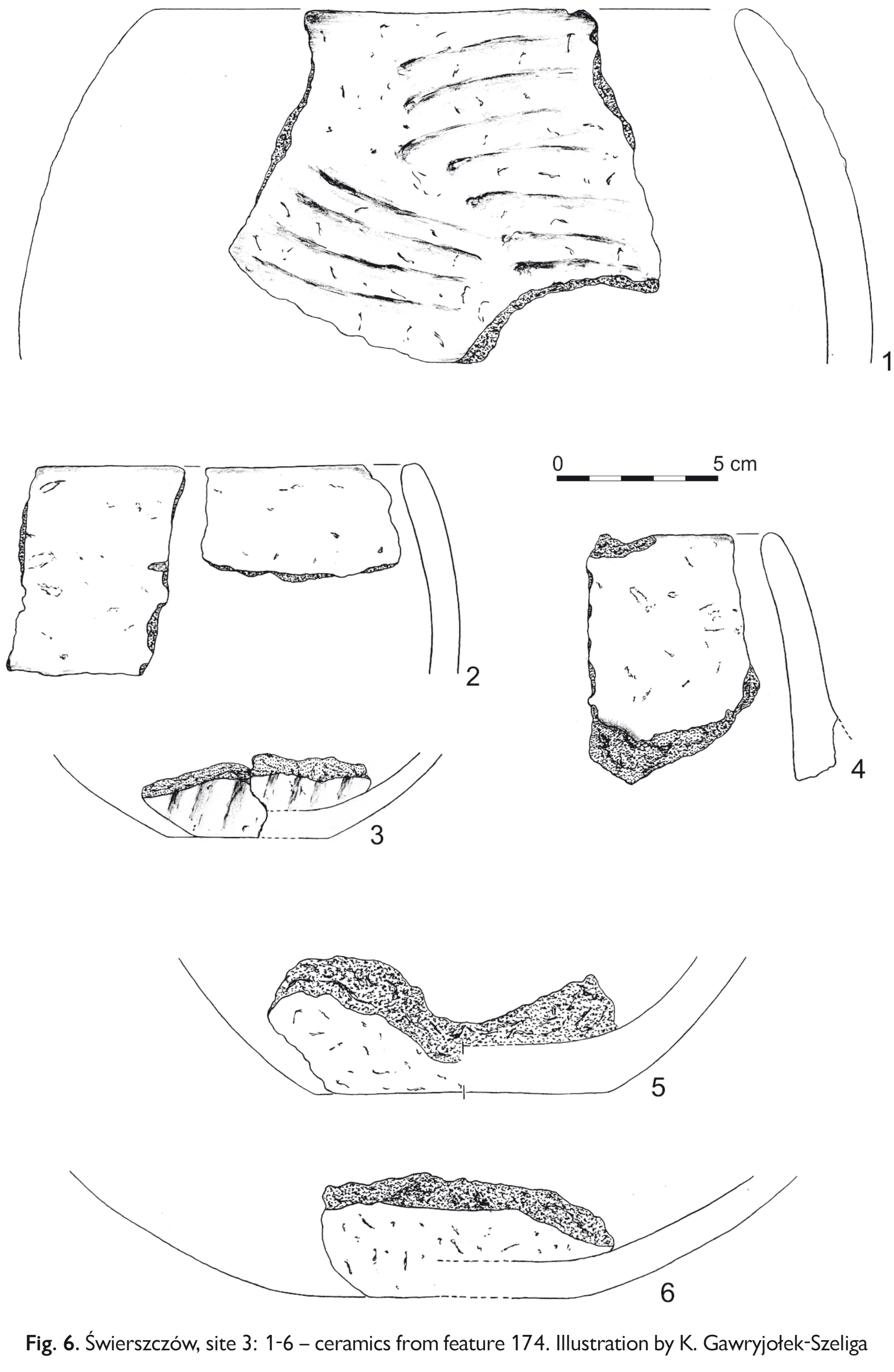

Fig. 6. Świerszczów, site 3: 1-6 – ceramics from feature 174. Illustration by K. Gawryjołek-Szeliga

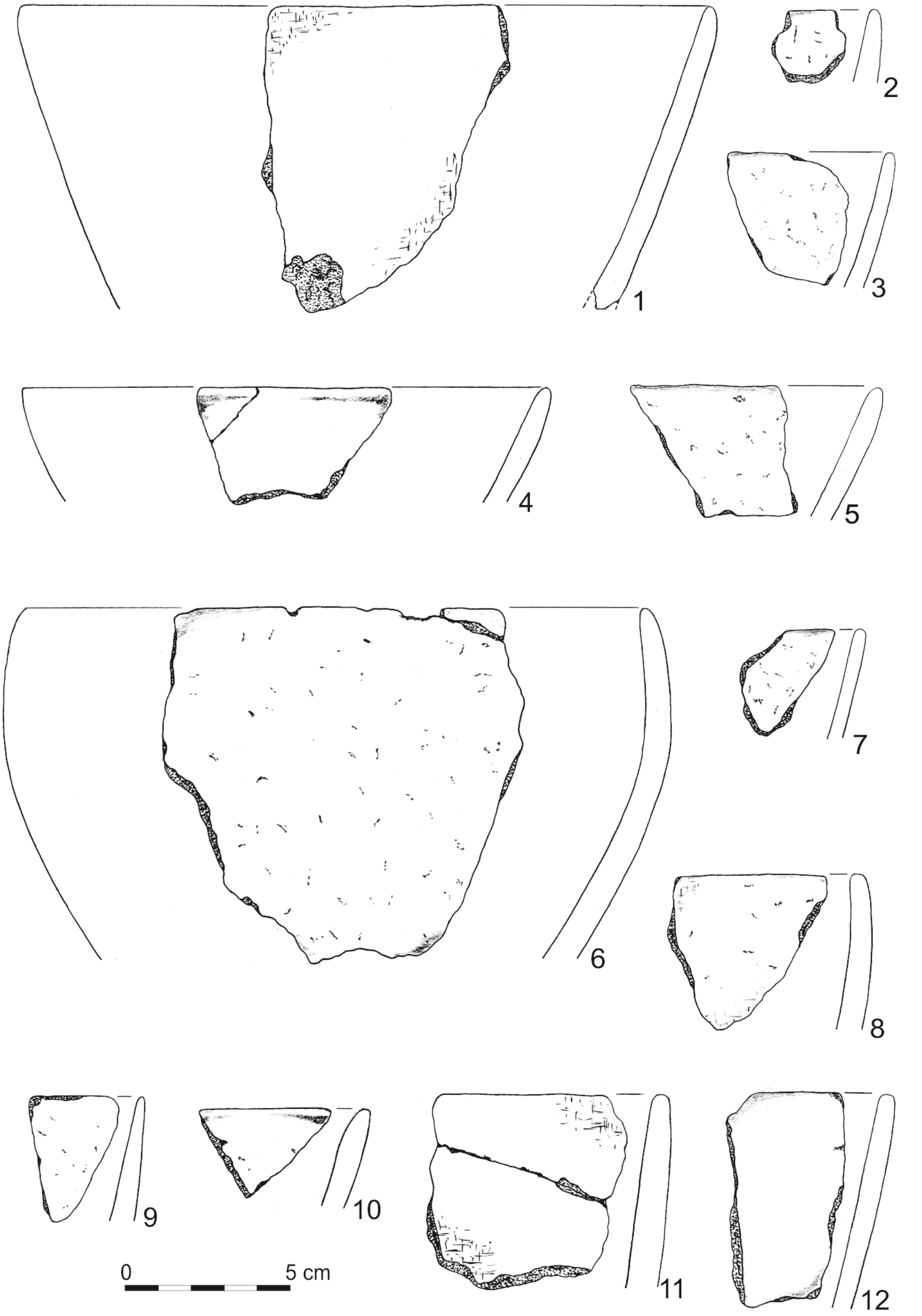

Fig. 7. Świerszczów, site 3: 1-12 – fragments of bowls: 1, 2, 4, 6, 8-9, 12 – feature No. 174; 3, 5, 7 – feature No. 19; 10-11 – feature No. 176. Illustration by K. Gawryjołek-Szeliga

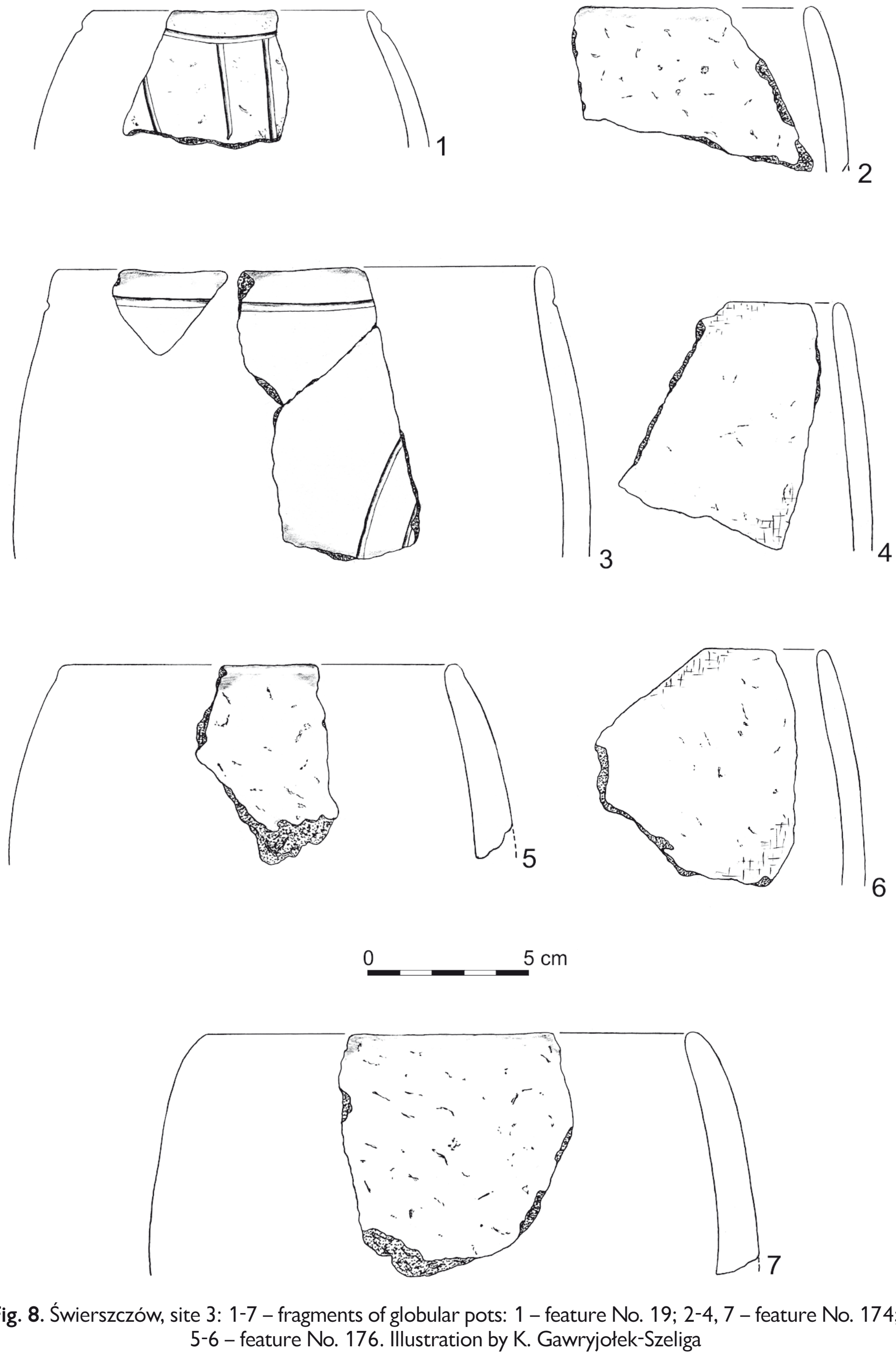

Fig. 8. Świerszczów, site 3: 1-7 – fragments of globular pots: 1 – feature No. 19; 2-4, 7 – feature No. 174; 5-6 – feature No. 176. Illustration by K. Gawryjołek-Szeliga

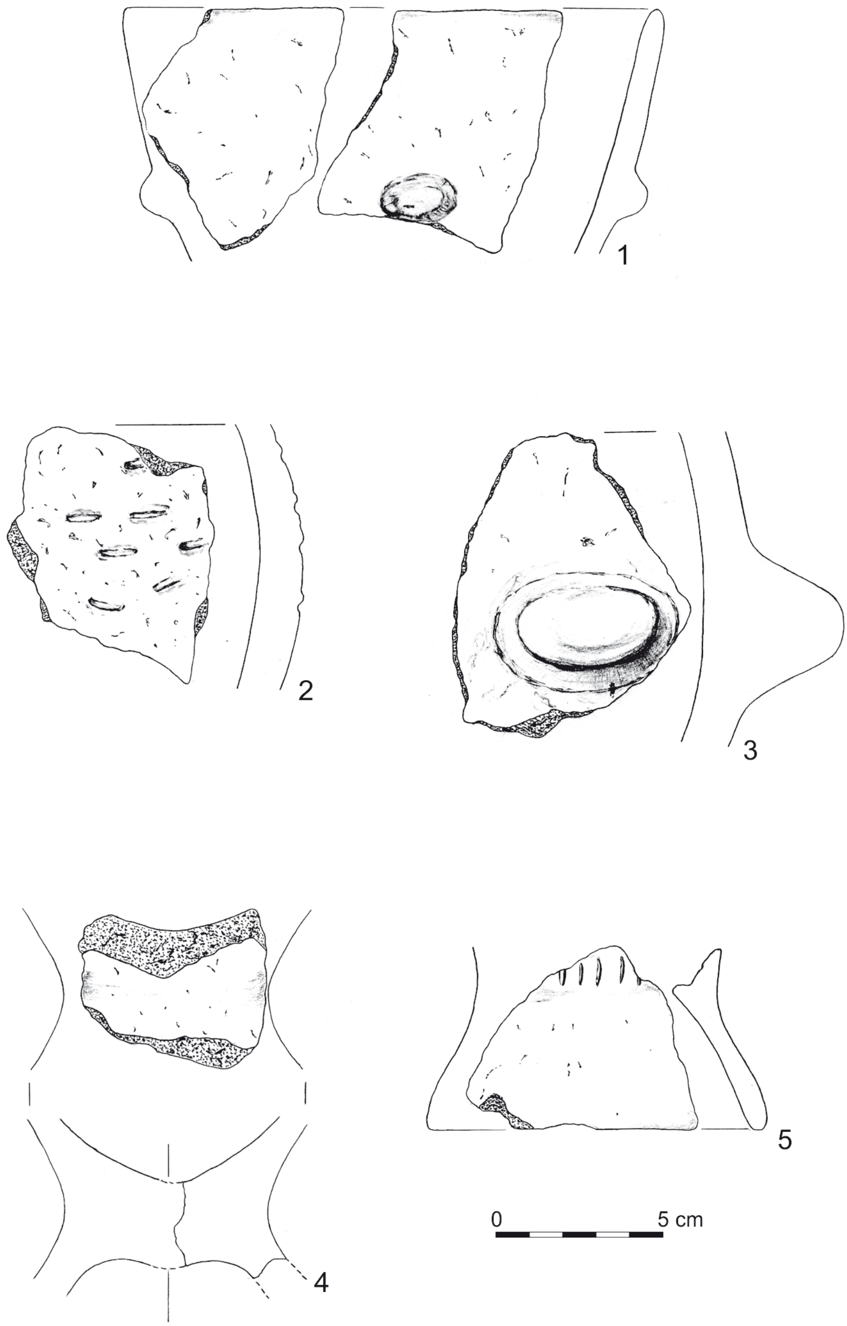

Fig. 9. Świerszczów, site 3: 1-5 – selection of ceramics from feature No. 174.
Illustration by K. Gawryjołek-Szeliga

motifs (Fig. 3: 2, 4-5, 9-12; 5: 1; 8: 3) and vertical geometric ones (Fig. 3: 1, 3, 13). The surfaces of two body fragments were covered with a sequence of longitudinal, fairly shallow and short quasi-incisions, made with a narrow and blunt tool (Fig. 9: 2). One of them, next to the furrows, has also a massive, vertically dissected nodule. A single row of quite densely arranged, short, vertical incisions has also been preserved on the surface of the pedestalled bowl/beaker, located on the narrowing, at the point where the pedestal passes into the body (Fig. 9: 5). Rim motifs were recorded only in the case of two vessels, and are represented by single, encircling lines (Fig. 8: 1, 3). With the exception of one example (Fig. 5: 1) the presence of secondary motifs was not recorded in the collection.

Plastic elements were recorded on 12 (33.33% of the decorated pottery) fragments of pottery in total, occurring almost exclusively on thick-walled globular pots. In seven cases, quite large (10 × 12-13 mm), oval fingerprints, forming single, circumferential rows under the rims of the vessels were found (Fig. 4: 1, 3-7). On three fragments, oval nodules of different sizes were recorded (Fig. 9: 1, 3). The surfaces of two vessels were covered with a barbotine ornament, applied in lines with bare fingers (Fig. 6: 1, 3). In addition, a plastic strip with three preserved fingerprints occurred on a single fragment, deposited on a secondary deposit in a Malice culture feature (Fig. 4: 8). In only one case did the plastic element (a vertically pierced handle) co-occur with an incised ornament (Fig. 5: 1).

Flints

Flint materials constitute a very modest group of finds, consisting of only 8 artefacts made of Volhynian flint. Despite the minimal quantitative content of the collection, it corresponds very well with the previous findings on the resource preferences of the oldest agricultural communities occupying the areas of the eastern Lublin region, including the Hrubieszów Basin area, oriented primarily towards high-quality cretaceous raw materials from the central-western part of the Volhynia-Podole Upland (Zakościelna 1981, tab. 1; Balcer 1983, 56-58).

Flint artefacts reveal a low degree of morphological differentiation (Tab. 3). Half of the collection consists of flakes and their fragments – of various, usually undefined techno-

Table. 3. Świerszczów, site 3, Hrubieszów municipality: morphological structure and frequency of particular types of flint products originating from LBK features

Flints artefacts	Feature 11	Feature 19	Feature 174	Feature 176	Total
Cores	-	1	-	1	**2**
Blades and fragments	-	1	-	-	**1**
Flakes and fragments	-	2	2	-	**4**
Retouched tools	-	1	-	-	**1**
Total	**-**	**5**	**2**	**1**	**8**

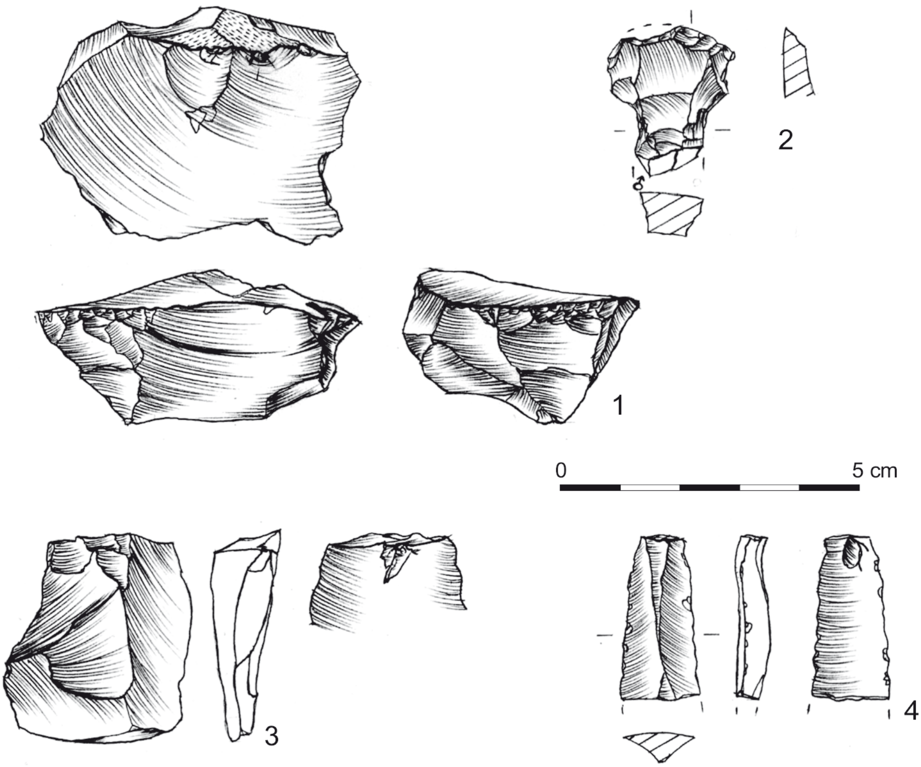

Fig. 10. Świerszczów, site 3: 1-4 – flint artefacts from feature 19 (1-4 – Volhynian flint). Illustration by M. Szeliga

logical origins (Fig. 10: 3). The second position is occupied by flake cores, represented by one residual, multi-platform specimen bearing traces of numerous orientation changes, and one single-platform specimen made of a massive flake (Fig. 10: 1). Rounding out the list of finds is a proximal fragment of a regular blade (Fig. 10: 4) and a rather unusual, small flake endscraper with retouch on both sides, forming a kind of handle (Fig. 10: 2).

RELATIVE CHRONOLOGY OF MATERIALS AND SETTLEMENT IN ŚWIERSZCZÓW

The analysis of ceramic materials reveals the homogeneous nature of the entire inventory, clearly justifying its relation with the pre-music-note stage of LBK development, and more precisely with its earliest sub-phase, correlated on the northern side of the Carpathians and the Sudetes with the Gniechowice phase/style (Ia phase; *cf*. Kulczycka-Leciejewiczowa

1968, 61-67; 1979, 48-51). This is clearly indicated by both the technological and morphological attributes of the vessel fragments present in the collection, as well as the stylistic parameters, especially the range of differentiation and the methods of ornamental motif creation. This is also reflected in the lack of a clear division of ceramics into "table" and "kitchen" ones, so typical for the classical and late stages of LBK development (*e.g.* Kulczycka-Leciejewiczowa 1983a, 74, 75; 2008, 81; Kadrow 1990, 33).

Such an early classification of the Świerszczów inventory is indicated primarily by the presence of wide and deep incised lines with an exclusively U-shaped cross-section, forming simple, single or double (less frequently more numerous) rectilinear or curvilinear ornamental compositions within the central parts of the vessels' bodies (Fig. 3), and only occasionally also on their rims (Fig. 8: 1, 3). The metric parameters and the method of ornamentation of the incised lines are diagnostic for the oldest stage of the LBK, clearly different from the Zofipole style (*e.g.* Kulczycka-Leciejewiczowa 1983a, 91-92; 2008, 80; 2010, 552). This also applies to ornamental threads, or more precisely, to the presence of a double rhombus motif, framed on the sides with triple, broken vertical lines on the body of a flask vessel with a short neck and outwardly curved rim – an ornament that most likely reached the base of the vessel (Fig. 3: 1b). In this case, not only the decorative composition, but also the form of the vessel itself reveals a clear relation with the oldest LBK phase (*e.g.* Tichý 1962, fig. 4: 4; 13: 2; Pavlů and Vokolek 1992, fig. 29; Cladders 2001, 21-23, 150, Kulczycka-Leciejewiczowa 2008, fig. 47). A very similar ornament was recorded on the surface of a small, richly decorated amphora with an open neck from pit 3a at Stary Zamek (Kulczycka-Leciejewiczowa and Romanow 1985, fig. 17: a3), and also on a seemingly analogous form discovered at Rívne in Volhynia (*cf.* Piasetskiy and Okhrimenko 1990, fig. 4: 9; Dębiec and Saile 2015, Abb. 8: 4).

Additionally, of particular importance for the relative chronology of the collection from Świerszczów, is the presence of a fragment of a large biconical globular pot, with a vertically pierced, "corded" handle, located on the bend of the body and an incised ornament in the form of double and single arch motifs, located strictly in relation to the position of the handle (Fig. 5: 1). Vessels of this type are among the most characteristic and common components of early LBK ceramic inventories in Central Europe (*e.g.* Tichý 1960, fig. 19: 1-3; Kneipp 1988, Abb. 1; Pavlů and Vokolek 1992, fig. 28; Cladders 2001, 8-19, 148; Pavúk 2005, Abb. 7), including the Gniechowice phase (Kulczycka-Leciejewiczowa and Romanow 1985, Fig. 10: d; 22: e-f; 24: f). They are also known in the Zofipole-stage collections (*e.g.* Godłowska 1976, tabl. LXI: 8), but are interpreted as archaic, diagnostic elements of the oldest stage of the LBK (Kulczycka-Leciejewiczowa 1983a, 86, 89).

For A. Kulczycka-Leciejewiczowa (*e.g.* 1987, 328; 2008, 72-77; 2010, 550), the presence of biconical globular pots with vertically pierced handles in the collections of the Gniechowice phase was one of the arguments justifying its correlation with the Biňa LBK phase of SW Slovakia. A different theory was presented by J. Pavúk, who limits the range of the Biňa phase only to the Danubian LBK formative zone, and the spread of this culture to more distant areas of Central Europe is related only with the Milanovce phase (Pavúk 2004, 77-80). According to this concept, the Gniechowice phase should be correlated only with the Milanovce phase (*e.g*. Czekaj-Zastawny 2008, 116; Pyzel 2014, 83). The data from Świerszczów, including the aforementioned globular pot from feature 174, seem to confirm this theory. Its biconical, though relatively gentle profile, as well as its straight rim, clearly differ from the forms known from the Biňa phase, which have a characteristic profile of the edge parts, due to a slight deflection of the edges (Pavúk 2004, 75, fig. 2). However, this reveals a very close, even strict resemblance to the non-carinated vessels with straight rims known from the Milanovce phase inventories, with vertically pierced handles and decorated on their bodies with a wavy ornament composed of one to four incised lines (Pavúk 2004, 78-80, fig. 7). This correlation is also well-related to other elements present in the pottery collection from Świerszczów, and more specifically, the methods of finishing and ornamenting of thick-walled globular pots. The first example is the ornament of single rows of fingerprints located below the rims of the vessels (Fig. 4: 1, 3-5, 7), common in the Gniechowice phase (*e.g*. Kulczycka-Leciejewiczowa and Romanow 1985, fig. 7: b, g-h; 9: l; 10: p-r; 15: a-b; 18: b, g; 21: b; 23: a, c, n; Kulczycka-Leciejewiczowa 2008, fig. 11: 4), and diagnostic for the Milanovce phase stylistics (Pavúk 2004, 78, fig. 5). The second example is a barbotine ornament applied in lines with fingers, recorded on the surfaces of two vessels from Świerszczów (Fig. 6: 1, 3). This ornament was a characteristic method of finishing the surfaces of thick-walled vessels, performed on their still-wet outer surfaces. It became popular in the Milanovce phase in place of the *Schlickbewurf* ornament applied by splashing semiliquid clay paste on the dry surfaces of vessels, which was characteristic of the Biňa phase (Pavúk 2004, 75, 78; 2005, 28-29; Pavúk and Farkaš 2013, 229-230). The coexistence of these elements seems to allow us to unambiguously correlate the collection from Świerszczów with the Milanovce phase.

The diagnostic elements in the collection from Świerszczów also include fragments of two pedestalled vessels, probably bowls or beakers with low, conical pedestals (Fig. 9: 4-5). These forms, derived from the Balkan Neolithic tradition, are quite common in the earliest LBK ceramic inventories, both in the Danubian and the Central European regions (*e.g*. Tichý 1960, fig. 13: 1; 20: 7; Pavúk 1980, tab. 1, Abb. 12; 17: 4-7; 25; Pavlů and Vokolek 1992, fig. 28; Cladders 2001, 23-25, 149; Lenneis and Lüning 2001, Taf. 25: 5-153/11, 5-142/49; 27: 6-56/45; Bánffy 2004, 231-232; Pavúk and Farkaš 2013, Abb. 4: 5), including those known from Lower Silesia and Lesser Poland (Kulczycka-Leciejewiczowa 1983a, fig. 3: 11, 13; 2008, fig. 6: 7; 7: 9; 8: 12; 13: 2-3, 5 7-9; Kulczycka-Leciejewiczowa and Romanow 1985, fig. 4: r-v; 12: j; 17: m-o). The occasional presence of non-decorated forms was also recorded in the inventories of the Zofipole phase (Kulczycka-Leciejewiczowa 1983a, 90; 2008, fig. 15: 18, 21; Czekaj-Zastawny and Przybyła 2012, tab. 17: 11), but in this context they were only stylistic reminiscences of archaic forms, or possibly redeposited materials from the older phase.

In turn, the fragments of two, probably quite tall, ovoid vessels decorated with single incised lines under the rim, and with accompanying rectilinear or curvilinear main motifs

(Fig. 8: 1, 3), should be considered as quite unusual elements in the analysed collection. In the areas of the upper Vistula and Odra River basins, the occurrence of similar ornamental compositions in the context of ceramic materials of the oldest LBK has not been unambiguously confirmed so far. This applies to both the rim motif (an encircling incised line) and to total motif compositions present on both vessels from Świerszczów. In fact, the only similar ornament was recorded on one of the globular pots from pit 3 in Samborzec (Kulczycka-Leciejewiczowa 2008, fig. 7: 3). Unfortunately, the stratigraphy and the structure of the ceramic collection from this pit allow us to exclude the homogeneous nature of this inventory, as well as its relation with the Gniechowice phase. On the other areas of the oldest LBK, similiar motifs were recorded extremely rarely. They were recorded on the surfaces of only a few globular pots in the area of the Milanovce phase collections from Slovakia (Pavúk 2004, fig. 7: 2), as well as the oldest LBK inventories from Austria (Lenneis and Lüning 2001, Taf. 8: 1-397/744). In any case, the aforementioned examples do not represent direct formal and stylistic analogies to the specimens from Świerszczów. Similar ornamental compositions are much more common in the collections of the Zofipole phase, although they are present mainly on thin-walled bowls or globular pots (*cf.* Kulczycka-Leciejewiczowa 2008, fig. 15: 1, 4, 7, 15; Kadrow and Okoński 2008, fig. 6: r; Doros *et al.* 2019, Tab. III: 1, 6-7).

Therefore, the presented data reveal a fundamental problem in the unambiguous assessment of the relative chronology of both of the aforementioned vessels from Świerszczów, and at the same time they justify doubts as to their relation with the oldest phase of the LBK. However, such a classification may be supported by the presence of wide and deep incised lines with U-shaped cross-sections, typical for the Gniechowice style. The very concept of such an ornament, and the way it is arranged on the surfaces of both vessels, seems to have a slightly younger date.

The remaining elements of the collection from Świerszczów also have close analogies in other assemblies of the oldest LBK phase. This applies, on the one hand, to wide-open, undecorated conical bowls with strongly protruding, straight rims (Fig. 7: 1, 3-5, 7, 9, 12; 9: 1), and on the other hand, to the ornament in the form of a rain pattern, composed of short pseudo-cuts, which is present on two fragments from feature 174 (Fig. 9: 2). Originally, this ornament covered a larger surface – perhaps even the entire surface of the vessel – probably additionally equipped with a large, vertically and deeply notched, bipartite knob.

Both the above-mentioned forms of bowls, as well as the rain-pattern ornament and the vertically notched, bipartite knob find close and numerous analogies in the oldest stage of the LBK, both in the upper Vistula and Odra basins (*e.g.* Kulczycka-Leciejewiczowa and Romanow 1985, fig. 7: a; 10: a; fig. 12: i; 17: e; 21: n-o; Kulczycka-Leciejewiczowa 1983b, fig. 3: 10; 2008, fig. 6: 5; 8: 8) and in other areas of Central Europe (*e.g.* Tichý 1960, fig. 11: 9-10; 12: 10; Pavúk 1980, Abb. 8; 18: 1-2; 22: 1-6; 31; 32: 5; Cladders 2001, Taf. 1-2; 5: 8; 12; 15: 1; 22: 4; 23: 4; 43: 1-2, 4; Lenneis and Lüning 2001, Taf. 12: 100-46/80; 15: 102-

6/270; 24: 5-135/91, 5-153/10). They are also present in the younger stage of the pre-music-note LBK phase, which is confirmed by numerous finds related to the Zofipole phase (*e.g.* Uzarowiczowa 1964, fig. 3: a; Kulczycka-Leciejewiczowa 1983a, fig. 4: a; 5: b, d; 2008, fig. 9: 10; 15: 8-14; Kadrow and Okoński 2008, fig. 7: z; Zastawny and Grabowska 2014, tabl. 40: a-b; 57: b; 59: c, f; 65: h, j; 79: j; 88: j).

Summing up, the relative chronology of the LBK settlement in Świerszczów, considered in terms of the formal and stylistic differentiation of ceramic materials, defines a narrow range corresponding to the oldest LBK phase, or more precisely to the Gniechowice phase (Ia), which, according to the latest findings, should be correlated with the Milanovce phase (*cf.* Pavúk 2004, 78-80; Czekaj-Zastawny 2008, 116; Pyzel 2014, 83). This is clearly reflected in the numerous formal and stylistic components of the analysed collection, which find many close analogies within the similarly classified inventories in the Transcarpathian areas. It would seem that such an interpretation also applies to the aforementioned fragments of two globular pots with oval cross-sections (Fig. 8: 1, 3). Although, in terms of stylistics, they include the youngest ornamental motifs of whole collection, their manner of ornamentation is typical for the oldest LBK. Therefore, it cannot be ruled out that their presence in the Świerszczów inventory is a manifestation of the adaptation of newer ornamental trends in the oldest LBK tradition or – in a broader perspective – of the coexistence of different traditions in the same area.

The discussed collection is currently the stylistically oldest excavated LBK settlement complex in the Lublin region, and the second – next to Samborzec (Kulczycka-Leciejewiczowa 1983b, fig. 1; 2008, 103-106) – within the entire upper Vistula basin. These inventories are also supplemented by a few diagnostic cave finds (Maszycka Cave and Okopy Wielka Dolna Cave; Kulczycka-Leciejewiczowa 1968, 63, 64; 1983b, 51; Rook 1980, 89, 91), interpreted as the remains of camps (Czekaj-Zastawny 2008, 154-156; Czekaj-Zastawny *et al.* 2020, 32), as well as single surface materials (Michalak-Ścibior 1993). The other finds of Gniechowice phase pottery, known from the Małopolska and Podkarpacie regions, did not form any compact and homogeneous feature complexes, each time coexisting with Zofipole materials (*cf.* Godłowska 1976, 88; Kulczycka-Leciejewiczowa 1983a, 69-73; Kukułka 2001, 13-22; Kadrow 1990, 60; Czekaj-Zastawny *et al.* 2020, 5). The vast majority of these finds should probably be considered as secondary, archaic elements, accompanying the contemporary wave of colonization of these areas, initiated only in the younger section of the early LBK, *i.e.*, in the Zofipole phase (*e.g.* Kulczycka-Leciejewiczowa 2008, 128-129; Czekaj-Zastawny 2008, 116; Czekaj-Zastawny *et al.* 2020, 27). It seems that this also applies to a small (24 pieces) ceramic inventory from three features in Zwięczyca. In this inventory, apart from the elements typical for the oldest LBK phase (Dębiec 2014, 88; 2015, 33), an extensive, horizontal nodule with at least three fingerprints (Dębiec 2014, Taf. 56: 3; 2015, 35, Abb. 2: 5) was also found, which is a common decorative element of thick-walled vessels of the Zofipole phase (*e.g.* Kulczycka-Leciejewiczowa 1983a, 92, fig. 6: k, ł; Zastawny and Grabowska 2014, tabl. 5: a-e; 16: g-h; 21: e; Grygiel 2004, 624). However, taking into account that the above-mentioned concentration of features has not yet been fully excavated (Dębiec 2015, Abb. 1), the issue of their unambiguous classification within the early periodization of LBK still should be considered as open.

The highly homogeneous nature and small size of the Świerszczów collection allows us to assume its relatively narrowly defined chronological position, as well as the likely single-phase (transitory) nature of the LBK settlement within the site. Unfortunately, the lack of radiocarbon dates makes it impossible to verify this hypothesis, as well as to determine the moment of settlement construction. The attempts made to date two animal bones from the fills of features 19 and 176 provided, unfortunately, highly incorrect dates, going far beyond the LBK time frame (Poz-96696: 3495 ± 35 BP; Poz-97220: 5290 ± 40 BP).

THE EARLIEST PHASE OF THE LBK IN THE LUBLIN REGION

In light of the current state of research, a total of six sites are related to the oldest phase of the LBK in the Lublin region, concentrated only in its eastern part, mainly in the Hrubieszów Basin, and only in one case in the northern part of Central Roztocze (Fig. 11). Along with the other four sites known from the Ukrainian part of the Volhynian Upland, they form a clearly isolated zone, farthest to the East in relation to the other clusters of the early LBK known from the upper Vistula basin (Fig. 11). Most of the early LBK finds from the Lublin region were obtained during excavations. Except for a single cremation grave at site no. 2 in Gródek, all the others are of a settlement nature. They are usually represented by relatively poor inventories or single ceramic materials obtained both from the fills of features, as well as from off-feature layers. Unfortunately, only some of them have been published to a degree that allows for an unambiguous assessment of either their quantitative and qualitative structure or their chronological and stylistic verification. Despite these significant interpretive limitations, the scope of currently available data allows for a preliminary characterization and a very general reconstruction of the course of the oldest LBK phase in these areas. Taking into account the concentration of most of the finds within the Hrubieszów Basin, the observations fit into a slightly larger territorial context, clearly spreading also into the remaining Ukrainian part of the Volhynian Upland.

Apart from the inventory from Świerszczów, the earliest horizon in that area is marked only by finds from Gródek, represented by a cremation grave with a poor collection of pottery from site 2 (Kempisty 1962, fig. 1-2) and a few ceramic materials from sites 1B and 6 (Uzarowiczowa 1964, Fig. 3, 8; Buszewicz 1990, Fig. 3-4a). Among the finds, the best known is the cremation grave from Gródek, site 2. Its relation to the Gniechowice phase may be indicated by the presence of ceramics decorated with deep, U-shaped, incised lines, including fragments of globular pots with biconical profiles (Fig. 12: 13, 15). However, such a functional and cultural classification of the feature is sometimes called into question (Czekaj-Zastawny 2009, 36, fig. 8). It would seem that ceramics in the Gniechowice style

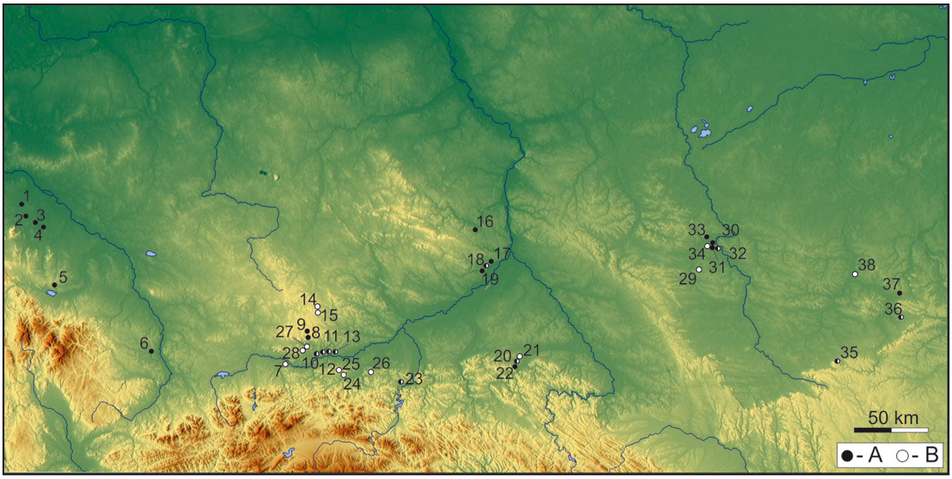

Fig. 11. Location of LBK pre-music-note phase sites in southern Poland and Volhynia (A – Gniechowice phase; B – Zofipole phase): 1 – Gniechowice; 2 – Stary Zamek; 3 – Dankowice; 4 – Strzelin; 5 – Ligota Wielka; 6 – Pietrowice Wielkie; 7 – Spytkowice; 8 – Ojców, Okopy Wielka Dolna Cave; 9 – Maszyce, Maszycka Cave; 10 – Kraków-Bieńczyce; 11 – Kraków-Mogiła; 12 – Kraków-Pleszów; 13 – Zofipole; 14 – Pstroszyce; 15 – Miechów; 16 – Ćmielów; 17 – Andruszkowice; 18 – Samborzec; 19 – Sośniczany; 20 – Rzeszów, Os. Piastów; 21 – Rzeszów-Staromieście; 22 – Zwięczyca; 23 – Gwoździec; 24 – Zagórze; 25 – Zakrzów; 26 – Targowisko; 27 – Modlnica; 28 – Modlniczka; 29 – Sumin 1; 30 – Gródek 1B; 31 – Gródek 2; 32 – Gródek 6 (1D); 33 – Świerszczów 3; 34 – Hrubieszów-Podgórze 5; 35 – Josipivka; 36 – Mežirič; 37 – Rivne; 38 – Baïv (map based on https://maps-for-free.com/, dispersion of sites after Kulczycka-Leciejewiczowa 2000, fig. 3; Czekaj-Zastawny 2008, tab. II; Kadrow and Okoński 2008, fig. 16; Pyzel 2010, fig. 1; Dębiec and Saile 2015, Abb. 1, modified)

from Gródek 6 are represented only by a few fragments of vessels, including a body fragment with a vertically pierced, so-called "corded" handle (Fig. 12: 10), which is considered to be a secondary, archaic element in the collection, among the dominant Zofipole materials (Kulczycka-Leciejewiczowa 1983a, 88). The fragment of the globular pot with the motif of a horizontal rectangle with a single horizontal line incised inside is also archaic (Fig. 12: 7). This specimen was assigned to the Zofipole phase (Kulczycka-Leciejewiczowa 1983a, 88), but such a classification seems doubtful due to the presence of identical decorations in the Gniechowice phase collections (Kulczycka-Leciejewczowa and Romanow 1985, fig. 22: e) and their absence in the Zofipole inventories (*cf.* Kadrow and Okoński 2008, 10, 11; Zastawny and Grabowska 2014, 90, 91; Doros *et al.* 2019, 133-135). Most likely, an incomplete vessel discovered accidentally at site 1B in Gródek should also be related to the Gniechowice phase (Buszewicz 1990, fig. 3-4a). It is a small, asymmetrical (deformed before firing?) vessel with a relatively small rim diameter, a flat base and a more or less biconical profile (Fig. 12: 1). It was adorned with massive, pointed knobs, located on the bend of the body, and decorated with an incised ornament in the form of a simple composition of three arched lines placed between the knobs above the bend of the body. Both the form and style

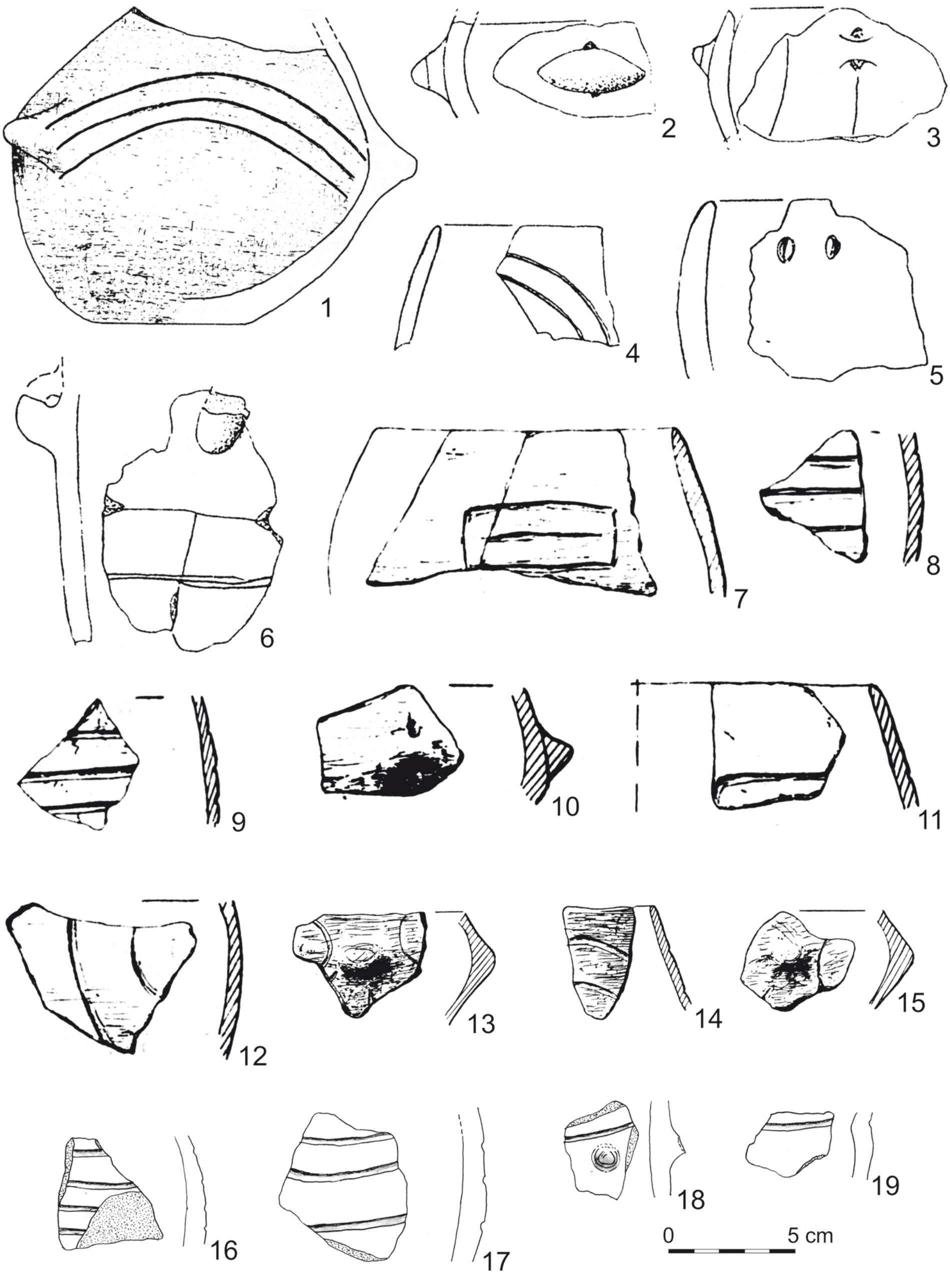

Fig. 12. Selection of ceramics of the early LBK from the Lublin region: 1 – Gródek, site 1B (after Buszewicz 1990, fig. 3: 4); 2-6 – Hrubieszów-Podgórze, site 5 (after Niedźwiedź and Panasiewicz 1994, fig. 2: 2, 4, 6-8); 7-12 – Gródek, site 6 (1D) (after Uzarowiczowa 1964, fig. 3: b, h, n, r; 8: w-z); 13-15 – Gródek, site 2 (after Kempisty 1962, fig. 2: a-c); 16-19 – Sumin, site 1 (after Brzozowski 1986, tabl. 23: a-d)

of ornamentation of the discussed vessel are definitely archaic in nature, finding their closest analogies among the vessels from the Biňa phase inventories in SW Slovakia (Pavúk 1980, Abb. 6: 1-2). The off-feature context of the discovery of this single vessel, unfortunately, excludes the possibility of assessing its real nature and chronological position within the studied areas (archaic element within the inventory of phase Ia?). The collection of materials dated to the oldest LBK from the Hrubieszów Basin is also supplemented by Volhynian materials. Their most numerous series originate from the site in Rěvne (*e.g.* Piasetskiy and Okhrimenko 1990, fig. 3-4; Okhrimenko 2001, 18-25), correlated with the Gniechowice and Milanovce phases (Dębiec and Saile 2015, 6). At least some of the ceramics discovered in Mežirič, and presumably also in Josipěvka, are very similar in nature (Milian *et al.* 2008, fig. 1; Chernovol *et al.* 2009, fig. 4; Dębiec *et al.* 2014, fig. 2-3; Dębiec and Saile 2015, Abb. 2; 12: 2-6). However, the current degree of development and publication of the materials from both sites prevents their comprehensive and unambiguous interpretation.

The vast majority of the early LBK finds from the eastern Lublin region is related to the younger stage of its stylistic development, *i.e.*, the Zofipole phase (Fig. 11). This horizon is represented by numerous finds from site 6 in Gródek, including three features (two pits and a fire-pit) and a collection of several dozen fragments of vessels obtained from their fills, as well as an unspecified amount of ceramic materials from off-feature layers (Uzarowiczowa 1964, 431, fig. 3, 8). The analysis of the ceramics revealed the presence of delicate forms and coarse work with flat bases, including globular pots, undecorated conical and hemispherical bowls, as well as vessels with tall necks and outwardly curved rims. The surfaces of the vessels were decorated with rectilinear and curvilinear incised motifs (Fig. 12: 8-9, 11-12), as well as plastic fingerprints and fingernails or knobs with dimples or incisions (Uzarowiczowa 1964, fig. 3: 1). Finds from site 5 in Hrubieszów-Podgórze are also related to the Zofipole phase, including four immovable features and an undefined collection of historic materials (Niedźwiedź and Panasiewicz 1994, 52). The limited degree of analysis of the finds from this site and the perfunctory nature of their publication make it impossible to fully verify the validity of such an early dating of this inventory. Some of the decorated forms (Fig. 12: 2-6) allow us to consider such a possibility as highly probable. A small collection of surface materials from site 1 in Sumin has also been analogously classified (Brzozowski 1988, 2). It includes a total of eight fragments of vessels, including four body sherds with straight and curved decorative motifs, composed of 1 to 4 wide incised lines with a V-shaped cross-section (Fig. 12: 16-19). Although such an early classification of the collection is widely accepted (*e.g.* Kulczycka-Leciejewiczowa 2000, 200, fig. 3; Czekaj-Zastawny 2008, fig. 68; Kadrow and Okoński 2008, fig. 16; Dębiec and Saile 2015, Abb. 1), its superficial nature excludes the possibility of assessing either the degree of its homogeneity or the actual form and scale of activity of the early LBK community within the site. The list of finds related to the horizon in question is also supplemented by the site in Baïv in Volhynia (Fig. 11) – more specifically, a single, incomplete flask vessel obtained from a grave (Sveshnikov 1954, Taf. V: 10; Passek and Chernysh 1963, fig. 4). This form is decorated with a spatially extensive motif of a rhombic meander composed of quadruple incised lines, additionally enriched with large music note pits, irregularly arranged on the bends of the lines (Bardec'kyj *et al.* 2013, Abb. 2-3). Based on analogous finds related to the Ib2 phase of the LBK from the cemetery in Vedrovice, the vessel from Baïv was related with the declining episode of the Zofipole phase (Bardec'kyj *et al.* 2013, 256; Dębiec and Saile 2015, 4). The presence of the music note ornament indicates a very similar chronological position to that of the materials from Mežirič (Dębiec *et al.* 2014, fig. 4-5; Dębiec and Saile 2015, Abb. 13: 5-6; 14). Such dating also cannot be ruled out in the case of some materials discovered at Yosipevka (Milian *et al.* 2008, fig. 1; Chernovol *et al.* 2009, fig. 4).

SUMMARY

The stylistic diversity of the ceramic inventories from the eastern Lublin region (as well as from the Volhynian Upland) currently allows us to assume two basic stages of colonization of these areas by the early LBK community. The first stage corresponds to the Gniechowice phase (Ia) in the upper Vistula and Odra basins, correlated with the Milanovce phase. The small number of such classified collections indicates that settlement within those areas was most likely ephemeral and of a low intensity, and was associated with the formation of relatively few small settlements. Despite this, the potential presence of permanent settlement relics in Świerszczów allows us to assume that the LBK settlement in that period was relatively permanent, not only a short-term "reconnaissance", which may be indicated by materials from western Lesser Poland, including cave finds (*cf.* Kulczycka-Leciejewiczowa 1968, 63; Rook 1980, 89, 91; Czekaj-Zastawny *et al.* 2020, 32). The main wave of colonization of the eastern Lublin region and Volhynia by the communities of the early LBK was related only with the dissemination of the Zofipole style. This is indicated by the vast majority of the previous finds (Fig. 11), although the current scope of identification of particular sites, as well as the development and publication of ceramic materials, makes it difficult to clearly assess the form and the actual intensity of settlement processes in this period. This stage, later than the Milanovce phase, should be correlated with the Moravian phase Ib (Pyzel 2010b, 545; 2014: 90), including at least its younger stage of development (sub-phase Ib2), characterized by, *i.a.*, the presence of music-note holes in the ornamentation of vessels (Čižmář 2002, 178, fig. 13). This is confirmed by, among others, Volhynian materials (Baïv, Mežirič), which have very close analogies among the funerary collections in Vedrovice (Bardec'kyj *et al.* 2013, 256; Dębiec and Saile 2015, 6). It also corresponds very well with the marked increase in the settlement dynamics of the LBK in the younger section of the Zofipole phase, visible in the remaining areas in the upper Vistula basin (*e.g.* Kadrow and Okoński 2008, 19). The lack of unequivocal evidence allowing the correlation of Zofipole materials from the eastern Lublin region with the Moravian sub-phase Ib1 may only be due to the incomplete degree of analysis of the source materials. Some of

the published data from the sites in Hrubieszów-Podgórze (site 5), Gródek (site 6) and Josipěvka allow us to consider such an interpretation as highly probable.

In the context of the postulated two-stage colonization of the discussed areas by the early LBK community, one of the most important research problems is the issue of their mutual chronology. The discoveries made so far regarding the chronology of the early LBK allow us to assume that the emergence of a community with ceramics decorated in the Gniechowice style in the eastern Lublin region took place after 5400 BC, but probably no later than 5350/5300 BC (see Jakucs *et al.* 2016, fig. 24). The upper limit of this range is purely arbitrary and is determined by the ^{14}C range of the oldest music-note inventories in the upper Vistula basin, revealing chronological similarity with most of the previous LBK dates in these areas (*cf.* Dębiec and Dzbyński 2007, Abb. 5; Kulczycka-Leciejewiczowa 2008, fig. 55; 2010, 551-553; Czekaj-Zastawny 2008, pl. I; 2014, pl. XI; Czekaj-Zastawny *et al.* 2020, fig. 16). This range also corresponds partly to the ^{14}C range obtained for the early LBK inventory in Rívne in the Volhynian Upland (Kotova *et al.* 2007, 415, tab. 2; Okhrimenko 2009, 82).

A separate and much more problematic issue is the moment when collections with Zofipole-style ceramics appeared in the eastern Lublin region. Taking into account the radiocarbon dates from Gwoździec and Samborzec, it could not have happened until around 5300 BC or later. Earlier dating of assemblies containing, among other things, features typical for the Zofipole style from Kuyavia and Chełmno Land (Kukawka *et al.* 1990; Grygiel 2004, 633; Pyzel 2014, Abb. 5), as well as the ^{14}C date of a fragment of Zofipole pottery from Brzezie (Czekaj-Zastawny 2014, pl. XI), does not allow us to explicitly exclude the possibility of an earlier date for this phenomenon. In the case of the analysed area, this problem seems to be particularly important, at least due to the presence of elements stylistically deviating from the ornamental convention typical for the Gniechowice phase and having analogies in the Zofipole inventories (Fig. 8: 1, 3). This situation implies the possibility of at least a partial co-existence of old and new ornamental traditions in the oldest phase of the LBK in the Hrubieszów region. The lack of absolute dating precludes the verification of this hypothesis; however, such a possibility cannot be ruled out, due, for example, to the quite short duration of the entire early LBK period (Jakucs *et al.* 2016). This extremely important issue is still open today.

Another open issue is the identification of initial areas of settlement and potential routes of the influx of the early LBK community into the eastern Lublin region. The dispersion of such dated sites in the upper Vistula basin (Fig. 11) seems to imply at least two likely possibilities in this respect. In previous studies, the colonization of these areas was directly linked to the migration of early LBK groups from the Sandomierz Upland, travelling up the San and then the Tanew River (Brzozowski 1988, 2). This hypothesis, although highly probable, is unfortunately not supported by source materials (due to the complete lack of early LBK finds between the Sandomierz and eastern Lublin regions; *cf.* Fig. 11). However, it is also worth considering another, purely hypothetical concept, taking into account the entirety of the current "eastern" finds of the early LBK – that is, the possibility of the colonization of Volhynia and the eastern Lublin region as a result of the shifting of the oldest LBK communities from the upper Vistula basin (*i.e.* from Podkarpacie) to the east, to the areas on the upper Bug and Horyń, and then north, down the course of both these rivers, or only the Horyń (Fig. 11). The latter option implies the possibility of colonization of the Hrubieszów Basin by communities who came directly from Volhynia. This may be indicated by the presence only of products made of Volhynian flint in the flint inventory from Świerszczów. Regardless of this, the processes initiated in the oldest phase of the LBK were also continued in its younger episode related to the spread of Zofipole stylistics. This may be inferred from the presence of sites dated to the Zofipole phase in the Horyń and Bug basins, and indirectly also in the Hrubieszów Basin and Central Roztocze (Fig. 11). However, the increase in the number of Zofipole sites visible within the eastern Lublin region, allows us to consider the possibility that the LBK community penetrated these areas by other routes as well, leading directly either from the Sandomierz region (San – Tanew – Huczwa) or from the Podkarpacie zone – more precisely from the Rzeszów region (Wisłok – San – Tanew – Huczwa). This issue, due to the lack of sufficient source materials, remains open at the moment, but it is undoubtedly one of the most important aspects of research on the neolithization of areas between the Vistula and Bug Rivers – all the more so, because the phenomena initiated in the oldest phase of the LBK within the eastern part of the Lublin region (especially in the Hrubieszów Basin) constituted a specific prelude of fundamental, dynamic and permanent settlement processes documented in its remaining areas in the next, *i.e.*, classical, period of LBK development (*cf.* Brzozowski 1986, 2; Szeliga 2021).

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LITHIC INDUSTRY OF TWO LINEARBANDKERAMIK SITES IN MOLDOVA (NICOLAEVCA V AND ŢÂRA II)

ABSTRACT

Kiosak D., Dębiec M., Saile T. and Ţerna S. 2021. Lithic industry of two Linearbandkeramik sites in Moldova (Nicolaevca V and Ţâra II). *Sprawozdania Archeologiczne* 73/1, 303-329.

The two Linear Pottery culture lithic complexes presented in this paper came from northern Moldova. The Nicolaevca V assemblage was gathered from excavations of a small LBK dwelling, while the Ţâra II collection came from an eight-shaped pit. There was a “deposit” of objects suitable for knapping found in Nicolaevca V. This complex reflects flake-oriented expedient knapping. The Ţâra II complex represents a complicated sequence for obtaining regular blades. The interpretation of their differences is sought in the social organization of Neolithic flint-knapping, in which the Nicolaevca V lithic assemblage supposedly reflects domestic production in a household context, while Ţâra II products could have been involved in the exchange network.

Keywords: Neolithic, lithic technology, operative chain approach, caches of objects for knapping
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INTRODUCTION

The lithic industry of the Linearbandkeramik (LBK) culture is represented to a large extent by laminar complexes dominated by end-scrapers and retouched blades from a typological point of view. The so-called "sickle inserts" are usually recovered in notable series (Tringham 1968; Kaczanowska 1980; Kozłowski 1989; Allard 2004). On the other hand, there is a fair selection of counterexamples: sites that have peculiar structures of lithic complexes for a variety of (supposed) reasons (Gronenborn 1997, 62-65; Gronenborn 1998; Burnez-Lanotte, Allard 2003; Mateiciucova 2008, 156-162; Allard and Denis 2015; Nikitin *et al.* 2019). The interpretation of this variability is an important problem to solve.

The easternmost line limiting the extent of the LBK has changed recently. Dmytro Haskevych (Gaskevych) found a new site, Vita-Poshtova, on the Dnieper river, near Kyiv (Gaskevych 1997). In 2011, the Odessa National University survey team found a new site, Kamyane-Zavallia, on the Southern Buh river, thus moving the conventional boundary further to the south-east (Kiosak 2013; Kiosak *et al.* 2014a; Kiosak *et al.* 2014b; Saile *et al.* 2016; Kiosak and Salavert 2018). The notion of a clearly delineated boundary is purely conventional (Nowak 2019, 104-106). The area of settlement in the early Neolithic was not continuous. Rather, it existed in the shape of a number of settled microregions with multiple sites clustered on 10-25 km stretches of land (Lüning 1982). The latter were surrounded by scattered sites of single finds of LBK artefacts in the contexts of indigenous cultures (Nowak 2007; Kiosak 2014; Kitagawa *et al.* 2018, 203-204). Recent research

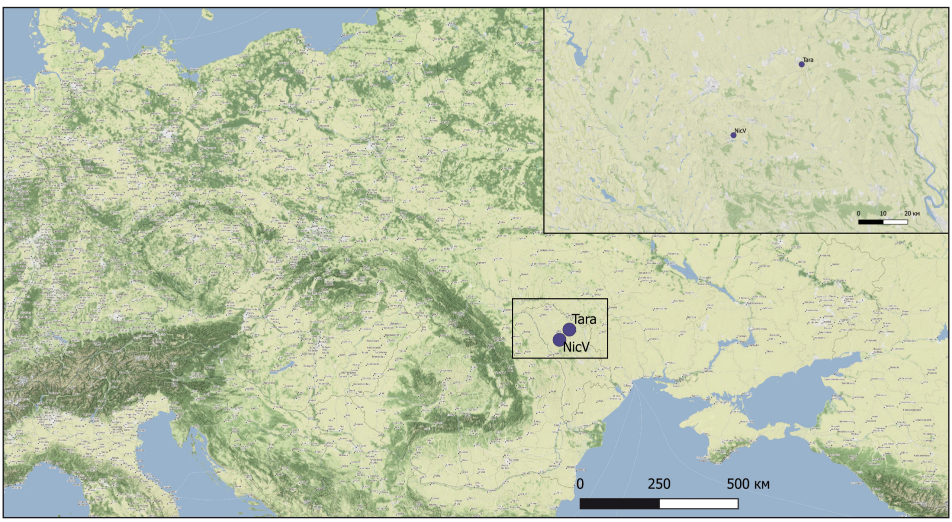

Fig. 1. Location of Nicolaevca V (Nic V) and Ţâra II (Tara).
Topo: Stamen USA terrain accessed via QGIS 2.18

suggests that such a microregion existed around the Kamyane-Zavallia site (Kiosak 2017; Kiosak *et al.* 2020; Saile 2020).

In the marginal areas of the LBK distribution, the development of a Neolithic economy and society is usually placed within the framework of interaction between local foragers and external Neolithic farmers. Lithic artefacts form a category of material culture that is common for groups of both economic types. Thus, the traces of their interaction are often sought in the comparison of lithic complexes. Under such premises, the creativity and ingenuity of the knapping of early farmers is often underestimated, and complexes with a particular structure tend to be interpreted as direct evidence for "Mesolithic influence" (Gronenborn 1998; Mateiciucova 2008, 156-162; Nikitin *et al.* 2019).

From this point of view, studies on chipped stone assemblages are of particular importance for understanding the settlement at the easternmost fringe of the LBK. The subject of this text is the lithic assemblages of two sites from the territory between the Prut and Dniester rivers (Fig. 1). Both lithic assemblages stand out from the "standard", each in its own way. Interpretation of their peculiarities is far from straightforward.

STATE OF ART

The lithic industry of the LBK in the eastern part of its distribution has a long history of research. G. Korobkova subjected some LBK collections to use-wear analysis (Korobkova 1987, 165-169). O. Larina produced a synthesis on the typological composition of LBK lithic complexes of modern-day Moldova (Larina 1999, 46-50). The state of research was summed up by Dmytro Haskevych (2003), who defined two variants of the lithic industry. The Volhynian variant is characterized by the prevalence of end-scrapers on blades, retouched blades, "sickle inserts" made on truncated blades, etc. The Middle Dniester variant is characterized by a prevalence of end-scrapers on flakes, often subcircular, and the presence of conical cores and trapezes (Gaskevych 2003). In this paper, we are dealing with the sites of the Middle Dniester variant. Conical cores, geometric microliths and subcircular end-scrapers were treated as "Mesolithic heritage" (Păunescu 1970, 39; Larina 1999, 50; Turcanu 2009, 160; Dergachev and Larina 2015).

RAW MATERIAL

The raw material available to the early farmers in the south of Eastern Europe was described by V. Petrougne (1995). There are outcrops of so called excellent-quality "Volhynian" flint to the north of the region under study. The northern part of modern-day Moldova contains numerous outcrops of Middle Dniester silicites (Petrougne 1995). These two varieties are the most important for LBK sites of the Prut-Dniester region.

The flint varieties (lithogroups) were defined by macroscopic analyses on colour, texture, inclusions, cortex, *etc*., of the available pieces. They were named according to a code proposed by M. Pawlikowski (Pawlikowski 1992). The first component stands for the country of in which the lithogroup was discovered (MD, in our case Moldova), the second denotes the place of discovery (site, outcrop *etc*., Nic in our case, Nicolaeuca V) and the third indicates the type of raw material used (F – flint) and the number of the lithogroup (1-6).

MD-Nic-F1 – grey, dark-grey, with white inclusions, transparent when thin, in small whitish points and with spongy cortex, very cavernous (Petrougne 1971);

MD-Nic-F2 – rather similar to the previous group but with much larger white inclusions, giving a "zonal outlook" to a piece;

MD-Nic-F3 – very dark, with small, white punctuations; non-transparent flint;

MD-Nic-F4 – transparent, dark-grey, with small whitish points; very plastic flint;

MD-Nic-F5 – jelly-like, semi-transparent, plastic, with large white inclusions.

Md-Nic-F7 – very transparent, plastic flint, corresponding to the Turonian ("Volhynan") flints of Western Ukraine (Petrougne 1995).

THE SITES

The two sites that were selected for this study belong to the "Middle Dniester" variant of the LBK. They are situated in the north of modern-day Moldova. There is a distance of over 40 km between them (Fig. 1).

Ţâra II stands on the bank of the Reut river. It was discovered by V. Marchevici (Markevich) in 1958, and was excavated by T. S. Passek in 1960 (Passek and Chernysh 1963, 29-30). There, in a section of a riverbank, a typical eight-shaped pit was excavated. It contained numerous potsherds with *Notenkopf* decoration alongside shards of coarseware. Excavators noted an elevated amount of flintknapping debris at the bottom of the pit, near the fireplace that was recovered there.

The site, Nicolaevca V, was discovered by V. Bicbaev in 1973-1976, was surveyed and tested by trenches in 2014-2016, and was excavated in 2019 by an international expedition headed by Stanislav Ţerna and Maciej Dębiec (Saile *et al*. 2016). The remains of a typical LBK house were recovered – a *Kleinbau*-3-type building (Saile 2020). The site belongs to the *Notenkopf* phase of the LBK.

NICOLAEVCA V COLLECTION

Here we discuss the lithic artefacts that were found during the excavations of 2019. The materials from the preliminary surveys were not accessible to the authors, but are known to us from publication (Larina and Dergachev 2017, 185-187).

Table 1. General summary of the technological categories of the assemblage from Nicolaevca V

No.	Group	Quantity	Percentage %
1	Pebble	1	0.43
2	Pre-core	2	0.86
3	Core-like chunk	1	0.43
4	Hammerstone	5	2.15
5	"Retoucher"	1	0.43
6	Core	19	8.15
7	Flake	105	45.06
8	Chunk	8	3.43
9	Blade	24	10.30
10	Primary and subprimary flakes	11	4.72
11	Technical flake	12	5.15
12	Flake from hammerstone	1	0.43
13	Tools	43	18.45
14	Total	233	100.00

The presented collection consists of two different groups of objects. Pieces of the first group were gathered in the course of excavations of the dwelling structure (long house) in the excavation pit with a size of 514 m^2, while the second group is composed of items coming from a concentrated scatter of finds (deposit?), mostly of chipped stone on the surface of a 1 × 1 m^2 area, which lay in a long pit, just outside the house.

The first group is representative of the lithic technology of the Nicolaevca V site "in general", and the second group reflects a particular episode of flint-working. They will be described separately in the following text.

Summary of assemblage. Assemblage I consists of 22 pieces of knapping (9.44%, groups 1-3, 6 from Table 1), 6 "tools for knapping" (2.58%, groups 4-5), 23 technical and primary flakes (9.87%, groups 10-12), 129 unmodified products of debitage (55.36%, groups 7-9) and 43 items with modified shape, either by retouching or trimming or burin blows, or by macrotraces of use ("tools", 18.45%, group 13).

Objects of knapping are represented by a tested pebble (1 item), two pre-cores, a core-like chunk, and 19 cores. The tested pebble has an alluvial cortex. Several detachments were taken off it, and it was later rolled by water flow again in such a way that detachments were covered by secondary cortex. It is 70.5 mm long and 59 mm wide, with a weight of 217 gr. It is quite suitable for future knapping and maybe represents an object taken to the site in anticipation of future needs.

The core-like chunk is a fragment of a core that was very cavernous. After the inhomogeneity of the raw material had stopped the knapping, several flakes were still detached.

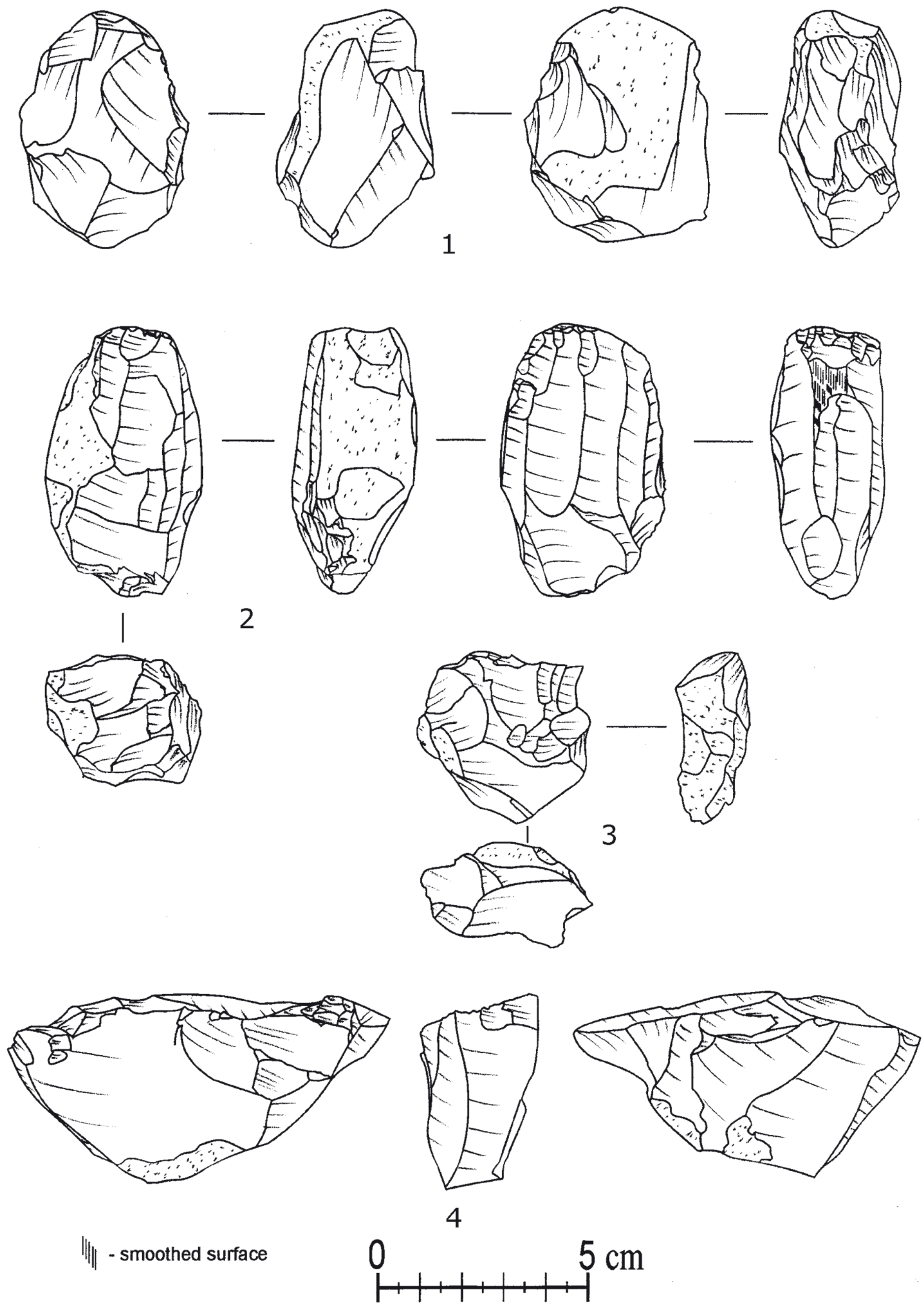

Fig. 2. Nicolaevca V. Cores (1-4).
Drawing conventions: circle – point of impact, filled – with a bulb preserved, dotted line – breakage

Pre-cores are generally smaller than cores, so they actually do not represent the earlier stages of the operative chain that resulted in the shaping of most available cores. The pre-core (Fig. 2: 1) is in fact a pebble with the remains of a working surface on one side and with a crest formed on the other side. Thus, the core was exploited for a while, and later, an attempt to open a new working surface was made. The crest was formed by a sequence of alternating detachments forming the sides by using the notch of the bulb of a previous removal as a point of impact for the next. A similar crest was shaped along the complete perimeter of a chunk (another pre-core), also probably in an attempt to re-use a piece that was already knapped.

Cores were used mostly for the detachment of flakes (10 pcs), flakes and blades (3 pcs) and blades (6 pcs). The cores for flakes are amorphous (4 pcs) or subprismatic (4 pcs). There are also a prismatic core and a radial core for flakes. The detachments of flakes were rarely prepared, which was mostly limited to the trimming of overhang (Fig. 2: 3). Striking platforms are flat and unmodified. They often bear ring-cracks indicating quite rough impact in order to detach flakes. Cores for flakes had one platform (7 pcs) or two platforms (2 pcs). The radial core has a radial striking platform along its perimeter. In many cases, the knapping occurred on the suitable angle of the flint piece.

Some cores were used for the production of both blades and flakes. Usually flakes and blades were detached from different working surfaces. Such cores (3 pcs.) are amorphous, subprismatic and prismatic. Their products have curved edges and an irregular dorsal pattern of negatives.

Cores for laminar production were prismatic (3 pcs) and subprismatic (3 pcs). Only one core was used for the removal of microblades and bladelets – a very small (30 × 30 mm, 15 gr) exhausted core, belonging to the so-called "flat" core type (Telegin 1976).

Cores for blades have complex striking platforms with a history of repair and correction reflected in the negatives of rejuvenation flakes. These cores had either two striking platforms (3 pcs) or a single striking platform preserved (3 pcs). The fronts of laminar detachments are relatively short and narrow; often, they are flanks of knapped objects (Fig. 2: 4). Neo-crests (Marchand 1999) were formed in order to widen working surfaces, but sometimes without success. A broken core for regular blades was re-oriented and re-used for laminar detachment without much preparation – not even the removal of an overhang. The resulting blades were short and irregular. It seems the complex sequences of blade-core preparation were not used by Nicolaevca knappers. The cores were used to detach flakes and short, irregular blades and bladelets in opportunistic way. The only core designed for a prolonged, serial laminar production (Fig. 2: 2) is a prismatic core with a single striking platform and a working surface along 3/4 of its perimeter. Its back and keel were shaped with a double-sided crest. It is 58 × 34 mm and weighs 66 gr. It could be considered an outlier in a rather flake-oriented industry.

The tools for knapping include 5 spherical hammerstones. Some are evidently re-used cores covered with starry surfaces from multiple hits, as a result of which their shape became subspherical. Their weights range from 73 to 188 gr, indicating probable differences in functional application. There is also one "retoucher", which is an elongated object shaped by 3 double-sided crests. The crests give it a sub-cylindrical shape. Its edges and ends bear traces of multiple hits. Similar items were also labelled as "retouchers" (Markevich 1974, 85); however, definite evidence for their function is still missing.

Primary and subprimary flakes are made of raw materials that are indicative of local origin. Their percentage is typical for a situation in which the decortification itself took place elsewhere and the knapping of the tested nodules occurred on-site. Some cortex was removed on site, but only rarely were the resulting cortex-bearing flakes the first flakes detached from a given piece of raw material. Thus, the raw material was imported to the site in the shape of tested nodules and/or prepared pre-cores and cores.

Technical flakes included edge removals (elongated flakes of triangular cross-section, 6 pcs), crested flakes (3 pcs), two flakes of re-orientation and a crested blade. They are connected with the renovation of short and narrow working surfaces, the reorientation of cores after a primary working surface was exhausted and the widening of a working surface to new sides of a core. The short, crested detachments (rather flakes than blades) may in fact be related to similar operations and, thus, should be treated as neo-crested flakes – elements of core utilization and not the initial detachments of serial production. The absence of rejuvenation flakes of cores is very diagnostic. It seems that cores were prepared elsewhere and there was utilization of pre-prepared cores on site, mostly limited by the small size of the cores and multiple cavities in the original pieces of raw material, which resulted in numerous attempts at core reorientation and shifting of working surfaces in order to finalize the already quite exhausted cores.

The composition of *Debitage products* at the site is very interesting. Flakes are more than four times as common as blades when we compare unmodified blanks. *Façonnage* touched blades and flakes are in almost equal proportions; however, some retouched blades are too regular to have been produced by the simple techniques in use on the site. They could have been brought from elsewhere. Thus, the Nicolaevca V industry was flake-oriented. Almost 3/4 of the flakes had lengths between 10-30 mm, and about one quarter were between 30-50 mm (Table 2). Smaller and larger flakes are very rare. Large flakes were probably impossible to obtain due to the small size of the raw material pieces (pebbles

Table 2. Flakes. Metrics

No.	Metric group (length)	Quantity	Percentage %
1	0-10 mm	2	1.90
2	10-30 mm	74	70.48
3	30-50 mm	26	24.76
4	over 50 mm	3	2.86
5	Total	105	100.00

Table 3. Blades. Metrics

Metrical group (width)	Distal	Medial	Proximal	Complete	Total
0-7 mm	0	0	0	0	0
7-12 mm	1	1	2	0	4
12-20 mm	4	3	7	2	16
over 20 mm	0	0	3	1	4
Total	5	4	12	3	24

and nodules). Absence of smaller flakes, which are omnipresent indicators of on-site knapping, points to major knapping efforts taking place elsewhere, outside the excavated area. However, the location of knapping was likely not too far from the excavated "long" house, because the multiplicity of flakes and other by-products of knapping, which are usually useless to transport, would indicate that these products were widely available for expedient use in the Nicolaevca V household (Saile 2020).

Flakes often exhibit cortex or parts of cavities and other inhomogeneities that were exposed by their detachment. It seems that cavities were often an obstacle for better knapping.

Blades usually are fragmented (Table 3). Complete blades are very unusual. Fragmentation often occurred just by removing the curved distal part, so proximal "long" fragments (Fig. 3: 5) dominate the assemblage. Rarely does the length of a blade surpass 40 mm. Regular, laminar products with parallel edges and dorsal ridges were exceptionally rare (Fig. 3: 7).

Modified items ("tools", Table 4) are made on flakes (22 pcs), blades (18 pcs), and technical flakes (2 pcs), and a chunk was retouched as well.

End-scrapers form the most numerous group (35%). They are mostly done on flakes (4/5). The front ends of scrapers were shaped on ends of blades with removed bulbs ("shortened"; Stanko 1982; 3 pcs) and flakes (5 items, Fig. 3: 12, 13, 16, 17). The front ends of scrapers were also widened on sides of flakes, sometimes even forming subcircular tools (2 pcs, Fig. 3: 11; 18). In a single case, an end-scraper with a rounded front was formed on a side of a flake (Fig. 3: 15). There is also a single side-scraper. Retouched blades include a fragment with two sides bearing semi-abrupt retouch and 4 pieces with marginal, simple, partial retouch (Fig. 3: 2, 6). Five blades bear characteristic angular polish – so called "sickle gloss" (Fig. 3: 8-9); in three cases, this is accompanied by retouch on the sides. Flakes and blades were truncated by abrupt retouch. A single flake bears both a truncated end and an abruptly retouched side (Fig. 3: 4). *Encoches* were retouched on a flake and on a subcrested blade (Fig. 3: 3). Some items bear irregular retouch (flakes, a chunk, and an edge flake). There is a straight perforator on a blade, formed by abrupt retouch along two sides (Fig. 3: 10). This is definitely a Neolithic element, absent in Mesolithic collections of the region (Telegin 1976). A fire-striker is a flake with multiple ring-cracks on

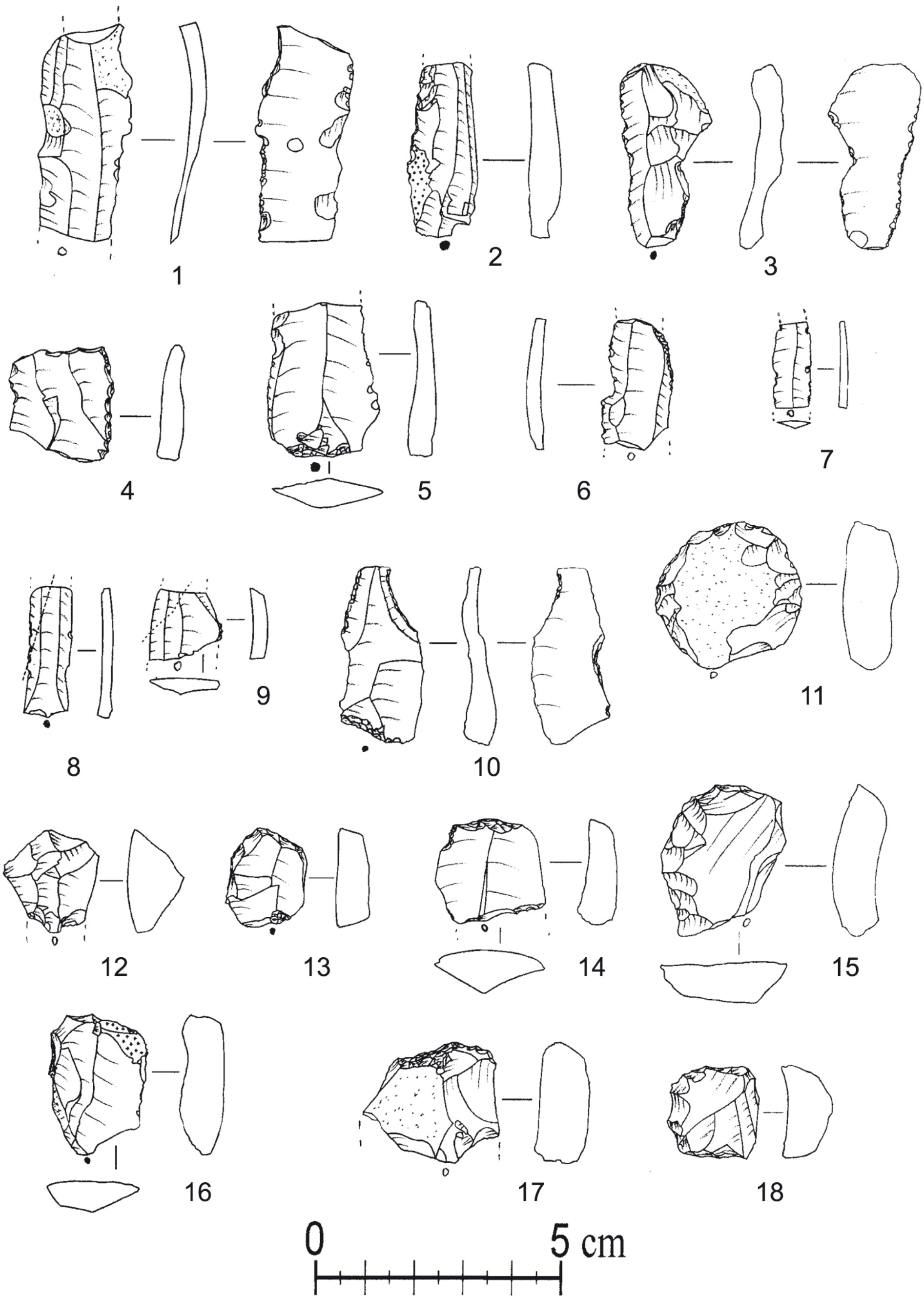

Fig. 3. Nicolaevca V. Tools (1-18)

Table 4. Tools and worked pieces

No.	Type	Quantity	Percentage %
1	End-scrapers	15	34.88
	on shortened blade	3	6.98
	on flake	5	11.63
	on side of flake	1	2.33
	subcircular	2	4.65
	on end and side of flake	2	4.65
	front of scraper	2	4.65
2	Side-scraper	1	2.33
3	Blade with polish and retouch	5	11.63
4	Truncated flake	2	4.65
5	Truncated blade	3	6.98
6	Blade with retouch	5	11.63
	semi-abrupt on 2 sides	1	2.33
	marginal simple	4	9.30
7	Edge flake with retouch	1	2.33
8	Retouched flake	4	9.30
9	Multiple transversal burin on a blade	1	2.33
10	Perforator on blade	1	2.33
11	*Encoches*	2	4.65
	on flake	1	2.33
	on subcrested blade	1	2.33
12	Fire-striker	1	2.33
13	*Piece ecaille*	1	2.33
14	Retouched chunk	1	2.33
15	Total	43	100.00

its ventral surface, opposite to multiple facets of repeated detachments. A multiple transversal burin was made on a blade. The burin blows were delivered from the side of the blade, along the surface of breakage, when fragmenting the blade. Burins are few in LBK collections from Moldova (Larina 1999, 46-50), but are rather numerous in Volhynia (Manko and Telizhenko 2016).

"Deposit"

A dense scatter (object 3008) of lithic finds was comprised of 32 chipped flint pieces and 1 sandstone plate (61 × 42 mm). Similar artefacts were called "pallets" by V. I. Marchevici. The chipped stone assemblage consisted of a hammerstone, four pre-cores, two core-like chunks, three thick flakes, a subprimary flake, a blade and 20 cores.

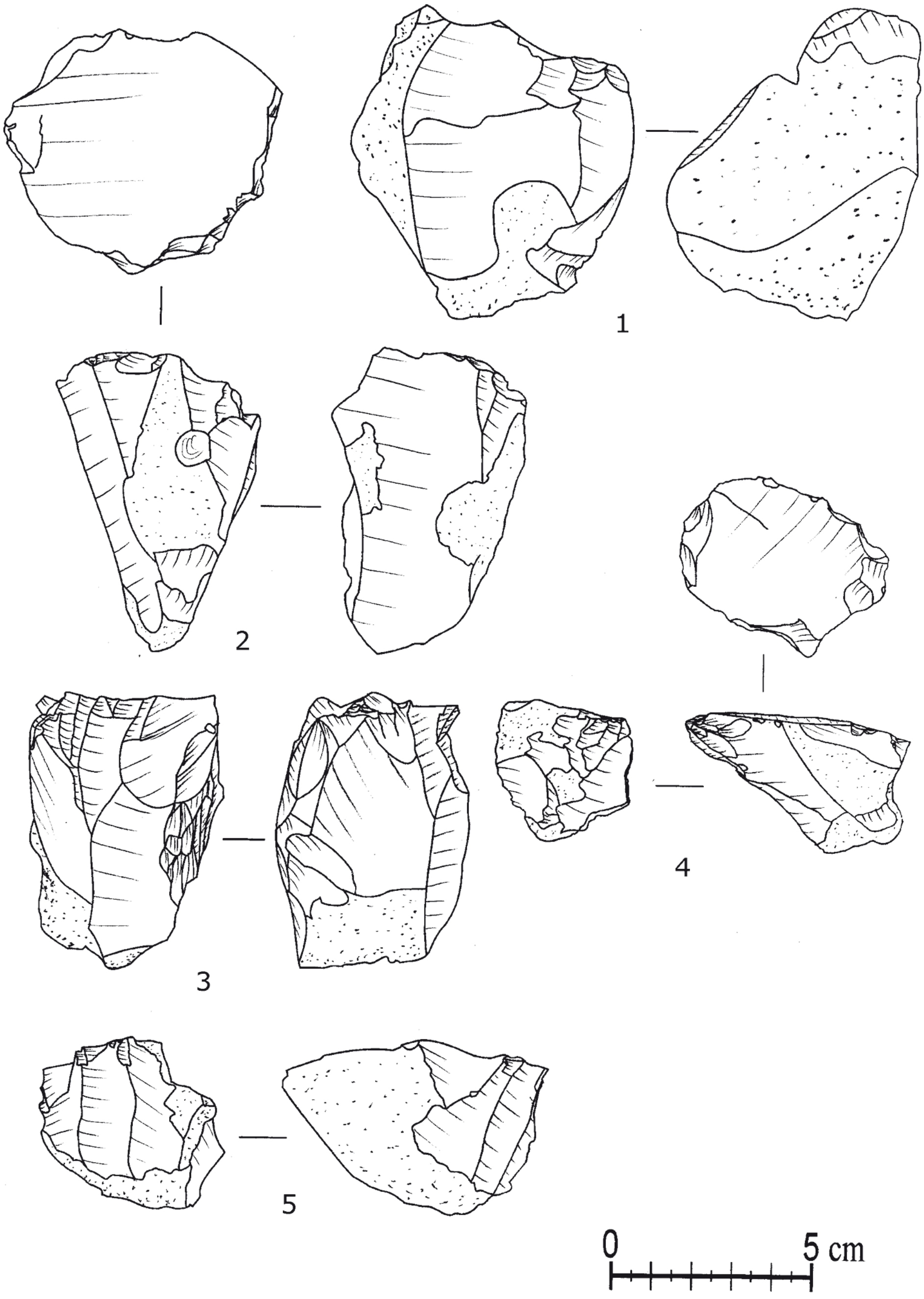

Fig. 4. Nicolaevca V. Cores from "deposit" (1-5)

The hammerstone (Fig. 6: 6) is spherical with a diameter of 44 mm and a weight of 110 gr. It is made of flint, and in fact represents a re-used core.

Pre-cores are variable. One pre-core (Fig. 6: 2) is semi-naviform. A wide platform was shaped by a single blow. The flank was prepared by a row of wide trapezoidal flakes. An attempt to create a keel failed due to the inhomogeneity revealed by small detachments from another flank. Still, it could have been useful for flake production. Another pre-core (Fig. 5: 4) had a double-sided crest formed on its narrow face. After an attempt to remove it, the object was left unmodified. Nonetheless, it retained enough volume to continue knapping (163 gr). A third pre-core is of naviform shape (Fig. 5: 2). It had a crest formed by convergent flake removal and, further down, by typical double-sided preparation. The crest was not removed, probably in anticipation of further knapping. The last pre-core is too small for further serial production. It is encompassed by a double-sided crest. Probably, it was prepared to be re-used as a hammer, and the crest was needed as an accommodative element.

Cores were mostly used for flake production (13 pcs, Fig. 4: 1; Fig. 5: 3). They each had a single striking platform, along with a secondary core where a second platform was situated in order to exploit the second narrow face of a thick flake. Flake cores are wedge-like (1 pcs, Fig. 4: 2), prismatic (6 pcs), narrow-faced (1 pcs) or narrow-faced on the sides of thick flakes (secondary, 4 pcs). These categories are arbitrary so far as in almost every case, a suitable front was knapped for a series of flakes that were removed without much preparation. Sometimes such a front was found along the wider side of a core and quite often along the narrow side (Fig. 4: 4, 5), but in particular along the edges of thick flakes. The secondary core (Fig. 6: 3) had some flakes removed off its ventral surface, making it technically a Kombewa core (Inizian *et al.* 1995). The cores are less exhausted than cores found in the excavation pit in general. They have fewer platforms, fewer working surfaces and fewer traces of re-orientation. In most cases, it seems that a single series of flakes was removed before objects were deposited in scatter 3008.

Three cores were used for both blade and flake production. Usually, they are subprismatic and have two striking platforms and working surfaces, each for a separate type of product (Fig. 4: 3). Sometimes, in course of mostly flake production, some products were obtained that were long enough to be treated as short, irregular blades.

Four cores were utilized in the course of blade production. In two cases, thick flakes were used as cores. The edges of the flakes were used as narrow faces to detach a series of curved, short blades. Small alluvial pebbles (up to 90 mm long) were used to remove laminar products from one of the sides (Fig. 5: 1). Striking platforms of blade cores bear traces of preparation by flaking, and sometimes even abrasion.

Most cores did not show hinges or other visible obstacles for further knapping. They were suitable for the continuation of serial detachments, and due to their weight, they retained some useful volume.

Core-like chunks have some traces of knapping, h but there was no evidence of repetitive, serial use. They are suitable for further utilization.

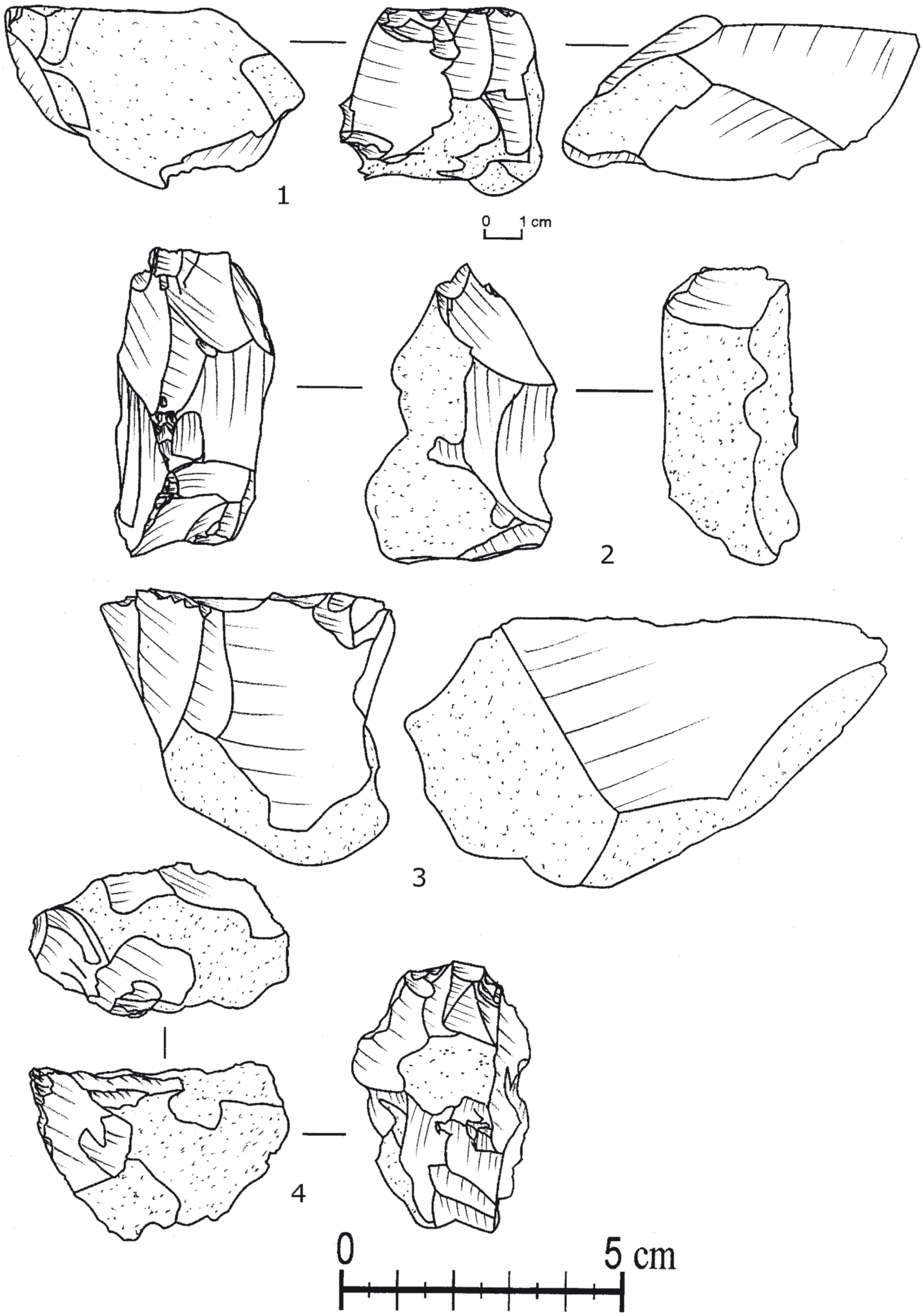

Fig. 5. Nicolaevca V. Cores from "deposit" (1-4)

Debitage products are mostly intended for re-use as secondary cores. Flakes are thick (17-33 mm) and resemble other flakes that were used as secondary cores in the assemblage. There is one technical flake in the assemblage: a wide, trapezoidal flake, formed in course of flanks formation. It has a shape and dimensions that made it a suitable blank for a retouched tool. The only blade is clearly an aim product of reduction. It is a long, proximal part, 45 × 14 mm, with a concave, prepared butt.

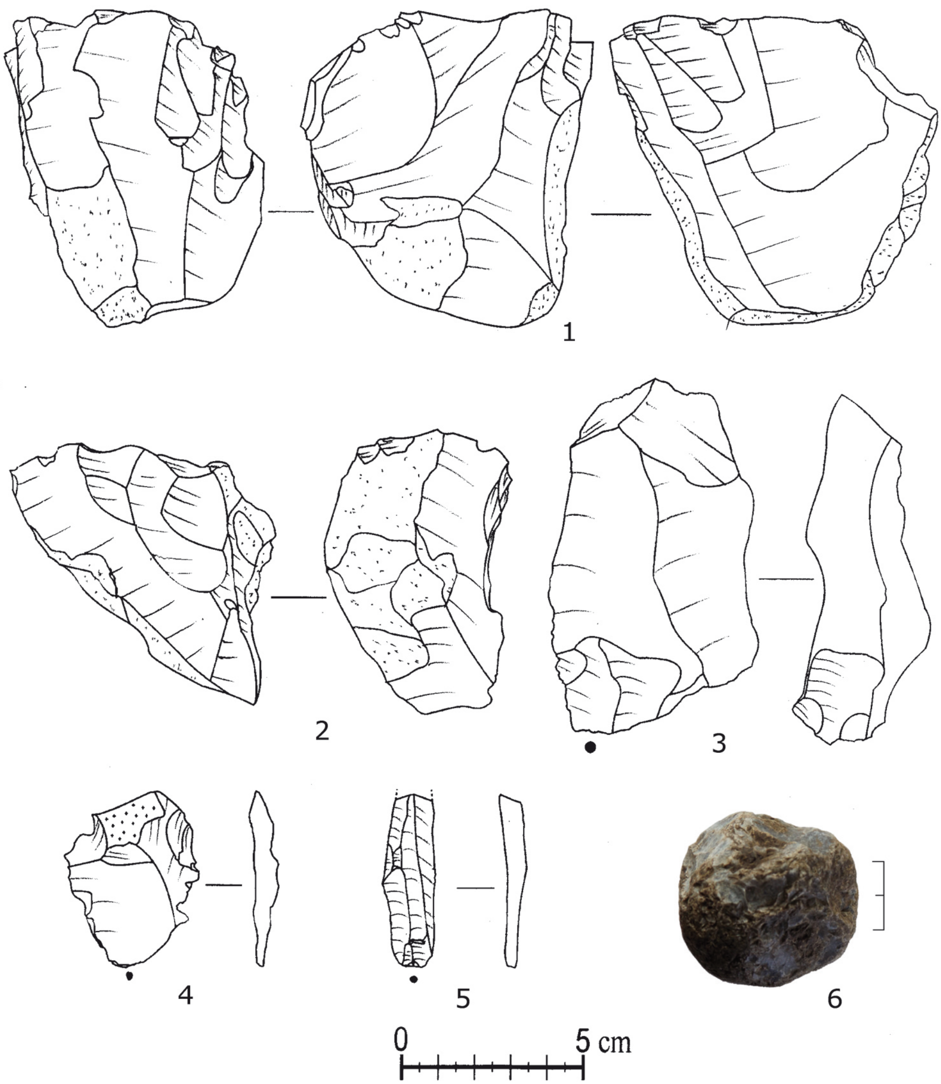

Fig. 6. Nicolaevca V. Objects from "deposit" (1-6)

Thus, the lithic assemblage of Nicolaevca V *Kleinbau* represents simple, opportunistic knapping in pursuit of flakes or short, irregular blades. Preparation for detachment is rare and uneven. The laminar component of the complex is confined to a few items. Regular serial production of blades was limited, if indeed it ever existed on the site.

Țâra II collection

The chipped stone assemblage consisted of 180 pieces from Țâra II. We were able to study 121 artefacts kept in the Odessa Archaeological Museum of the Ukrainian NAS. Over 40 finds are kept in Chişinau, in the National Historical Museum of Moldova. They were published by V. Dergachev and O. Larina (2017). Descriptions of the finds, made by the excavators, seem to imply that the collection from the pit is kept in Odessa, while other miscellaneous lithic finds are in Chişinau.

Assemblage consists of 21 pieces of knapping (17.36%), 4 fragments of "tools for knapping" (3.31%), 21 pieces of technical and primary flakes (17.35%), 39 pieces of unmodified products of debitage (32.23%) and 21 pieces with shapes modified either by retouch, trimming, burin blows, or by macrotraces of use ("tools", 17.36%).

The collection includes numerous pebbles and fragments thereof (11 pcs, 9.09%). They represent lithogroups MD-Nic-F1 – F3. Outcrops of similar flint are known in close vicinity of the site. The bottom of Reut river is sometimes paved with flint pebbles of similar quality (Larina 1999). Some pebbles from Țâra II weigh about 1 kg, retaining a large mass of raw material. A single core re-used as a hammerstone still had cortex portions preserved in such a way that we can reconstruct the general dimensions of the pebble. It was an oval,

Table 5. General summary of the technological categories of the assemblage from Țâra II

No.	Group	Quantity	Percentage %
1	Pebbles flaked and unflaked	11	9.09
2	Chunks	4	3.31
3	Pre-cores	2	1.65
4	Expedient cores	10	8.26
5	Cores	9	7.44
6	Primary and subprimary flakes	13	10.74
7	Technical flakes	8	6.61
8	Flakes	24	19.83
9	Blades	15	12.40
10	Hammerstones	4	3.31
11	Tools	21	17.36
12	Total	121	100.00

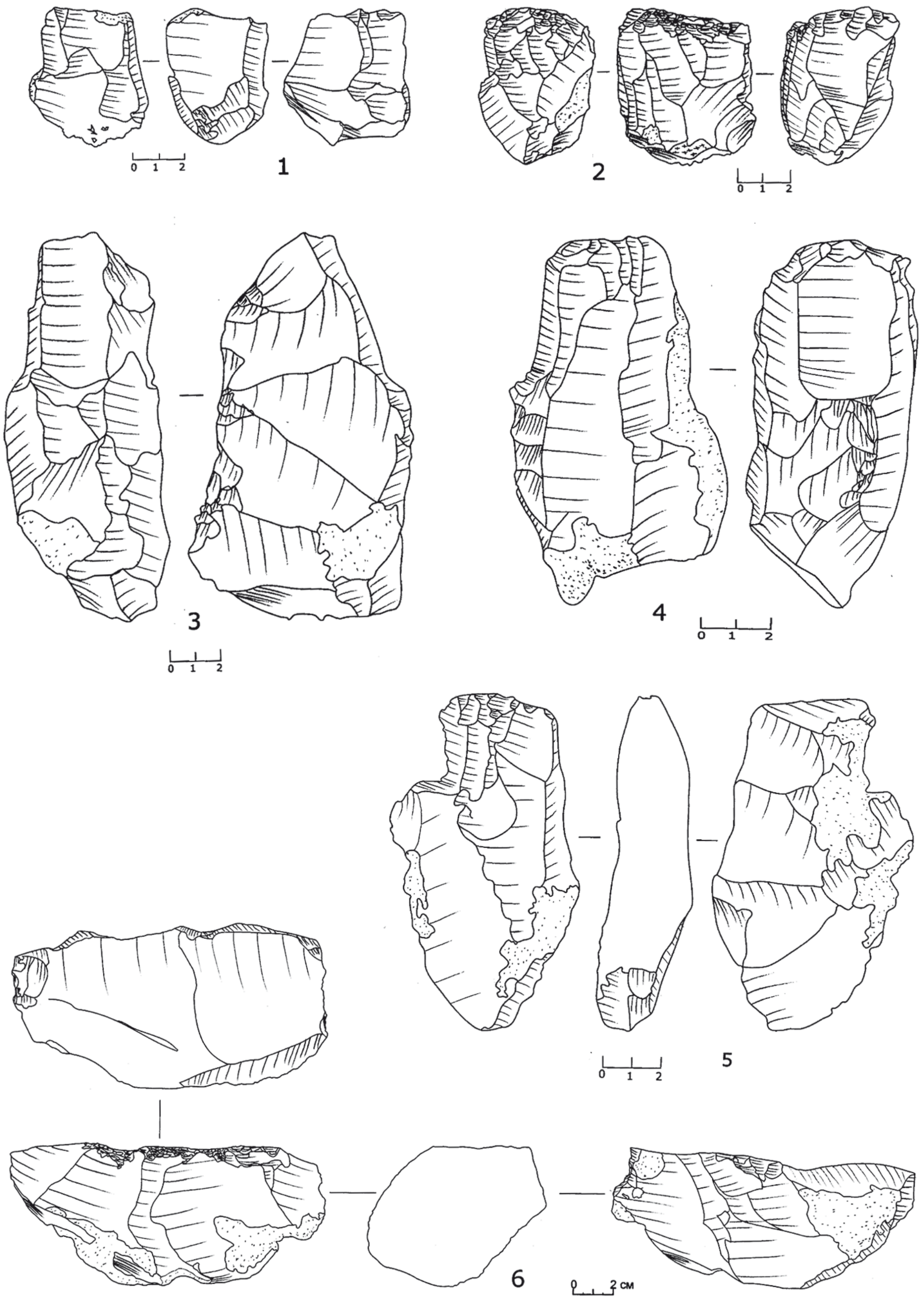

Fig. 7. Ţâra II. Pre-core and cores (1-6)

flattened pebble, 40 × 40 mm in section, with a length of 80 mm at least. T.S. Passek mentions a single core made of "chalk dark flint" (Passek and Chernysh 1963, 30). However, it was absent in the studied selection.

Most cores are expedient (10 pcs). Flakes were struck from a suitable surface without a preparatory effort. Eight expedient cores each have a single striking platform. A core with two opposed platforms was knapped in order to produce short microblades. Another core has three platforms. It was initially made for regular laminar production. It was then reoriented in an effort to strike two series of short, irregular bladelets off the core.

Regular laminar production is represented by items discarded at various stages. There are two typical pre-cores in the collection (Fig. 7: 6), which have a naviform shape. A series of wide, trapezoid detachments were removed on both sides of one of the pre-cores. Striking platforms have angles of 60-75 degrees. Both pre-cores have a weight of 500-550 grams.

Further knapping proceeded in the following way: a crest was knapped off the pre-core. The narrow working surface was opened on a flank of the pre-core. The second striking platform of a pre-core was not used systematically. The knapping proceeded in a unidirectional manner. Cores looked like flank prismatic cores (Fig. 7: 3). Then, when the flank was flattened, an attempt was made to transfer knapping to another side (Fig. 7: 4). A semi-crest was formed by detachments off the working surface on a planned side, and then this *néo-crête* (Marchand 1999) was removed. In at least one case (Fig. 7: 4), this attempt failed. This process, when successful, resulted in a core with a conical or subconical shape. Usually, after finishing serial laminar production, a core was finalised by a series of lamellar removals, or more often by irregular knapping in pursuit of flakes.

Technical flakes (8 pcs, Fig. 8) include rejuvenation flakes from striking platforms (4 pcs), a half-crested blade, re-orientation flakes and a flake from the keel of a sub-conical core. They reflect basically the same technological sequence, as described above – proceeding from a naviform pre-core, knapping flakes off a unidirectional core with two platforms, then widening the working surface to its flanks, and re-shaping it into a prismatic or subconical core with negatives of regular detachments around most of its perimeter.

The collection contains only 15 blades (8%) and only 24 flakes (19.83%).

Flakes are generally larger than those from Nicolaevca V, and larger items are more numerous (Table 6). This pattern is difficult to find in the remains of knapping *in situ*. This suggests a selection of pieces for discard into the pit of Ţâra II.

Metrical parameters of blades differ from the picture typically seen on residential settlements of the LBK (Table 7). Complete specimens form 1/3 of the selection. Surprisingly, blades are mostly represented by complete, irregular specimens or distal portions. Taking into account the regular laminar patterns of negatives on working surfaces of cores, we would expect the removal of blades from the collection in prehistory.

Retouched tools include eight end-scrapers, two side-scrapers, three fragments of flakes with marginal retouch, two perforators on flakes, two blades with marginal retouch and a blade with oblique truncation (Table 8).

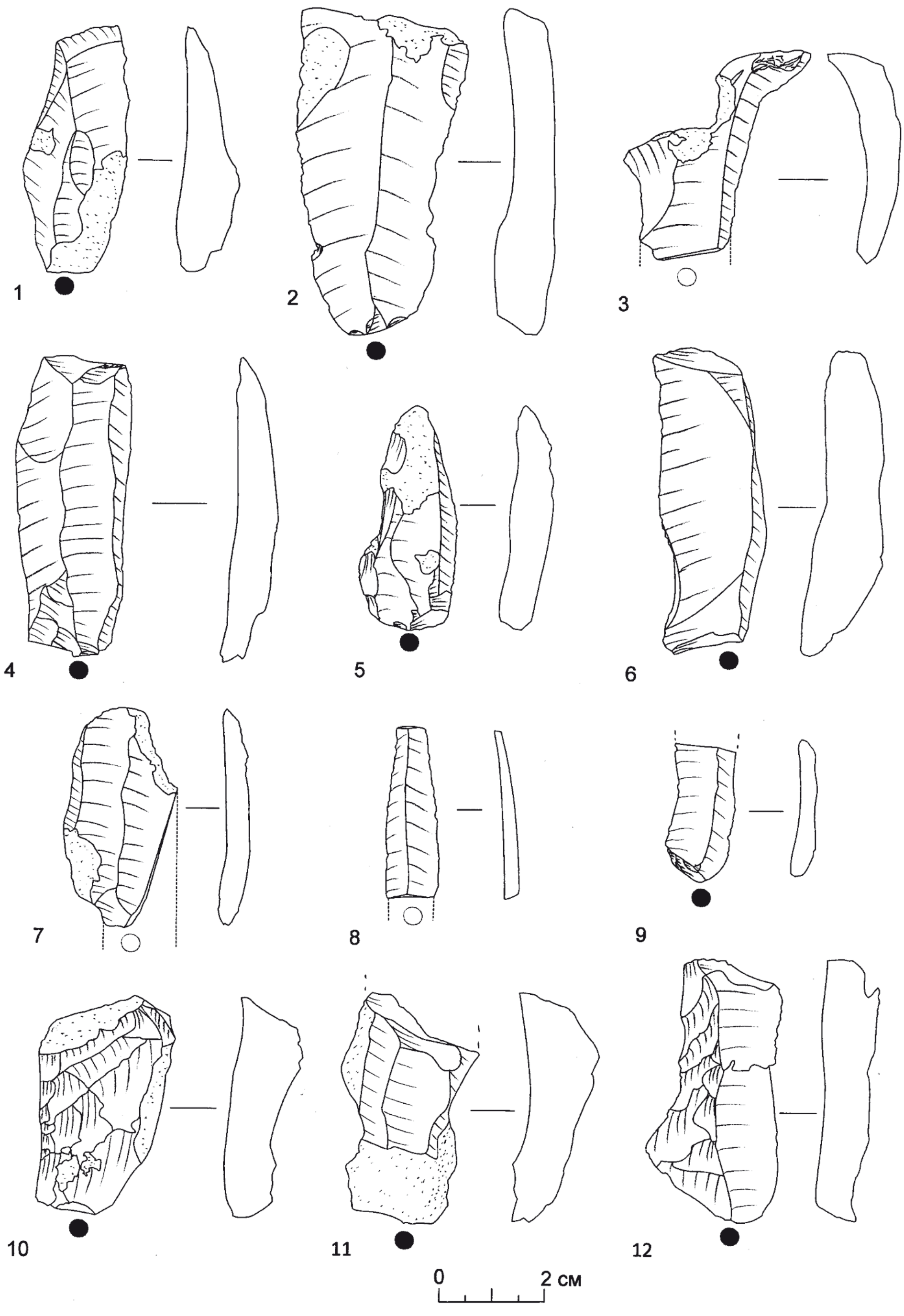

Fig. 8. Țâra II. Blanks and technical flakes (1-12)

Table 6. Ţâra II. Metric parameters of flakes

No.	Metric group (length)	Quantity	Percentage %
1	0-10 mm	0	0.00
2	10-30 mm	7	19.44
3	30-40 mm	11	30.56
4	over 40 mm	18	50.00
5	Total	36	100.00

Table 7. Ţâra II. Metric parameters of blades

Width	Complete	Proximal	Medial	Distal	Total
0-7 mm	0	0	0	0	0
7-12 mm	1	1	0	1	2
12-20 mm	0	1	0	2	3
over 20 mm	4	1	0	4	5
Total	5	3	0	7	15

Table 8. Tools and worked pieces

Type	Quantity	Percentage %
Side-scrapers	2	9.5%
End-scrapers	8	38.1%
on an end of a flake	1	4.8%
on an end of a blade	1	4.8%
on technical flakes	1	4.8%
on a side of a flake	2	9.5%
on a side of a technical flake	1	4.8%
fronts	2	9.5%
Flakes with marginal retouch	6	28.6%
Perforators on flakes	2	9.5%
Blades with marginal retouch	2	9.5%
Blades with oblique truncation	1	4.8%
Total	21	100.0%

Thus, the Ţâra II collection demonstrated an operative chain oriented towards laminar production. An important feature is the prevalence of cores and by-products of knapping in the collection. Tools are few and atypical. Does this imply that the eight-shaped pit of Ţâra II was likely a place where mostly knapping occurred – a "workshop"? The available information makes it unlikely. More likely, the eight-shaped pit was an evacuation zone.

The absence of small flakes and chips is an important argument contra knapping on-site, considering the disproportions (noted above) in the representation of different technological groups of artefacts. However, knapping oriented toward blade production, followed by the extraction of the produced blades occurred on the site of Țâra II.

DISCUSSION

In order to develop an interpretation, we need to place Țâra II and Nicolaeuca V into a wider context and compare them to larger collections from other sites: Kamyane-Zavallia, Gura-Camencii VI, Sîngerei I, and Dănceni I (Kiosak 2016; 2017; Larina and Dergachev 2017). The primary composition of each complex indicates important differences (Fig. 9). In some sites, like in Dănceni I, retouched tools outnumber blanks. In others, flakes are very numerous, indicating on-site production. Țâra II stands out by a high percentage of cores.

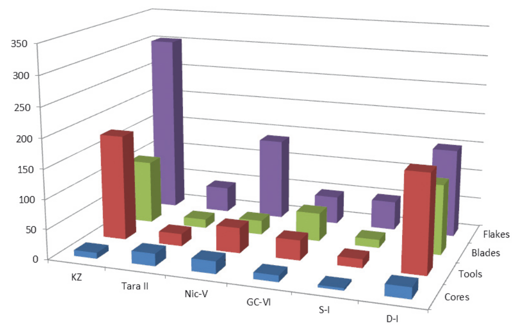

Fig. 9. Comparison of lithic complexes' structures for sites of the easternmost LBK area. KZ – Kamyane-Zavallia (n = 598, after Kiosak 2017), Tara II - Țâra II (n = 121), Nic-V – Nicolaevca V (n = 226, this work), GC-VI – Gura Camencii VI (n = 140), S-I – Sîngerei I (n = 82), D-I – Dănceni I (n = 452, after Larina and Dergachev 2017)

Deeper analysis of the composition of the assemblage reveals several groups of sites. The sites with high indices of retouched tools, Dănceni I and Gura-Camencii VI, stand out. They are clearly "consumer" sites, where lithic implements were widely applied in domestic contexts, while remains of knapping are disproportionally underrepresented considering the amount of retouched blanks. On the other hand, the group of sites in which such remains are well-represented is heterogeneous. Production sites include sites with a blade-oriented industry (like Kamyane-Zavallia) and flake-producing sites (like Nicolaevca V). The Țâra II complex is, in fact, a selection of items resulting from a blade-producing facility, probably with the intention of the further re-utilization of the blades.

The Late Mesolithic of Moldova is characterised by a fine, regular bladelet knapping technique (Larina *et al.* 1997; Covalenco 2003; Kitagawa *et al.* 2018, 195, 196). It existed in two aspects: geometric (Hrebeniki) and non-geometric (Kukrek).

The typical Hrebeniki complexes yielded trapezes of varying shapes (Stanko 1967; Stanko and Kiosak 2010). Although the isosceles types predominate, the scalene specimens are also numerous (Covalenco 2017). A small percentage of microburins is also known (Nuzhnyj 2008, 64). Analogies for the scalene trapezes, which are sometimes known from LBK sites of Moldova and adjacent territories, can be found in the rich, Late Mesolithic assemblages (Stanko 1982). However, they are not the most typical representatives of the Hrebeniki style in any case. Flattened, prismatic, one-sided, unidirectional cores, which are typical for Hrebeniki sites (Stanko and Kiosak 2010, 71), are few or completely absent from Moldovan LBK collections. The cores found in such collections are mostly volumetric prismatic cores with a tendency of development into subconical shapes with reduction. Hrebeniki assemblages are dominated by lamellar components (Stanko and Kiosak 2010, 71), while in LBK complexes, blades are usually more numerous than bladelets.

Kukrek sites yielded a distinctive set of tools and cores (bullet cores, "Abuzova Balka" points, Kukrek inserts, Kukrek burins (Stanko 1967; Stanko *et al.* 1981; Telegin 1982; Potekhina and Telegin 1995)). Pencil-like (bullet) cores are commonly interpreted as products of the standing pressure technique (Zaliznyak 2005, 78). The end-products of their reduction were microblades (laminar flakes less than 8 mm wide). None of these features is found in the Moldova LBK assemblages. Microblades are not typical products of serial production for LBK knappers in the region.

Thus, "Mesolithic heritage" is an unlikely explanation for the peculiarities of the assemblages that were described above (Kiosak 2016; 2019).

On the other hand, expedient core technologies are well known from a variety of sedentary societies all over the world (Parry and Kelly 1987). It was suggested that the immediate availability of debris from prior acts of knapping made planned and prepared detachments unnecessary (McCall and Horowitz 2014). Sedentary knappers were able to re-shape and re-utilize the items shaped and applied previously (Parry 2008). The LBK people of Moldova obviously tended to re-use and re-shape by-products of previous knapping. For example, cores re-used as hammerstones are known to any LBK researcher (Kaczanowska 1980; Hofmann *et al.* 2019).

The lithic industry of the LBK is known to be a complex system, which involves the long-distance transport of raw material and includes finished blades and tools (Mauvilly 1997). The logistic networks corresponded to a mesh of social relations (Zimmermann 1995; Reepmeyer *et al.* 2011). In some cases, surplus production was described on LBK sites (Burnez-Lanotte and Allard 2003; Allard 2004). These surpluses could be traded further along chains of exchange. Most complexes of the LBK in the region under study were formed both by local production and by the inclusion of some items obtained via exchange networks. In this context, the production of blades at Țâra II is not extraordinary. Blades missing from this assemblage could have been supplied to other complexes on the site or traded further on. Meanwhile, the simplistic industry of Nicolaevca V is an anomaly.

A. Zimmermann has demonstrated that LBK sites can be ranged depending on their position in the exchange networks (Zimmermann 1995). There are nodal sites, redistribution sites and consumer sites at the very end of the exchange chain. From this point of view, Nicolaevka V Kleinbau complex is little included in the exchange network. Some objects (like tools on blades) may be products of exchange. However, most artefacts in the complex were obtained by simplistic, expedient, flake-oriented technology, most probably on-site. The "deposit" gives us a unique insight into the organization of knapping at the site. It represents, most probably, the objects selected for further knapping in case of need in a domestic context. The cores and debitage found in the excavation pit could have been produced from objects similar to those found in the deposit in the course of their continued reduction. In other words, a knapper may have selected these pieces (a stone pallet resembling a retouching support, a hammerstone, a flake and a blade, which could be blanks for tools, and 29 objects suitable for further knapping) from some primary knapping place and took them home in anticipation of future needs. They then would likely have used a very simple, expedient technology of blank production, probably via a few blows with a hard stone. Thus, the "deposit" is a selection of objects suitable for further reduction by a knapper, who anticipated his/her need for some pieces of raw material with ample volume, and was not very demanding in regard to the shape of these pieces. It resembles the "caches" for expedient knapping described in some anthropological contexts (McCall 2012; Horowitz and McCall 2019).

Thus, we would expect that the simple, flake-oriented industry of Nicolaevca V should be the result of a domestic mode of production in which a knapper tried to supply the needs of his/her household on his/her own – both obtaining raw material and executing expedient knapping in cases of need.

CONCLUSION

The structural analysis of lithic collections allows us to define three groups of LBK sites in the territory of modern-day Moldova: 1) sites with a flake-oriented industry (Nicolaevca V); 2) sites with abundant evidence for blade production, but which lack blades themselves (Țâra II); 3) sites with an excess of blades and tools on blades (Dănceni I, Gura-Camencii VI).

From the point of view of the social organisation of lithic technology, these differences can be interpreted in the following way: the first group represents remains of domestic, expedient technology, employed by households while attempting to satisfy their own needs. The second and third groups are in systematic relation: the second produced blades, yet the assemblages lack them; assemblages of the third group contain a surplus of blades and tools on blades. Thus, the sites of the third group are consumers, most likely obtaining their suplusses of blades via exchange.

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OBSIDIAN SOURCE USE WITHIN THE ALFÖLD LINEAR POTTERY CULTURE IN SLOVAKIA

ABSTRACT

Werra D. H., Hughes R. E., Nowak M., Vizdal M. and Gačková L. 2021. Obsidian Source Use within the Alföld Linear Pottery culture in Slovakia. *Sprawozdania Archeologiczne* 73/1, 331-369.

This paper reports the results of non-destructive energy dispersive x-ray fluorescence (EDXRF) analysis of 186 obsidian artifacts from eight archaeological sites attributable to the Alföld Linear Pottery culture (c. 5600-4900 cal BC). This is the largest instrument-based study yet conducted and reported for Alföld Linear Pottery culture (ALPC) artifacts from Slovakia, where ALPC chipped lithic assemblages are almost entirely composed of obsidian items. Results show that all obsidian artifacts analyzed were manufactured exclusively from a volcanic glass of the Carpathian 1 chemical type, the source of which has been localised in Slovakia. This chemical variety of obsidian appears to have been the most important volcanic glass used by prehistoric communities in East-Central Europe during the Neolithic.

Keywords: obsidian, Alföld Linear Pottery culture, obsidian source analysis, non-destructive energy dispersive x-ray fluorescence (EDXRF), Slovakia

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INTRODUCTION

Due to its particular physical and aesthetic properties, obsidian – a natural volcanic glass – was widely used by past human communities. Its extraordinary features like gloss, colour, transparency, and razor-sharp edges, find their counterpart in its geochemical composition, where discrete combinations of trace elements created during the magma eruption and cooling allow each "source" (or, eruptive entity) to be identified. The characteristic trace and rare earth element composition, the so-called geochemical "fingerprint", of each source can be instrumentally-identified, and these can then be used for comparison with "fingerprints" determined for archaeological artefacts. The congruence between "source" and artefact fingerprints forms the scientific basis for studies of the temporal and spatial variation in the conveyance, use, and discard patterns evident in the archaeological record.

In this paper, we use energy dispersive x-ray fluorescence (EDXRF) analysis as the instrumental basis for identifying the obsidian sources used by Alföld Linear Pottery culture (ALPC) communities and discuss the results in the context of how the material may have been employed during that period.

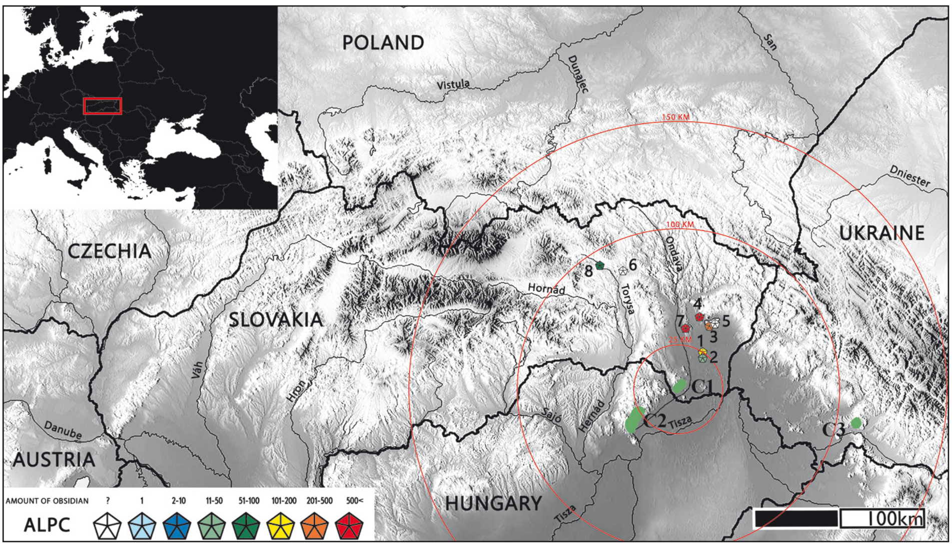

Fig. 1. Locations of ALPC archaeological sites in Slovakia containing obsidian artifacts analysed in this study. 1 – Malé Raškovce, Michalovce distr.; 2 – Slavkovce, Michalovce distr.; 3 – Zalužice, Michalovce distr.; 4 – Lúčky, Michalovce distr.; 5 – Moravany 'Stredné pole', Michalovce distr.; 6 – Zbudza, Michalovce distr.; 7 – Fintice; Prešov distr.; 8 – Ražňany-Farské, Sabinov distr.; C1 – Carpathian 1 geological obsidian outcrops; C2 – Carpathian 2 geological obsidian outcrops; C3 – Carpathian 3 geological obsidian outcrops. Red lines mark distances from Carpathian 1 source locations. Graphic design: Ł. Figura

CARPATHIAN OBSIDIAN

Several geological obsidian sources are located in, and proximate to, the Zemplén Mountains in Slovakia and Hungary (Fig. 1). Those outcrops of this material were the most important for prehistoric communities in Central Europe. By convention, obsidian raw materials are classified into three groups: Carpathian group 1 (C1) is used as a shorthand descriptor for obsidian from Slovakia, Carpathian group 2 (C2) identifies obsidian from Hungary, and Carpathian group 3 (C3) specifies material from Transcarpathian Ukraine (Thorpe *et al.* 1984; Rosania *et al.* 2008).

The occurrence of obsidian in what is today Slovakia and Hungary was first noted by Johann Ehrenreich von Fichtel (1732-1795) in 1791 (*Mineralogische Bemerkungen von den Karpathen*, Wien 1791-1794; Janšák 1935; Přichystal 2013, 160). Within Slovakia natural sources of obsidian are concentrated in Veľká Tŕňa, Malá Tŕňa, Viničky, Malá Bara, Vel'ká Bara and Streda nad Bodrogom, and secondary sources are known in the area of Brehov-Cejkov (Kaminská and Ďuďa 1985, 123; Kaminská 1991; 2013; 2018; Bigazzi *et al.* 2000, 225; Přichystal 2013, 160, 161; Přichystal and Škrdla 2014; Bačo *et al.* 2017, 208).

The best-known outcrop, and the one frequently cited as being most important to prehistoric communities, is in Viničky. This deposit has been described by O. Williams and J. Nandris (1977, 216), and its major and minor element composition appears in Macdonald *et al.* (1992, appendix 3, 189, 196). The obsidian there is either black or grey and poorly transluscent, with a matte surface. This raw material is found in primary deposits yielding nodules *c.* 7 cm in diameter, rarely 10-12 cm weighting up to 0.8 kg (Williams and Nandris 1977, 211; Přichystal 2013, 160). However, based on recent comparisons between obsidian artefacts and obsidian from the sources Přichystal and Škrdla (2014) suggest that the Brehov-Cejkov may have been the most important locus for prehistoric obsidian extraction (Bačo *et al.* 2017; Burgert *et al.* 2017, 8-10).

Three geological sources of obsidian occur in northeastern Hungary – Tolcsva, Erdobenye-Aranyospatak and Erdobenye-Ligetmajor (Biró 1981, 201; Přichystal 2013, 161), with obsidian present as nodules weighing over 5 kg. This obsidian is generally black in appearance, but it can also be found in a variety of different hues, such as dark brown, greenish, light red, reddish-brown, yellow, and yellowish-green. The most well-known variety is the obsidian from Tolcsva which is opaque, matt, and black (Williams and Nandris 1977, 213; Přichystal and Škrdla 2014, 161). The major and minor element chemistry of Tolcsva also was reported by Macdonald *et al.* (1992, appendix 3, 189, 196).

Some time ago O. W. Thorpe, S. E. Warren, and J. G. Nandris (1984, 184), pointed out that there are visible differences in colour and transparency that differentiate Hungarian obsidian from that found in Slovakia; the Hungarian variant is almost always black and opaque, while its Slovakian counterpart can be grey or brownish-grey, with some degrees of transparency (Přichystal 2013, 161). The discovery of a new visual variant of obsidian by Přichystal and Škrdla, however, throws into question the confidence one can have that these visual intrasource differences unambiguously separate Hungarian from Slovakian occurrences.

In the Transcarpathian Ukraine, not far from the villages of Rokosovo and Maliy Rakovets, V. F. Petrougne (1986) reported a local variety of obsidian that eventually became known as Carpathian 3 (Rosania *et al.* 2008; Hughes and Ryzhov 2018). To the north of Rokosovo and the south of Maliy Rakovets in the Upper Tertiary Sin'ka Formation, obsidian blocks and bombs occur in an agglomerate tuff. This obsidian has two visual subtypes: a freshly broken piece of the first variety has a glassy lustre and, occasionally, displays unique grey stripes. The second type is grey, with a dull sheen, is striped with darker bands and contains visible spherulite inclusions. These latter characteristics are very rarely noticeable within the first black variation (Rácz 2018).

MATERIALS

This paper focuses on EDXRF provenance analysis of 186 obsidian artefacts from eight Neolithic sites located within what is today Slovakia (Fig. 1; Table 1). We chose artifacts from sites associated with the activity of ALPC communities from each of its chronological phases, including the last stage connected with the Bükk culture. All materials analysed were selected from properly dated settlements with large quantities of pottery and with ^{14}C dates. With the exceptions of Lúčky and Fintice (Vizdal 2000a; 2000b), the results of archaeological investigations of the sites that we examined have all been published (see Table 1).

GENERAL REMARKS ON TECHNOLOGY-MORPHOLOGY AND LITHIC SOURCES CHARACTERIZATION OF THE ALPC IN SLOVAKIA

In the middle of the 6th millennium in the area of the middle and upper Tisza Basin the ALPC came into being as a result of northward expansion of the Körös culture and its regional, cultural transformations. Afterwards, the scientific consensus seems to be that those communities diffused northward from the Great Hungarian Plain to the Košice Basin, the Eastern Slovak Plain, and the Transcarpathian Ukraine, but the expansion never crossed the Carpathian Mountains (Kalicz and Makkay 1966; 1977; Šiška 1989; Pavúk 2004, 74; Kozłowski and Nowak 2007; 2010; Domboróczki and Raczky 2010).

The earliest ALPC expression (Szatmár group, equivalent to the so-called proto-Linear phase in eastern Slovakia) is dated to the period *c.* 5600-5400 cal BC (Domboróczki 2010, 156-161; Domboróczki and Raczky 2010, 213-215). In sites of this phase, the lithic resources used are nearly always of local origin, mostly obtained in the Slovak-Hungarian borderland (limnoquartzites, and Carpathian obsidian 2) and Transcarpathian Ukraine (predominantly the stone used in the ground stone industry). Some imports of radiolarite from Šariš are recorded (Slavkovce site) in the Eastern Slovak Lowland during the early ALPC phase but, overall, there is very little evidence for contacts with territories to the north and the east of the Carpathians (Kozłowski 1997; Kozłowski and Nowak 2010; Raczky *et al.* 2010; Kozłowski *et al.* 2014, 42-45).

The typical assemblage composition of ALPC sites throughout most of the Eastern Slovak Lowland consists of obsidian (dominant), with lower proportions of limnoquartzites, radiolarite, and others (*e.g.* hornstornes at Moravany). Except for "others", all of those sources can be found within several dozen kilometres from the site (< 50 km distant up to 120 km; Kozłowski and Nowak 2010, 76, 86; Kaczanowska *et al.* 2013, 113, 114; Kaczanowska *et al.* 2015, 172). Evidence of long-distance contacts in lithic sources occurs only rarely. For example, two artefacts recovered at Moravany were of chocolate flint (Upper Jurassic, the highest Oxfordian limestone and Lower Kimmeridgian, located within Central Poland) and the other of Volhynian flint (Cretaceous flint Turonian age; primary deposits located within the Volhynian Upland; Kozłowski 1989, 378, 391; Kaczanowska and Kozłowski 1997, 221; Kozłowski and Nowak 2010, 76, 86; Kaczanowska *et al.* 2013, 112-114; 2015, 172).

Unmodified obsidian nodules are often found on these sites; e.g. Slavkovce contained a cache of 34 obsidian nodules (see Kaczanowska and Kozłowski 1997, 184). Direct percussion and pressure techniques were mostly used to obtain blade blanks. There is some evidence that in younger ALPC assemblages a punch was used. Cores preparation was limited to platform preparation, and did not extend to the lateral side, back and distal end. It seems that core reduction proceeded from a prepared platform and during the manufacturing process, the flaked surface was extended to the sides of the core, until a conical, semi-conical or subdiscoidal form was achieved. Single platform blade cores predominate, except during the last phase when the method of reduction was changed and the object became a flake core. Flaking surface rarely extends over the lateral edges. Flakes were derived from cortical platforms or prepared with a single blow. Percussion points and bulbs are conspicuous, and percussion scars on the bulb indicate that hard hammerstones were used for core reduction. Blades also have platforms prepared with a single blow, and the distinctive bulb and bulbar scar also are consistent with the use of the direct percussion technique. Based on lithic analysis, the most desired end products were obsidian blades of dimensions: 30-40 mm long, 15-15 mm wide and 3-4 mm tick. Tool-kits were mainly composed with different proportions of retouched blades, retouched flakes, end-scrapers and geometric microlithic, which reflect the different domestic economic activities undertaken by the inhabitants of various settlements (Kozłowski 1989, 391; Kaczanowska and Kozłowski 1997, 178-180, 188, 189, 191, 194, 195, 220; Kaczanowska *et al.* 2013, 112; 2015, 173, 175). The Bükk culture assemblages contain large numbers of cores and blades. Cores are single-platform and their exploitation was preceded by careful preparation, as evidenced by technical forms, like crested blades. The pressure technique was used to obtain blade blanks, mainly up to 5 cm long. Most tools produced however, were end-scrapers and truncations with lateral retouch and notched forms. Tool-kit composition appears to be related to site function rather than to time period. It is commonly stated that the Bükk culture lithic economy was built only on obsidian (Kulczycka and Kozłowski 1960, 44; Kalicz and Makkay 1977), but the evidence from *e.g.* Šarišské Michaľany and Ražňany-Farské indicate this was not always the case (Kaczanowska *et al.* 1993, 95, 107-109; Karabinoš *et al.* 2018). Obsidian played a major role at settlements at a distance around 55 km from the outcrops. The amount of obsidian utilized appears to have depended not only on the site location but the different domestic economic activities that took place there.

PREVIOUS PROVENANCE INVESTIGATIONS

Over the last few decades since the first description of Carpathian obsidians, numerous modern analytical methods have been applied to determine the provenance of obsidian artifacts (see e.g. Biró 2006; Rózsa *et al.* 2006; Kasztovszky *et al.* 2014; Prokeš *et al.* 2015; Kasztovszky and Přichystal 2018).

However very little instrumental analysis has been undertaken on obsidian from ALPC sites. Kozłowski published results of the trace elements analysis of some obsidian samples from Zemplínske Kopčany and Prešov-Šarišské Lúky (Kozłowski 1989, Tab. 2), wherein all the analysed items were attributed to Carpathian obsidian type 1, from the Malá Tŕňa-Viničky region (Kozłowski 1989, 377). The results show a high degree of homogeneity suggesting that the raw material must have been obtained from a single eruptive source.

The obsidian raw material at Moravany – which was imported most probably as unworked nodules with surface sculpture typical of secondary (redeposited) natural sources – was determined to be Carpathian variety 2 obsidian by Małgorzata Kaczanowska on the basis of macroscopic appearance (Kaczanowska *et al.* 2015, 172; see Bačo *et al.* 2017, 209).

METHODOLOGY

As stated above, a study of the provenance of 186 artifacts of obsidian from 8 archaeological sites was conducted (see Table 2). The first step of selection was macroscopic. In this stage, samples were separated on the basis of differences in lustre, transparency and colour, as well as texture and pattern in obsidian structure (Fig. 2). We also paid attention to the size of all items and surface sculpture, keeping in mind the features of Carpathian obsidian identified by Přichystal and Škrdla (2014) and by Bačo *et al.* (2017; 2018). Table 2 breaks down the artifacts analysed in this study on the basis of a classification intended to document the presence of obsidians items in each stage of the lithic reduction (see Dzieduszycka-Machnikowa and Lech 1976; Lech 2012). The first group (natural nodules

Fig. 2. Obsidian artifacts analysed in the present study: a-h – Moravany 'Stredné pole', Michalovce distr.; i-l – Zbudza, Michalovce distr.; m-o – Slavkovce, Michalovce distr.; p, q – Ražňany-Farské, Sabinov distr.; r, s – Fintice; Prešov distr.; t-v – Malé Raškovce, Michalovce distr.; w, x – Zalužice, Michalovce distr.; y-b' – Lúčky, Michalovce distr.; Photo: D.H. Werra

and cores) contains 24 items; seven unworked (natural) obsidian nodules, roughouts in different stages of preparation, and 17 cores in different stages of reduction. The second group consists of ten whole blades and 44 blade fragments. The other three specimens are technical blades. The third group of 77 artifacts is made up of flakes and waste, along with platform rejuvenation and preparation flakes. The fourth and final group (retouched tools) consisted of 28 artifacts, mostly end-scrapers together with retouched blades and flakes. We used these groups to guide our selection of obsidian artifacts for EDXRF analysis to investigate whether or not some elements of the obsidian lithic reduction system (of which there were distinctive types in each morphological group) might have employed obsidian from different sources (chemical types).

GEOCHEMICAL ANALYSIS AND RESULTS

The 186 samples selected for this study were analysed in the Geochemical Research Laboratory in California using EDXRF spectrometry and assigned to a geochemical type/ variety and therefore a source (*sensu* Hughes 1998). Laboratory analysis conditions, instrumentation, geochemical type attribution procedures, element-specific measurement

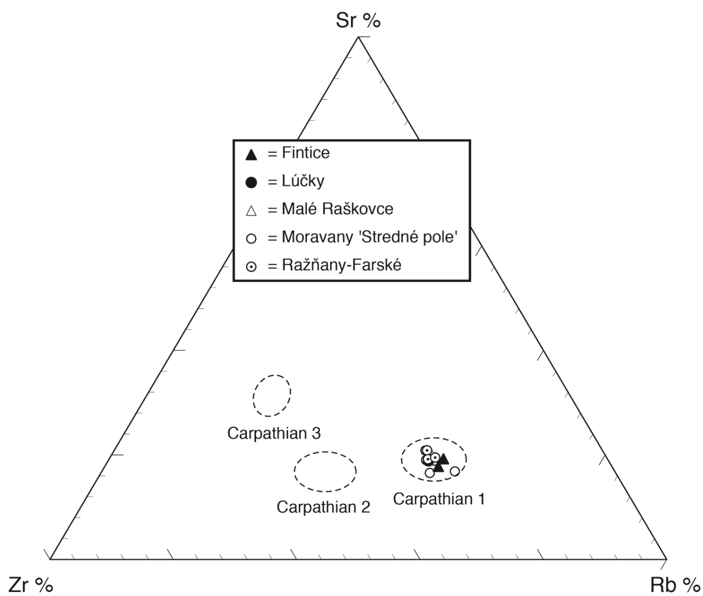

Fig. 3. Normalized Rb/Sr/Zr composition of small obsidian artifacts from Fintice, Lúčky, Malé Raškovce, Moravany 'Stredné pole' and Ražňany-Farské. Dashed lines depict the range of composition variation measured in archaeologically significant geological reference samples. (adapted from Hughes and Werra, 2014: figure 5). Symbols plot the artifacts listed in Table 4

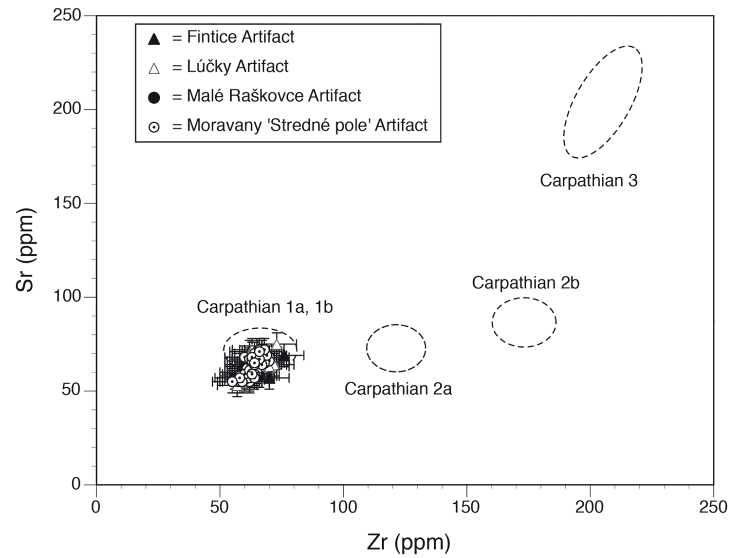

Fig. 4. Sr vs. Zr composition of large obsidian artifacts from Fintice, Lúčky, Malé Raškovce, Moravany 'Stredné pole'. Dashed lines depict the range of composition variation measured in archaeologically significant geological reference samples (adapted from Hughes and Werra, 2014: figure 4). Symbols plot the artifacts listed in Table 3

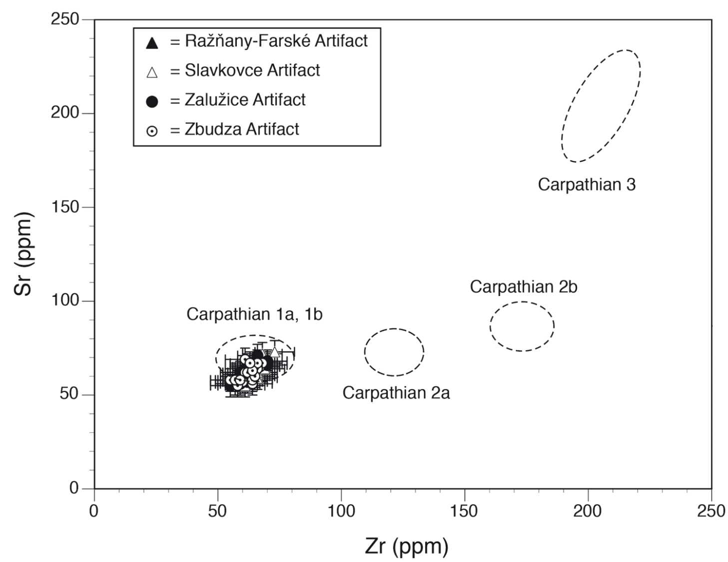

Fig. 5. Sr vs. Zr composition of large obsidian artifacts from Ražňany-Farské, Slavkovce, Zalužice and Zbudza. Dashed lines depict the range of composition variation measured in archaeologically significant geological reference samples (adapted from Hughes and Werra, 2014: figure 5). Symbols plot the artifacts listed in Table 3

resolution, and literature references applicable to these samples follow those that we reported for artifacts from Ryndo XIII/1959 (Hughes and Werra 2014) and from other Mesolithic and Paleolithic sites in Poland (Hughes *et al.* 2018). Table 3 and Fig. 4-5 present trace element concentration values for the 174 obsidian artifacts that were large enough to generate reliable quantitative composition estimates. The Sr/Zr data for all specimens plotted within the range established for Carpathian 1a/1b obsidians (Rosania *et al.* 2008, Milić 2014, Table 6), that occur in the Zemplén Mountains in northeast Hungary and southeast Slovakia (Fig. 3 and 4). Twelve other obsidian specimens in our sample were too small and thin to generate x-ray counting statistics adequate for proper conversion from background-corrected intensities to quantitative concentration estimates (i.e., ppm), so they were analysed to generate integrated net count (intensity) data for the elements Rb, Sr, Y, Zr, Nb, Fe and Mn. After background subtraction, the intensities (counts per second) were converted to percentages. The counting data and derived ratios appear in Table 4, and the plotted values appear in Fig. 3. Source assignments were made by comparing the plots for various element intensity ratios determined on artifacts against the parameters of known source types identified in Central Europe. Integrated net peak intensity data (Table 4, Fig. 3) indicate that all 12 small flakes also were manufactured from Carpathian 1a/1b obsidian. The EDXRF analysis did not reveal any source-specific differences within or among different ALPC morphological or typological groups.

DISCUSSION AND CONCLUSIONS

Obsidian artefacts are present on archaeological sites in Slovakia dated from the Middle Palaeolithic, through the Upper Palaeolithic, Mesolithic, Neolithic, up to the Early Bronze Age. However as Early Neolithic communities began to appear in Slovakia, the incidence of obsidian use increased (Kaczanowska 1985; Kaminská 2018). The ALPC inventories, for example, are almost entirely composed of obsidian items.

Almost 100% utilization of obsidian was registered at some sites (*e.g.* Zbudza, Zalužice, Slavkovce and Malé Raškovce). At Moravany, obsidian makes up almost 90% of the industry (Kozłowski 1989; Šiška 1989; Kaczanowska and Kozłowski 1997, 220, 221; Kaczanowska *et al.* 2015), while in the following Tiszadob group utilization of obsidian represented almost a half of all finds (Kaminská *et al.* 2016). In the following Bükk culture, obsidian dominates the entire chipped stone lithic industry. However in the material that we present here from the inventory from Ražňany-Farské obsidian does not conform to this pattern (Karabinoš *et al.* 2018, 348), nor does it at the Šarišské Michaľany site (Kaczanowska *et al.* 1993).

Obsidian was subject to conveyance and long-distance distribution since Palaeolithic times (see Moutsiou 2014; Hughes *et al.* 2018) and, during the Neolithic, these activities intensified. Volcanic glass artifacts are present in inventories connected with Linear Pottery culture sites (especially in the Želiezovce group), in western Slovakia, in southern Poland, and in ALPC assemblages in eastern Slovakia and Hungary (Kulczycka and Kozłowski 1960; Godłowska 1982; Milisauskas 1986; Šiška 1998; Grygiel 2004; Kaczanowska and Godłowska 2009; Szeliga 2009; Tunia 2016; Biró 2018; Kaminská 2018; Riebe 2019; Szeliga *et al.* 2019a; 2019b). Even higher demand for obsidian seems to have existed during the Late Neolithic (following the decline of the Bükk culture, during the beginning of the Lengyel culture), when raw material exchange and conveyance moved semi-products and finished products of obsidian as far as the central Danube region (Šiška 1989, 77), Czechia (Burgert 2015; Burgert *et al.* 2016; 2017), Poland, and the Polish Lowlands (Więckowska 1971; Kabaciński 2010; Wilczyński 2016). At the end of the Neolithic and during the Eneolithic period obsidian lost its dominant status, although it has been found occasionally in Early Bronze Age deposits (Biró 2014, 60-64; 2018, 219-222; Kaminská 2018, 209).

Based on our current study it is clear that the obsidian artefacts from the ALPC archaeological in eastern Slovakia sites that we analysed originated exclusively from the Carpathian obsidian source (chemical type) C1 (see Fig. 3-5; Table 3 and 4). These results parallel those from neighbouring countries. Investigations in Czechia and Hungary show that the Slovakian variant predominates at Neolithic sites, with a minor representation of the C2 variant (Biró 2014; 2018; Burgert *et al.* 2016; 2017; Riebe 2019). A similar situation seems to have existed in Romania (Constantinescu *et al.* 2014, 148), although at some sites the Hungarian variant of obsidian predominates (*i.e.* Măgura-Teleorman; Kasztovszky *et al.* 2019, 86). The limited geochemical analysis previously conducted on Neolithic obsidian from Poland also indicates the exclusive dominance of the C1 obsidian variant (Kabaciński *et al.* 2015; Szeliga *et al.* 2019a; Szeliga *et al.* 2021). Obsidian of the Carpathian 1 chemical type seems to have been the most important volcanic glass for prehistoric communities in East-Central Europe (Biró 2014, 64, Fig. 13), and this is underscored by the results of our study.

The tracing of the origins of the obsidian used for tools is a success story in Central European lithic provenance studies (Biró 2014, 47). Thanks to its unique geochemical features ('fingerprints') different chemical varieties can be distinguished by using instrumental methods. Such identifications allow us to analyse sources and uses, and to track synchronic and diachronic changes in distribution paths and conveyance mechanisms. Determining the sources is just one step in piecing together the puzzle (Biró 1998; Tykot 2017, 274) with the ultimate goal of understanding the complex interrelationships that existed between and among prehistoric communities. Carpathian obsidian is found in Neolithic site inventories at a considerable distance from the outcrops (even over 500 km; for example Kowalewko site 14, Oborniki dist., Kabaciński *et al.* 2015), and its presence can be useful in identifying such human connectivities, as well as possible differences in status, social rankings, and symbolic links to homeland/ancestors (see Mateiciucová 2010; Burgert 2016). We hope the data and conclusions presented here will contribute to a broader understanding of all these issues during the Neolithic period.

Table 1. List of ALPC sites from Slovakia from which samples were analysed

Fig. 1 location	Site	Chronology	Total number of obsidian at the site	Number of items from other lithic sources	Number of obsidian analyzed by ED-XRF	References
1	Malé Raškovce; Michalovce distr.	early phase of the ALPC (proto-Kopčany group?)	25	4	20	Kozłowski 1997
2	Slavkovce; Michalovce distr.	proto-linear phase, similarity to Szatmár II group of the ALPC	167	8	20	Kozłowski 1997
3	Zalužice; Michalovce distr.	early phase of the ALPC (proto-Kopčany group?)	261	112	20	Kozłowski 1997
4	Lúčky; Michalovce distr.	ALPC middle and late phase (Tiszadob group)	?	?	20	Vizdal 2000a
5	Moravany 'Stredné pole'; Michalovce distr.	ALPC, the whole period *ca.* 5600-5100 BC	3904	486	58	Kaczanowska *et al.* 2015; Kozłowski *et al.* 2015
6	Zbudza; Michalovce distr.	early phase of the ALPC (proto-Kopčany or Kopčany group)	887	91	20	Kozłowski 1997
7	Fintice; Prešov distr.	ALPC middle and late phase (Tiszadob group)	?	?	20	Vizdal 2000b
8	Ražňany-Farské; Sabinov distr.	Bükk culture (continue from ALPC, its final stage)	60	1467	8	Karabinoš *et al.* 2018
TOTAL			5316	2248	186	

Table 2. List of obsidian artifacts from Neolithic archaeological sites in Slovakia analysed by EDXRF spectrometry

No.	Site	Feature	length (mm)	width (mm)	thickness (mm)	weight (g)	description	EDXRF analysis number	Illustrated
1	Slavkovce, Michalovce distr., Slovakia	Feature E/1988	80,8	46,9	42,9	279,3	nodule	SK-081	
2			115,7	48,4	37	213,9	nodule	SK-082	Fig. 2:m
3			31,7	22,8	20,5	18,8	nodule fragm.	SK-083	
4			20,7	35,1	5,5	3,3	flake	SK-084	
5			34,5	20,1	3	2,4	flake	SK-085	
6			13,3	21,5	2,5	0,7	waste	SK-086	
7			43	24,5	5	8,6	flake	SK-087	
8			27,9	38,2	8,5	6,6	retouched blade	SK-088	
9			26,4	32	3,8	2,4	flake	SK-089	
10			46	17	21,5	23,8	core	SK-090	Fig. 2:n
11			36,2	21,4	20,9	15,9	core frgm.	SK-091	
12			25	38	4	2,8	platform rejuvenation flake	SK-092	
13			33	27	4	6,6	flake	SK-093	
14			23,8	41,9	8,2	7,1	flake	SK-094	
15			43,3	28,5	12,4	11,6	retouched blade	SK-095	
16			17,4	21,7	3,4	1,7	backed piece	SK-096	Fig. 2:o
17			27,6	16,8	4,8	2,4	retouched blade	SK-097	
18			21,5	27,8	7,5	4,5	waste	SK-098	

Table 2.

No.	Site	Feature	length (mm)	width (mm)	thickness (mm)	weight (g)	description	EDXRF analysis number	Illustrated
19	Slavkovce, Michalovce distr., Slovakia	Feature E/1988	54,6	42,4	13,2	30,5	flake	SK-099	
20			27,8	28,1	6,2	4,7	end-scraper	SK-100	
21	Malé Raškovce, Michalovce distr., Slovakia	Feature 1/1988	63,5	57,9	18,5	58,7	platform rejuvenation flake	SK-121	
22			23	18,6	4,9	2,8	blade fragm.	SK-122	
23			29,7	6,3	1,9	0,3	blade fragm.	SK-123	
24			26,8	13,4	2,1	1,1	blade fragm.	SK-124	
25			32,6	13,5	2,9	1,5	retouched blade	SK-125	Fig. 2:t
26			31,8	27,6	9,9	7,2	platform rejuvenation flake	SK-126	
27			34,1	13,7	4	1,8	blade	SK-127	
28			31,7	15,9	6	3,3	retouched blade	SK-128	
29			35,8	40,5	7,7	13,6	flake	SK-129	Fig. 2:u
30			36	15,2	6,3	3,6	retouched blade	SK-130	
31			28	12,5	3,7	1,3	blade fragm.	SK-131	
32			30,2	30	9	7,4	flake	SK-132	
33			39,5	12	7,7	3,5	blade fragm.	SK-133	
34			20	25	19,8	9,3	core	SK-134	
35			30,3	21,5	6,8	5	retouched blade	SK-135	

36	Malé Raškovce, Michalovce distr., Slovakia	Feature 1/1988	17,3	28,8	28	17,6	core	SK-136	
37			48,6	15	7,1	4,3	retouched blade	SK-137	
38			36,7	17,2	6,4	4	retouched blade	SK-138	Fig. 2:v
39			23	24,6	7	4,1	platform rejuvenation flake	SK-139	
40			33	14	4,5	2,2	blade	SK-140	
41	Zalužice, Michalovce distr., Slovakia	Feature 1/1991	24	24,4	4	2,3	flake	SK-141	
42			30,7	33,1	12,5	12,1	waste	SK-142	
43			51,7	33,2	8,5	10,6	flake	SK-143	
44			39,7	14	3,5	2,1	retouched blade	SK-144	
45			44,4	40	8,7	16,6	waste	SK-145	
46			26,3	18,6	4,6	1,7	flake	SK-146	
47			23,2	16	4,3	1,6	blade fragm.	SK-147	Fig. 2:w
48			41,3	27	16,1	6,2	platform rejuvenation flake	SK-148	
49			15,8	13	6,3	1,3	waste	SK-149	
50			30,7	19,4	9,3	5,5	preparation flake	SK-150	
51	Zalužice, Michalovce distr., Slovakia	Feature 2/1994	26,6	15,7	3,2	1,1	flake	SK-151	
52			28,7	11,2	3,3	1,1	blade	SK-152	Fig. 2:x
53			20,3	20,7	6,7	3	end-scraper	SK-153	
54			29,9	19,2	5,8	2,9	blade fragm.	SK-154	

Table 2.

No.	Site	Feature	length (mm)	width (mm)	thickness (mm)	weight (g)	description	EDXRF analysis number	Illustrated
55	Zalužice, Michalovce distr., Slovakia	Feature 2/1994	45,7	45,2	16,5	20,3	flake	SK-155	
56			51,4	14,2	4,3	4,6	blade	SK-156	
57			23	21,6	2,9	1,2	flake	SK-157	
58			37,1	23,2	4,3	4,9	flake	SK-158	
59			30	17,7	3	2,1	blade fragm.	SK-159	
60			24,6	14,6	9,2	2,2	waste	SK-160	
61	Zbudza, Michalovce distr., Slovakia	Feature 1/1992	24,3	11,8	2,6	0,9	platform rejuvenation blade	SK-101	
62			28,7	16,6	9	2,6	preparation flake	SK-102	
63			18,8	13,3	3,1	0,9	platform rejuvenation flake	SK-103	
64			15,3	29	5,5	2	flake	SK-104	
65			16,7	13,4	2,9	1,4	retouched blade	SK-105	Fig. 2:i
66			20,6	13,1	3,6	0,9	retouched blade	SK-106	
67			17,7	24,7	4,6	1,8	blade fragm.	SK-107	
68			17,4	29,9	9,5	3,5	flake	SK-108	
69			22,9	16,8	6,5	3	blade fragm.	SK-109	
70			20,2	22,8	4,5	1,8	flake	SK-110	
71			26,3	22,2	7,3	4,7	crested blade	SK-111	

72	Zbudza, Michalovce distr., Slovakia	Feature 1/1992	27,9	14,4	14,6	5,6	flake	SK-112	Fig. 2:j
73			28,9	16	9,3	3,2	waste	SK-113	
74			24,4	37,9	9,8	11,4	flake	SK-114	Fig. 2:k
75			31,2	35,6	14,3	13,2	waste	SK-115	
76			32,8	14,6	4,5	2,4	blade fragm.	SK-116	Fig. 2:l
77			15,8	17,7	6,7	2,3	blade fragm.	SK-117	
78			42,6	15,8	3,8	2,8	retouched blade	SK-118	
79			15,9	16,5	5,2	1,6	retouched blade	SK-119	
80			24,6	10,9	4,9	1,5	blade fragm.	SK-120	
81	Lúčky, Michalovce distr., Slovakia	Feature 1/1999, Trench A, B, C; depth 0-30 cm	16,9	29	5,2	2	waste	SK-161	
82			36,3	16,1	5,5	3,2	retouched blade	SK-162	
83			30,6	9,4	1,7	0,6	blade fragm.	SK-163	
84			29,6	8,9	2,5	0,7	retouched blade	SK-164	Fig. 2:y
85			33,8	12,8	3,6	1,7	blade	SK-165	
86			24,1	15,6	3,3	1,3	blade fragm.	SK-166	Fig. 2:z
87	Lúčky, Michalovce distr., Slovakia	Feature 1/1999, Trench A; depth 20-30 cm	26,1	19,3	3	1,5	retouched flake	SK-167	
88			28	20	3,3	1,8	flake	SK-168	
89	Lúčky, Michalovce distr., Slovakia	Feature 1/1999, Trench A; depth 10-15 cm	29,5	17,1	4	1,7	flake	SK-169	Fig. 2:a'
90			47,4	19,9	5,2	5,2	retouched blade	SK-170	Fig. 2:b'
91			25,3	28,1	13	10,5	core	SK-171	
92			29,8	13	2,6	1,2	blade fragm.	SK-172	

Table 2.

No.	Site	Feature	length (mm)	width (mm)	thickness (mm)	weight (g)	description	EDXRF analysis number	Illustrated
93	Lúčky, Michalovce distr., Slovakia	Feature 1/1999, Trench A; depth 10-15 cm	21,7	16,8	3,4	1,2	blade fragm.	SK-173	
94			31,5	10,8	3,1	0,9	blade fragm.	SK-174	
95			31,2	26,7	7,5	6,7	platform rejuvenation flake	SK-175	
96	Lúčky, Michalovce distr., Slovakia	feature 1/1999, sonda C; depth 0-10 cm	12,3	9,2	3,5	0,3	waste	SK-176	
97			29,3	10,6	3,7	1,3	blade fragm.	SK-177	
98	Lúčky, Michalovce distr., Slovakia	Feature 1/1999, Trench C; depth 0-10 cm	42,7	38,5	8,1	8,8	flake	SK-178	
99			35,2	21,9	3,7	3,3	blade fragm.	SK-179	
100			23,1	13,7	3,1	1,1	blade fragm.	SK-180	
101	Fintice, Prešov distr., Slovakia	Feature 1/1999	32	10,8	2,5	1,2	blade fragm.	SK-061	Fig. 2:r
102			31,5	17	5,3	3,9	retouched blade	SK-062	
103			42	16	5	4	blade fragm.	SK-063	
104			21,5	20	4,6	1,9	platform rejuvenation flake	SK-064	
105			18	8,4	4,5	0,6	waste	SK-065	
106			40,1	17,8	4,7	4,4	blade fragm.	SK-066	Fig. 2:s
107			38,3	34,9	30,6	34,9	core	SK-067	
108			21,4	14,7	4,7	1,2	flake	SK-068	
109			20,9	27,9	1,5	0,9	waste	SK-069	

110	Fintice, Prešov distr., Slovakia	Feature 1/1999	31,5	19,5	10,9	8	nodule fragm.	SK-070	
111			20,9	25,5	6,7	2,6	end-scraper	SK-071	
112			22	18	3	2,2	blade fragm.	SK-072	
113			17,8	11,4	1,5	0,2	blade	SK-073	
114			19	8,7	5,5	0,7	waste	SK-074	
115			10,3	12,5	1,3	0,2	waste	SK-075	
116			28,7	12,8	3	1,3	waste	SK-076	
117			27,3	12,7	5,7	1,7	retouched blade	SK-077	
118			36,7	13,9	4,4	2,7	blade fragm.	SK-078	
119			12,5	17,8	6,2	1,5	end-scraper	SK-079	
120			41,2	13,2	3,5	2,2	blade fragm.	SK-080	
121	Moravany 'Stredné pole', Michalovce distr., Slovakia	Trench M; Cutting 11/2016, Feature 1/06(A)/W; E - 306 cm; S - 177 cm; depth 85-95 (- 220 cm)	36	35	19	23,5	pre-core	SK-001	
122			24,5	7	2	0,4	blade	SK-002	
123			30,6	19,7	5,1	3,5	platform rejuvenation flake	SK-003	
124			16,6	10,9	2,2	0,5	blade fragm.	SK-004	
125			18,8	12,6	3,3	0,7	flake	SK-005	
126			37,5	26,8	12,7	11,9	nodule fragm.	SK-006	
127			45	22,1	14	10,2	nodule fragm.	SK-007	
128			12,5	9,5	3	0,3	blade fragm.	SK-008	
129			36,3	34,7	13,5	18,5	core	SK-009	

Table 2.

No.	Site	Feature	length (mm)	width (mm)	thickness (mm)	weight (g)	description	EDXRF analysis number	Illustrated
130	Moravany 'Stredné pole', Michalovce distr., Slovakia	layer 0-40 cm (depth); next to Feature 4/2002 (07.2002)	41,2	25,7	12	13,3	core	SK-010	
131	Moravany 'Stredné pole', Michalovce distr., Slovakia	Trench F; Cutting 3/2001 part S; Feature 3/01, depth 70 cm; 22.07.2002	22,5	14	3	1	blade fragm.	SK-011	
132			12,4	8,8	3	0,4	blade fragm.	SK-012	
133			22,5	9,5	3	1,1	blade	SK-013	
134			19,1	12,9	2,9	0,6	flake	SK-014	
135			38,6	35,7	6,6	5	flake	SK-015	
136	Moravany 'Stredné pole', Michalovce distr., Slovakia	Trench F; Cutting 2B/2001; Feature 10/01, depth 20-40 cm; 10.07.2002	31,5	23,3	15,2	8,1	flake	SK-016	
137			23	18,2	8,2	3,6	blade fragm.	SK-017	
138	Moravany 'Stredné pole', Michalovce distr., Slovakia	Trench 11; Cutting 12/2006; depth 20-25 cm; 16.07.2006	16,8	11,5	5,5	1	waste	SK-018	
139			26,2	16,2	4,2	1,9	flake	SK-019	
140			7,8	7,2	2,2	0,1	waste	SK-020	
141			18,7	13	5,5	1,1	flake	SK-021	
142			39,3	32,8	16,7	22,9	nodule fragm.	SK-022	
143	Moravany 'Stredné pole', Michalovce distr., Slovakia	Trench H; Cutting 4/2002; Feature 4/02; 22.07.2002	50	26,3	43,2	53,3	core	SK-023	Fig. 2:a
144			10,4	7,4	2,5	0,1	waste	SK-024	
145			24,7	19,7	4,8	2,1	flake	SK-025	

146	Moravany 'Stredné pole', Michalovce distr., Slovakia	Trench H; Feature 4/02; 24.07.2002	24,3	23,3	6,8	3,6	blade fragm.	SK-026	Fig. 2:c
147			16,9	17,7	5	1,8	blade fragm.	SK-027	
148	Moravany 'Stredné pole', Michalovce distr., Slovakia	Trench F; Cutting 2B/2001; Feature 10/01, depth 40-50 cm; 17.07.2002	29,5	14,5	4	1,3	blade fragm.	SK-028	
149			8,2	11,2	3,2	0,3	blade fragm.	SK-029	
150			14	20,5	7,8	1,7	waste	SK-030	
151			16	18,7	4,4	1,1	waste	SK-31	
152			47,7	31,7	18,2	37,9	core	SK-032	Fig. 2:b
153			17,5	14,4	3	1,1	backed piece	SK-033	
154	Moravany 'Stredné pole', Michalovce distr., Slovakia	Feature 1/1998; sector C; September 1998	14	17,5	4,5	2,1	flake	SK-034	
155			22,7	26,5	7,5	4,1	waste	SK-035	
156			26,7	25,3	7,5	4	flake	SK-036	Fig. 2:d
157			21,2	21,2	6	2,3	flake	SK-037	
158			16,4	12,7	2,1	0,5	flake	SK-038	
159			25,7	27	5,9	1,9	waste	SK-039	
160			30,2	29,9	4,9	3,7	platform rejuvenation flake	SK-040	Fig. 2:e
161			24,8	15,2	7,8	2,5	blade fragm.	SK-041	
162			18,1	16,5	5,7	1,4	flake	SK-042	
163			25,7	12,1	7,9	1,6	waste	SK-043	
164	Moravany 'Stredné pole', Michalovce distr., Slovakia	Feature 1/1998; sector A; September 1998	26,8	28,4	10,1	8,2	core frgm.	SK-044	
165			36,7	18,8	9,9	6	overpassed blade from single platform core	SK-045	

Table 2.

No.	Site	Feature	length (mm)	width (mm)	thickness (mm)	weight (g)	description	EDXRF analysis number	Illustrated
166	Moravany 'Stredné pole', Michalovce distr., Slovakia	Feature 1/1998; sector A; September 1998	33,9	25,1	17,5	16,3	core frgm.	SK-046	
167			32	36	16,9	18,8	core frgm.	SK-047	
168			37	32,8	32,1	37,6	core	SK-048	
169	Moravany 'Stredné pole', Michalovce distr., Slovakia	Feature 1/1998; sector A; September 1998	53	13	5	3,4	blade fragm.	SK-049	
170			39,8	17,5	5	3,7	blade	SK-050	Fig. 2:f
171			52,5	13,7	4,8	3,6	blade	SK-051	
172			34,7	12,5	3,2	1,9	retouched blade	SK-052	Fig. 2:g
173	Moravany 'Stredné pole', Michalovce distr., Slovakia	Trench H; Feature 4/02; 24.07.2002	16,1	13,3	2,4	0,7	blade fragm.	SK-181	
174	Moravany 'Stredné pole', Michalovce distr., Slovakia	Trench M, Cutting 11/2006; Feature 1/06 part W; depth 85-95 cm	22,8	31,8	5,4	3,4	flake	SK-182	
175	Moravany 'Stredné pole', Michalovce distr., Slovakia	Trench F Cutting 4/2001; Feature 3/01 depth 60-70 cm	26	27	13,8	8,4	core frgm.	SK-183	
176	Moravany 'Stredné pole', Michalovce distr., Slovakia	Trench F Cutting 5/2002; Feature 3/01 part S; depth 20-50 cm	30,1	16,5	11	5,9	flake	SK-184	
177	Moravany 'Stredné pole', Michalovce distr., Slovakia	Trench M, Cutting 11/2006; Feature 1/06 part W; depth 75-85 cm	31,7	15,3	4,5	2,7	retouched blade	SK-185	Fig. 2:h

178	Moravany 'Stredné pole', Michalovce distr., Slovakia	Trench M, Cutting 11/2006; Feature 1/06 part W; depth 55-65 cm	23,6	29,6	15,3	12,1	core	SK-186	
179	Ražňany-Farské; Sabinov distr., Slovakia	Trench IV/2012 sector C depth 35-45 cm	23	7	3	1	blade fragm.	SK-053	
180			25	15	3	2,3	blade fragm.	SK-054	
181			17,7	14,8	3,4	1	blade fragm.	SK-055	Fig. 2:p
182	Ražňany-Farské; Sabinov distr., Slovakia	Trench IV/2012 Feature 1/2012 sector C depth 60-65	14,7	10,2	2,7	0,3	blade fragm.	SK-056	
183			16,6	19,5	3,2	0,9	flake	SK-057	
184			21,5	20	8,4	3,3	platform rejuvenation flake	SK-058	
185	Ražňany-Farské; Sabinov distr., Slovakia	Trench IV/12 Feature 5; sector C; depth 45 cm	12,3	15,7	2,5	0,3	waste	SK-059	
186	Ražňany-Farské; Sabinov distr., Slovakia	Feature 1/2012 sector D depth 55-60 cm	27	13,4	4,2	1,4	blade fragm.	SK-060	Fig. 2:q

Table 3. EDXRF composition estimates for large obsidian artifacts from Neolithic archaeological sites in Slovakia

Site	Cat. No.	Trace and Rare Earth Element Composition														Ratio	Chemical Type	Illustrated
		Rb	±	Sr	±	Y	±	Zr	±	Nb	±	Ba	±	$Fe_2O_3^T$	±	Fe/Mn		
Slavkovce, Michalovce distr.	SK-081	191	5	58	3	38	3	59	3	7	2	413	22	1,02	0,02	24,8	C1	
	SK-082	179	5	56	3	39	3	57	3	8	2	433	21	nm		25,9	C1	Fig. 2:m
	SK-083	184	5	59	3	31	3	64	3	8	2	458	23	1,03	0,02	26,3	C1	
	SK-084	195	5	61	3	30	3	66	3	7	2	464	21	1,02	0,02	24,4	C1	
	SK-085	190	5	58	3	31	3	60	3	8	2	421	20	nm		24,3	C1	
	SK-086	210	5	59	3	34	3	66	3	7	2	421	21	1,04	0,02	27,1	C1	
	SK-087	198	5	55	3	28	3	61	3	8	2	400	20	nm		24,6	C1	
	SK-088	207	5	73	3	31	3	73	3	9	2	530	22	nm		26,2	C1	
	SK-089	208	5	64	3	34	3	69	3	8	2	405	21	1,16	0,02	24,9	C1	
	SK-090	211	5	72	3	30	3	68	3	9	2	454	22	nm		26,8	C1	Fig. 2:n
	SK-091	191	5	65	3	29	3	63	3	8	2	490	22	nm		24,3	C1	
	SK-092	191	5	59	3	31	3	60	3	8	2	430	20	1,03	0,02	24	C1	
	SK-093	210	5	65	3	34	3	64	3	8	2	493	22	1,18	0,02	24,4	C1	
	SK-094	180	5	57	3	27	3	61	3	8	2	489	22	nm		24,3	C1	
	SK-095	179	5	56	3	30	3	58	3	7	2	437	21	nm		23,9	C1	
	SK-096	209	5	62	3	32	3	60	3	9	2	415	20	1,1	0,02	24,8	C1	Fig. 2:o
	SK-097	200	5	62	3	31	3	66	3	10	2	436	25	1,11	0,02	24,5	C1	
	SK-098	193	5	61	3	32	3	62	3	8	2	460	21	1,01	0,02	24,5	C1	
	SK-099	180	5	60	3	29	3	59	3	8	2	452	22	nm		26,2	C1	
	SK-100	203	5	65	3	31	3	65	3	8	2	447	22	1,13	0,02	23,8	C1	

Malé Raškovce, Michalovce distr.	SK-121	184	4	60	3	28	3	60	4	10	2	393	21	nm		26,8	C1	
	SK-122	173	4	57	3	27	3	58	3	9	2	463	21	nm		27,6	C1	
	SK-124	196	5	65	3	31	3	68	3	8	2	425	21	1,08	0,02	25,5	C1	
	SK-125	197	5	62	3	31	3	62	3	8	2	421	20	1,02	0,02	24,5	C1	Fig. 2:t
	SK-126	184	5	58	3	28	3	60	3	8	2	413	21	1,03	0,02	26,5	C1	
	SK-127	188	5	66	3	31	3	63	3	8	2	444	23	1,09	0,02	25	C1	
	SK-128	199	5	64	3	32	3	63	3	8	2	417	20	1,15	0,02	25	C1	
	SK-129	184	5	63	3	29	3	60	3	8	2	487	22	nm		26,1	C1	Fig. 2:u
	SK-130	200	5	61	3	30	3	64	3	8	2	441	22	1,07	0,02	26,4	C1	
	SK-131	205	5	63	3	32	3	63	3	8	2	389	25	nm		25	C1	
	SK-132	202	5	58	3	31	3	62	3	8	2	427	21	1,1	0,02	25	C1	
	SK-133	203	5	57	3	28	3	56	3	8	2	481	25	nm		26,4	C1	
	SK-134	196	5	58	3	32	3	65	3	10	2	480	23	1,16	0,02	25,2	C1	
	SK-135	188	5	58	3	31	3	66	3	8	2	425	20	1,03	0,02	24,9	C1	
	SK-136	169	4	63	3	38	3	62	3	7	2	478	22	nm		24,4	C1	
	SK-137	200	5	61	3	30	3	63	3	8	2	418	23	1,17	0,02	24,3	C1	
	SK-138	204	5	60	3	31	3	64	3	89	2	385	22	1,17	0,02	23	C1	Fig. 2:v
	SK-139	175	4	60	3	28	3	60	3	9	2	449	21	nm		27,6	C1	
	SK-140	195	5	66	3	28	3	61	3	8	2	417	26	1,16	0,02	25	C1	

Table 3.

Site	Cat. No.	Trace and Rare Earth Element Composition														Ratio	Chemical Type	Illustrated
		Rb	±	Sr	±	Y	±	Zr	±	Nb	±	Ba	±	$Fe_2O_3^T$	±	Fe/Mn		
Zalužice, Michalovce distr.	SK-141	200	5	60	3	31	3	64	3	9	2	415	20	1,05	0,02	24,9	C1	
	SK-142	179	5	71	3	31	3	66	3	8	2	482	22	1,09	0,02	25,6	C1	
	SK-143	168	5	66	3	28	3	63	3	7	2	472	22	nm		26,8	C1	
	SK-144	171	5	64	3	27	3	64	4	7	2	462	21	nm		26,5	C1	
	SK-145	175	5	62	3	26	3	59	3	8	2	432	21	nm		28,5	C1	
	SK-146	205	5	68	3	32	3	66	3	8	2	421	0	nm		23,8	C1	
	SK-147	188	5	56	3	32	3	59	3	8	2	382	20	nm		24,6	C1	Fig. 2:w
	SK-148	195	5	61	3	30	3	60	3	8	2	438	21	1,07	0,02	26	C1	
	SK-149	184	5	59	3	30	3	60	3	8	2	456	21	nm		24,9	C1	
	SK-150	177	5	64	3	28	3	61	3	8	2	500	22	nm		25,8	C1	
	SK-151	207	5	68	3	33	3	70	3	8	2	384	27	nm		24,7	C1	
	SK-152	200	5	55	3	30	3	55	3	7	2	418	28	1,01	0,02	25	C1	Fig. 2:x
	SK-153	192	5	60	3	30	3	63	3	7	2	486	22	nm		25,1	C1	
	SK-154	209	5	57	3	34	3	62	3	8	2	393	20	1,06	0,02	23,1	C1	
	SK-155	184	5	58	3	28	3	58	3	8	2	457	22	nm		24,4	C1	
	SK-156	185	5	66	3	30	3	70	3	8	2	466	22	nm		27,1	C1	
	SK-157	179	5	58	3	30	3	64	3	8	2	444	20	nm		25,6	C1	
	SK-158	190	5	62	3	29	3	63	3	7	2	423	20	1,09	0,02	25,4	C1	
	SK-159	192	5	58	3	31	3	60	3	8	2	431	20	nm		22,7	C1	
	SK-160	180	5	67	3	29	3	66	3	8	2	497	22	1,03	0,02	27,1	C1	

Zbudza, Michalovce distr.	SK-101	206	5	65	3	31	3	67	3	7	2	460	22	1,15	0,02	25,7	C1	
	SK-102	205	5	56	3	31	3	64	3	9	2	383	20	1,12	0,02	22,9	C1	
	SK-103	204	5	66	3	32	3	66	3	9	2	421	21	1,19	0,02	25,9	C1	
	SK-104	170	5	57	3	27	3	60	3	7	2	480	22	nm		24,2	C1	
	SK-105	204	5	62	3	33	3	61	3	8	2	415	20	1,08	0,02	25,1	C1	Fig. 2:i
	SK-106	197	5	62	3	32	3	62	3	9	2	447	20	nm		23,5	C1	
	SK-107	205	5	67	3	36	3	68	3	9	2	391	19	nm		23,7	C1	
	SK-108	191	5	58	3	38	3	64	3	8	2	487	22	nm		24,4	C1	
	SK-109	181	5	63	3	29	3	64		7	2	488	22	nm		24,9	C1	
	SK-110	195	4	55	3	31	3	58	3	7	2	385	20	nm		23,4	C1	
	SK-111	183	5	58	3	30	3	55	3	7	2	385	21	nm		22,5	C1	
	SK-112	191	5	65	3	32	3	66	3	8	2	464	24	1,06	0,02	25,1	C1	Fig. 2:j
	SK-113	190	5	64	3	32	3	66	3	7	2	387	24	nm		24,4	C1	
	SK-114	152	5	69	3	23	3	61	3	8	2	479	21	nm		26,7	C1	Fig. 2:k
	SK-115	186	5	58	3	30	3	57	3	8	2	390	20	nm		23,2	C1	
	SK-116	164	4	67	3	26	3	66	3	6	2	440	21	1,1	0,02	30,3	C1	Fig. 2:l
	SK-117	186	5	60	3	29	3	65	3	8	2	470	22	nm		22,3	C1	
	SK-118	200	5	58	3	31	3	59	3	7	2	399	20	1,04	0,02	22,7	C1	
	SK-119	201	5	63	3	31	3	64	3		2	474	21	1,12	0,02	25,2	C1	
	SK-120	180	4	67	3	29	3	63	3	9	2	475	21	1,11	0,02	26,9	C1	

Table 3.

Site	Cat. No.	Trace and Rare Earth Element Composition														Ratio	Chemical Type	Illustrated
		Rb	±	Sr	±	Y	±	Zr	±	Nb	±	Ba	±	$Fe_2O_3^T$	±	Fe/Mn		
Lúčky, Michalovce distr.	SK-161	181	5	52	3	39	3	57	3	9	2	444	21	nm		24,9	C1	
	SK-162	206	5	66	3	31	3	65	3	8	2	470	21	1,13	0,02	23,1	C1	
	SK-163	204	5	67	3	32	3	63	3	8	2	415	23	1,13	0,03	24,9	C1	
	SK-164	206	5	63	3	32	3	62	3	7	3	380	25	1,07	0,02	25,3	C1	Fig. 2:y
	SK-165	198	5	53	3	31	3	57	3	8	2	387	21	0,95	0,02	23	C1	
	SK-166	204	5	55	3	31	3	59	3	8	2	410	20	nm		25,9	C1	Fig. 2:z
	SK-167	205	5	64	3	33	3	72	3	10	2	398	21	1,15	0,02	24,6	C1	
	SK-168	203	5	63	3	33	3	70	3	9	2	398	21	nm		23,6	C1	
	SK-169	189	5	72	3	29	3	63	3	7	2	422	25	1,15	0,02	28,2	C1	Fig. 2:a'
	SK-170	201	5	63	3	32	3	66	3	8	2	412	20	1,11	0,02	23,9	C1	Fig. 2:b'
	SK-171	172	5	55	3	28	3	58	3	7	2	515	24	nm		23,2	C1	
	SK-172	203	5	66	3	32	3	64	3	8	2	384	21	1,14	0,02	26,1	C1	
	SK-173	196	5	64	3	31	3	61	3	8	2	433	20	1,03	0,02	25	C1	
	SK-174	203	5	64	3	32	3	65	3	9	2	409	22	1,15	0,02	25,4	C1	
	SK-175	185	5	58	3	31	3	60	3	8	2	463	21	0,96	0,02	25,9	C1	
	SK-177	191	5	59	3	30	3	62	3	9		440	21	0,97	0,02	24,2	C1	
	SK-178	179	5	59	3	28	3	59	3	8	2	392	20	0,98	0,02	24,5	C1	
	SK-179	190	5	58	3	30	3	61	3	10	2	396	20	0,98	0,02	24,3	C1	
	SK-180	204	5	75	3	31	3	73	3	6	2	433	20	nm		26,9	C1	

Fintice, Prešov distr.	SK-061	200	5	68	3	30	3	64	3	9	2	425	27	nm		25,7	C1	Fig. 2:r
	SK-062	171	4	64	3	29	3	60	3	8	2	459	21	nm		25,1	C1	
	SK-063	196	5	65	3	30	3	66	3	7	2	422	21	1,17	0,02	24,8	C1	
	SK-064	200	5	65	3	33	3	64	3	8	2	458	21	1,14	0,02	26,2	C1	
	SK-065	205	5	69	3	34	3	67	3	8	2	403	22	nm		25,8	C1	
	SK-066	204	5	64	3	31	3	64	3	9	2	426	20	1,16	0,02	24,9	C1	Fig. 2:s
	SK-067	180	4	60	3	29	3	58	3	9	2	465	23	1,05	0,02	26	C1	
	SK-068	210	5	65	3	32	3	67	3	10	2	425	20	nm		24,5	C1	
	SK-069	204	5	64	3	35	3	69	3	9	2	396	22	1,13	0,02	24,8	C1	
	SK-070	192	5	61	3	29	3	61	3	7	2	423	20	1,11	0,02	26,6	C1	
	SK-071	193	5	59	3	31	3	61	3	8	2	453	21	1,03	0,02	24,7	C1	
	SK-072	191	5	71	3	32	3	67	3	7	2	459	21	1,15	0,02	25,7	C1	
	SK-074	208	5	67	3	31	3	67	3	10	2	435	26	nm		23,5	C1	
	SK-076	189	5	71	3	31	3	62	3	7	2	416	26	nm		26,8	C1	
	SK-077	193	5	60	3	30	3	61	3	7	2	456	21	1,06	0,02	26,2	C1	
	SK-078	203	5	70	3	31	3	63	3	7	2	435	23	nm		27,2	C1	
	SK-079	206	5	60	3	32	3	64	3	7	2	415	21	1,15	0,02	24,7	C1	
	SK-080	210	5	57	3	33	3	70	3	9	2	390	23	1,1	0,02	23,4	C1	

Table 3.

Site	Cat. No.	Trace and Rare Earth Element Composition														Ratio	Chemical Type	Illustrated
		Rb	±	Sr	±	Y	±	Zr	±	Nb	±	Ba	±	$Fe_2O_3^T$	±	Fe/Mn		
Moravany 'Stredné pole', Michalovce distr.	SK-001	169	4	68		29	3	60	3	6	2	504	22	1,04	0,02	27,9	C1	
	SK-002	200	5	68	3	32	3	70	3	8	2	448	28	1,05	0,02	26,1	C1	
	SK-003	185	5	57	3	30	3	61	3	9	2	429	21	nm		26,3	C1	
	SK-005	201	5	58	3	33	3	64	3	7	2	384	21	1,07	0,02	23,6	C1	
	SK-006	194	5	63	3	29	3	65	3	8	2	479	22	1,12	0,02	27,4	C1	
	SK-007	199	5	56	3	32	3	62	3	8	2	448	21	1,09	0,02	25,7	C1	
	SK-009	176	5	55	3	28	3	62	3	7	2	438	21	nm		25,8	C1	
	SK-010	204	5	72	3	32	3	68	3	7	2	490	23	nm		26,2	C1	
	SK-011	197	5	66	3	32	3	66	3	8	2	429	21	1,08	0,02	24,4	C1	
	SK-012	205	5	66	3	33	3	70	3	10	2	408	23	1,16	0,02	24,7	C1	
	SK-013	192	5	60	3	31	3	61	3	8	2	440	21	1,02	0,02	24,8	C1	
	SK-014	209	5	64	3	33	3	66	3	7	2	404	21	1,1	0,02	24,5	C1	
	SK-015	193	5	62	3	31	3	61	3	8	2	427	20	1,04	0,02	25,6	C1	
	SK-016	188	5	56	3	31	3	60	3	9	2	451	22	nm		25	C1	
	SK-017	181	4	67	3	3	3	62	3	7	2	415	22	1,02	0,02	27,2	C1	
	SK-018	192	5	63	3	31	3	65	3	7	2	478	21	1,1	0,02	26,6	C1	
	SK-019	194	5	62	3	30	3	63	3	8	2	431	20	1,04	0,02	25,3	C1	
	SK-020	207	5	67	3	32	3	66	3	9	2	459	25	nm		25,8	C1	
	SK-021	199	5	66	3	32	3	66	3	8	2	485	21	nm		27,1	C1	
	SK-022	171	4	65	3	26	3	64	3	8	2	494	23	1,01	0,02	27,3	C1	

Moravany 'Stredné pole', Michalovce distr.	SK-023	185	5	65	3	31	3	68	3	8	2	436	21	nm		24,6	C1	Fig. 2:a
	SK-025	195	5	65	3	30	3	65	3	8	2	448	22	1,09	0,02	25,6	C1	
	SK-026	187	5	61	3	29	3	70	3	10	2	418	21	nm		29,1	C1	Fig. 2:c
	SK-027	191	4	59	3	28	3	60	3	8	2	481	21	nm		26,4	C1	
	SK-028	171	5	64	3	31	3	63	3	6	2	453	20	nm		27,5	C1	
	SK-030	171	5	60	3	26	3	65	3	9	2	463	22	nm			C1	
	SK-031	177	5	67	3	31	3	63	3	7	2	446	20	nm			C1	
	SK-032	192	4	58	3	33	3	58	3	8	2	415	21	1,04	0,02	22,4	C1	Fig. 2:b
	SK-033	197	5	70	3	31	3	64	3	9	2	465	21	1,12	0,02	24,9	C1	
	SK-034	168	4	55	3	29	3	55	3	10	2	468	22	nm			C1	
	SK-035	183	5	57	3	28	3	62	3	8	2	465	22	nm			C1	
	SK-036	176	4	66	3	30	3	63	3	7	2	445	22	nm			C1	Fig. 2:d
	SK-037	183	5	55	3	30	3	59	3	6	2	431	21	nm		23,7	C1	
	SK-039	185	5	59	3	30	3	64	3	8	2	433	21	1,02	0,02	26,4	C1	
	SK-040	183	4	59	3	30	3	60	3	9	2	430	21	nm		22,2	C1	Fig. 2:e
	SK-041	177	4	55	3	28	3	59	3	7	2	455	22	nm		24,1	C1	
	SK-042	183	4	59	3	29	3	64	3	7	2	476	21	nm		23,2	C1	
	SK-043	193	4	57	3	30	3	64	4	8	2	470	24	nm		23,1	C1	
	SK-044	186	3	64	3	29	3	67	3	10	2	457	21	1,07	0,02	25,3	C1	
	SK-045	188	5	72	3	30	3	66	3	8	2	484	21	1,15	0	26,1	C1	
	SK-046	190	5	68	3	32	3	63	3	8	2	522	23	1,08	0,02	25,5	C1	
	SK-047	204	5	71	3	32	3	67	3	9	2	506	22	nm		26,4	C1	
	SK-048	181	4	61	3	28	3	62	3	7	2	488	23	nm		25,6	C1	

Table 3.

Site	Cat. No.	Trace and Rare Earth Element Composition														Ratio	Chemical Type	Illustrated
		Rb	±	Sr	±	Y	±	Zr	±	Nb	±	Ba	±	$Fe_2O_3^T$	±	Fe/Mn		
Moravany 'Stredné pole', Michalovce distr.	SK-049	195	5	59	3	29	3	63	3	8	2	424	20	1,11	0,02	24,8	C1	
	SK-050	203	5	69	3	33	3	69	3	9	2	455	21	nm		26,1	C1	Fig. 2:f
	SK-051	200	5	72	3	32	3	68	3	8	2	420	31	nm		24,8	C1	
	SK-052	201	5	67	3	31	3	66	3	8	2	431	26	1,11	0,02	24,2	C1	Fig. 2:g
	SK-181	200	5	64	3	31	3	64	3	9	2	422	21	1,06	0,02	24,1	C1	
	SK-182	179	4	57	3	27	3	58	3	8	2	427	21	nm		25	C1	
	SK-183	199	5	65	3	31	3	64	3	8	2	523	23	1,16	0,02	24,6	C1	
	SK-184	186	4	71	3	30	3	66	3	8	2	471	21	1,15	0,02	27,6	C1	
	SK-185	176	4	55	3	30	3	55	3	8	2	416	20	nm		25,7	C1	Fig. 2:h
	SK-186	203	5	65	3	31	3	64	3	9	2	467	22	1,16	0,03	27,1	C1	
Ražňany-Farské, Sabinov distr.	SK-053	193	5	59	3	31	3	66	3	9	2	395	23	1,17	0,02	25	C1	
	SK-054	178	5	65	3	28	3	67	3	8	2	464	21	1,03	0,02	26,5	C1	
	SK-057	196	5	60	3	33	3	62	3	8	2	447	20	1,02	0,02	25,3	C1	
	SK-058	178	5	62	3	31	3	66	3	7	2	483	23	1,08	0,02	28,2	C1	
	SK-060	185	5	58	3	31	3	61	3	9	2	447	21	nm		25,2	C1	Fig. 2:q
U.S. Geological Survey Reference Standard																		
RGM-1 (measured)	RGM-1	150	4	111	3	24	3	223	4	8	3	813	23	1.87	.02	65	Glass Mtn., CA	
RGM-1 (recommended)	RGM-1	149		108		25		219		9		807		1.86		nr	Glass Mtn., CA	

Values in parts per million (ppm) except total iron (in weight %) and Fe/Mn intensity ratios; ± = 2-sigma estimate of x-ray counting uncertainty and regression fitting error at 120-360 seconds livetime; nm = not measured; nr= not reported.

Table 4. Integrated Net Peak Intensity Data for small obsidian artifacts from Neolithic archaeological sites in Slovakia

Site	Cat. no.	Intensities/Counts			Σ	Intensity Ratios									Chemical Type	Illustrated
		Rb	Sr	Zr	Rb, Sr, Zr	Rb%	Sr%	Zr%	Fe/Mn	Rb/Sr	Zr/Y	Y/Nb	Zr/Nb	Sr/Y		
Malé Raškovce, Michalovce distr.	SK-123	431	167	233	831	0,519	0,201	0,280	25,7	2,6	2,4	2,8	6,9	1,7	C1	
Lúčky, Michalovce distr.	SK-176	402	146	226	774	0,519	0,189	0,292	26,8	2,8	2,4	3,1	7,3	1,5	C1	
Fintice, Prešov distr.	SK-073	469	167	230	866	0,542	0,193	0,266	23,7	2,8	2,4	3,0	7,2	1,7	C1	
	SK-075	498	164	259	921	0,541	0,178	0,281	24,9	3,0	2,4	3,3	7,9	1,5	C1	
Moravany 'Stredné pole', Michalovce distr.	SK-004	417	154	239	810	0,515	0,190	0,295	27,1	2,7	2,5	2,7	6,8	1,6	C1	
	SK-008	467	145	264	876	0,533	0,166	0,301	27,1	3,2	2,5	3,3	8,3	1,4	C1	
	SK-024	435	128	197	760	0,572	0,168	0,259	25,3	3,4	2,0	2,6	5,2	1,3	C1	
	SK-029	403	144	215	762	0,529	0,189	0,282	25,2	2,8	2,5	2,9	7,2	1,7	C1	
	SK-038	392	162	223	777	0,505	0,209	0,287	26,0	2,4	2,5	2,7	6,8	1,8	C1	
Ražňany-Farské, Sabinov distr.	SK-055	430	177	241	848	0,507	0,209	0,284	27,1	2,4	2,5	2,9	7,3	1,8	C1	Fig. 2:p
	SK-056	380	141	214	735	0,517	0,192	0,291	25,4	2,7	2,6	3,0	7,6	1,7	C1	
	SK-059	438	162	231	831	0,527	0,195	0,278	25,5	2,7	2,3	3,2	7,2	1,6	C1	

Elemental intensities generated at 40 seconds livetime.

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CHIPPED LITHIC ASSEMBLAGE FROM LINEAR POTTERY CULTURE SITE ROVANCI – HNIDAVSKA HIRKA, LUTSK OBLAST (VOLHYNIA, WEST UKRAINE)

ABSTRACT

Pelisiak A. 2021. Chipped lithic assemblage from Linear Pottery culture site Rovanci – Hnidavska Hirka, Lutsk Oblast (Volhynia, West Ukraine). *Sprawozdania Archeologiczne* 73/1, 371-388.

This paper describes the analysis of LBK chipped artefacts discovered during rescue excavations carried out on the site of Hnidavska Hirka in the suburbs of Lutsk, western Volhynia. This assemblage consists of 103 artefacts made of Volhynian flint (93 artefacts) and obsidian (10 artefacts). This material constitutes one of the largest LBK chipped assemblages from area of the Volhynia.

Keywords: Volhynia, Neolithic, LBK, chipped artifacts, lithics, Volhynian flint, obsidian.
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1. INTRODUCTION

The multicultural site of Hnidavska Hirka is located near the bank of the Rudka River, the left side tributary of the Styr River, in Rovanci, in the southwestern part of the town of Lutsk. It was discovered in 1935 by Jan Fitzke. Small scale excavations were carried out on this site from 1967-1969, in 1972, 1981, 1988 and from 2002-2007. The last rescue excavations in 2009 were conducted by Oleksiy Zlatogorskiy and Andriy Bardetskiy. On an area

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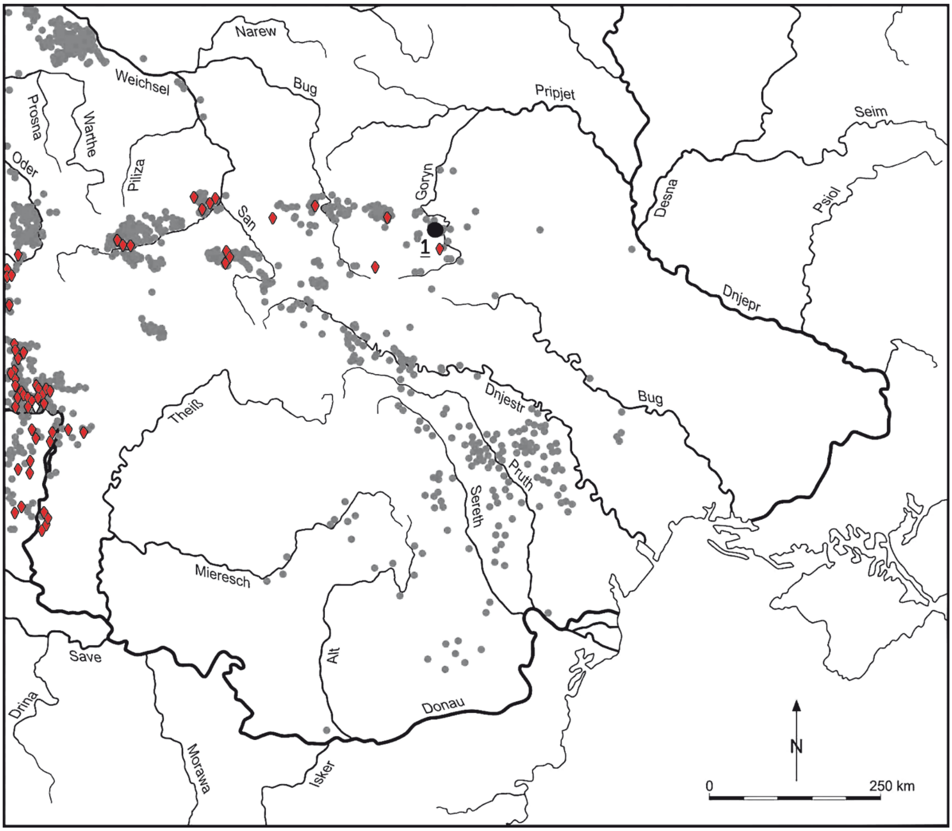

Fig 1. Eastern area of the LBK distribution. Red pots = Early LBK sites, grey pots = younger LBK sites. 1 – Rovanci – Hnidavska Hirka site (after Dębiec and Saile 2015)

of 636.5 m², material dated to various periods from the Early Neolithic to modern times were discovered. The oldest period of occupation of this site corresponds to the Linear Pottery culture. This is confirmed by settlement features and relatively large numbers of various artefacts (Zlatogorskiy and Bardetskiy 2010; Dębiec and Saile 2015; Bardec'kij *et al.* 2016; Bardetskiy *et al.* 2017; Becker *et al.* 2018; Saile *et al.* 2018). There were also flint, stone and obsidian artefacts discovered in the LBK context. This paper details the results of an analysis of chipped lithic artefacts discovered in 2009. In total, the chipped assemblage available for analysis from the LBK site of Hnidavska Hirka consisted of 103 artefacts made of Volhynian flint (93 artefacts) and obsidian (10 artefacts) (Table 1). Unfortunately, only a small portion of the chipped artifacts is currently available for the preparation of illustrations and photographic documentation. As a result, only part of this assemblage can be presented in the figures in this paper. This material constitutes one of the largest LBK chipped assemblages from the area of Volhynia.

Table 1. Rovanci – Hnidavska Hírka. Typological composition of LBK chipped assemblage

Category of artifacts	Volhynian flint		Obsidian	Total	
	n	%	n	n	%
Single platform blade cores	2	2,15	1	3	2,91
Blades and their fragments	17	18,28	4	21	20,39
Burnt blades	2	2,15	---	2	1,94
Flakes	2	2,15	1	3	2,91
Tools	70	75,27	4	74	71,85
Total	93	100,00	10	103	100,00

2. CHIPPED ARTEFACTS

Feature 6

Within Feature 6 a regular, single platform, conical blade core, with the flaking surface extending onto both sides of the core. The back of the core is a partly natural, prepared striking platform, formed by the detachment of several flakes from the flaking surface. The angle of the edge (platform/flaking surface) is approximately 90°, while the dimensions of the striking platform measure 32 × 37 mm and the height of the flaking surface is 68 mm. On the flaking surface, the negatives of 13 regular blades up to 66 mm in length can be seen. The blades were curved in their distal portions (obsidian; Fig. 2: 1).

Feature 7

Several items were found in Feature 7, including: a fragment of a crushed core (Volhynian flint); 11 fragments of blades from single-platform blade cores (Volhynian flint); 3 fragments of blades from single-platform blade cores (obsidian); 1 crushed fragment of a blade (obsidian); 1 fragment of the crushed medial portion of a blade (Volhynian flint); 1 flake from the preparation of a striking platform of a core, with a length of 52 mm, a width of 31 mm, and a thickness of 8 mm in the bulb portion and in the medial portion (Volhynian flint); 1 flake from the preparation of the striking platform of a blade core with an edge-like butt, a convex bulb, a length of 13 mm, a width of 18 mm, and a thickness of 3 mm in the bulb portion and 2 mm in the medial portion (obsidian); 1 end-scraper on a large blade from a single-platform core, with a front that was semi-steep and rounded, a damaged butt, a flat bulb, a length of 29 mm, a width of 28 mm, and a thickness of 8 mm in the bulb portion as well as in the medial portion (Volhynian flint; Fig. 3: 5); 1 double end-scraper on a cortical blade with semi-steep, slightly rounded fronts, one of them crushed, a length of 30 mm, a width of 27 mm, and a thickness of 8 mm (Volhynian flint); 1 double end-

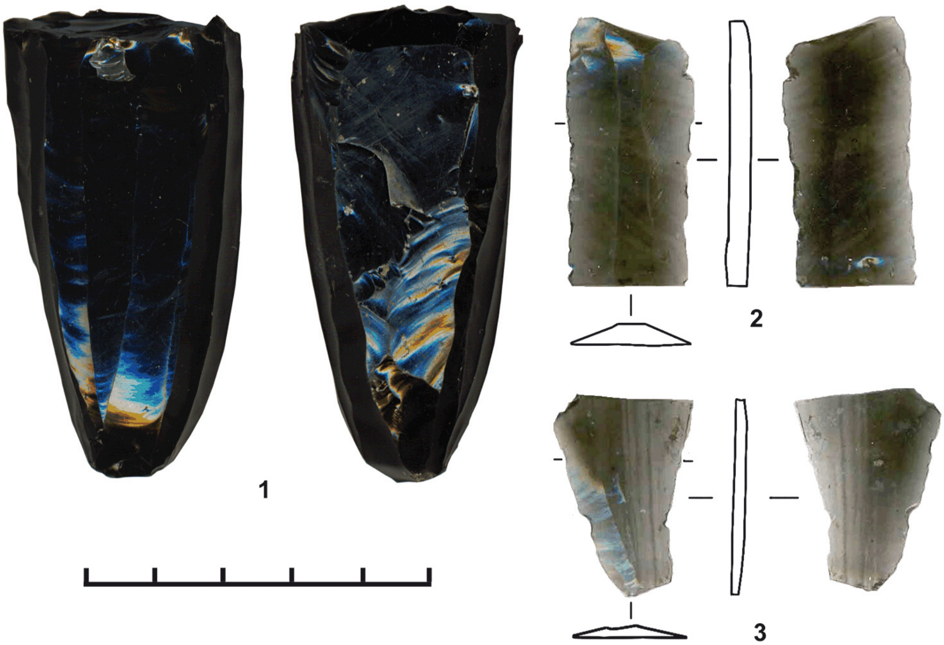

Fig. 2. Rovanci – Hnidavska Hirka, obsidian artefacts. 1 – feature 6; 2, 3 – feature 24 (photo by A. Bardetskiy)

scraper made from a partly cortical blade with steep fronts, a length of 28 mm, a width of 29 mm, and a thickness of 13 mm (Volhynian flint); 1 end-scraper on a cortical flake with a slightly oblique, semi-steep front, a length of 25 mm, a width of 31 mm, and a thickness of 10 mm (Volhynian flint; Fig. 4: 4); 1 irregular end-scraper on a cortical flake, with a semi-steep, rounded front, a length of 37 mm, a width of 27 mm, and a thickness of 10 mm (Volhynian flint); 1 truncation on a large, regular and partially cortical blade, with a steep front, a slightly rounded and oblique, polyhedral butt, a convex bulb, a length of 29 mm, a width of 19 mm, and a thickness of 6 mm in both the bulb portion and the medial portion (Volhynian flint); 1 truncation made on a regular blade with a significantly oblique front, glossy polishing on both faces of one edge, a length of 48 mm, a width of 17 mm, and a thickness of 4 mm (Volhynian flint; Fig. 3: 1); 1 slender truncation and end-scraper, with a length of 46 mm, a width of 16 mm, and a thickness of 6 mm (Volhynian flint); 1 burin on a blade fragment with a length of 35 mm, a width of 30 mm, and a thickness of 5 mm (Volhynian flint; Fig. 4: 2); 1 small, partly cortical blade, retouched on both edges, with a tip in the form of a perforator, steep retouch on the ventral face of both edges, nearly flat retouch on the dorsal face near the tip, a length of 44 mm, a width of 12 mm, and a thickness of 5 mm (Volhynian flint; Fig. 4: 12); 1 proximal/medial part of a regular blade with slight retouch on one edge on the ventral face, an edge-like butt, and a diffuse bulb, with a length of 42 mm,

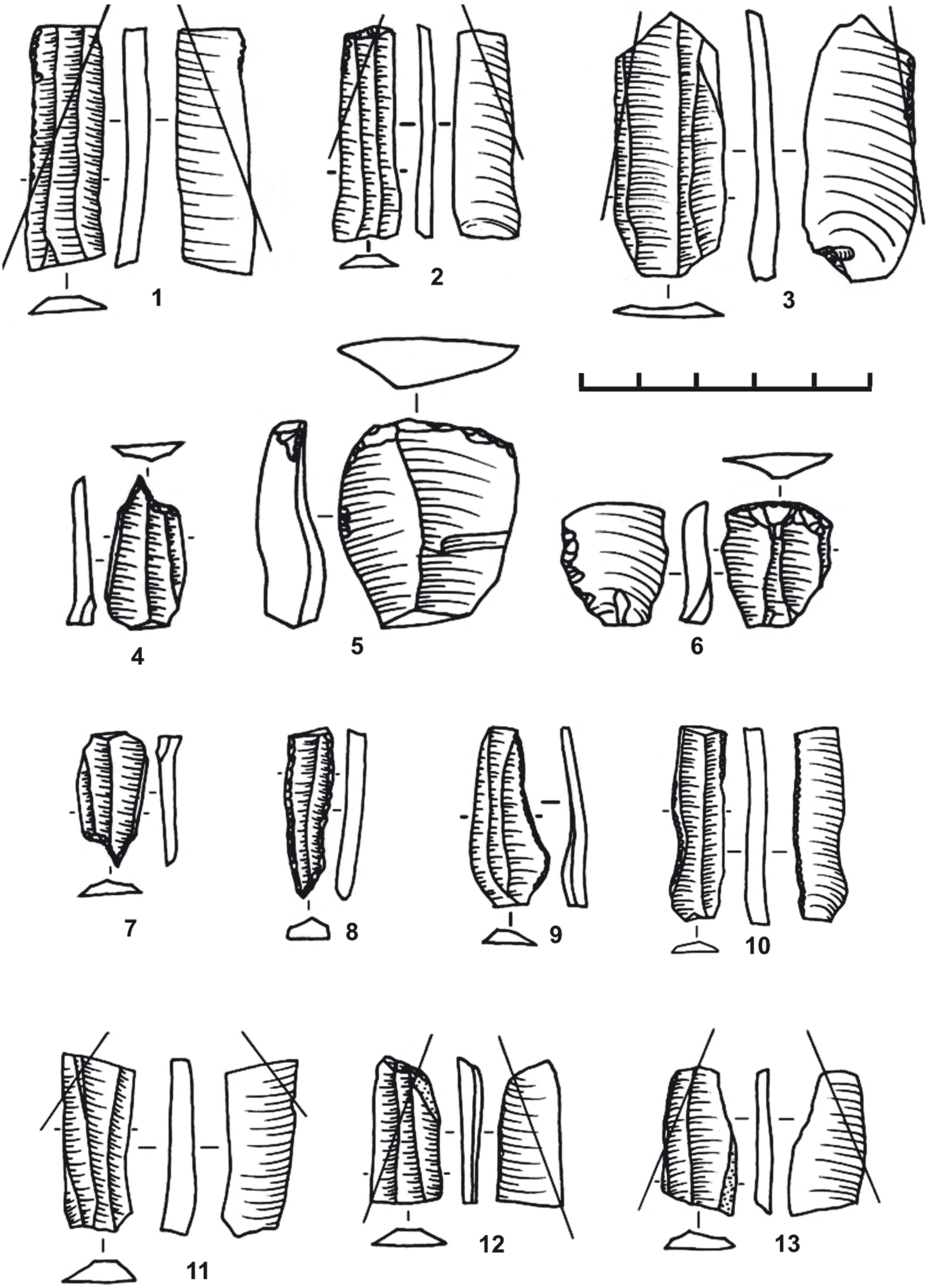

Fig 3. Rovanci – Hnidavska Hirka, artefacts made of Volhynian flint.
1, 3 – 5, 13 – feature 7; 2, 6 – feature 19; 8 – 12 – feature 41; 7 – feature 46
(illustrations by A. Bardetskiy; after Zlatogorskiy and Bardetskiy 2010)

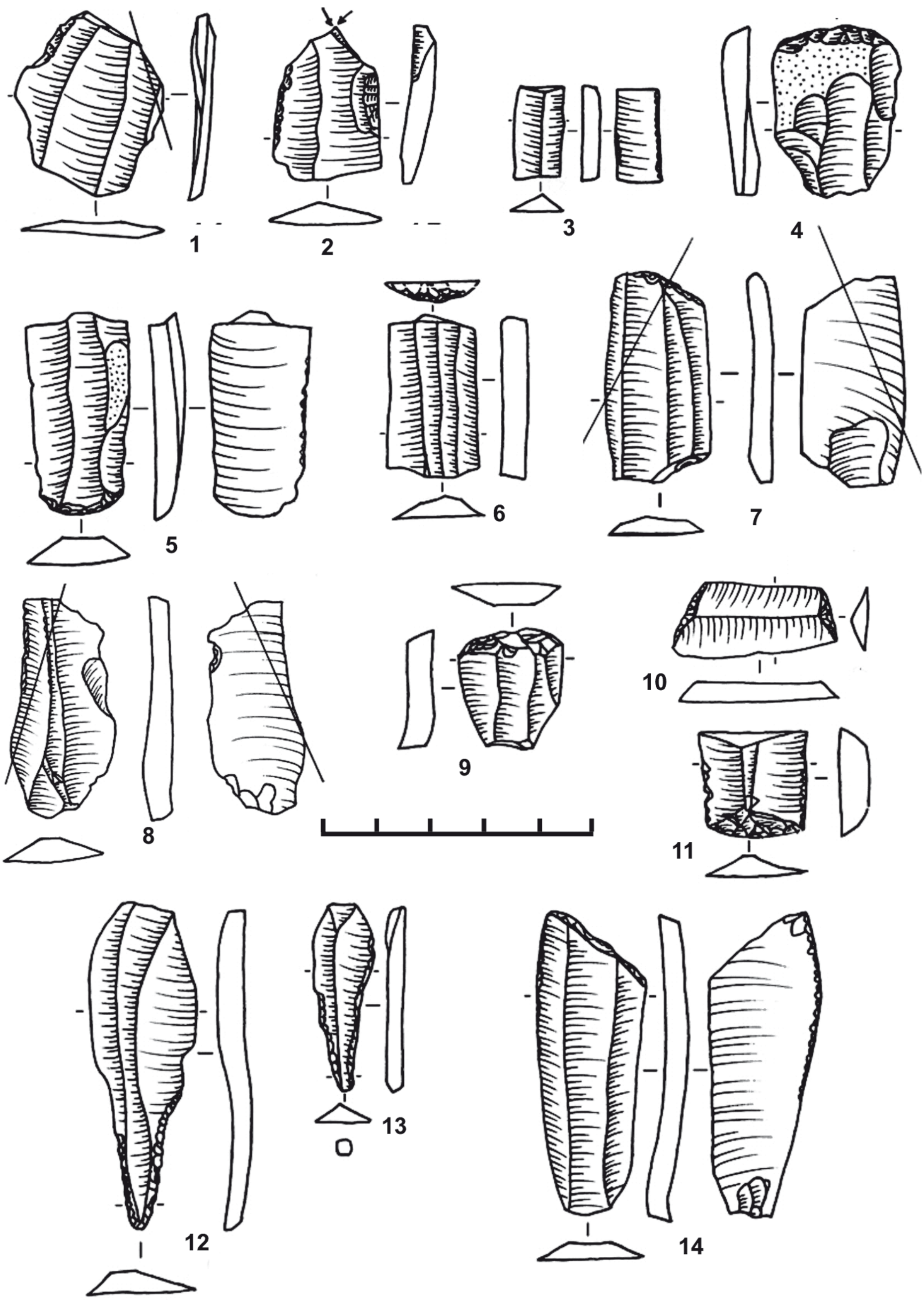

Fig. 4. Rovanci – Hnidavska Hirka, artefacts made of Volhynian flint.
1, 2, 4, 12, 14 – feature 7; 7, 9, 10 – feature 19; 6, 11 – feature 41; 3, 5, 8, 13 – feature 46
(illustrations by A. Bardetskiy; after Zlatogorskiy and Bardetskiy 2010)

a width of 21 mm, and a thickness of 4 mm in both the bulb portion and the medial portion (Volhynian flint); 1 flake with flat retouch on the dorsal face, and with a length of 35 mm, a width of 41 mm, and a thickness of 10 mm (Volhynian flint); 1 irregular blade with use retouch on the edges and distinct glossy polishing on one edge, a polyhedral butt, a flat bulb, and a length of 45 mm, a width of 18 mm, and a thickness of 3 mm in both the bulb portion and the medial portion (Volhynian flint; Fig. 3: 3); 1 fragment of a crushed blade with use retouch on the edge (Volhynian flint; Fig. 3: 4); 1 irregular blade with use retouch one both edges, a cortical butt, a crushed bulb, and a length of 56 mm, a width of 27 mm, and a thickness of 18 mm (Volhynian flint; Fig. 4: 14); 1 distal and mid portion of a blade made of a single-platform core with glossy polishing on one edge, a length of 32 mm, a width of 16 mm, and a thickness of 5 mm (Volhynian flint); 1 distal part of a large, regular blade, with glossy polishing on one edge, and a length of 30 mm, a width of 25 mm, and a thickness of 3 mm (Volhynian flint; Fig. 4: 1).

Feature 19

Feature 19 included: a blade end-scraper with a slightly oblique, steep front, a polyhedral butt, a convex bulb, and a length of 32 mm, a width of 18 mm, and a thickness of 5 mm in both the bulb portion and the medial portion (Volhynian flint; Fig. 3: 6); 1 blade end-scraper with a slightly oblique front, a length of 22 mm, a width of 18 mm, and a thickness of 5 mm in both the bulb portion and the medial portion (Volhynian flint; Fig. 4: 9); 1 truncation made of a regular, partly cortical blade with a slightly rounded front, one edge with distinct glossy polishing on both faces, and a length of 41 mm, a width of 21 mm, and a thickness of 3.5 mm (Volhynian flint); 1 crushed truncation with glossy polishing on both faces of one edge, a length of 51 mm, a width of 22 mm, and a thickness of 6 mm in the bulb portion and 5 mm in the medial portion (Volhynian flint); 1 fragment of a truncation (Volhynian flint); 1 trapeze (Volhynian flint; Fig. 4: 10); 1 fragment of a (probably) retouched blade (obsidian, but of another kind, similar to the raw material used to prepare the core discovered in feature 6; a white mass without grey dregs); 1 proximal/medial portion of a regular blade with use retouch on the edges, a polyhedral butt, a convex bulb, and a length of 45 mm, a width of 19 mm, and a thickness of 5 mm in the bulb portion and 4 mm in the medial portion (Volhynian flint; Fig. 3: 2); 1 proximal/medial portion of a blade with use retouch on the edges, a polyhedral butt, a convex bulb, a length of 38 mm, a width of 17 mm, and a thickness of 3 mm in both the bulb portion and in the medial portion (Volhynian flint); 1 blade with use retouch on the edges, a flat butt, a convex bulb, a length of 56 mm, a width of 18 mm, and a thickness of 3 mm in both the bulb portion and the medial portion (Volhynian flint); 5 regular, small blades, curved in their distal portions, with use retouch on the edges, edge-like butts, convex bulbs, lengths of 58 mm, widths of 13 mm, and thickness of 3 mm in both the bulb portions and in the medial portions (Volhynian flint).

Feature 24

The following two objects were found in Feature 24: The medial portion of a large blade, with the tip broken off obliquely to the percussion axis (the oblique edge of the fracture makes this blade similar to a truncation), and with use retouch on one edge, a length of 38 mm, a width of 18 mm, and a thickness of 4 mm (obsidian; Fig. 2: 2); 1 distal portion of a blade with use retouch, and a length of 30 mm, a width of 30 mm, and a thickness of 2 mm (obsidian; Fig. 2: 3).

Feature 41

The following were recorded in Feature 41: A fragment of a crushed blade (Volhynian flint); 2 fragments of burnt blades; 1 fragment of a blade with use retouch on the edges (Volhynian flint; Fig. 4: 6); 1 end-scraper made of a regular, cortical blade, with use retouch on one edge, a length of 26 mm, a width of 26 mm, and a thickness of 5 mm (Volhynian flint); 1 end-scraper on a large blade, with use retouch on the edges, and with a length of 22 mm, a width of 27 mm, and a thickness of 5 mm (Volhynian flint; Fig. 4: 11); 1 end-scraper made of a cortical blade, with a length of 44 mm, a width of 22 mm, and a thickness of 8 mm (Volhynian flint); 1 fragment of a double end-scraper (Volhynian flint); 1 fragment of a flake end-scraper (Volhynian flint); 1 truncation (sickle blade) on a partly cortical blade, with glossy polishing on one edge, a length of 29 mm, a width of 13 mm, and a thickness of 3 mm (Volhynian flint); 1 medial portion of a retouched blade, with a length of 35 mm, a width of 23 mm, and a thickness of 6 mm (Volhynian flint; Fig. 3: 12); 1 blade with edges irregularly retouched on the ventral face of the distal portion, curved on the ventral side, with a polyhedral butt, a convex bulb, a length of 60 mm, a width of 28 mm, and a thickness of 7 mm in the bulb portion and 6 mm in the medial portion (Volhynian flint); 1 distal part of a regular, curved blade with use retouch on the edges, a length of 39 mm, a width of 21 mm, and a thickness of 5 mm (Volhynian flint; Fig. 3: 9); 1 fragment of a blade with use retouch on the edges (Volhynian flint; Fig. 3: 8); 1 medial portion of a blade with use retouch on the edges, a length of 34 mm, a width of 14 mm, and a thickness of 4 mm (Volhynian flint; Fig. 3: 10); 1 proximal and mid portion of a curved blade with use retouch on the edges, a flat butt, a convex bulb, a length of 42 mm, a width of 13 mm, and a thickness of 3 mm (Volhynian flint); 1 fragment of a regular blade with use retouch on the edges, a length of 9 mm, a width of 17 mm, and a thickness of 3 mm (Volhynian flint); 1 distal part of a blade with glossy polishing of the edges, a flat butt, a convex bulb, a length of 40 mm, a width of 11 mm, and a thickness of 3 mm in the bulb portion and 2 mm in the medial portion (Volhynian flint); 1 fragment of a blade with glossy polishing on one edge, a length of 29 mm, a width of 14 mm, and a thickness of 3 mm (Volhynian flint; Fig. 3: 11); 1 fragment of a sickle-blade made of a partly cortical blade, with glossy polishing on both the dorsal and ventral faces of one edge, a length of 33 mm, a width of

13 mm, and a thickness of 4 mm (Volhynian flint); 5 flint hammers made from rounded flint nodules, one of which was on a single-platform blade core – the largest diameters of the hammers were 51, 48, 54, 39 and 48 mm (Volhynian flint).

Feature 45

Feature 45 included: 5 fragments of blades from single-platform blade cores (Volhynian flint); 1 fragment of a partially cortical flake with dimensions of 80 × 43 × 18 mm (Volhynian flint); 1 truncation on an irregular, partially cortical blade with a flat butt, a convex bulb, and a length of 34 mm, a width of 16 mm, a thickness of 6 mm in the bulb portion, and a thickness of 4 mm in the medial portion (Volhynian flint); 1 flint hammer, with one edge as well as opposite faces crushed, and dimensions of 48 × 36 × 24 mm (Volhynian flint).

Feature 46

The following were documented in Feature 46: 1 blade end-scraper with a semi-steep front, use retouch on the edges of the blade, a polyhedral butt, a convex bulb, and a length of 22 mm, a width of 18 mm, and a thickness of 4 mm in both the bulb and the medial portions (Volhynian flint); 1 blade end-scraper with use retouch on the edges of the blade, a length of 28 mm, a width of 19 mm, and a thickness of 7 mm (Volhynian flint); 1 blade end-scraper with a slightly oblique front, flat butt of the blade, a diffuse bulb, a length of 52 mm, a width of 24 mm, and a thickness of 6 mm (Volhynian flint; Fig. 4: 5); 1 blade end-scraper with a length of 35 mm, a width of 14 mm, and a thickness of 3 mm (Volhynian flint); 1 destroyed blade end-scraper made of partly cortical blade (Volhynian flint); 1 fragment of a truncation with glossy polishing on both the ventral and dorsal sides of one edge, and with a length of 41 mm, a width of 12 mm, and a thickness of 2 mm (Volhynian flint); 1 proximal and mid portion of a blade with flat retouch on the ventral face of one edge, use retouch on the second edge, a polyhedral butt, a diffuse bulb, a length of 28 mm, a width of 18 mm, and a thickness of 7 mm in the bulb portion and 5 mm in the medial portion (Volhynian flint); 1 partly cortical blade or perforator with retouch on the ventral face of both edges, the perforator-shaped tip, a length of 34 mm, a width of 11 mm, and a thickness of 3 mm (Volhynian flint; Fig. 4: 13); 1 crushed blade with retouched and crushed edges, curved in the distal portion, with a flat butt, a convex bulb, a length of 60 mm, a width of 28 mm, and a thickness of 9 mm in the bulb portion and 8mm in the medial portion (Volhynian flint); 1 retouched blade or perforator with a sharp fang, a polyhedral butt, a convex bulb, a length of 28 mm, a width of 13 mm, and a thickness of 4 mm in the bulb portion and 3 mm in the medial portion (Volhynian flint; Fig. 3: 7); 1 proximal/medial portion of partly cortical blade with use retouch on one edge, a flat butt, a convex bulb, a length of 35 mm, a width of 15 mm, and a thickness of 4 mm in a bulb portion and 3 mm in the medial portion (Volhynian flint); 1 proximal/medial portion of a blade with use retouch on the edges, a flat butt, a convex bulb, a length of 40 mm, a width of 18 mm, and a thickness of 4 mm in both the bulb and medial portions (Volhynian flint); 1 medial portion of a blade with use retouch on the edges, a length of 48 mm, a width of 16 mm, and a thickness of 3 mm (Volhynian flint; Fig. 4: 8); 1 fragment of a blade with use retouch on the edges (Volhynian flint); 1 fragment of a blade with use retouch on the edges, a length of 28 mm, a width of 11 mm, and a thickness of 2 mm (Volhynian flint; Fig. 4: 3); 1 fragment of a partially cortical blade with use retouch on one edge, a polyhedral butt, a convex bulb, a length of 38 mm, a width of 16 mm, and a thickness of 4 mm in the bulb portion and 3 mm in the medial portion (Volhynian flint); 1 fragment of a blade with use retouch on one edge, a flat butt, a flat bulb, a length of 23 mm, a width of 23 mm, and a thickness of 7 mm in the bulb portion and 5 mm in the medial portion (Volhynian flint); 1 medial part of a blade with strong glossy polishing on both the ventral and dorsal faces of one edge, and with a length of 22 mm, a width of 17 mm, and a thickness of 3 mm (Volhynian flint); 1 blade with glossy polishing of one edge, a polyhedral butt, a convex bulb, a length of 52 mm, a width of 22 mm, and a thickness of 4 mm in the bulb portion and 3mm in the medial portion (Volhynian flint).

Feature 50

Feature 50 included two specimens: 1 conical, single-platform blade core with the flaking surface extending onto the sides, almost around the core, an edge angle (platform/flaking surface) of about 90°, a prepared striking platform, and negatives of 15 blades (which were curved on their distal portions) on the flaking surface – the dimensions of the striking platform were 48 × 35 mm, and the height of the flaking surface was 66 mm (Volhynian flint); 1 S-shaped blade with retouch on the surface of the ventral face.

3. ANALYSIS

The Hnidavska Hirka site yielded one of the largest collections of chipped LBK artifacts from Volhynia. This material was analyzed within 5 general classes (Table 1), including the class of tools containing 12 categories of artefacts (Table 2).

Three single-platform blade cores were discovered in an LBC context (2.91% of all chipped artifacts). Two cores were made of Volhynian flint (2.15% of artifacts of this raw material), and one was made of obsidian. One conical core of Volhynian flint has a flaking surface extending onto the sides and back of the core and a platform/flaking surface angle of about 90°. The flaking surface is 66 mm high, and there are 15 negatives of detached blades visible on it. The second blade core made of Volhynian flint is crushed and preserved as small fragment.

Table 2. Rovanci – Hnidavska Hírka. Typological composition of LBK chipped tools

Category of artifacts	Volhynian flint		Obsidian	Total	
	n	%	n	n	%
Blade end-scrapers	12	17,13		12	16,23
Double blade end-scrapers	3	4,29		3	4,05
Flake end-scrapers	2	2,86		2	2,70
Truncations	8	11,43		8	10,81
Truncation+end-scraper	1	1,43		1	1,35
Burin	1	1,43		1	1,35
Trapezium	1	1,43		1	1,35
Retouched blades (including 3 perforator-like items)	13	18,57	2	15	20,27
Blades with use retouch	15	21,43	2	17	22,97
Retouched flake	1	1,43		1	1,35
Blades with glossy polishing edge	7	10,00		7	9,46
Hammers	6	8,57		6	8,11
Total	70	100,00	4	74	100,00

The regular, conical core made of obsidian has a flaking surface extending onto both sides of the core, a partially natural back, and a striking platform formed by the detachment of several flakes from the edge of the flaking surface. The platform/flaking surface angle is *ca.* 90°, 13 negatives of regular blades are on the flaking surface, and the longest one is about 66 mm.

Blades and their fragments constitute one of the largest groups of artifacts (23 items – 22.33% of all chipped artefacts). This group consists of 19 specimens made of Volhynian flint (20.43% of artifacts of this raw material) and 4 made of obsidian. Blades of Volhynian flint are mostly preserved in fragments: proximal and medial – 5 specimens, medial – 2 specimens, and media and distal – 6 specimens (Table 3). One medial blade fragment is crushed. Three completely preserved items are 58, 58 and 59 mm long. Blades (and their fragments) are from 27 to 59 mm long (average 40.3 mm), from 9 to 28 mm wide (average 15.4 mm), from 2 to 5 mm thick in the bulb portion (average 3.6 mm), and from 2 to 7 mm thick in the mid portion (average 3.3 mm). Their bulbs are convex (7 items) or flat (6), and they have polyhedral (6), edge-like (1) or flat butts. The blades are curved in their distal (7) or mid portions.

There are also 4 fragments of rectangular blades made of obsidian: 1 small and crushed fragment, 1 proximal and medial portion, 1 mid portion, and 1 mid and distal portion. They are from 17 to 22 mm in length (average 19 mm), 10 to 12 mm wide, and 2 to 3 mm thick.

There were only 3 small flakes found in an LBK context on the Rovanci Hnidavska Hirka site: 2 of them of Volhynian flint, with dimensions of 52 mm in length, 31 mm in

Table 3. Rovanci – Hnidavska Hírka LBK site. Characteristics of the blades

Feature No.	Raw material	whole	proximal portion	mid portion	distal portion	length	width	thickness in bulb portion	thickness in mid part	straight	curved in mid part	curved in distal portion	convex bulb	flat bulb	plane butt	edge-like butt	point-like butt	conical butt	polyhedral butt
7	obsidian		1	1		18	12	2,5	2				1			1			
7	obsidian			1		17	10		2										
7	obsidian			1	1	22	12		3										
7	Volhynian flint		1	1		40	18	5	4		1		1						1
7	Volhynian flint	1				58	17	3,5	3,5			1	1						1
7	Volhynian flint			1	1	41	14		3			1							
7	Volhynian flint			1		36	21		7										
7	Volhynian flint		1	1		31	13	2	2			1	1						1
7	Volhynian flint		1	1		31	13	3	3			1	1						1
7	Volhynian flint			1	1	43	15		3			1							
7	Volhynian flint			1	1	28	12		3			1							
7	Volhynian flint			1	1	27	10		3			1							
7	Volhynian flint		1	1		35	14	3	2			1	1						1
7	Volhynian flint			1	1	33	9		2			1							
45	Volhynian flint	1				59	28	5	6			1		1		1			
45	Volhynian flint			1	1	42	15		3			1							
45	Volhynian flint	1				58	16	3,5	3,5			1	1						1
45	Volhynian flint			1		31	13		3,5										
45	Volhynian flint		1	1		52	19	4	2			1	1		1				

width, and with a thickness of 8 mm in both the bulb and medial portions; one of obsidian (dimensions: length 13 mm, width 18 mm, thickness 3 mm in the bulb portion and 2 mm in the medial portion).

Tools constitute the most numerous group of chipped artifacts (74 items – 71.85% of the chipped assemblage). This group contains 70 tools made of Volhynian flint (75.27% of items made of this raw material) and 4 made of obsidian.

End-scrapers on blades of Volhynian flint constitute the third most frequent group of LBK tools found on this site (12 items – 16.23% of the tools). With the exception of two specimens, they were made from regular blades (two of them of partially cortical blades). Blade end-scrapers with preserved proximal portions of the blades have flat or polyhedral butts, and convex, diffuse bulbs. They have steep or, in three cases, semi-steep, slightly oblique, rounded fronts, as well as use retouch on the edges (4 specimens). Their lengths vary from 22 to 52 mm (average 32.2 mm), while their widths are between 14 and 28 mm (average 21.4 mm), and their thickness is from 3 to 8 mm; however, one specimen is significantly thicker, reaching 14 mm (average 6.6 mm).

There are only two flake end-scrapers in this assemblage, both made of Volhynian flint (4.29% of artifacts of Volhynian flint and 4.05% of all chipped artifacts). The first one, on a cortical flake, has a slightly oblique, semi-steep front; its length is 25 mm, its width is 1 mm, and its thickness is 10 mm. The second irregular specimen was also made on a cortical flake. It has a semi-steep, rounded front, with a length of 37 mm, a width of 27 mm, and a thickness of 10 mm.

Three double, blade end-scrapers made of Volhynian flint were discovered at this site. One of them is preserved as a small fragment; one is made on cortical blade and has semi-steep, slightly rounded fronts – its length is 30 mm, its width is 27 mm, and its thickness is 8 mm; the third specimen is made of a partly cortical flake with steep fronts (length – 28 mm, width – 29 mm, thickness – 13 mm).

Truncations are relatively frequent in the overall assemblage. There are 8 specimens made of Volhynian flint (11.43% of artifacts made of this raw material and 10.81% of the LBK chipped assemblage from this site). They were made on regular blades – in four cases, partially cortical. They have steep, oblique fronts (in four cases, the fronts were slightly rounded) and glossy polishing on both sides of one edge. Their length ranges from 29 to 48 mm (average – 41 mm), while their width varies between 12 and 21 mm (average – 17. 14 mm) and their thickness from 2 to 6 mm (average – 4. 26 mm).

There is one combined tool in the assemblage: a truncation/end-scraper of Volhynian flint. Its length is 46 mm, its width is 16 mm, and its thickness is 6 mm.

The only example of a burin made from a blade fragment of Volhynian flint has a length of 35 mm, a width of 30 mm, and a thickness of 5 mm.

One fragment of a trapeze, made from a regular blade of Volhynan flint, was found at this site.

Retouched blades make up the second-largest group of tools. This group contains 15 specimens (20.27% of the assemblage): 13 made of Volhynian flint (most of them in fragments; 18.57% of tools made of this raw material), and 2 small fragments made of obsidian. Specimens made of Volhynian flint are regular and have one edge partially retouched on the dorsal face. They range in length from 35 to 60 mm (average 45 mm), with a width fluctuating between 18 and 28 mm (average 23.6 mm), and thickness from 4 to 8 mm (average 6.4 mm).

Three retouched blades made of Volhynian flint have perforator-shaped distal portions. One of these is a small and regular, partially cortical blade, with retouch on the ventral face of both edges and a tip formed by flat retouch on the dorsal face (length – 44 mm, width – 12 mm, thickness – 5 mm). Another specimen, made on a cortical blade, has retouch on the ventral face of both edges and a perforator-shaped tip (length – 34 mm, width – 11 mm, thickness – 3 mm). The third, quasi-perforator, has a sharp fang and is made of a blade with a polyhedral butt and a convex bulb, with a length of 28 mm, a width of 13 mm, and a thickness of 4 mm.

Blades with use retouch constitute, by far, the largest group of the tools (17 specimens; 22.97% of the tools). This group contains 15 items made of Volhynian flint (21.43% of the tools made of this raw material). Most of them are preserved in fragments. The lengths of the discovered items varies from 23 to 58 mm (average 42.79 mm), while the width is from 13 to 27 mm (average 17.36 mm) and the thickness is from 3 to 7 mm, with the exception of one specimen, which is 18 mm thick (average 4.86 mm). They are regular in shape. The preserved butts are polyhedral (5 specimens), edge-like (1 specimen), or flat (5 specimens). Their bulbs are flat (2 specimens) or convex (9 specimens). There were also two specimens made of obsidian: 1 mid portion of blade with an oblique fracture edge (which makes it similar to a truncation) has a length of 38 mm, a width of 18 mm, and a thickness of 4 mm; and 1 distal part of a blade with use retouch has a length of 30 mm, a width of 30 mm, and a thickness of 2 mm.

The only example of a retouched flake has flat retouch on its dorsal face; its length is 35 mm, its width is 41 mm, and its thickness is 10 mm.

The group of blades with glossy polishing on their edges consists of 7 specimens made of Volhynian flint. All of them are preserved as fragments. They are from 22 to 52 mm long (average 33.25 mm), from 11 to 25 mm wide (average 16.13 mm), and from 2 to 5 mm thick (average 3.38 mm). These blades are regular in shape. Their bulbs are convex and their preserved butts are polyhedral (1 specimen), flat (1 specimen), or conical (1 specimen).

The group of flint hammers includes 6 specimens made of Volhynian flint: 5 of them were made from nearly spherical natural nodules with a diameter from 48 to 54 mm; one of them was probably made from a single-platform blade core (diameter – 48 mm).

4. FINAL REMARKS

The analyzed chipped material from the site at Hnidavska Hirka contains artefacts typical for the LBK in other parts of Europe settled by these communities. Similarities are clear in the typological composition of the tool groups, the characteristics of the tools themselves (blade end-scrapers, truncations, unretouched sickle-blades), the shape and size of the blade cores, as well as in the use of regular blades whose length was usually up to 10 cm. All the recognized classes of artefacts and categories of tools have analogies at other LBK sites all over Europe (Bacskay and Siman 1987; Biró 1987; Engelhardt 1991; Gronenborn 1990; 1997; Kaczanowska 1987; 2001; Lech 1985; 2008 Kadrow 1990; Zimmermann 1995; Popelka 1999; Kukułka 2001; Mateiciucová 2002; 2008; Czopek *et al.* 2014; Dębiec *et al.* 2014; 2015; Osipowicz *et al.* 2015; Furmanek and Masojć 2016; Kalita *et al.* 2016).

Local Volhynian flint played a leading role in the everyday life of the LBK community from this site. However, several artifacts made of obsidian were also discovered there. This relatively large component of the chipped assemblage from Hnidavska Hirka contains: a single platform blade core, 4 fragments of blades, 1 flake, and 4 tools (2 retouched blades and 2 blades with use retouch). These specimens constitute a relatively significant group of chipped artefacts discovered there. Moreover, the typological composition of the group of obsidian artefacts shows that the cores "came" to this site, as well as the blades and tools. It is also possible that the obsidian cores were exploited on-site, and the blades and blade tools were made of these cores.

The presence of obsidian artefacts at the Hnidavska Hirka LBK site seems surprising. This site is located in the vicinity of the primary sources of Volhynian flint, and Volhynian flint was available at many localities in the region. In this respect, tools made of obsidian were not necessary in everyday life on this site. Thus, obsidian itself, as well as blades and tools made of obsidian, must have played an important, but not an economic (or not solely economic) role in this community. Because of the specific physical features of obsidian (hardness, good transparency, opalescent lustre, color, sharpness of the edges) and the large distance to the sources of this raw material (more than 300 km in a straight line), obsidian must have been perceived by the LBK people in Volhynia as something exotic and a rarity in this area. Additionally, it cannot be excluded that due to their extremely sharp edges, blades and tools made of obsidian were used in specific ways and for specific purposes. Blades or blade tools made of obsidian might have been used, for example, in medical treatments or in rituals. However, the medical and/or ritual role of obsidian and items made of obsidian in an area so far away from sources of obsidian (and, additionally, in a region with access to such good-quality Volhynian flint) is only one possible hypothesis, put forth as an open question.

In conclusion, the site of Hnidavska Hirka yielded a relatively large collection of LBK chipped artifacts from the area of Volhynia. It should also be emphasized that, unfortunately, only a handful of Ukrainian LBK sites have been excavated. The material from these sites has only partially been published, if at all (Konopla 1999; 2008; 2010; Kozłowski 1985; Dębiec 2012).

For this reason, it is not possible to compare the LBK assemblage from Hnidavska Hirka to the other assemblages of LBK chipped material from Ukraine. Important questions regarding the production of "Ukrainian" chipped material, the possible differentiation of LBK chipped assemblages from different parts of Ukraine (Kozłowski 1985), as well as the similarities and differences between chipped material from Ukraine and other parts of the LBK distribution remain open. On the other hand, it should be noted that the most recent excavations in Ukraine resulted in discoveries of large LBK lithic inventories containing remarkable series of artefacts. These comprise a potentially valuable foundation for future studies of various aspects of chipped production in this area.

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LINEAR POTTERY CULTURE FACE VESSEL FROM THE SITE BISKUPICE 18, SOUTHERN POLAND

ABSTRACT

Korczyńska M., Kenig R., Nowak Marek, Czekaj-Zastawny A., Nowak Maciej and Moskal-del Hoyo M. 2021. Linear Pottery culture face vessel from the site Biskupice 18, southern Poland. *Sprawozdania Archeologiczne* 73/1, 389-420.

This paper presents the stylistic analysis of a unique face vessel fragment, found at a recently excavated settlement of the Linear Pottery culture near Biskupice, located in the Carpathian foothill region in southern Poland. The evaluation is based on a multivariate analysis of the stylistic features of 130 human face vessels from 91 Central European Neolithic sites of the Linear Pottery culture and the Alföld Linear Pottery culture, and is conducted with the help of multiple correspondence analysis (MCA). The main objective of the research is to find the closest analogies of the Biskupice by tracking similarities between the manner of execution of the combination of facial elements and accompanying motifs appearing on the Biskupice vessel and on other depictions of the human face. This investigation also aims to make inferences about the chrono-cultural connections of the first agrarian societies in the area of the Carpathian foothills with other regions of the Linear Pottery world.

Keywords: Linear Pottery culture, Early Neolithic, anthropomorphic representation, face vessels, multivariate statistics
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1. INTRODUCTION

Figural representations of humans in form of both figurines and ornaments on vessels, including the so-called face vessels, are relatively common findings in the Early Neolithic of South-Eastern and Central Europe. Figural art of the first agricultural societies in these territories has been the subject of intensive research since the 1960s (*e.g.* Höckmann 1967; 1966; Kaufmann 1976; Gimbutas 1989; Bánffy 1991). In the 21st century, this topic was the subject of three important monographs, which were focused on: (1) anthropomorphic figurines and vessels with figural motifs of the Linear Pottery culture (LBK) (Becker 2011), (2) stylistics of Early – Late Neolithic anthropomorphic vessels from the Near East, through the Balkans, to Central Europe (Schwarzberg 2011) and (3) the Neolithic and Chalcolithic figural representations from South-Eastern Europe (Hansen 2007). Early Neolithic figurines were also recently studied in Macedonia (Naumov 2015) and Saxony (Lehmann 2018). The majority of recent works follow a typo-chronological stylistic analysis (*e.g.* Beljak-Pažinová 2018; Csengeri 2011; 2013; 2014), but there are also studies that include an emblematic and ideological interpretation of ornamental motifs (*e.g.* Domboróczki 2013) or the symbolic meaning of pottery (*e.g.* Tomašovičová 2018; Sebők 2014, 2018).

It should be noted that there are noticeably fewer examples of vessels with anthropomorphic ornaments in the LBK compared to its "eastern" counterpart, *i.e.* the Alföld Linear Pottery culture (ALPC), not to mention Early and Middle Neolithic cultures in the Balkan Peninsula. In the territory of Poland, such vessels are rare, *i.e.* only a human figure motif engraved on a spherical LBK bowl from Brzezie 17 (Czekaj-Zastawny 2014, fig. 39), the LBK face vessel from Żegotki (Czerniak 1998, fig. 6) and an abstract example from Zwięczyca, related to the Bükk culture (Sebők 2014, 80-81, fig. 20: 7) can be quoted. Therefore, the appearance of a new face vessel with horn-liked protrusions from Biskupice is an exceptional find of the Early Neolithic period north of the Carpathian and Sudety Mountains.

The aim of this article is to present a stylistic analysis of this new find in the context of other Early Neolithic representations from Central Europe in order to determine the degree of similarity of the Biskupice face vessel with similar human representations of the LBK and ALPC. This work is based on a multivariate statistical analysis of the complex of elements of the human face and accompanying stylistic features. As a result, the closest analogies to the Biskupice artefact, as well as the area of their occurrence, will be shown.

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2. FIND CONTEXT

The site at Biskupice is located in the Wieliczka Foothills (Kondracki 1998), on a loess-mantled hummock of south-eastern exposition, surrounded by two streams: on the south by the Królewski Brook, a left-hand tributary of the Raba River, and on the north by a nameless one (Fig. 1). This site belongs to the LBK settlement macroregion located in the loess uplands of the Upper Vistula River Basin (Fig. 2), which covers a number of important settlement clusters on both sites of this river (Czekaj-Zastawny 2008; 2009). One of the significant aggregations is located on the right bank of the Upper Vistula River in the Raba River Basin (*i.e.*, Brzezie 17, Brzezie 49, Targowisko 11/12, Targowisko 13, 14 and 16, Szarów 9; Czekaj-Zastawny 2008, 41; Czekaj-Zastawny 2014; Lityńska-Zając and Czekaj--Zastawny 2020). However, the Biskupice site lies outside of the main cluster of the settlement zone (Fig. 3), on the left bank of the Raba River (Czekaj-Zastawny 2008, 88). Its location on a relatively high hill (*ca*. 312 m.a.s.l.) is quite a unique feature in this zone, more closely resembling the cluster of settlements situated in more southern areas of the foothills, near the Dunajec river (Czekaj-Zastawny *et al*. 2020).

The site was discovered during systematic field surveys (long-term campaign: the Polish Archaeological Record/AZP) and was chronologically attributed to the Early

Fig. 1. Biskupice, site 18. Aerial photography of the trench in season 2020 with Biskupice village in the background (photo: M. Korczyńska)

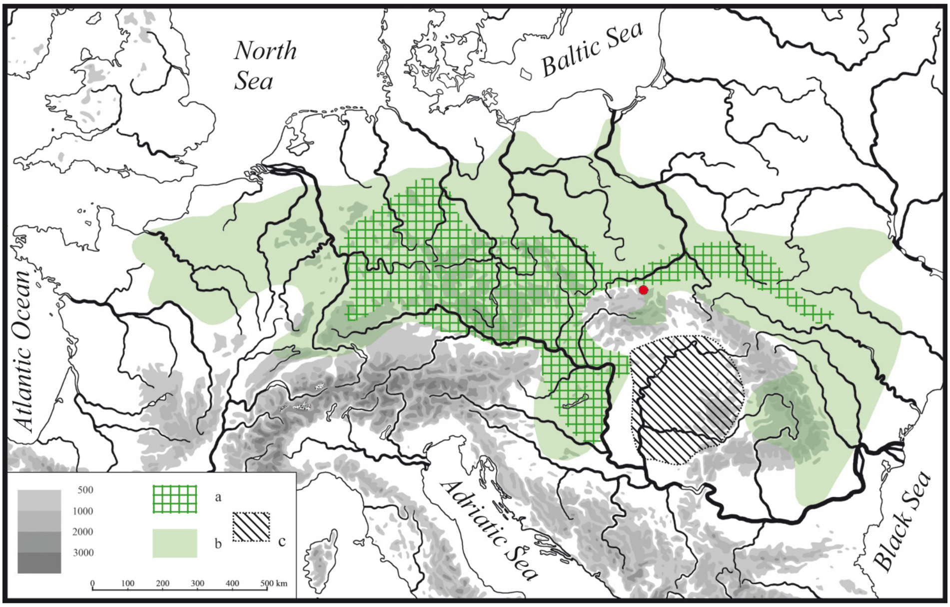

Fig. 2. Extent of the LBK and the ALPC; a – extent of the LBK in the oldest phase; b – maximal extent of the LBK; c – extent of the ALPC (Czekaj-Zastawny *et al.* 2018; Hansen 2007, fig. 181, modified)

Neolithic and the Roman period. In 2013, rescue excavations, related to construction works, were conducted on the site. In one small trench, neither artefacts nor features were found (Lasota-Kuś 2013), while in the other one, several dozen archaeological features were documented, representing a well preserved LBK household unit (longhouse with post construction and elongated pits). The stylistic analysis of the pottery showed that all features are related to the Želiezovce phase of the LBK (Czerniak 2014). The great preservation of the LBK features, as well as the exceptional location of the settlement within the region called for a more detailed excavation, which was conducted in 2020. The excavation covered an area of 1,100 square meters, in which the remains of three LBK household units were discovered.

The face vessel was found in pit no. 25, which is functionally connected to house no. 2 (Fig. 4). The house was located in the eastern part of the trench, and was oriented along a NE-SE axis, with a deviation of about 28° from the north. Traces of 37 posts, arranged in five rows, were documented. Seventeen of them belonged to the three internal lines of posts supporting the load-bearing structure, while 20 smaller ones belonged to two outer rows connected with the construction of the walls. The diameter of the first group of postholes reached 40 cm, whereas the diameter of the outer rows was about 10 cm. In several cases, pits for the posts were also visibly preserved, but only in the internal rows. Moreover, six lateral pits were found. Thanks to the well-preserved traces of the house, it was

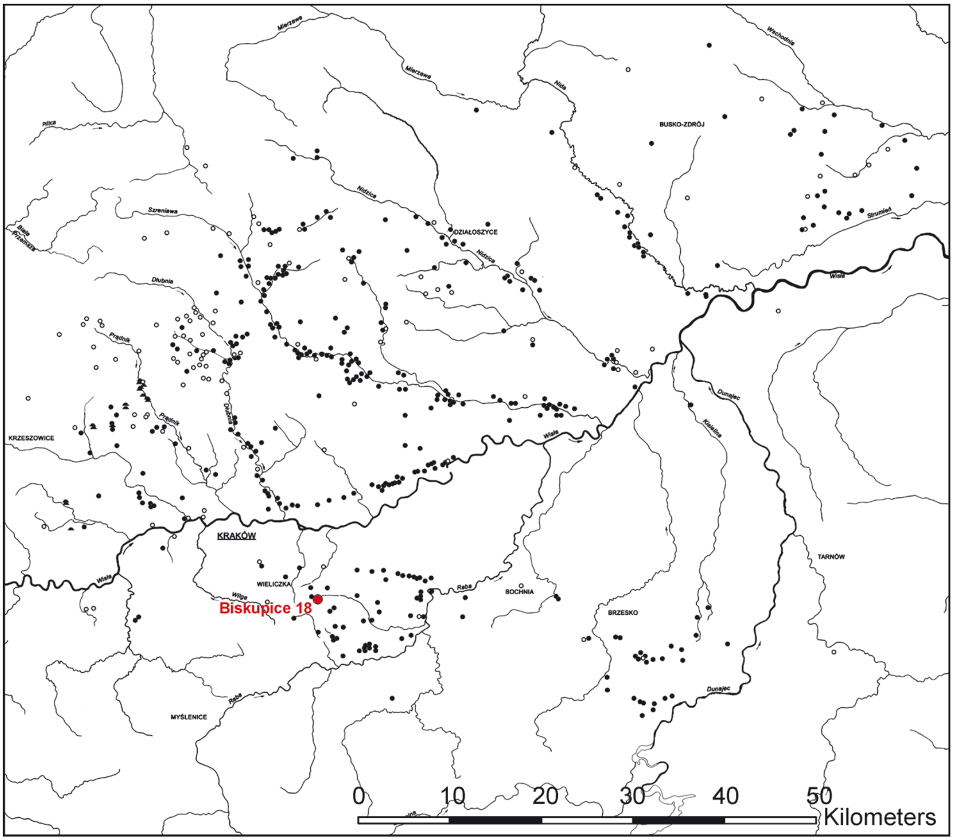

Fig. 3. Location of the site in Biskupice against the background of the LBK settlement in western Lesser Poland (Czekaj-Zastawny 2014, fig. 57)

possible to reconstruct its size. Originally, the house was rectangular, and about 6 m wide. Its length was approximately 11 m, placing it among the shortest constructions known from LBK settlements in the Upper Vistula Basin (see: Czekaj-Zastawny 2008, 39-42). According to the division proposed by P. J. R. Modderman (1986, fig. 29), this house may be classified as Type 2 (*i.e.* with one corridor on the north side) based on the arrangement of the all posts of the structure. A house of the same type, in terms of both the layout of the internal space and the length, is known from the site Brzezie 17, a few kilometres east of Biskupice (Czekaj-Zastawny 2008; Czekaj-Zastawny 2014).

Feature 25 is located in the eastern part of house no. 2 (Fig. 4). It is an elongated pit (type 4 according to: Czekaj-Zastawny 2008, 55), measuring approx. 4 × 2 m, with a depth of approx. 40 cm. The vertical profile was shaped like a trough, being more shallow in the north (Fig. 4: B). The fill of the feature was dark-brownish, with numerous smaller

Fig. 4. Biskupice, site 18. Orthophotograph of house no. 2 (A) and the cross section of feature no. 25 (B) (photo: M. Korczyńska)

inclusions, as well as with a significant number of artefacts. In this feature, apart from the face vessel, pottery (373 fragments) and lithic materials made of Jurasic flint (237 artefacts) and obsidian (one example) were discovered (Fig. 5). Also, stones (48 fragments) and daub (5 pieces) were documented. Figure 5 shows the exact position of the face vessel

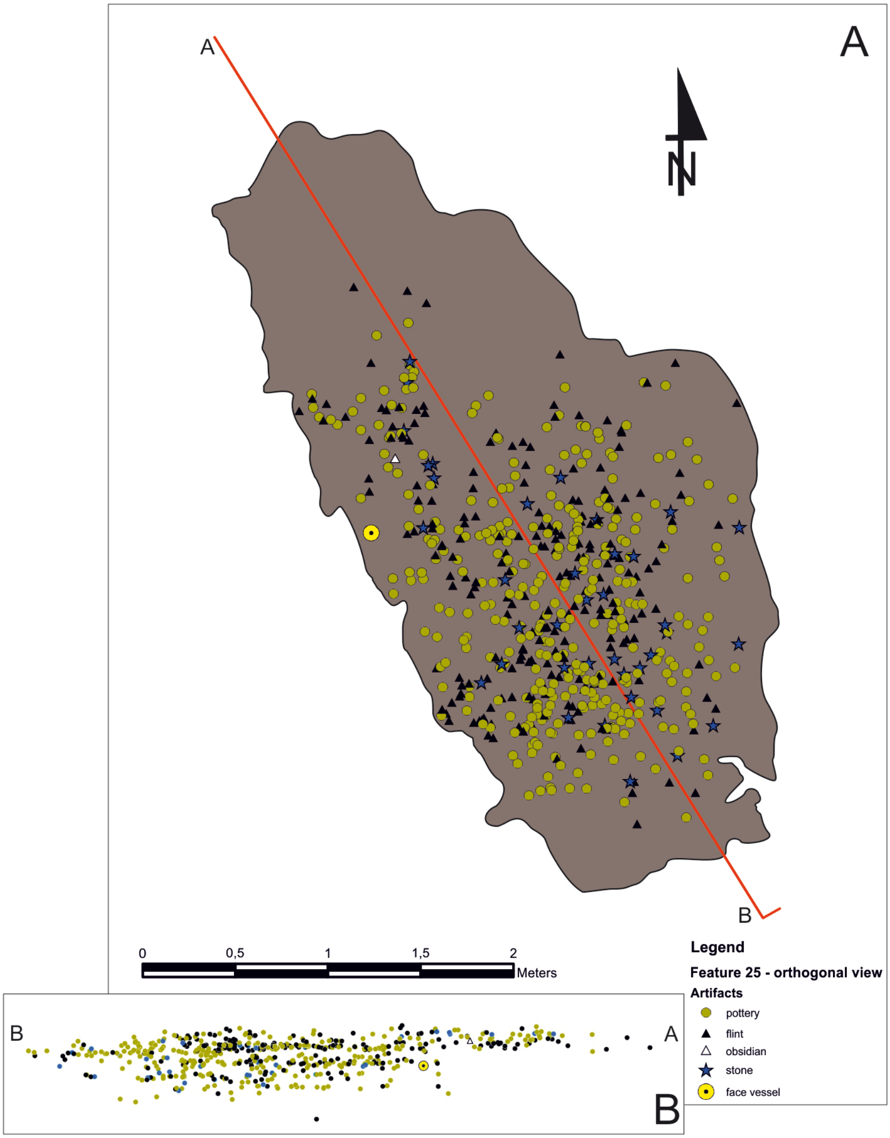

Fig. 5. Biskupice, site 18. Location of artifacts in feature no. 25 in plan view (A) and section view (B) (prepared by: M. Korczyńska)

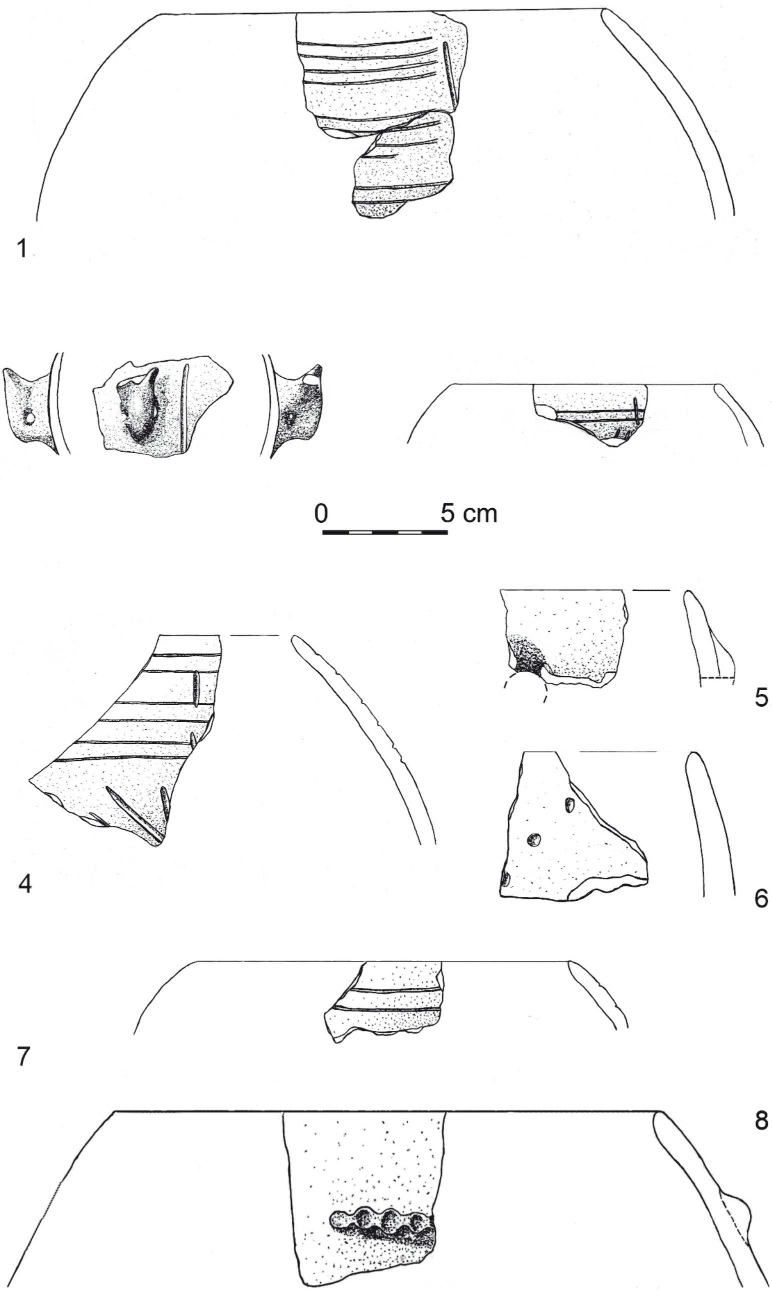

Fig. 6. Biskupice, site 18.
Selection (1-8) of characteristic pottery from feature no. 25
(illustration by: R. Kenig)

within the pit. It was noticed that this pottery fragment appeared near the wall of the house, and that there were no other artefacts in its immediate vicinity. In general, however, the face vessel was embedded in the horizontal layer with the largest and best-preserved potsherds, concentrated mainly in the southern part of the backfill.

The analysis of all the pottery fragments found in pit no. 25 – including their dimensions, weight, state of preservation, and technology, as well as the presence / absence of decorations, and the reconstruction of possible vessel types – showed the structure of the ceramic inventory. A minimum number of 73 different vessels was determined based on rim fragments. These represent five technological groups (according to Czekaj-Zastawny and Rauba-Bukowska 2014; Rauba-Bukowska and Czekaj-Zastawny 2020). With regard to form, spherical bowls, open bowls, vessels with a high neck, footed vessels, and a miniature vessel were discerned (Fig. 6). It is worth mentioning the presence of fragments of two vessels with holes below the rim, like a kind of short funnel (Fig. 6: 5). Much of the pottery is ornamented, including 35 pieces with engraved lines (mainly in the form of arched lines), but there are also other motifs, such as simple cuts, especially under the rim (Fig. 6: 1, 3, 4). The second type of ornament, present on 25 fragments, is that of plastic decorations, such as bumps, finger and nail imprints, and clay bands (Fig. 6: 8). Three of the above-mentioned potsherds are ornamented with both engraved lines and plastic additions in the form of bumps.

The diagnostic features of the pottery (style and technology) indicate that the assemblage is related to the late phase of LBK, namely the Želiezovce phase (*i.a.* Pavúk 1969, fig. 6; Kadrow 2020, 147; Moskal-del Hoyo *et al.* 2017; Rauba-Bukowska and Czekaj-Zastawny 2020).

3. THE FACE VESSEL FROM BISKUPICE

As already mentioned, apart from the above-mentioned ornamented sherds, in feature 25, a fragment with an almost complete image of a human face was preserved (Fig. 7 and 8). The shape of the rim indicates that the ornament was placed on a medium-walled (thickness *ca.* 8 mm) spherical bowl. The vessel belongs to the category of larger forms, being not as delicate as the so-called tableware. The entire countenance is inscribed in the shape of the letter "M", formed by engraved lines, which is considered in this study as the "main motif". The details of the face were shaped by the linear arrangements of convex clay bands. One of the elements, parallel to the rim of the vessel, forms an eyebrow with small conical protrusions on both edges (*ca.* 2 cm in length). In the centre, a vertical convex band shapes the nose. Even the nostrils are visible in its lower, slightly widened part. On both sides of the nose, just below the brow, there are two short, horizontal lines symbolizing the eyes. The left horn-shaped protrusion is complete, while the right one has a broken tip. The preserved part of the pot ends just below the "nose". On the outer part of

Fig. 7. Biskupice, site 18. Face vessel from feature no. 25 (photo by: A. Walanus)

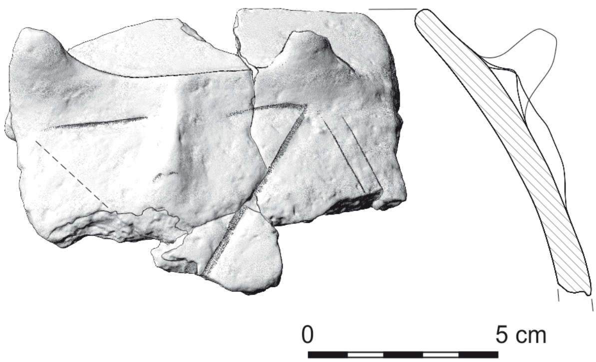

Fig. 8. Biskupice, site 18. 3D Model of the face vessel (prepared by: M. Korczyńska, based on data obtained by: Jakub Gawryjołek from Centrum Druku in Kraków)

the vessel, the original surface has only been preserved partially, and the inner surface is abraded. The vessel was made of a fabric that contains a relatively high amount of organic and chamotte temper. Coarse sand is also visible, but rather as a natural component of the clay raw material.

Based on the presence of two distinct protrusions connected with the eyebrows, which resemble horns, the representation from Biskupice can be regarded as one of the so-called "mixed creatures" – term used for the representations with human traits, which are supplemented with stylistic elements that resemble animal features – for example, horn-like protrusions (Becker 2011, 119). Vessels with representations of "mixed creatures" (in German "Mischwessen", *ibidem*) spread from middle Germany through the Czech Republic to Austria (Fig. 9) are dated to the Music-Note phase, as well as to the Želiezovce style/phase/group. Until now, from the territory of Poland and Slovakia, such creatures were only known from two settlements: Żegotki (Fig. 10: 1; Czerniak 1998, fig. 6) and Spišský Hrhov (Soják 2000, tab. 32).

4. THE STYLISTIC FEATURES OF THE HUMAN FACE MOTIF FROM BISKUPICE

4.1. Materials and methods

The stylistic analysis of the human face motif from Biskupice, presented in the context of other LBK and ALPC face vessel finds, aims to reveal which Central European pottery tradition has the greatest influence on the style of the find from Biskupice. In order to reach this goal, a multivariate analysis was carried out. It was based on multiple variables,

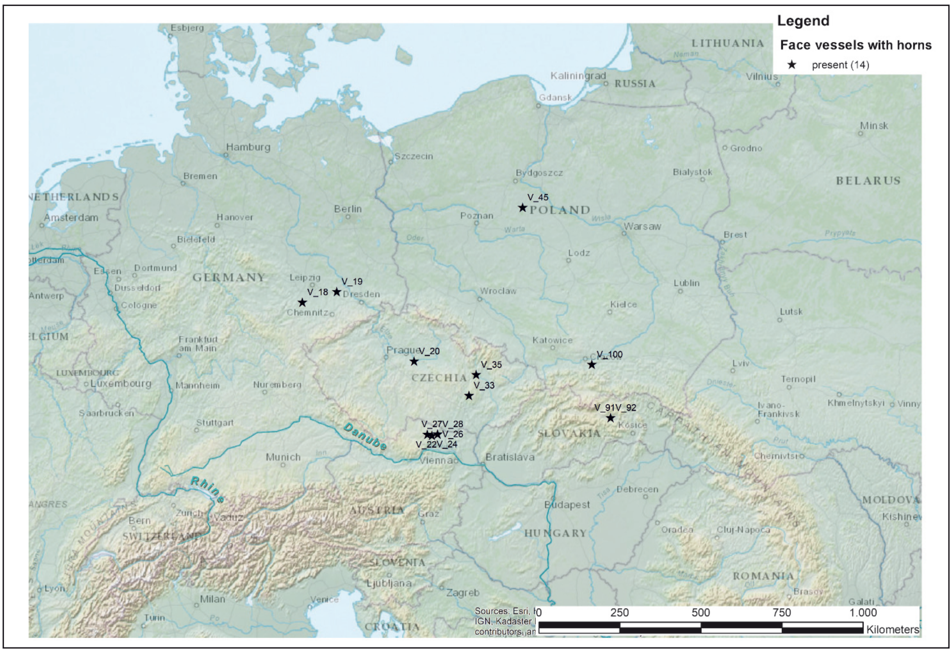

Fig. 9. Distribution of the "mixed creatures" face vessels in Europe (prepared by: M. Korczyńska). For site designations see Table 1

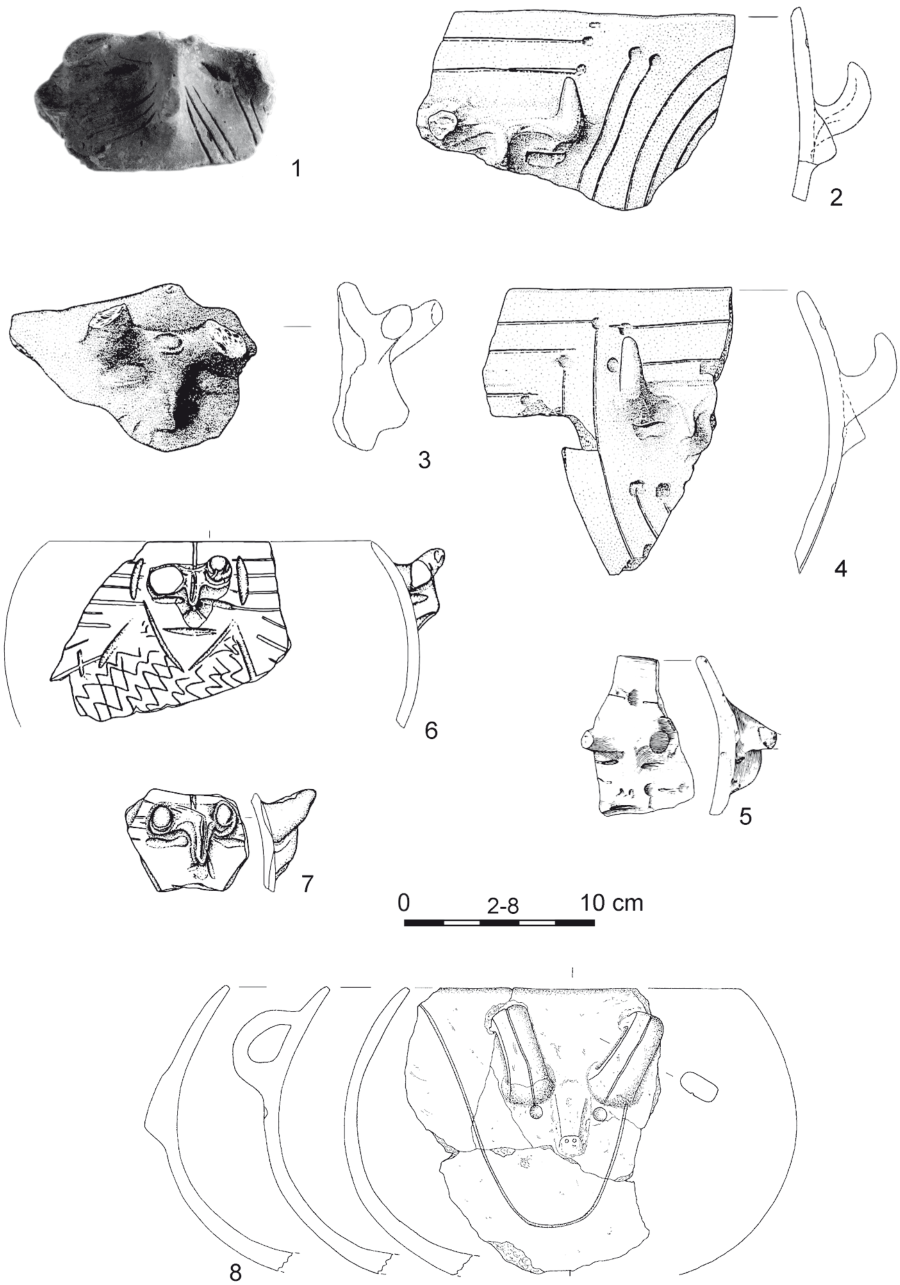

Fig. 10. Examples of face vessels supplemented by horn-like protrusions: 1 – Żegotki (no scale); 2-4 – Pulkau; 5 – Mohelnice; 6-7 – Spišský Hrhov and 8 – Mügeln (after: Becker 2011, figs. 67-68; Conrad *et al*. 2012, fig. 7; Czerniak 1997, fig. 6; prepared by: M. Korczyńska)

which reflect the style of the face representations. For this purpose, a database of 130 LBK and ALPC face vessels was compiled (Tab. 1). In addition, one face vessel with protrusions (Pavlů and Šumberová 2017) from the Stroke Ornamented Ware culture was also included in the dataset. In order to keep the formal coherency of the data, solid figurines were not taken into consideration. The dataset is based on the catalogues of V. Becker (2011) and H. Schwarzberg (2011). However, it was complemented by finds acquired in the last 10 years (mostly from the area of the ALPC). It includes only representations in which the degree of fragmentation allows the determination of the type of so-called "facial field" (in German "Gesichtsfeld", Schwarzberg 2011, fig. 2), and thus a classification of the facial elements within. Basically, for the classification of particular elements of the representations, the typology developed by H. Schwarzberg (2011) was implemented. For example, the main motif in relation to finds from the Rhine area was, according to Schwarzberg, included in the group of M-motifs, although it was described by V. Becker as a U-motif. Additionally, the typology was complemented by a few additional categories (types), which were not included in Schwarzberg's original grouping. In such cases, new variables were included in a descriptive way (see Tab. 1. Suppl., *e.g.*, concerning a possible hair style). Furthermore, in some disputable cases, it was decided to assign the face elements to a slightly different class than the one proposed by Schwarzberg. In addition, for 19 objects, despite the presence

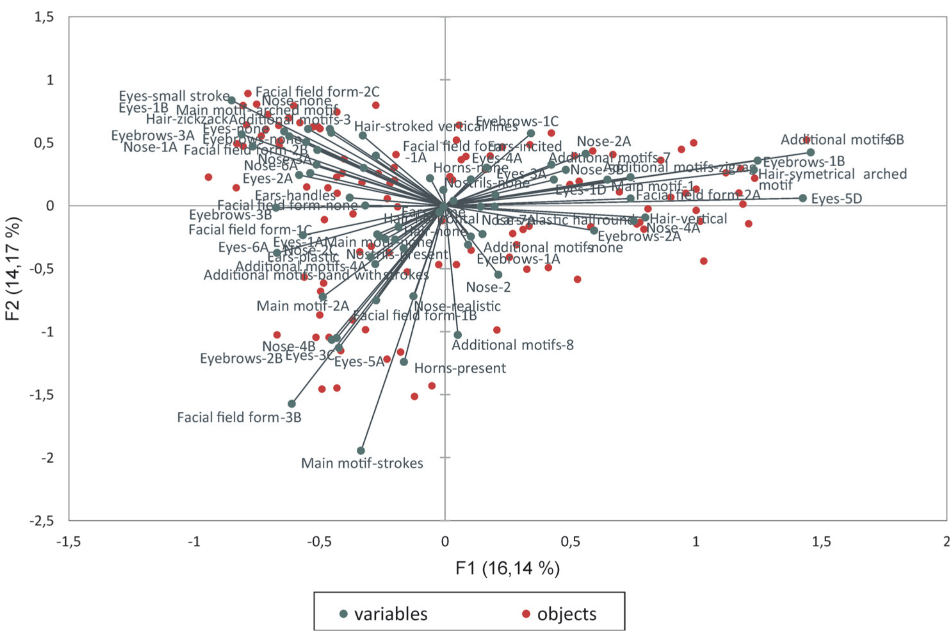

Fig. 11. Plot of the first and second dimensions of the multiple correspondence analysis (MCA) of the face vessels, according to their stylistic features (prepared by: M. Korczyńska)

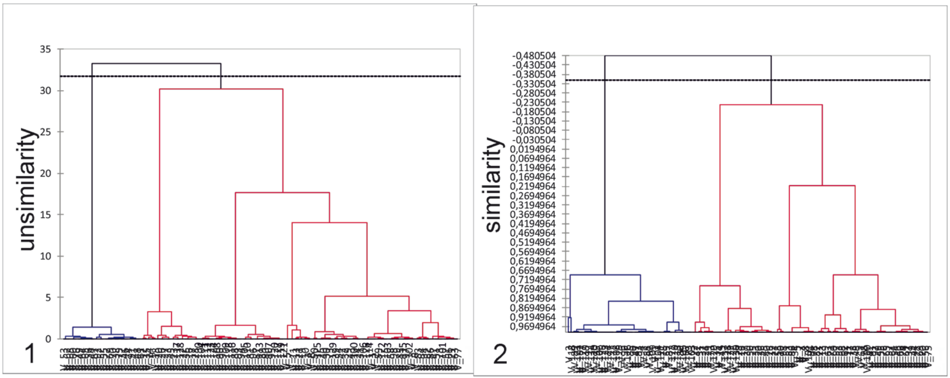

Fig. 12. Dendrograms of the hierarchical cluster analysis of face vessels, based on the relationships of unsimilarity (1) and similarity (2) among the coordinates of the objects in the geometrical space of the first three principal MCA axes (prepared by: M. Korczyńska)

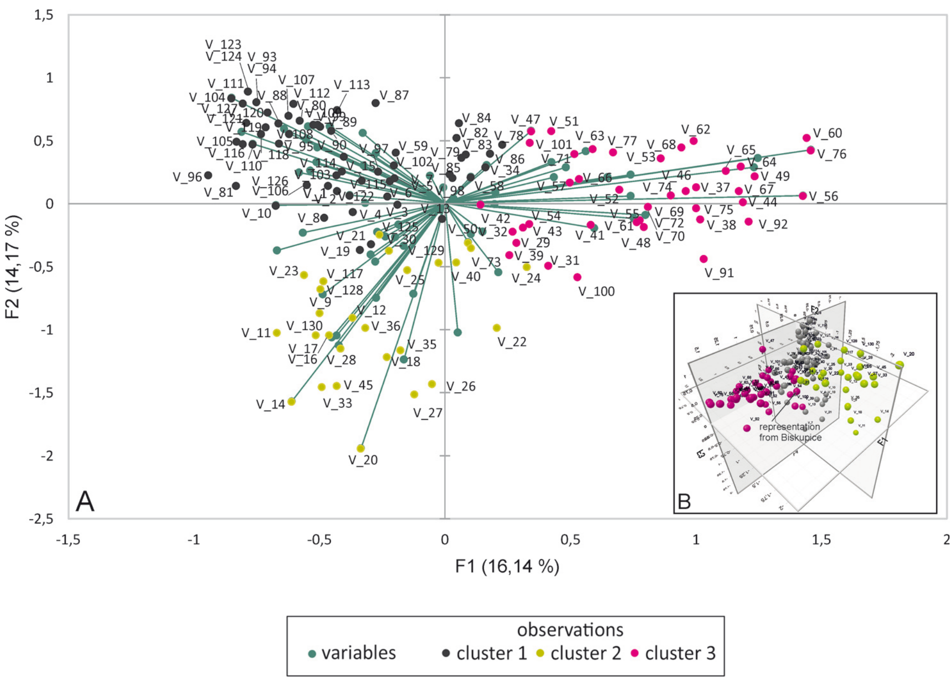

Fig. 13. Three clusters of face vessels with respect to the first and second MCA dimensions (A) and within the three-dimensional MCA plot (B) (prepared by: M. Korczyńska)

of other elements, the mouth part was not preserved, therefore, this variable (mouth type) was excluded from further multivariate statistics. The following variables were used in the analysis: "facial field" form, eyes, nose, eyebrows, possible hair style, the main motif (M-motif, Ʊ-motif, arched motif), and in the case of face vessels with complex ornamentation, the secondary motif (based on Schwarzberg 2011, Abb. 7 and complemented by the authors see: Tab. 1. Suppl.). A schematic illustration of the types has been published by H. Schwarzberg (2011, fig. 2-6). Finally, a variable consisting of the presence or absence of horn-like protrusions/bosses was created, as both anthropomorphic and syncretic anthropo-/zoomorphic representations (in the sense of V. Becker 2011) were investigated. All variables were considered as equal and none of them was pre-weighted. In the next step, as we are dealing with nominal, categorical data, in order to investigate a correlation of particular stylistic features, a multiple correspondence analysis (MCA) was performed. This extension of the simple correspondence analysis (CA) is successfully applied in archaeological studies, as it is useful when a dataset has more than two categorical columns or contains multiple response (non-binary) data (for application examples see: *e.g.* Korczyńska 2014; Macheridis 2017). The result of the MCA was directly represented in the geometric space (Fig. 11 and 13). The biplot of the first and the second axis explains altogether

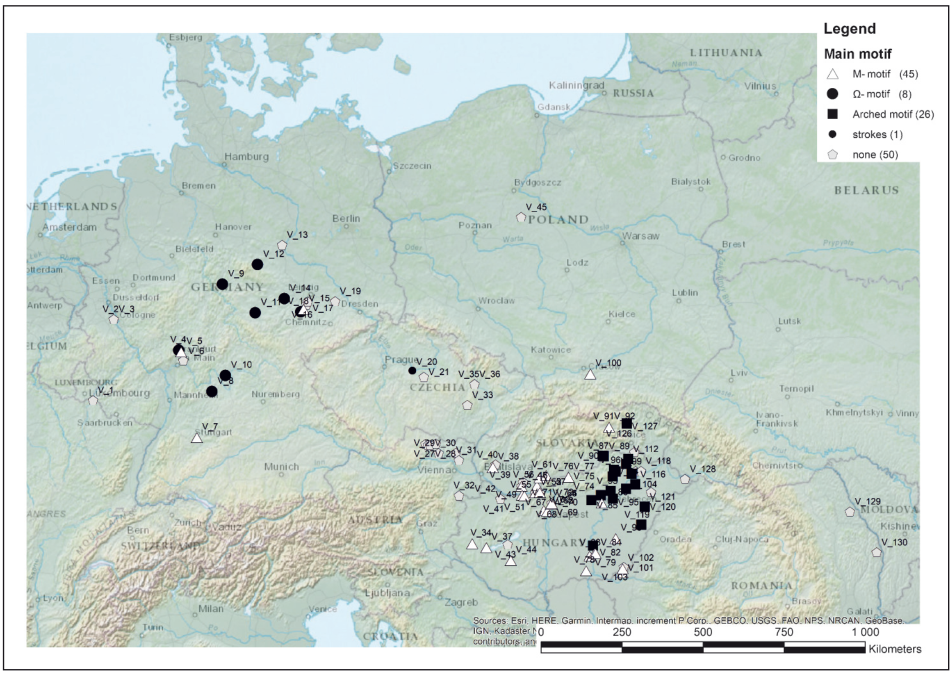

Fig.14. Distribution of face vessels, taking into account the differentiation of the main motif (prepared by: M. Korczyńska). For site designations see Table 1

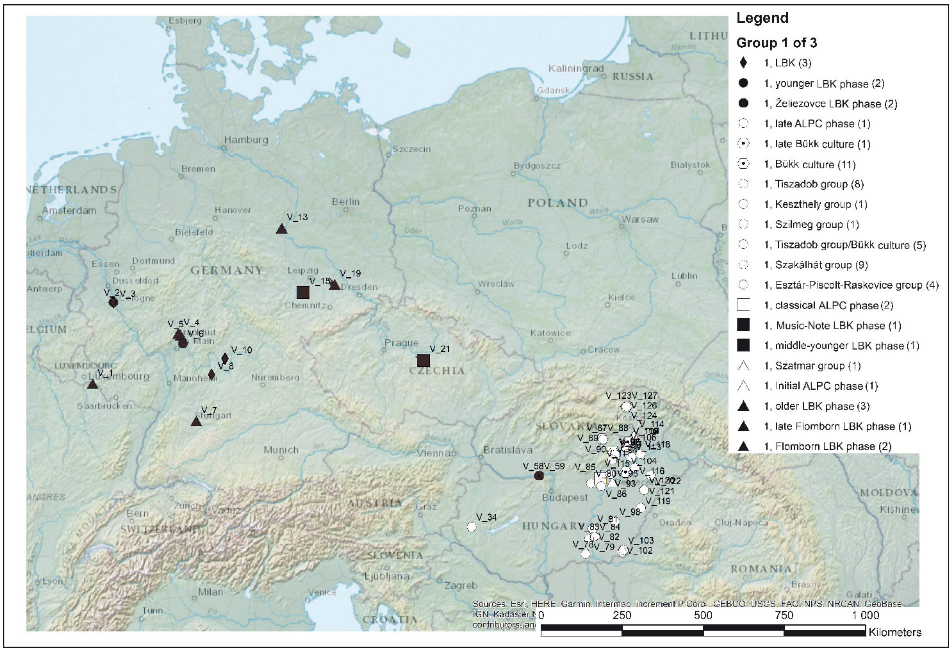

Fig. 15. Mapping of face vessels belonging to the first cluster; LBK sites marked in black, ALPC sites marked in white (prepared by: M. Korczyńska). For site designations see Table 1

30% of all cases – a common problem of the MCA performed for archaeological data – in order to increase the statistical sufficiency the third axis was included in the further analysis as well. In the next step, in the accordance with the plot of the F1, F2 and F3 principal coordinates, a k-means cluster analysis was performed to determine the number of clusters, and the evaluation of the intra-class variance of the k-means cluster analysis was conducted. Additionally, to support the decision as to the number of clusters, dendrograms of the hierarchical cluster analysis were used (Fig. 12). Finally, the clusters were pictured on the MCA plots (Fig. 13A and 13B) and the face vessels were mapped not only according to the main motif (Fig. 14) but also according to the affiliation of their k-mean cluster (Fig. 15-17, see also: Tab. 1).

4.2. Results of the analysis

The variable which seems to play the most important role for the MCA structure and further indication of all three clusters, is the main motif. The test values of this variable are significant when considering the first two dimensions of almost all levels (categories) at the 0.05 level of significance. Also, some categories of the type of the nose, possible hair-style and additional motif seem to play a significant role in determining the style of the face vessels. Along the second axis, a significant role was also played by the presence or absence of the horn-like protrusions. A graphical result of the MCA forms an arc-shaped layout in the plot of first two dimensions (Fig. 11 and 13). Although the so-called arc effect is characteristic for data with patterned continuity between objects and variables (Zimmermann 1997, 10-14; for an example of application see: Mrówka 2011) the immediate interpretation of the plot in the sense of chronological diversification in our case is rather problematic. Accidental stylistic similarities of diachronous face vessels clustered in the 1st quarter of the plot (see: below) might cause a spurious correlation and influence the outcome. As a result of the hierarchical cluster analysis, two or possibly three clades could be distinguished (Fig. 12). The k-means analysis suggests the division of objects into two (intraclass variance 0.711) or alternatively three (intra class-variance 0.442) clusters as well (Fig. 13). As the plot of two clusters, based on the k-means analysis, was not satisfying from an archaeological point of view, a statistically second-best option, namely three clusters, was taken into further consideration. Although the MCA plots might be regarded as a sufficient description of the analysis (Fig. 13), for a better understanding and for a correct interpretation of the obtained clusters, the spatial information of the origin of the face vessels was also taken into account.

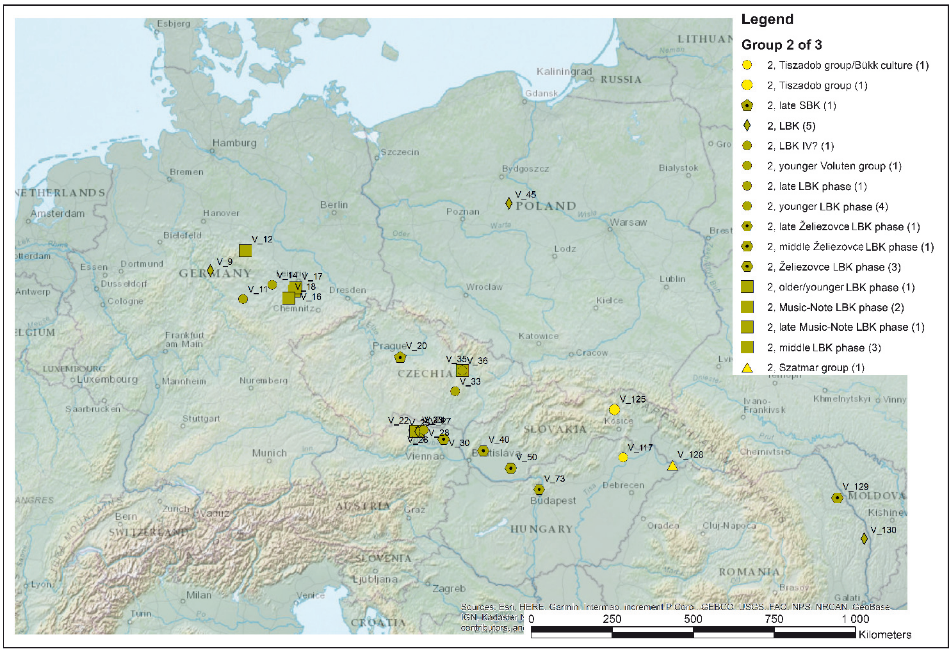

Fig. 16. Mapping of face vessels belonging to the second cluster; LBK sites marked in dark yellow, ALPC sites marked in bright yellow (prepared by: M. Korczyńska). For site designations see Table 1

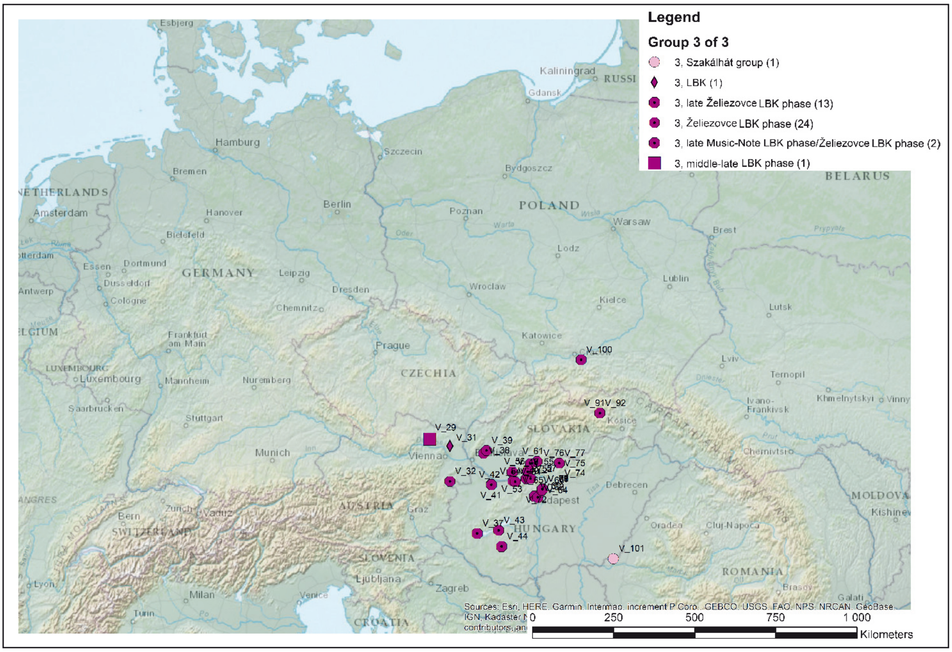

Fig. 17. Mapping of face vessels belonging to the third cluster; LBK sites marked in dark pink, ALPC sites marked in bright pink (prepared by: M. Korczyńska). For site designations see Table 1

Traditionally, the main motif, such as the Ʊ-motif, the M-motif, and the arch motif, is regarded as a crucial variable, as it describes the regional diversification of the face vessels and is widely discussed in the literature (*e.g.*, Becker 2011; Schwarzberg 2011; Raczky and Anders 2003). Mapping the main motifs based on our dataset yields a result that is coherent with current observations (Fig. 14). Face vessels with a Ʊ-motif are typical for the Rhine-Elbe area, a "sickle" motif (or arch motif) for the northern settlements of the ALPC, while the M-motif is common in southern and south-western Hungary. However, its variations might also be observed on a few vessels from Germany. It should be noted, however, that V. Becker (2011, Taf. 58) classified the "facial fields" from Friedberg-Dorheim (V_5) and Stuttgart-Bad Cannstatt and (V_7) as U-shaped, while in the present analysis the authors decided to classify this motif as a variant of the M-motif (comp. Schwarzberg 2011). Furthermore, a straightforward mapping of the main motifs (Fig. 14) can be discussed in relation to the maps of the clusters obtained by the multivariate analysis (Fig. 15-17), in the case of which no singular stylistic feature is taken into consideration, but mapped face vessels constitute a complex compound of various stylistic trends.

The first cluster (responding well to the 1st quadrant of the MCA plot of the two principal axes, Fig. 13) includes all representations dated to the Flomborn phase from the area of Germany, as well as every object from the Rhine area and, surprisingly, almost all ALPC artefacts (Fig. 15). Included in this cluster are also the big pots and smaller vessels of the Szakálhát group (Sebők and Kovács 2009), which due to the presence of the M-main motif, and therefore some similarity to the face vessels known from the Želiezovce phase, were nevertheless placed in the 2nd quadrant of the first two principal axes (Fig. 13: A). Most of the representations in this cluster do not have limited "facial fields"and/or plastically shaped eyebrows. Moreover, in the case of the majority of the ALPC vessels, a hypothetical coiffure is shown with stroked vertical lines, whereas groups of angular ornamentations (Schwarzberg's Type 3) are additional motifs. The only "horned" vessel in this cluster is a disputed representation from Mügeln in Saxony (V_19, see: mixed creature in Conrad *et al.* 2012 *versus* zoomorphic representation in Lehmann 2018, 43).

In the second cluster (3rd and 4th quadrants of the MCA plot, Fig. 13), with a few exceptions, almost all vessels from the classic LBK phase from Central Germany, the Czech Republic and Lower Austria are included (Fig. 16). Representations in this cluster have either a main motif in the form of an "Ʊ" sign (Schwarzberg's Type 2A) or they lack any main motif at all. This cluster also includes objects with a hypothetical hair style in the form of a decoration of horizontal lines, as well as almost all of the representations of mixed creatures. Geographically, this group covers quite a large area, spreading longitudinally from Saxony-Anhalt to eastern Romania.

The third cluster is the most coherent as it consists almost exclusively of vessels of the Želiezovce phase of the LBK, with the mixed creature from Biskupice among them (Fig. 17). It consists of almost all objects located in the 4th quadrant of the first two axes of the MCA plot (Fig. 13). This group includes the vessels, which in most cases have a "facial field" in the form of an inverted triangle, depicted with the following variables according to Schwarzberg's Types: a carved line (2A), narrow, engraved eyes (1D and 3A), straight eyebrows connected with a nose (4A) and either no main motif, or an M-motif (1). Interestingly, the vessel from Biskupice (V_100) and two other objects from Spišský Hrhov (V_91 and V_92) are the only examples of "mixed creatures" in this cluster.

5. DISCUSSION AND CONCLUSIONS

The representation from Biskupice contains both human and animal features, and thus belongs to the type of the so-called "mixed creatures" (after Becker 2011 type 4.2). In most cases of this type, zoomorphic features are represented by horns. Representations of horns appear frequently in connection with cattle, and probably the first association are bucrania and the famous wall paintings in the so-called communal spaces of Çatalhöyük (*e.g.*, Hodder 2006; Twiss and Russel 2010). During the transition of the Starčevo/Körös culture to the LBK/ALPC, the motif of a sheep/goat was replaced by that of a bull (Raczky *et al.* 2010, 160-161). This transition may also be related to the increasing role of bovines in animal husbandry (*ibidem*; Bánffy 2019, 87-113). As a consequence, there are zoomorphic bull figurines known already from an older phase of the ALPC (*i.e.*, Polgár-Ferencihát grave, Raczky and Anders 2018, 323-324, fig. 3: 2), and so-called centaur figurines found in the Körös culture sites in north-west Hungary, also known as “Horns of Consecration” in the Central Hungarian Plain (*ibidem*). The significant role of cattle is also reflected in the ornamentation of the vessel of the earliest ALPC site, Košice-Červený rak, in eastern Slovakia, recalling a human-animal (bull) hybrid (Kaminská *et al.* 2008, 85-86, fig. 7-8). This phenomenon occurred simultaneously with the northward spread of the Neolithic lifeway into its “marginal zones” (Kalicz and Raczky 1982). In this context, the lack of face vessels with horns in the territory of the ALPC (Fig. 10) is an interesting phenomenon. It is uncertain what kind of ideological factor might be responsible for the spatial and chronological limitation of the quadrupedal figurines with human faces, which are restricted only to the early phases of the ALPC (for the compilation of this representation type see: Becker 2011, 269-70), and the complete absence of human representations with horns in this cultural milieu.

In turn, in the LBK, among zoomorphic figural vessels and handles, bovids form a substantial group (see: Becker 2007), as demonstrated by handles from Šturovo and Straubing-Lerchenhaid (Becker 2007, 25, 28). Knobs resembling cattle horns also appear on vessels with representations of mixed features. Their human-like faces correspond well with the stylistic details of the anthropomorphic representations, and, apart from horns, they only seldom include motifs known from zoomorphic objects, like a piercing on the head. Aside from the aforementioned centaur figurines, such a feature appeared, for example, between the “horns” of the mixed creature vessel from Pulkau (V_28, Fig. 10: 3; Becker 2011, 481, fig. 67: 3). For that reason, these are usually studied together with the purely anthropomorphic representations, and interpretations of these vessels are strongly connected to those of typical anthropomorphic representations.

The diversification of the LBK and the ALPC is visible not only in the distribution of the mixed creatures with horn-liked protrusions, but also in the general stylistic identity of the face vessels. Multivariate analysis confirmed the crucial role of the main motifs in research on the stylistic differentiation of the analysed objects. However, in some cases, the combination (presence or absence) of other variables seems to be even more significant for constructing the clusters. The anthropomorphic vessels of the Szakálhát group might be used as an example. Based on the second motif and nose-type, despite the presence of the main M-motif, they are clustered together with other ALPC artefacts (Fig. 15). The assignment of the vessel from Biskupice to the third cluster is quite convincing, as this cluster incorporates almost all of the face vessels dated to the Želiezovce phase of the LBK. Moreover, the stylistic analysis of ornamented pottery fragments deposited in pit no. 25 shows strong similarities with the “standard” pottery found at the sites of this group (*e.g.*, Bajč or Štúrovo, Pavúk 1969, fig. 31, 49: 1, 4, 5). Territorially, this cluster is most compact, unlike the previous ones, which generally spread over multiple regions, where the majority of figural representations of both the LBK and the ALPC have been found. Let us recall in this context, that, according to the opinion of some authors, the spatial variability in the appearance of the main (mainly M and arch) motifs mirrors regional identities (Raczky and Anders 2003, 170; Schwarzberg 2011, 186). On the other hand, while face vessels with an M-motif from the Želiezovce phase concentrate in the region of Transdanubia, representations of mixed creatures are more common at Lower Austria and Moravia. So, the vessel from Biskupice, due to its syncretic manner, is an exceptional example of the influences from both regions, where the occurrence of a mixed creature has been included in the canon of the Želiezovce style. Certainly, the LBK, during the development of the Želiezovce phase/style, drew ideas, knowledge and information from neighbouring territories (Rauba-Bukowska and Czekaj-Zastawny 2020). Hence, the details of the face vessel from Biskupice can be also observed in other areas and in slightly different cultural environments. In its third stage of development, the LBK was characterized by extremely developed interregional contacts, as evidenced by the presence of imported pottery and raw stone materials (Czekaj-Zastawny 2017).

For now, we do not wish to speculate about the social meaning and the role of the face vessel from Biskupice. Given the plethora of interpretive theories on the subject, such considerations would be premature before detailed evaluation of both the artefact and the site are complete. Therefore, future work shall include a comprehensive study of the vessel from Biskupice within its archaeological context. The clay raw materials and the technology used will be studied from a mineralogical and petrographic point of view to enhance the knowledge about the provenance of the vessel (local *versus* import). An attempt will be made to determine substances stored in the pot using lipid residue analysis. Also, the context of its deposition will be analysed by conducting a microstratigraphic study of feature no. 25. In conjunction with the results of the present stylistic analysis, these investigations will hopefully advance the discussion on the symbolic function of this exceptional find – a key topic in the discussion of figural representations in the Neolithic – and will also contribute to the understanding of interregional contacts maintained by the inhabitants of the settlement at Biskupice.

Acknowledgments

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Table 1. Catalogue of the LBK and ALPC face vessels in Central Europe. Prepared by: M. Korczyńska. Table provides a selection of the dataset. The complete version of this table is included as an electronic supplementary material (Tab.1. Suppl.)

ID	Site	N	E	Chronology	Literature	Cluster analysis three classes
V_1	Remerschen-Schengerwis	49°29'22.0"N	6°21'08.3"E	Flomborn LBK phase	Becker 2011, Taf. 75.1; Schwarzberg 2011, 125.2	1
V_2	Köln-Lindenthal -1	50°55'34"N	6°55'34"E	younger LBK phase	Becker 2011, Taf. 75.5; Schwarzberg 2011, 125.5	1
V_3	Köln-Lindenthal -2	50°55'34"N	6°55'34"E	LBK	Becker 2011, Taf. 75.7	1
V_4	Bad Nauheim-Nieder Mörlen	50°22'51"N	8°43'34"E	late Flomborn LBK phase	Schwarzberg 2011, Taf. 124.4	1
V_5	Friedberg-Dorheim	50°20'57"N	8°47'22.3"E	older LBK phase	Becker 2011, Taf. 58.2; Schwarzberg 2011, Taf. 122.1c	1
V_6	Schöneck-Kilianstädten	50°12'5"N	8°51'13"E	younger LBK phase	Becker 2011, Taf. 75.2; Schwarzberg 2011, Taf. 125.1	1
V_7	Stuttgart-Bad Cannstatt	48°48'39"N	9°13'29.8"E	Flomborn LBK phase	Becker 2011, Taf. 58.1; Schwarzberg 2011, Taf. 122.1a-b	1
V_8	Acholshausen	49°38'43"N	9°38'43"E	LBK	Becker 2011, Taf. 73.2; Schwarzberg 2011, Taf. 126.2	1
V_9	Göttingen	51°32' 2"N	9°56'8"E	LBK	Becker 2010, Taf. 73.1; Schwarzberg 2011, Taf. 124.2	2
V_10	Hausen	49°56'0"N	10°1'0"E	LBK	Becker 2011, Taf. 58.3; Schwarzberg 2011, Taf. 123.2	1
V_11	Kleinfahner	51°2'15"N	10°50'42"E	younger LBK phase	Becker 2011, Taf. 59.1; Schwarzberg 2011, Taf. 123.3	2
V_12	Derenburg	51°52'15"N	10°54'30"E	older/younger LBK phase	Becker 2011, Taf. 60.1; Schwarzberg 2011, Taf. 124.1	2
V_13	Balrleben	52°12'19.2"N	11°35'25.0"E	older LBK phase	Becker 2011, Taf. 59.2; Schwarzberg 2011, Taf. 123.3	1
V_14	Karsdorf	51°16'59"N	11°39'0"E	younger LBK phase	Meller 2012: 174	2
V_15	Draschwitz	51°6'1"N	12°10'56"E	middle-younger LBK phase	Becker 2011, Taf. 66.4; Schwarzberg 2011, Taf. 125.9	1
V_16	Zauschwitz	51°10'49.9"N	12°15'48.2"E	middle LBK phase	Becker 2011, Taf. 66.3; Schwarzberg 2011, Taf. 125.4	2
V_17	Eythra	51°14'0"N	12°18'0"E	middle LBK phase	Lehmann 2019, Taf.11.3	2

V_18	Grana-Kleinosida	51°3'19"N	12°6'19"E	middle LBK phase	Schwarzberg 2011, Taf.125:6	2
V_19	Mügeln	51°14'17.6"N	13°03'33.4"E	older LBK phase	Conrad, Conrad, Ender, Herbig, Homann 2012, Abb.7	1
V_20	Kolín	50°01'00"N	15°12'00"E	late SBK	Pavlů, Šumberová 2017, Fig. 6.2, 6.3	2
V_21	Močovice	49°54'23"N	15°30'54"E	Music-Note LBK phase	Becker 2011, Taf. 60.3; Schwarzberg 2011, Taf. 119.1a-b	1
V_22	Poigen	48°41'44"N	15°33'57"E	late LBK phase	Becker 2011, Taf. 67.1; Schwarzberg 2011, Taf. 115.1	2
V_23	Fraunhofen - Ried Milchtaschen	48°40'24"N	15°37'50"E	Music-Note LBK phase	Becker 2011, Taf. 61.2; Schwarzberg 2011, Taf. 118.3	2
V_24	Breiteneich -1	48°40'27.07"N	15°41'34"E	late Music-Note LBK phase	Becker 2011, Taf. 61.1; Schwarzberg 2011, Taf. 119.2	2
V_25	Breiteneich -2	48°40'27.07"N	15°41'34"E	LBK	Becker 2011, Taf. 72.4	2
V_26	Pulkau -1	48°42'0"N	15°51'0"E	younger LBK phase	Becker 2010, Taf. 67.4; Schwarzberg 2011, Taf. 117.2	2
V_27	Pulkau -2	48°42'0"N	15°51'0"E	LBK	Becker 2011, Taf. 68.1; Schwarzberg 2011, Taf. 117.3	2
V_28	Pulkau -3	48°42'0"N	15°51'0"E	younger LBK phase	Becker 2011, Taf. 67.3; Schwarzberg 2011, Taf. 121.4	2
V_29	Ziersdorf	48°31'42.42"N	15°55'37.2"E	middle-late LBK phase	Becker 2011, Taf. 56.5; Schwarzberg 2011, Taf. 114.4	3
V_30	Thomasl	48°31'53.6"N	16°23'54.0"E	Želiezovce LBK phase	Becker 2011, Taf. 54.1; Schwarzberg 2011, Taf. 113.1	2
V_31	Ulrichskirchen	48°24'0"N	16°29'0"E	LBK	Becker 2010, Taf. 71.2	3
V_32	Draßburg - Taborac	47°44'46"N	16°29'17"E	Želiezovce LBK phase	Becker 2011, Taf. 72.7; Schwarzberg 2011, Taf. 112.2	3
V_33	Vavřinec - Koňská Jáma	49°24'9"N	16°43'11"E	younger LBK - Voluten group	Becker 2011, Taf. 62.1; Schwarzberg 2011, Taf. 119.1	2
V_34	Zalaegerszeg-Andráshida	46°50'21"N	16°51'4"E	Keszthely LBK group	Becker 2011, Taf. 55.2; Schwarzberg 2011, 83.3	1
V_35	Mohelnice -1	49°46'36.5"N	16°55'7"E	Music-Note LBK phase	Becker 2011, Taf. 68.2	2
V_36	Mohelnice -2	49°46'36.5"N	16°55'7"E	LBK IV?	Becker 2011, Taf. 75.3	2
V_37	Keszthely	46°45'55.2"N	17°14'34.19"E	late Želiezovce LBK phase	Becker 2011, Taf. 62.3	3
V_38	Blatné	48°15'56"N	17°25'15"E	Želiezovce LBK phase	Becker 2011, Taf. 70.1	3
V_39	Cifer-Pác -1	48°19'0"N	17°30'0"E	Želiezovce LBK phase	Becker 2011, Taf. 64.1; Schwarzberg 2011, Taf. 112.1	3

ID	Site	N	E	Chronology	Literature	Cluster analysis three classes
V_40	Cifer-Pác -2	48°19'0"N	17°30'0"E	Želiezovce LBK phase	Becker 2011, Taf. 70.4	2
V_41	Győr -1	47°41'0"N	17°38'0"E	late Želiezovce LBK phase	Becker 2011, Taf. 69.7; Schwarzberg 2011, Taf. 85.4	3
V_42	Győr -2	47°41'0"N	17°38'0"E	Želiezovce LBK phase	Becker 2011, Taf. 69.8	3
V_43	Balatonszárszó	46°49'33"N	17°50'5"E	Želiezovce LBK phase	Becker 2011, Taf. 69.1; Schwarzberg 2011, Taf. 84.1	3
V_44	Ráksi	46°31'1.24"N	17°55'8.76"E	late Želiezovce LBK phase	Becker 2011, Taf. 55.3; Schwarzberg 2011, 85.3	3
V_45	Żegotki -1	52°40'31"N	18°12'31"E	LBK	Czerniak 1996, ryc. 6	2
V_46	Bajč -1	47°55'0"N	18°13'0"E	late Želiezovce LBK phase	Becker 2011, Taf. 56.1; Schwarzberg 2011, Taf. 115.4	3
V_47	Bajč -2	47°55'0"N	18°13'0"E	late Želiezovce LBK phase	Schwarzberg 2011, Taf. 116.1	3
V_48	Bajč -3	47°55'0"N	18°13'0"E	late Želiezovce LBK phase	Becker 2011, Taf. 64.4	3
V_49	Iža - Velký Harcás	47°45'2"N	18°14'0"E	Želiezovce LBK phase	Schwarzberg 2011, Taf. 120.1	3
V_50	Dvory nad Žitavou	47°59'37"N	18°15'51"E	middle Želiezovce LBK phase	Schwarzberg 2011, Taf. 111.1	2
V_51	Patince	47°44'15"N	18°17'40"E	Želiezovce LBK phase	Becker 2011, Taf. 75.4; Schwarzberg 2011, Taf. 114.1	3
V_52	Mužla-Čenkov -1	47°47'32"N	18°35'52"E	Želiezovce LBK phase	Becker 2011, Taf. 63.3; Schwarzberg 2011, Taf. 116.2	3
V_53	Mužla-Čenkov -2	47°47'32"N	18°35'52"E	Želiezovce LBK phase	Becker 2011, Taf. 63.4; Schwarzberg 2011, Taf. 121.2	3
V_54	Mužla-Čenkov -3	47°47'32"N	18°35'52"E	Želiezovce LBK phase	Becker 2011, Taf. 65.1; Schwarzberg 2011, Taf. 120.7	3
V_55	Bíňa	47°55'20"N	18°38'33"E	Želiezovce LBK phase	Becker 2011, Taf. 70.3; Schwarzberg 2011, Taf. 115.3	3
V_56	Vel'ký Pesek / Sikenica - Agota Major	48°4'30"N	18°43'0"E	Želiezovce LBK phase	Becker 2011, Taf. 69.9	3
V_57	Štúrovo -1	47°47'56"N	18°43'20"E	Želiezovce LBK phase	Becker 2011, Taf. 63.1; Schwarzberg 2011, Taf. 116.3	3
V_58	Štúrovo -2	47°47'56"N	18°43'20"E	Želiezovce LBK phase	Becker 2011, Taf. 63.2; Schwarzberg 2011, Taf. 117.4	1

V_59	Štúrovo -3	47°47'56"N	18°43'20"E	Želiezovce LBK phase	Becker 2011, Taf. 70.5; Schwarzberg 2011, Taf. 121.1	1
V_60	Biatorbágy-Tyúkberek	47°28'0"N	18°50'0"E	late Želiezovce LBK phase	Becker 2011, Taf. 55.1; Schwarzberg 2011, Taf. 83.1	3
V_61	Tupá	48°7'0"N	18°54'0"E	Želiezovce LBK phase	Becker 2011, Taf. 70.2; Schwarzberg 2011, Taf. 120.3	3
V_62	Törökbálint-Dulácska -1	47°26'42"N	18°55'44"E	late Noteknopf/Želiezovce LBK phase	Schwarzberg 2011, Taf. 85.1	3
V_63	Törökbálint-Dulácska -2	47°26'42"N	18°55'44"E	late Noteknopf/Želiezovce LBK phase	Schwarzberg 2011, Taf. 85.2	3
V_64	Budapest-Aranyhegyi -1	47°34'45.0"N	19°01'48.2"E	Želiezovce LBK phase	Becker 2011; Schwarzberg 2011	3
V_65	Budapest-Aranyhegyi -2	47°34'45.0"N	19°01'48.2"E	Želiezovce LBK phase	Becker 2010; Schwarzberg 2011	3
V_66	Budapest-Aranyhegyi -3	47°34'45.0"N	19°01'48.2"E	Želiezovce LBK phase	Becker 2011; Schwarzberg 2011	3
V_67	Budapest-Békásmegyer -1	47°36'0"N	19°3'0"E	late Želiezovce LBK phase	Becker 2011, Taf. 54.2; Schwarzberg 2011, Taf.83.2	3
V_68	Budapest-Békásmegyer -2	47°36'0"N	19°3'0"E	late Želiezovce LBK phase	Becker 2011, Taf. 55.4	3
V_69	Budapest-Békásmegyer -3	47°36'0"N	19°3'0"E	late Želiezovce LBK phase	Becker 2011, Taf. 55.5	3
V_70	Budapest-Békásmegyer -4	47°36'0"N	19°3'0"E	late Želiezovce LBK phase	Becker 2010, Taf. 55.6	3
V_71	Budapest-Békásmegyer -5	47°36'0"N	19°3'0"E	late Želiezovce LBK phase	Becker 2011, Taf. 69.4; Schwarzberg 2011, Taf. 84.5	3
V_72	Budapest-Békásmegyer -6	47°36'0"N	19°3'0"E	late Želiezovce LBK phase	Becker 2011, Taf. 69.5; Schwarzberg 2011, Taf. 84.10	3
V_73	Budapest-Békásmegyer -7	47°36'0"N	19°3'0"E	late Želiezovce LBK phase	Becker 2011, Taf. 61.4; Schwarzberg 2011, Taf. 84.9	2
V_74	Szécsény -1	48°5'0"N	19°31'0"E	Želiezovce LBK phase	Becker 2011, Taf. 57.1	3
V_75	Szécsény -2	48°5'0"N	19°31'0"E	Želiezovce LBK phase	Becker 2011, Taf. 57.2	3
V_76	Szécsény -3	48°5'0"N	19°31'0"E	Želiezovce LBK phase	Becker 2011, Taf. 57.3	3
V_77	Szécsény -4	48°5'0"N	19°31'0"E	Želiezovce LBK phase	Becker 2011, Taf. 65.1	3
V_78	Csanytelek-Újhalastó -1	46°19'19"N	20°00'19"E	ALPC, Szakálhát group	Becker 2011, Taf. 177.4; Schwarzberg 2011, Taf. 89.3	1
V_79	Csanytelek-Újhalastó -2	46°36'22.28"N	20°06'17.29"E	ALPC, Szakálhát group	Becker 2011, Taf. 178.5; Schwarzberg 2011, Taf. 86.1	1

ID	Site	N	E	Chronology	Literature	Cluster analysis three classes
V_80	Tarnaméra-Cselőháza	47°39'22"N	20°09'29"E	late ALPC	Schwarzberg 2011, Taf. 79.2	1
V_81	Szelevény-Felsőföldek	46°48'07"N	20°12'04"E	ALPC, Esztár-Piscolt-Raskovice group	Becker 2010, Taf. 176.6; Schwarzberg 2011, Taf. 81	1
V_82	Szentes-Ilonapart	46°39'16"N	20°14'25"E	Szakálhát group	Becker 2010, Taf. 178.2	1
V_83	Szentes-Jaksorpart	46°39'16"N	20°14'25"E	ALPC, Szakálhát group	Schwarzberg 2011, Taf. 91	1
V_84	Szentes-Komitatshaus	46°39'13"N	20°16'03"E	ALPC, Szakálhát group	Becker 2011, Taf. 178.3; Schwarzberg 2011, Taf. 90	1
V_85	Füzesabony-Kettőshalom	47°45'00"N	20°25'00"E	classical ALPC phase	Becker 2011, Taf. 176.4; Schwarzberg 2011, Taf. 89.1	1
V_86	Kömlő	47°36'04"N	20°26'28"E	ALPC, Szakálhát group	Becker 2011, Taf. 177.3	1
V_87	Domica cave -1	48°28'39"N	20°28'10.06"E	ALPC, Bükk culture	Becker 2011; Schwarzberg 2011	1
V_88	Domica cave -2	48°28'39"N	20°28'10.06"E	ALPC, Bükk culture	Becker 2011; Schwarzberg 2011	1
V_89	Aggtelek cave -1	48°28'16.5"N	20°29'51"E	ALPC, Tiszadob group	Schwarzberg 2011, Taf. 78.7	1
V_90	Aggtelek cave -2	48°28'16.5"N	20°29'51"E	ALPC, Tiszadob group	Schwarzberg 2011, Taf. 79.9	1
V_91	Spišský Hrhov -1	49°00'00"N	20°38'30"E	Želiezovce LBK phase	Becker 2011, Taf. 68.3; Schwarzberg 2011, Taf. 118.1	3
V_92	Spišský Hrhov -2	49°00'00"N	20°38'30"E	Želiezovce LBK phase	Becker 2011, Taf. 68.4; Schwarzberg 2011, Taf. 118.2	3
V_93	Mezőkeresztes-Cet-halom	47°49'49"N	20°41'22"E	ALPC, Tiszadob group/Bükk culture	Csengeri 2014, fig.8.2	1
V_94	Miskolc-ALDI	48°05'50"N	20°44'53"E	ALPC, Tiszadob group/Bükk culture	Csengeri 2014, fig.9.4	1
V_95	Tiszavalk-Négyes	47°41'18"N	20°44'58"E	ALPC, Szatmar group	Becker 2011, Taf. 176.2; Schwarzberg 2011, Taf. 78.4	1
V_96	Sajószentpéter I	48°13'02"N	20°46'53"E	classical ALPC phase	Becker 2011, Taf. 176.3	1
V_97	Sajószentpéter-Kövecses	48°13'02"N	20°46'53"E	ALPC, Bükk culture	Schwarzberg 2011, Taf. 93.5	1
V_98	Gyoma-Őzed	46°56'10"N	20°49'025"E	ALPC, Szakálhát group	Becker 2011, Taf. 177.2; Schwarzberg 2011, Taf. 86	1
V_99	Sajóvámos	48°11'29"N	20°49'54"E	ALPC, Tiszadob group/Bükk culture	Csengeri 2014, fig.7.4	1
V_100	Biskupice	49°57'35"N	20°7'28"E	Želiezovce LBK phase		3

V_101	Battonya-Gödrösök	46°17'0"N	21°01'00"E	ALPC, Szakálhát group	Becker 2011, Taf. 177.1; Schwarzberg 2011, Taf. 89.1	3
V_102	Battonya-Vid	46°21'42"N	21°01'15"E	ALPC, Szakálhát group	Becker 2011, Taf. 178.1	1
V_103	Battonya-Parázs tanya	46°23'42"N	21°03'15"E	ALPC, Szakálhát group	Becker 2011, Taf. 178.4	1
V_104	Polgár-Nagy-Kasziba	47°52'02"N	21°07'00"E	ALPC, late Bükk culture	Raczky/Anders 2003, 159, 162 u. 161 Abb. 3,7; Schwarzberg 2011, Taf. 93.1	1
V_105	Encs-Kelecsény -1	48°19'42"N	21°07'15.2"E	ALPC, Tiszadob group/Bükk culture	Csengeri 2014, fig.6.4	1
V_106	Encs-Kelecsény -2	48°19'42"N	21°07'15.2"E	ALPC, Tiszadob group/Bükk culture	Csengeri 2014, fig.9.5	1
V_107	Garadna-Elkerülő út -1	48°25'07"N	21°10'29"E	ALPC, Bükk culture	Csengri 2011, fig.1,2,3	1
V_108	Garadna-Elkerülő út -2	48°25'07"N	21°10'29"E	ALPC, Bükk culture	Csengri 2011, fig.4	1
V_109	Garadna-Elkerülő út -3	48°25'07"N	21°10'29"E	ALPC, Bükk culture	Csengri 2011, fig.8.1	1
V_110	Garadna-Elkerülő út -4	48°25'07"N	21°10'29"E	ALPC, Bükk culture	Csengri 2011, fig.8.2	1
V_111	Garadna-Elkerülő út -5	48°25'07"N	21°10'29"E	ALPC, Bükk culture	Csengri 2011, fig.8.3	1
V_112	Garadna-Elkerülő út -6	48°25'07"N	21°10'29"E	ALPC, Bükk culture	Csengri 2011, fig.8.4	1
V_113	Mezőzombor-Temető	48°08'54"N	21°16'07"E	ALPC, Tiszadob group	Becker 2011, Taf. 179.2; Schwarzberg 2011, Taf. 80.1	1
V_114	Kéked-Hosszúföldek	48°32'45"N	21°20'45"E	initial phase Alföld LBK (ALPC I)	Csengri 2018, Tab.2.2	1
V_115	Tiszavasvári-Keresztfal	47°57'08"N	21°22'18"E	ALPC, Tiszadob group	Schwarzberg 2011, Taf. 78.10	1
V_116	Tiszavasvári-Paptelekhat	47°57'08"N	21°22'18"E	ALPC, Tiszadob group	Schwarzberg 2011, Taf. 78.12	1
V_117	Szegi-Ady Endre	48°11'42"N	21°22'35"E	ALPC, Tiszadob group/Bükk culture	Csengeri 2014, fig.7.6	2
V_118	Kenézlő-Fazekaszug	48°11'53"N	21°31'46"E	ALPC, Tiszadob group	Becker 2011, Taf. 179.1	1

ID	Site	N	E	Chronology	Literature	Cluster analysis three classes
V_119	Berettyószentmárton-Morotva	47°11'53"N	21°32'18"E	ALPC, Esztár-Piscolt-Raskovice group	Becker 2011, Taf. 176.7; Schwarzberg 2011, Taf. 82.1	1
V_120	Debrecen-Tócópart	47°32'0"N	21°38'00"E	ALPC, Esztár-Piscolt-Raskovice group	Becker 2011, Taf. 176.8; Schwarzberg 2011, Taf. 82.4	1
V_121	Tiszaigar-Homokbánya	47°32'0"N	21°38'00"E	ALPC, Esztár-Piscolt-Raskovice group	Becker 2011, Taf. 176.10	1
V_122	Szilmeg, Polgár-Folyás	47°48'33"N	21°48'21"E	ALPC, Szilmeg group	Becker 2011, Taf. 176.5	1
V_123	Šarišské Michaľany -1	49°4'9"N	21°8'14"E	ALPC, Bükk culture	Becker 2011, Taf. 179.7; Schwarzberg 2011, Taf. 114.2	1
V_124	Šarišské Michaľany -2	49°4'9"N	21°8'14"E	ALPC, Tiszadob group	Schwarzberg 2011, Taf. 114.3	1
V_125	Šarišské Michaľany -3	49°4'9"N	21°8'14"E	ALPC, Tiszadob group	Becker 2011, Taf. 179.5; Schwarzberg 2011, Taf. 115.2	2
V_126	Šarišské Michaľany -4	49°4'9"N	21°8'14"E	ALPC, Tiszadob group	Becker 2011, Taf. 179.4; Schwarzberg 2011, Taf. 121.7	1
V_127	Šarišské Michaľany -4	49°4'9"N	21°8'14"E	ALPC, Bükk culture	Becker 2011, Taf. 179.6	1
V_128	Sonkád „Új Élet“	48°3'0"N	22°45'0"E	ALPC, Szatmar group	Becker 2011, Taf. 176.1; Schwarzberg 2011, Taf. 78.6	2
V_129	Iacobeni	47°26'35"N	27°19'08"E	Želiezovce LBK phase	Becker 2011, Taf. 61.3; Schwarzberg 2011, Taf. 98.2	2
V_130	Huşi	46°40'27"N	28°3'35"E	LBK	Becker 2011, Taf. 72.8; Schwarzberg 2011, Taf. 98.1	2

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LINEAR POTTERY CULTURE ON THE LOWER DANUBE

ABSTRACT

Garvăn D. and Frînculeasa A. 2021. Linear Pottery culture on the Lower Danube. *Sprawozdania Archeologiczne* 73/1, 421-437.

Archaeological excavations carried out at Sudiţi (Buzău County, Romania) some decades ago unearthed several Linear Pottery culture features which were subsequently interpreted and used by various researchers in an attempt to explain the origin of Chalcolithic cultures (such as Boian). The poorly published findings generated conflicting or arguable theories. Even if it is not the only discovery of its kind, the Neolithic feature from Sudiţi is the most complex one from Wallachia. Until new, accurate field research is undertaken, this old discovery is still appropriate for further discussion, offering some valid points regarding the relation between the local culture and Linear Pottery at the turn of the fifth millennium.

Keywords: Lower Danube, Wallachia, Linear Pottery culture, pottery, chronology
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INTRODUCTION

Although more than half a century has passed since the Sudiţi investigations, there is still little information about the evolution of the Linear Pottery culture on the Lower Danube. Apart from the Sudiţi site, where several complexes (deep dwellings or pits) attributed to the Linear Pottery culture were researched, the other data are exclusively related to the presence of ceramic fragments in various local cultural contexts such as Dudeşti, Vădastra I and Boian – Bolintineanu.

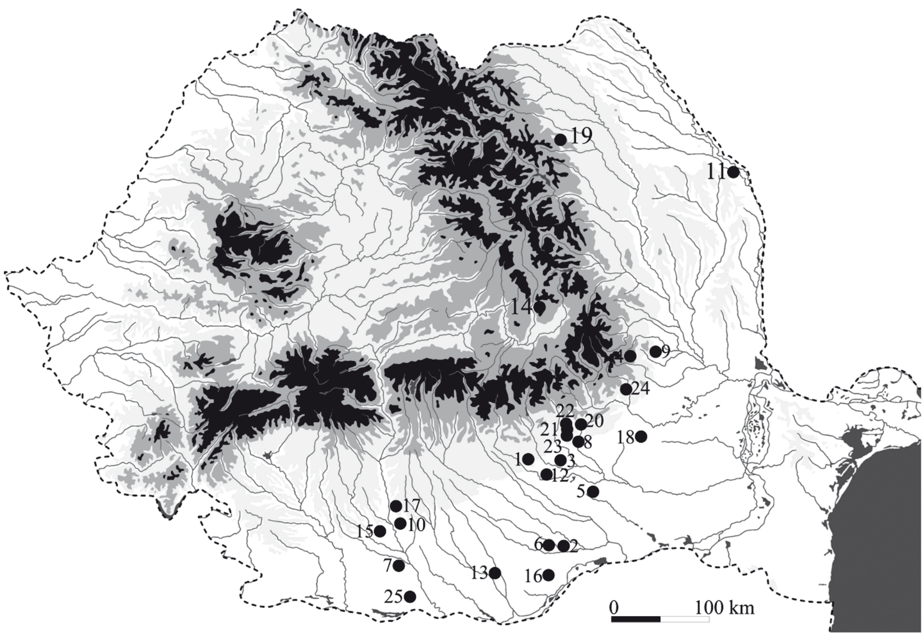
LINEAR POTTERY CULTURE ON THE LOWER DANUBE. A BRIEF PRESENTATION OF THE MAIN FINDS/DISCUSSIONS (FIG. 1)

The first ceramic fragments belonging to the Linear Pottery culture culture south of the Carpathians were found in 1958 in the lower level of the Vădastra – Movila Fetelor site, located not far from the Danube valley. They were associated with Boian – Bolintineanu archaeological materials (Mateescu 1961, 61, fig. 1: 2). Most finds come from the northern half of Wallachia, particularly as a result of the research conducted by V. Teodorescu, starting in the 1970s. We should mention the discoveries from Sudiţi in 1961, 1964, 1970-1973 (Teodorescu 1966; 2009), Coşereni (1963), Lacul Turcului (1964) (Teodorescu 1966, 224), Boldeşti-Grădiştea (1980) (Frînculeasa 2007, 29), all located in the plain area, and from Ghinoaica (1961, 1964) (Teodorescu 1966, 226), Vadu Săpat – La Silişte, Puţul Tătarului, La Grec (Teodorescu and Peneş 1984), and Tohani – Dumbrava (Frînculeasa 2010, 49), in the foothills. Linear Pottery culture fragments were found at four sites on the north-eastern border of Wallachia, in the piedmont area, namely Vadu Soreşti (Drâmbocianu 1980), Coroteni (Bobi 1987), Gugeşti (Bobi 1979, 26) and Voetin (Bobi and Paragină 1992).

A number of discoveries were made in the southern half of Wallachia, near Bucharest – some of them in archaeological contexts belonging to the Dudeşti culture, such as the finds at the eponymous site (Comşa 1969) and Cernica (Comşa 1978, 14). A few Linear Pottery culture sherds originate from Măgura, in the Teleorman valley, from a level with mixed Dudeşti and Vădastra materials (Frînculeasa 2010, 50, 51). Recently, Linear Pottery culture along with Dudeşti and Boian – Bolintineanu have been found at Pietrele (Hansen *et al.* 2017, 22, fig. 25).

As regards the area around the Olt River, in addition to the Vădastra find, there are those from Slatina – Crişana II, Piatra Sat – Nucet and Farcaşu de Sus – Pe Costă, in the Dudeşti/Vădastra I levels (Nica 1997, 107).

To this list of finds of ceramic materials, specific to this culture, we should add a number of decorative elements considered to be of Linear tradition. One should mention the deco-



1. Boldeşti-Grădiştea; 2. Cernica; 3. Ciorani; 4. Coroteni; 5. Coşereni; 6. Dudeşti;7. Farcaşu de Sus; 8. Ghinoaica; 9. Gugeşti; 10. Ipoteşti; 11. Isaiia; 12. Lacul Turcului; 13. Măgura; 14. Olteni; 15. Piatra-Sat; 16. Pietrele; 17. Slatina; 18. Sudiţi; 19. Târpeşti; 20. Tohani; 21. Vadu Săpat - *La Grec*; 22. Vadu Săpat - *Puţul Tătarului*; 23. Vadu Săpat - *La Silişte*; 24. Vadu Soreşti; 25. Vădastra.

Fig. 1. Main Linear Pottery culture sites cited in text

ration consisting of parallel lines, which sometimes end in a short, oblique line, encountered in some Boian – Giuleşti settlements in north-eastern Wallachia, at Siliştea – Conac, Lişcoteanca – Movila din Baltă (Pandrea 1999, 26, fig. 1, 2) and Pietrosu – La Arman (unpublished), or maybe the one consisting of triangles or parallel lines, made by incision, with the inside spaces filled with stitches.

THE SITE FROM SUDIȚI (BUZĂU) AND THE LINEAR POTTERY CULTURE (A STILL SOLITARY DISCOVERY)

The Sudiţi site (Gherăseni commune, Buzău County) lies in the north-east of Wallachia, in the Bărăgan Plain, about 25 km from the foothills, on the bank of the Călmăţui River. The Neolithic and Chalcolithic occupation is spread over a large area (approx. 10 ha), overlap-

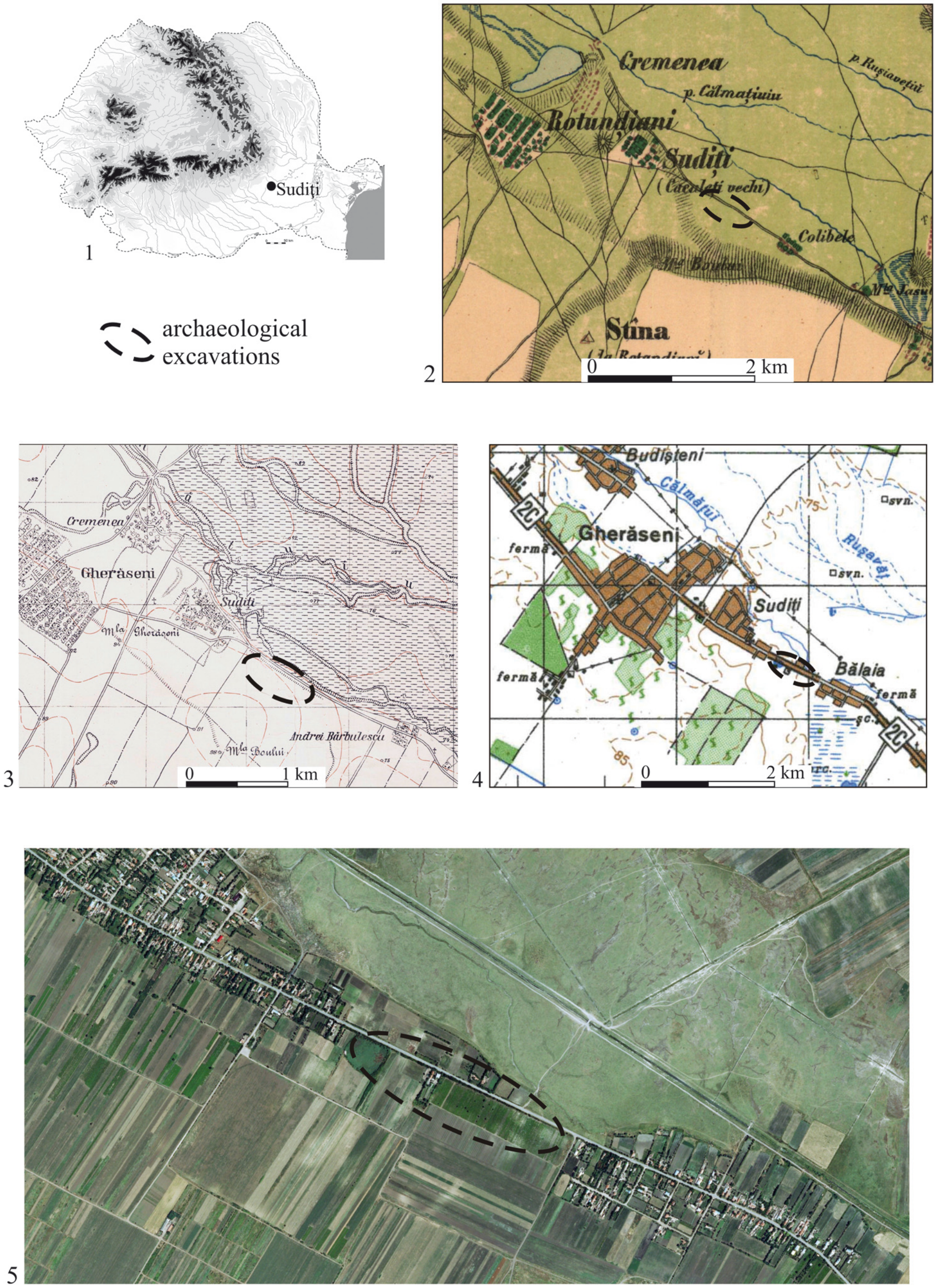


Fig. 2. Location of the Sudiți site (1) and the evolution of the area according to the Szathmary map, 19th century (2), the *Planurile Directoare de Tragere*, first half of the 20th century (3), military maps, 1997 (4) and the current orthophotograph (5)

ping almost the entire space between the villages of Sudiţi (Gherăseni commune) and Bălaia (Smeeni commune), on the right bank of the river (45.015274°N; 26.822364°E) (Fig. 2).

The site was identified by V. Teodorescu in 1961, following some surface research. The excavations were carried out in 1964, 1970, 1971, 1972 and 1973. Following the results obtained after the first excavation campaign, the "Sudiţi aspect", resulting from contacts between Linear and Dudeşti and Boian – Bolintineanu communities, was defined (Teodorescu 1966).

The materials attributed to the Linear Pottery culture lay in a 0.25 m thick layer, alongside other Dudeşti and Boian – Bolintineanu and Boian – Giuleşti materials. Some overlapped complexes were decisive in establishing the stratigraphy. On this basis, it was established that Linear communities had preceded the Boian – Bolintineanu and Giuleşti ones (Teodorescu 2009, 619), and that there could have been an archaeological level more ancient than the Linear one (Teodorescu 1966, 223-225).

Six pits were attributed to this community, amongst them CL 1/1964 and CL 2/1970, which were interpreted as dwellings on basis of their shape, size and layout. Pit CL 1/1964 had an oval shape, 0.30-0.35 m deep, with sides measuring 3.55 × 2.95 m. Pit CL 2/1970 was 0.30 m deep, with sides measuring 4 × 2.75 m. The remains of a hearth were preserved inside, and the outline was bordered / delimited by 11 postholes (Frînculeasa 2010, 45).

Identical situations were also identified in settlements attributed to the Linear Pottery culture east or west of the Eastern Carpathians. Ten pits were found at Târpeşti (Neamţ County), and based on their sizes (sides of 5 × 3 m and depths of 0.9-1 m from the excavation level), only one was labelled as a dwelling (Marinescu-Bîlcu 1981, 8). Remains of Linear dwellings, largely destroyed by later occupations, were also researched at the Isaiia settlement (Iaşi County) (Ursulescu *et al.* 2001, 111; 2002, 161, 162; 2005, 189). Fourteen deep dwellings and about 30 pits were investigated at Olteni (Covasna County) (Buzea *et al.* 2010, 286), considered to be one of the largest settlements in Romania. Boian – Giuleşti and Precucuteni I materials, which seem to be contemporaneous at this site, were also found here (Buzea *et al.* 2010, 286).

The situation in Sudiţi may be an exceptional one due to the presence of successive occupations over a very short period of time, but the contextualisation of the archaeological material discovered by V. Teodorescu remains problematic. In most cases, Boian – Bolintineanu or even Boian – Giuleşti materials were found at the upper part of Linear Pottery culture pits, which can be explained by their being filled in different stages (Frînculeasa 2010, 47, 48).

The ceramic inventory from Sudiţi is not very large, as the number of ceramic fragments is a little over 100. Two vessels, which today are part of the Buzău County Museum exhibition, were restored (Fig. 3: 1, 2). Almost the entire amount of pottery belongs to the category of fine ware. The only criterion of assignation was the decoration. The similar features of Neolithic coarse pottery (particularly the Linear and Dudeşti, but also Boian), the absence of distinctive ornamental elements and the context of discovery were impediments to separating this ceramic category based on cultural and chronological criteria.

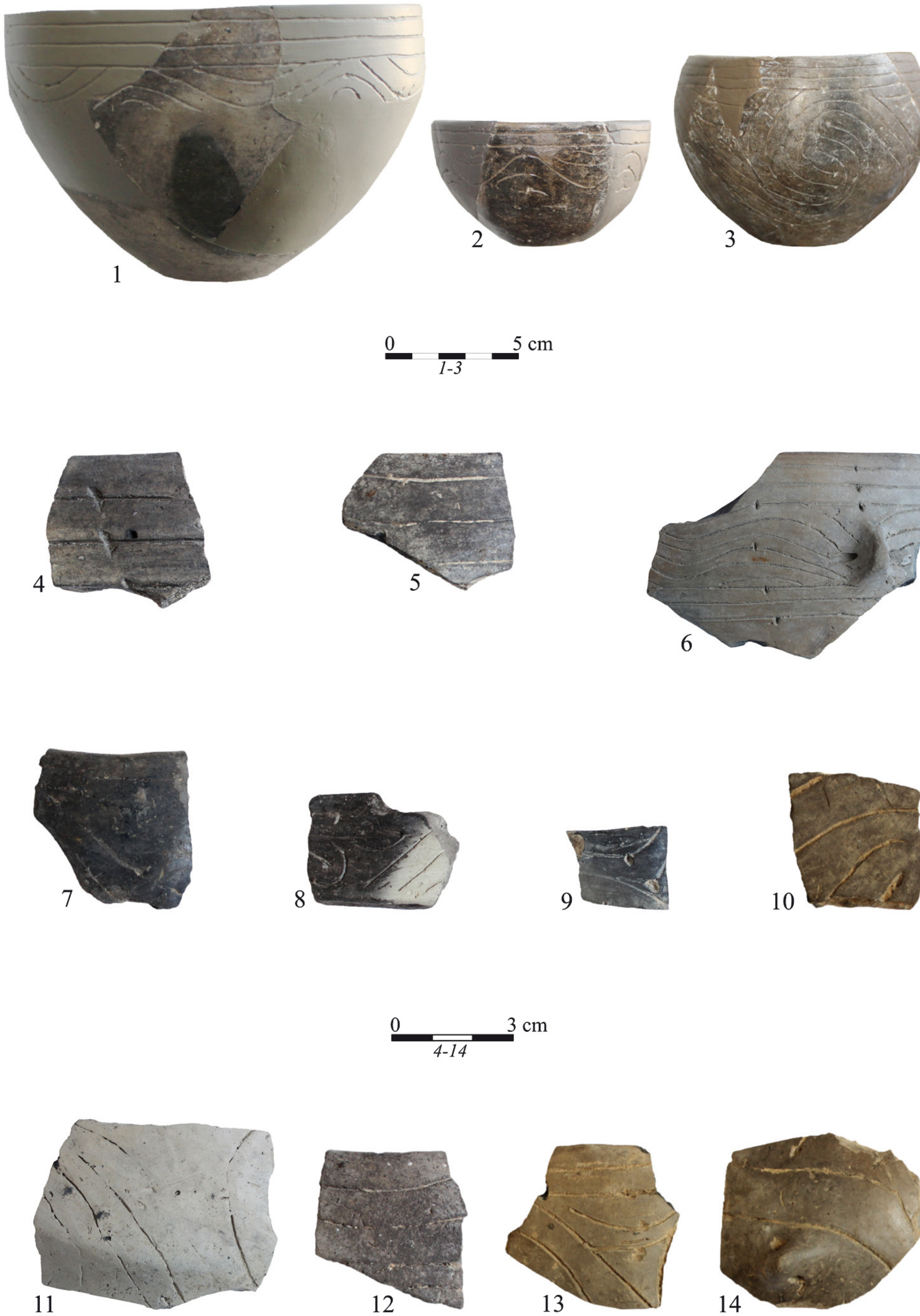


Fig. 3. Sudiți (1-2, 4-14) and Vadu Soreşti (3) pottery

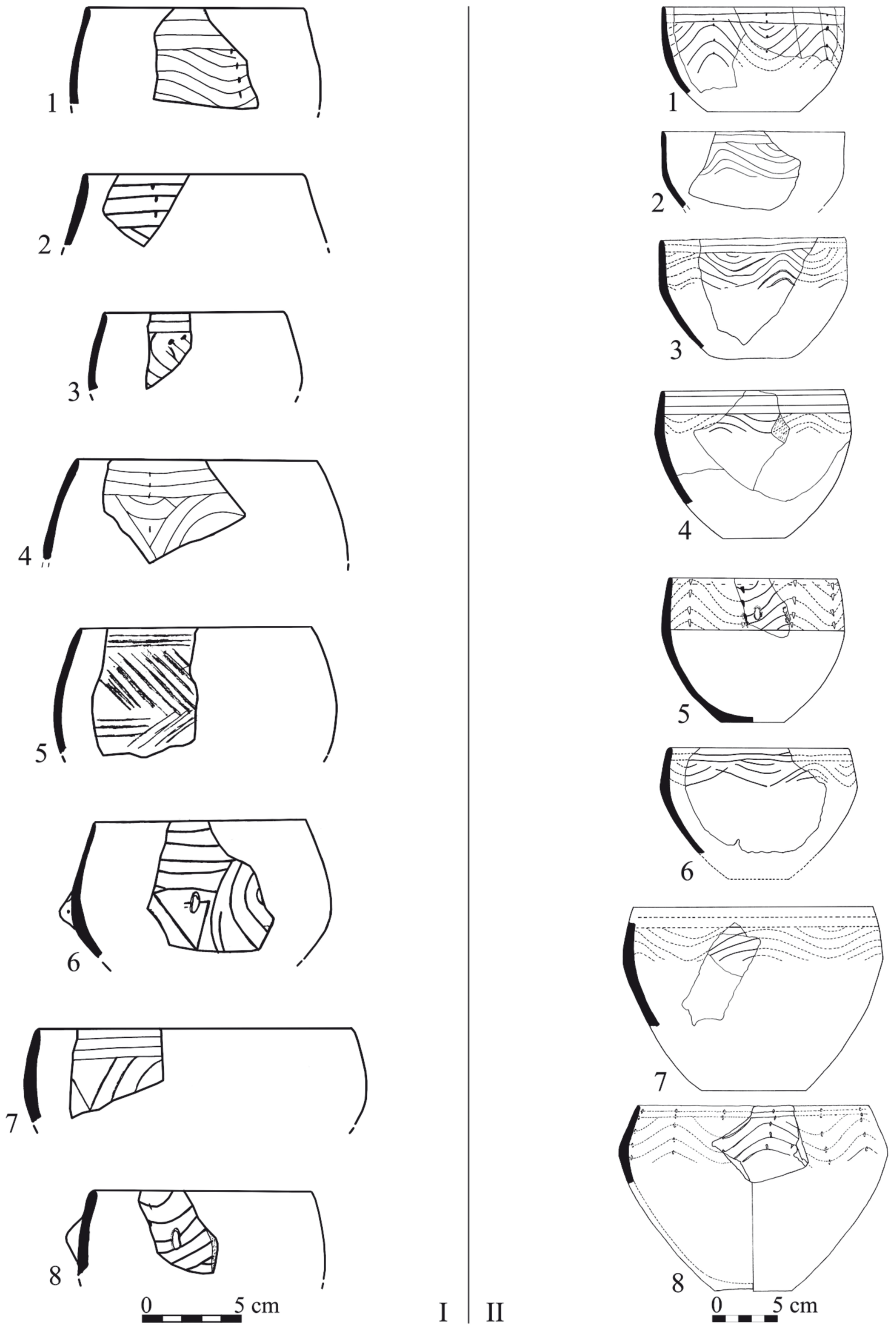


Fig. 4. I. Spherical bowls (1-8 – Sudiţi); II. Truncated cone-shaped bowls (1-8 – Sudiţi)

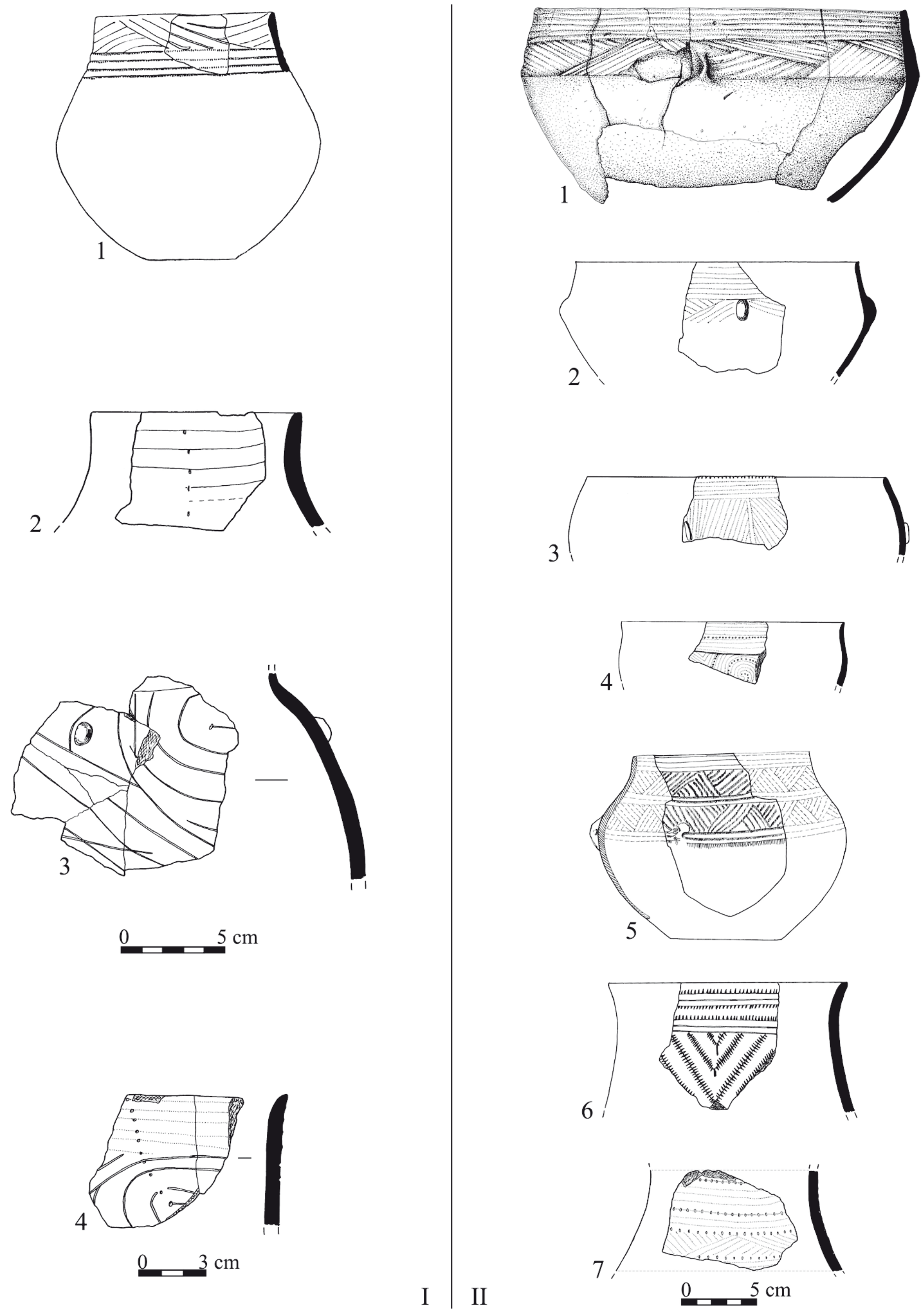


Fig. 5. I. 1-3 High-necked vessels; 4. Ceramic fragment with combined decoration (Linear Pottery culture and *Bolintineanu*) (1, 4 – Sudiţi; 2-3 – Vadu Soreşti); II. Boian – *Bolintineanu* pottery (1-6 –Sudiţi; 7 – Vadu Soreşti)

The typological repertoire is rather poor, partly due to the difficulty in identifying/separating the material. The "truncated cone-shaped bowl" (Fig. 4: II) is a frequently encountered form at Sudiţi. This form is considered to be of southern influence (Dudeşti or Boian) and attributed to the final stage of the Linear Pottery culture (Teodorescu 1966; Ursulescu 1990, 17). The spherical bowl (Fig. 4: I) and the high-necked vessels (Fig. 5: I) are specific to this culture and, in the area east of the Carpathians, are considered to be typical of the middle and late stages according to the chronology proposed by N. Ursulescu for this territory (Ursulescu 1991, 17, 18). Three types of decorations can be encountered at the settlement in the Călmăţui valley: the incised type (which prevails) (Fig. 3; 4: I), the type that combines notches with incisions (less common) (Fig. 5: I4) and the plastic type (perforated or unperforated protuberances) (Fig. 3: 6, 14; 4: I6, I8).

NEW DATA REGARDING THE RELATION BETWEEN THE LINEAR POTTERY CULTURE AND THE EVOLUTION OF CONTEMPORANEOUS LOCAL CULTURES

Linear materials occur alongside those of other cultures, often in unclear stratigraphic positions. There is information about the archaeological contexts of Dudeşti (Comşa 1969) and Cernica (Comşa 1978, 14), where Linear pottery was found alongside Dudeşti pottery. Linear pottery was discovered at Vădastra in a level corresponding to the end of the Dudeşti culture (Teodorescu 1966, 224), and in Slatina, Piatra and Farcaşu de Sus in Dudeşti/Vădastra I levels (Nica 1997, 107). Linear materials were found alongside Dudeşti and Bolintineanu ones in Cernica (Fig. 6: 1-7; Cantacuzino and Morintz 1968, 12, fig. 4), Pietrele (Fig. 6: 8; Hansen *et al.* 2017, 22, fig. 25), and Coroteni (Bobi 1987, 329, fig. 4: 1), whereas inside the Carpathian arch, at Hărman, they occur in association only with Bolintineanu pottery (Alexandrescu 1971). Linear, Bolintineanu and Vădastra I ceramic fragments were found at Ghinoaica (Frînculeasa 2010, 51) and Vadu Soreşti (Drâmbocianu 1980). Several Vădastra fragments were also discovered at Sudiţi (Frînculeasa 2010, pl. 37: 6-10), but in unclear contexts. Linear ceramic fragments associated with Vădastra were found in Boldeşti as well (Frînculeasa 2010, 51). As previously mentioned, Dudeşti, Vădastra I and Boian – Bolintineanu fragments were discovered alongside Linear pottery in the Sudiţi settlement. At Voetin (Vrancea County), the Linear settlement overlapped a Starčevo-Criş settlement, which, in its turn, was covered by a settlement attributed to the Spanţov phase of the Boian culture (Bobi and Paragină 1992, 25). A Linear settlement overlapped by a Boian-Giuleşti settlement was also discovered in Vrancea County, at Gugeşti (Bobi 1979, 26, fig. 4: 6-8).

In south-western Ukraine, ceramic fragments with a decoration typical of the Dudeşti culture were found in a Linear complex at Kamyane-Zavallia (Kiosak 2017, 253-268, fig. 9: 12-14).

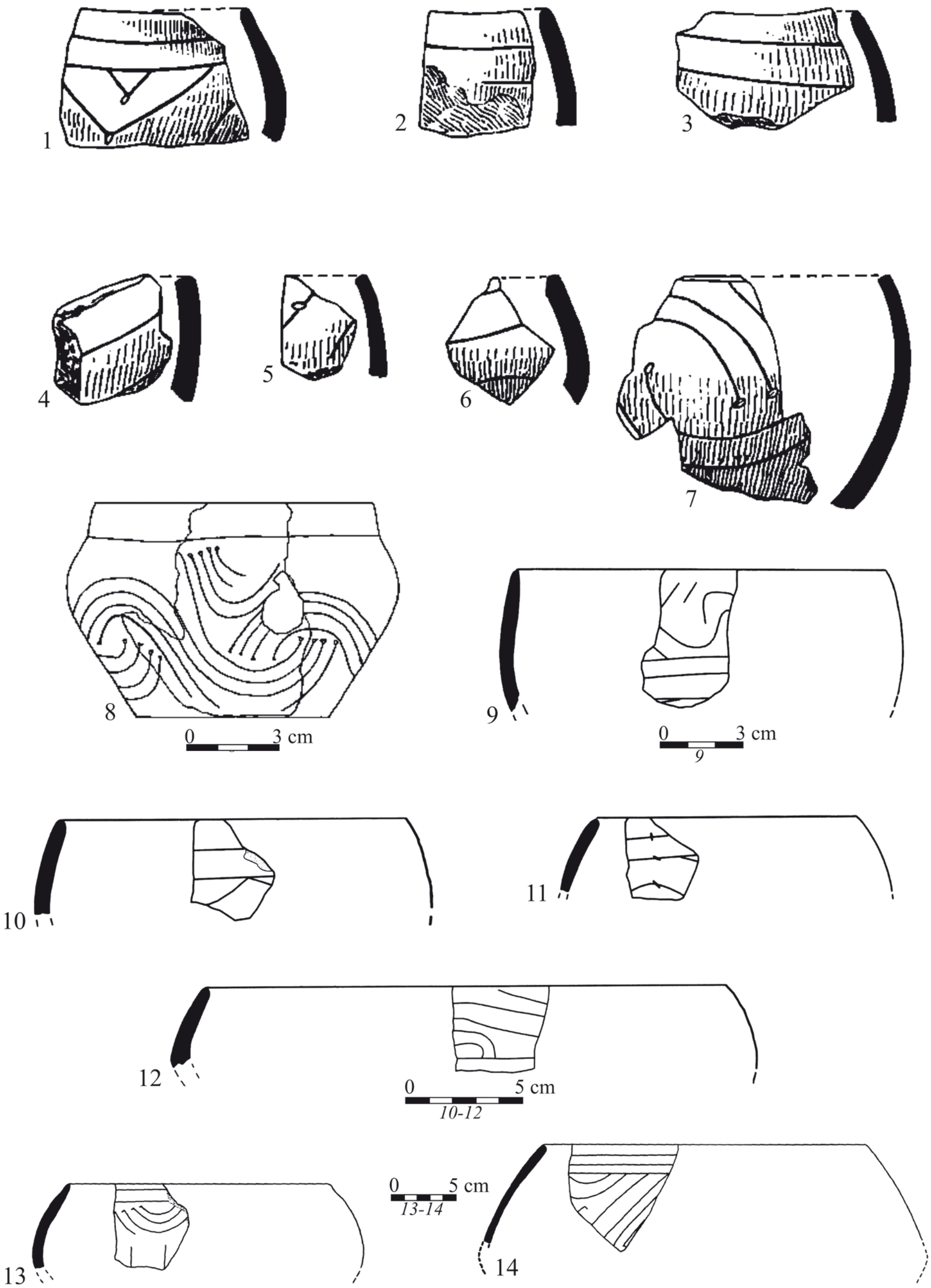


Fig. 6. Linear pottery found at Cernica (1-7), Pietrele (8), Boldeşti-Grădiştea (9), Ghinoaica (10-12) and Măgura (13-14) (1-7 acc. to Comşa 1969, without scale; 8 acc. to Hansen *et al*. 2017; 9-14 acc. to Frînculeasa 2010)

The lack of contexts and the period in which materials attributed to the Linear Pottery culture were investigated explain the absence of radiocarbon dating. The only option is to relate to the neighbouring areas and cultures. Radiocarbon dating carried out in Linear Pottery culture settlements (Nowak *et al.* 2017, fig. 6; Kiosak 2017, 258; Lazarovici and Lazarovici 2006, 463) points to a chronological interval closer to the Vădastra, approximately between 5200 and 5000 cal BC (Mirea 2015, 45). As for the Dudeşti culture, the most relevant radiocarbon dates are those from Măgura (Thissen 2013, 25, tab. 1). Attributed to an early stage of the culture, they are placed within an interval between 5500 and 5300 cal BC (Mirea 2015, 45). For the Boian – Bolintineanu phase, there is no radiocarbon dating from the settlements, and the dates from the Cernica graveyard (Stratton *et al.* 2018) are not relevant; however, some finds or associations of materials indicate the contemporaneousness of this phase with the Vădastra I (Neagu 2003, 145). Some authors consider the Boian – Bolintineanu phase to be an integral part of the Vădastra culture (Boroneanţ 2005, 64). The Linear Pottery culture and the Giuleşti phase of the Boian culture played an important role in the emergence of the Precucuteni culture, which shows that the two were contemporaneous. In north-east Wallachia, the Giuleşti phase has a longer evolution than in the Danube valley. Radiocarbon dates are also scarce for this period. The earliest ones carried out at the Isaccea site indicate an interval of 4900-4800 cal BC (Carozza *et al.* 2020, 151, fig. 9).

The Linear finds south of the Carpathians prove the existence of a period of cultural contacts, with the Dudeşti, Vinča B2 culture as the lower limit and the Boian – Giuleşti as the upper one.

DISCUSSIONS (ON THE NATURE OF THE PRESENCE OF THE LINEAR POTTERY CULTURE ON THE LOWER DANUBE)

The Sudiţi finds attributed to the Neolithic drew the attention of the researchers of the age, who formulated points of view regarding the internal evolution, the connections/contacts with the neighbouring area and the role played by the Călmăţui group in the emergence of the Boian and Precucuteni cultures.

As early as the first publication, inferences on the cultural identity of the archaeological features discovered here were presented: "…these more or less still Linear tribes (later of Sudiţi aspect)…" (Teodorescu 1966, 231). The wording of the 1966 text suggests the existence of two moments in the evolution of the complex here: the first one – the coming of Linear communities, the second one – the synthesis between the newcomers and the local communities (Dudeşti).

According to E. Zaharia, the Sudiţi finds are a late stage of the Linear, of the transition from the Dudeşti to the Bolintineanu (Zaharia 1967).

Based on the results obtained at Târpeşti, S. Marinescu-Bîlcu considers that the late Linear communities descending from Moldavia and the Bolintineanu ones had mixed at Sudiţi, thus excluding the participation of the *Sudiţi aspect* in the formation of the Precucuteni culture (Marinescu-Bîlcu 1968, 400).

E. Comşa would view the Sudiţi stratigraphy as uncertain and would attribute CL 1/1964 to the Dudeşti culture, arguing that the Linear pottery in the fill must have been an import, as it occurs also in a pit at Dudeşti eponymous site. Furthermore, he would acknowledge the antecedence of the Linear pottery from Dudeşti and Ghinoaica to that from Sudiţi (Comşa 1969, 572).

Studying the Hărman Linear material, A. Alexandrescu noticed its resemblance to that of Sudiţi, but considered the emergence of mixed elements to have resulted from the contact between Linear and Bolintineanu communities (Alexandrescu 1971, 13, 14).

Employing stylistic criteria, N. Ursulescu proposes three stages of evolution of the Linear Pottery culture in Moldavia and north-east Wallachia. As early as the first phase, these communities, who "dislocated and assimilated the Starčevo-Criş ones", would spread as far as the north-east of Wallachia (the Călmăţui valley – A/N) and even further south, coming into contact with the Dudeşti communities, in the second phase (Fundeni) (Ursulescu 2000, 252). During the second phase, that synthesis between the east-Carpathian and southern (Dudeşti) communities may have occurred, which the Iaşi-born scientist would regard as "a local aspect – the Sudiţi aspect" (Ursulescu 2000, 253, 257). It is then that some of the Linear communities from Moldavia would enter Transylvania, and the influence of southern cultures on the Linear one would become increasingly stronger, this being the beginning of the formation process of the Precucuteni culture (Ursulescu 2000, 258). It results, from the aforementioned, that N. Ursulescu also acknowledges the existence of two moments in the evolution of the Linear Pottery culture at Sudiţi.

While the northern, western and southern connections of the Linear Pottery community from Sudiţi are emphasised repeatedly, there are no clear data to ascertain the cultural relationship with the eastern territory (Haşotti 1990, 21).

S. Pandrea rules out the participation of the *Sudiţi aspect* to the formation of the Giuleşti phase, but admits there may have been a coexistence of the two ceramic styles (linear and Giuleşti), which is an idea based on the discovery of vessels with a decoration consisting of incised lines, sometimes interrupted by small alveoli, found at Siliştea – Conac and Lişcoteanca – Movila din Baltă (Pandrea 1999, 26, fig. 1, 2).

Reassessing the excavation data and V. Teodorescu's manuscripts, one of the authors of the present paper concluded elsewhere that the Linear Pottery culture from Sudiţi represent a particular phenomenon within the cultural evolution of north-eastern Wallachia that should be inserted between Dudeşti culture (Fundeni phase) and Boian culture (the Giuleşti phase), prior to or at least contemporary with the formation of the Precucuteni culture (Frînculeasa 2010, 56).

Traditions and influences of the Linear Pottery culture preceding the emergence of the Precucuteni culture were specified and observed following the discovery of vessels with anthropomorphic features at Dodeşti – the Stoicani-Aldeni cultural aspect (Niţu 1974), Isaiia – the Precucuteni II-III culture (Ursulescu and Tencariu 2004), or in the Bucovăţ cultural environment (Lazarovici 1979; Maxim 1999).

These are some of the theories regarding the finds of Sudiţi and their role in the new cultural constructions. Although many years have passed since the excavations carried out here, the echo of these finds has not disappeared. The lack of excavations in the area, which could confirm or refute what V. Teodorescu reported, makes it more and more difficult to discuss such an issue. The data on the Linear Pottery culture in eastern Romania still lacks substance. More recent discoveries, such as those from Isaiia (Iaşi County) and Olteni (Covasna County) are yet to be expounded in a conclusive manner. The data from Olteni are little known, but we believe they may have a significant impact on the interpretation of the occurrence of Linear, Boian and Precucuteni I materials in the same archaeological context (Buzea 2002, 183-225). As regards the ceramic inventory of Isaiia, it allowed J. Braungart to define three phases of evolution of this culture. He places the Sudiţi, Vadu Soreşti, Dudeşti, Vădastra and Hărman finds in the second phase (Braungart 2014, 25).

CONCLUSIONS

Analysing the evolution of the Linear Pottery culture on the Lower Danube, or its influence on the origin of contemporary or posterior cultures, is still far from being easy/accessible. Using only one element (pottery) within a model, namely the establishment of contact chronology based on "imports", we believe that such an analysis is inappropriate in the absence of additional elements. In establishing a relative chronology, the association of "imports" with indirect finds, which points to the contemporaneousness of cultural influences, complicates or at least raises questions regarding the absolute nature of this methodology. Acknowledging chronological gaps, cultural isolationism and conservatism seem easy answers, which are nevertheless difficult to prove only by studying the pottery. Certain materials are not "imports", but bear mere similarities or influences marked by the "fashion" of the age (Frînculeasa 2007, 35); however, they may also indicate access to technologies and innovations in the production of pottery and/or of other artefacts.

The finds attributed to the Linear Pottery culture in Romania led to the reassessment of the local cultural framework following the evolution of the Starčevo-Criş culture, which represented the engine for the cultural homogeneity of a large area north of the Danube in the 6th millennium. Unlike the previous stage, the end of the 6th millennium and the beginning of the following one represented a chronological segment which was culturally heterogeneous and fragmented. Within this local picture, the discovery of Linear ceramic

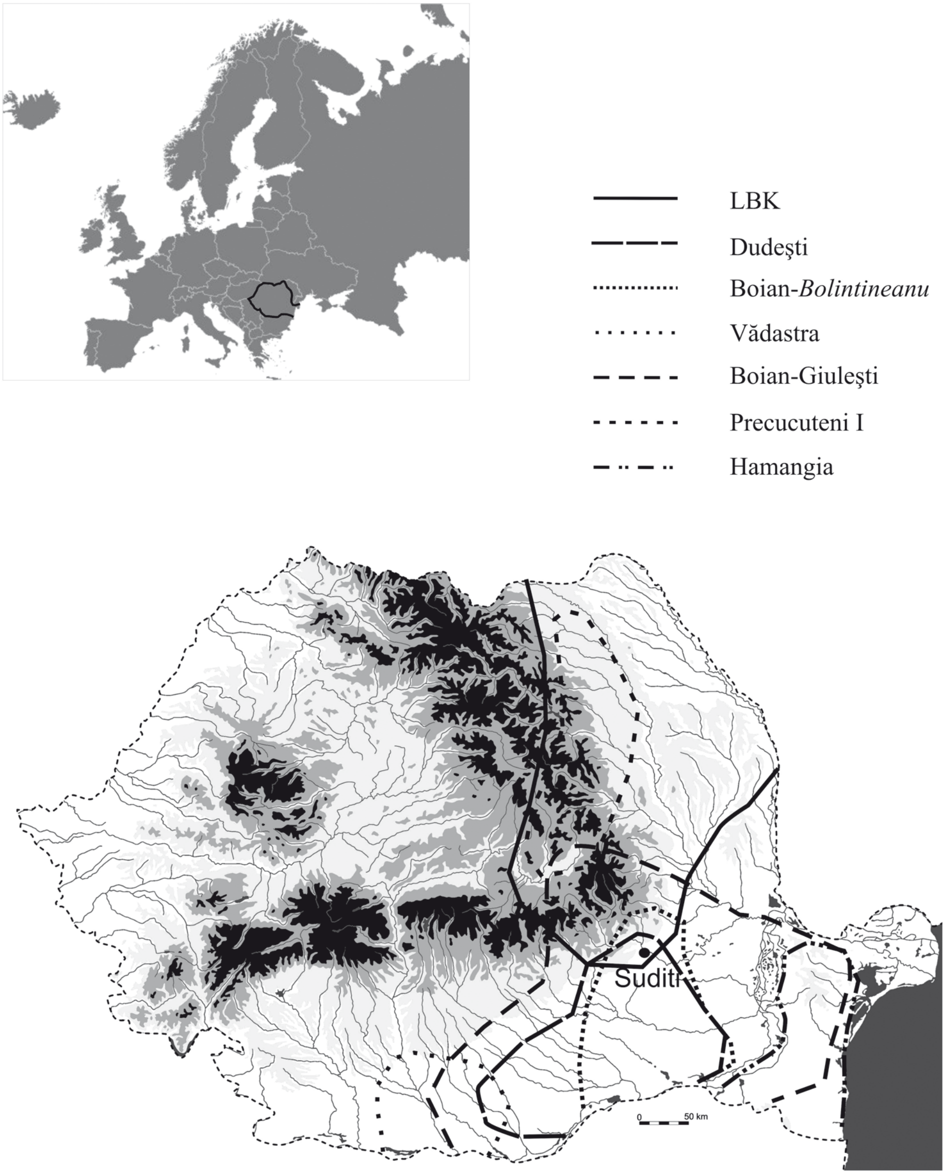


Fig. 7. Distribution of cultures discussed in the text

fragments south of the Carpathians marks a very culturally dynamic period, characterised rather by local evolutions, which however do not exclude contacts and interaction. The Sudiţi finds seem to represent a certain kind of cultural manifestation with a strong local imprint, generated both by the geographical context and by the interaction between the

Linear Pottery culture and the contemporary cultural environment (Fig. 7). The lack of consistent discoveries might mark a reality in which the Linear Pottery culture interacted with the local cultural environment and influenced it on a more or less archaeologically noticeable level.

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PATTERNS IN MATERIAL CULTURE: DATA FOR SOCIAL PRACTICES AND ACTIVITIES IN THE EARLY ALPC SETTLEMENT OF BÜKKÁBRÁNY-BÁNYA VII (NORTHEAST-HUNGARY)

ABSTRACT

Füzesi A., Tutkovics E. K., Kalli A. and Faragó N. 2021. Patterns in material culture: data for social practices and activities in the early ALPC settlement of Bükkábrány-Bánya VII (Northeast-Hungary). *Sprawozdania Archeologiczne* 73/1, 439-476.

Bükkábrány-Bánya VII, an early ALPC settlement in Northeast Hungary, was just recently exposed to international research, but we would like to illustrate in our study how much promise its archaeological material has. We focused our investigation on these finds because the site contains a three-hectare excavated area and a well-defined settlement structure. Our first results are based on a quantitative examination of the many categories of archaeological finds. The first stage in our intra-site investigation involved the analysis of artifact fragmentation, as evaluated by the weight-to-frequency ratio, which indicated variances in depositional procedures. The spatial distribution of each find category was analyzed using kernel density, which revealed unique hot spots within activity zones. To split the settlement territory into spatial units, we employed the primary structural characteristics, such as rows of houses, empty spaces, and wells. The distribution and fragmentation data matched our theoretical spatial units well, providing an interpretive framework for the early ALPC settlement's social units.

Keywords: Neolithic of Northeast-Hungary, early ALPC settlement, settlement structure, intra-site analysis, distribution pattern of archaeological material

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On its way to Central Europe, the Danubian route, one of the principal pathways of European Neolithization, traveled through the Balkans and the Carpathian Basin. Alternative approaches, on the other hand, led to the establishment of unique cultural groupings in nearby regions. In Central Europe, the Linearbandkeramik (LBK) cultural setting provided the backdrop for Neolithization, whereas, in the Carpathian Basin, the Alföld Linear Pottery culture (ALPC) provided a similar backdrop. The formation of these two cultures was linked at numerous stages (Bánffy 2006; Whittle *et al.* 2013; Raczky 2019). These significant links have not yet been studied in full due to variations and challenges in local research histories, while key parts have been discussed (Raczky and Anders 2003; Domboróczki 2009; Kozłowski and Raczky 2010; Mester and Faragó 2013). The formation of common narratives and the recognition of local cultural units as a unified cultural complex are both positive outcomes of the exchange of ideas at local and regional conferences (Kozłowski 2009; Kozłowski and Raczky 2010; Virag 2015).

1. INTRODUCTION – BÜKKÁBRÁNY-BÁNYA SITE VII

The relevance of rescue excavations has expanded in Hungary since 1990, as large economic investments have increased. Apart from highway construction projections, during which rescue excavations were undertaken to preserve archaeological data river regulation programs and mine extractions took away a considerable portion of the land previously inhabited by archaeological sites. The Bükkábrány lignite mine was a major undertaking, with a situation comparable to that of the Aldenhoven plateau (Lüning and Stehli 1994): years of mining damaged the environment throughout several square kilometers, but archaeologists working there were able to document monuments, artifacts, and date from recent millennia. Although surface mining at Bükkábrány began in 1985, due to the state of Hungarian heritage management, archaeological research has only been conducted since 2007 (Kalli and Tutkovics 2017, 4, 5, fig. 2, 3, Table 1).

Between 2011-2012, András Kalli and Eszter Tutkovics excavated a three-hectare section of Bükkábrány-Bánya Site VII (hereinafter Bükkábrány, Kalli and Tutkovics 2016). The topographic examination identified the site, and approximately one-third of it had been excavated over two seasons (Fig. 1). The landscape has since been destroyed as a result of the mining method used in the area, making further observation impossible. The earlier geographical databases, aerial photos, and other mappings should be used in analyses of this site. We reconstructed two waterways that once encircled the settlement based on the topographic conditions of the Bükkábrány micro-region (Fig. 1). Due to the destruction of the contemporary landscape, the nature of the streams (A and B) – periodic or constant – during the Neolithic can no longer be determined. However, it is important to note that the size of the site, as identified by pedestrian survey, corresponds to the plateau, flanked by the a valley on each side – on the northeast and the southeast.

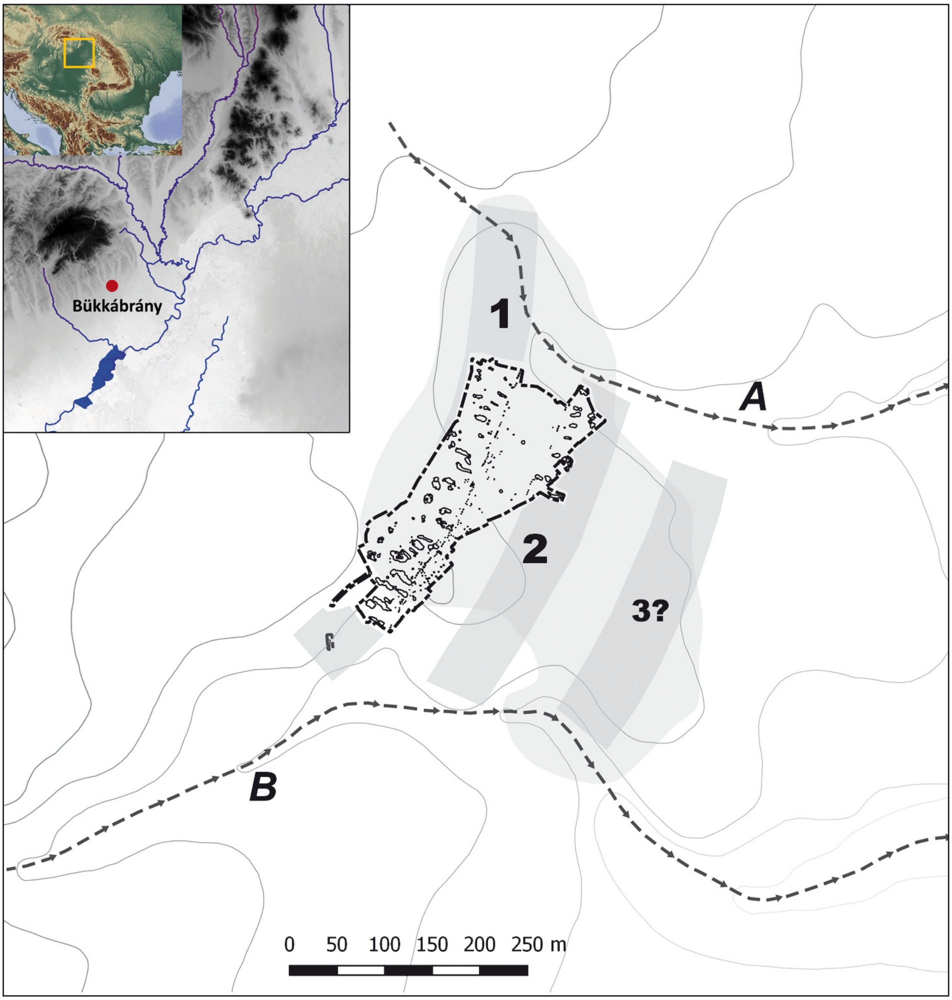

Fig. 1. Site plan of Bükkábrány-Bánya VII – grey polygon: the excavated area within the entire archeaological site, 1-2 – house rows, 3? – possible house row, A-B – waterways reconstructed based on relief

The majority of the 490 archaeological features discovered were dated to the Middle Neolithic and Roman Empire periods. Of these features, 254 had ceramic that could be linked to the early ALPC. The unearthed features belonged to a row-house community, with buildings that are now difficult to recognize as distinct components (Fig. 2). The row of residences in the southeast is shorter and less well-known. The axially symmetric layout of the village was corroborated by the spatial position of the features, even though the settlement units were only partially identified. Only two rows of homes are known to have

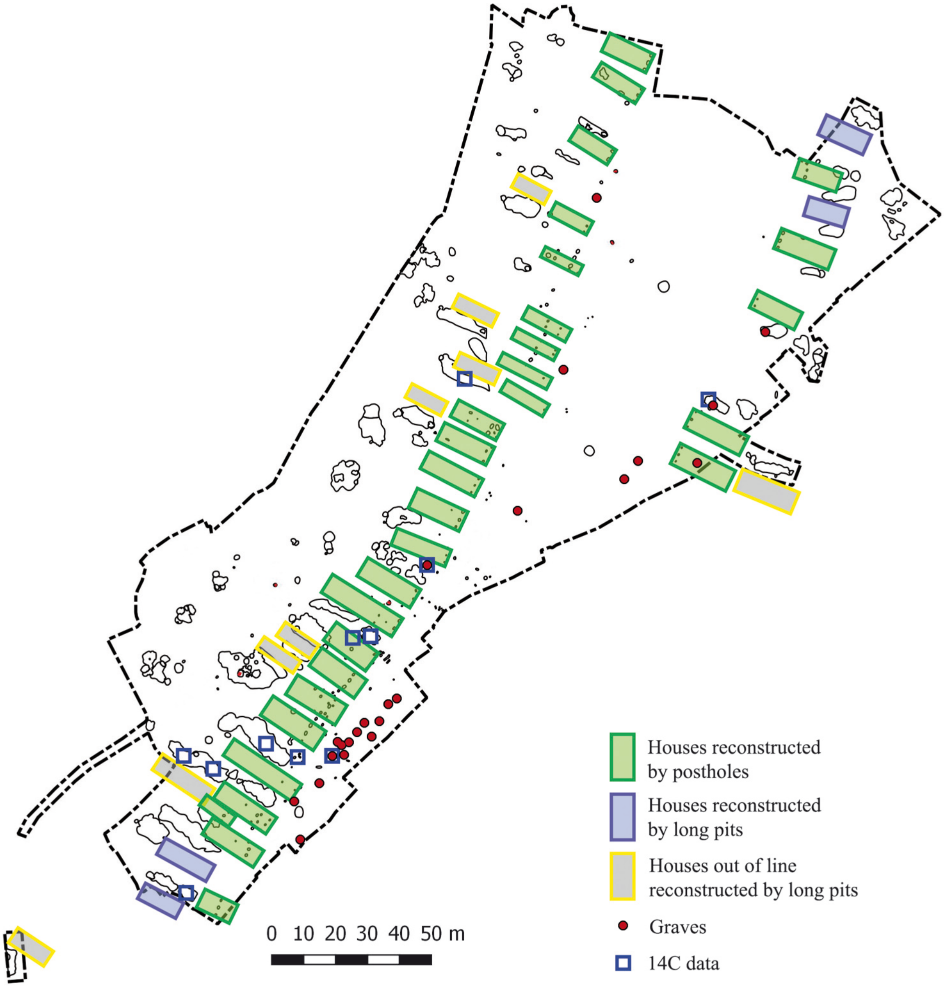

Fig. 2. The early ALPC features of Bükkábrány-Bánya VII

existed at the Bükkábrány site (1-2), but another village unit (3?) may have existed in the southeastern half of the site (Fig. 1). Both early ALPC and Roman-period village remnants have been identified in the southwestern third of the excavated area, the highest part of the site. However, only Neolithic features were found in the east. As a result, we can assume that the unexcavated portion of the settlement in the southeast belongs to the former rather than the latter. If this is correct, the third row of houses (Unit 3) could indeed have existed.

Due to the poor observation conditions and pedological qualities of the area, the number and size of buildings are unknown; only parts of the LBK longhouses remained. Structural elements indicated a substantial chunk of the expected 43 homes (30 buildings). The postholes, observed in triplets, only accounted for one row per building. Despite this, 194 postholes were dug. Based on analogies, the deepest row of postholes was built in the frontal third of the longhouses, or as their facade (Oross 2009; Rück 2009). Large clay pits close to and between the buildings identified 13 other dwellings, which were utilized primarily as construction phenomena and secondarily as depositional locations. The 31 long pits and 10 pit complexes held a large amount of the material. Based on their long pits the remaining buildings were assumed. The settlement's structures were placed in two rows, side by side. Four of the suspected dwellings were found behind the buildings in the first group, whereas nine were uncovered behind the structures in the second category.

Only 23 intramural burials discovered in the entire excavated area. This number corresponds to sites with similar ages (Domboróczki 1997; Kalicz and Koós 2014). The deceased were buried in separate grave pits, but in some cases, the skeletons were also placed in the fills of the large pit complexes. These examples were found in the southeastern row of houses. More than half of the graves were concentrated in the southwestern part of the settlement, in front of three adjacent houses (Fig. 2). The burial rite also corresponded to the early ALPC practice. Without exception, the skeletons lay on their left sides in a contracted position, and there were no artifacts in the graves. Unfortunately, the remains were in a very poor condition; in only seven graves, nearly complete skeletons were preserved, while in eight cases, the skull and long bones remained, in seven graves only the long bone fragments preserved, and one burial had only skull fragments.

Among the discovered phenomena, the wells are of particular importance, as they contain previously unknown equipment developed in the LBK-ALPC milieu. The internal structure of these features, which were 7.5-7.7 m deep, was not observable in detail. However, based on their size and their diameter (2.5-3.0 m), they can be identified as tubular wells (Király and Tóth 2015; Füzesi *et al.* 2015). The wells excavated in Bükkábrány were significant because of their location within the site. Two of them were discovered within the central axis of the settlement, dug 55 m apart in the empty, 50-m-wide space between the two rows of houses (Kalli and Tutkovics 2017, 6-7, fig. 4; Faragó *et al.* 2015). In a separate trench, a third installation was discovered on the southwestern outskirts of the settlement (Fig. 10). Wells became increasingly important sources of water in Neolithic communities, as well as in the internal layout of their settlements. Not only did well numbers increase, but so did the practices and rites associated with them (Hajdú 2007; Sebők *et al.* 2013). The Bükkábrány wells were located in the community space, indicating that they were used jointly.

The ceramic material discovered at the site demonstrates the characteristics of the early ALPC style: low and medium-high pedestals, bowls and pots with rectangular rims, simple geometric patterns, wide incised lines, filling with black painting, which rarely remained in Bükkábrány (Fig. 3-5; Domboróczki 1997; Kovács 2007; Nagy *et al.* 2014). Various clay figural representations were distinguished (Fig. 6-7): triangular-headed idols, animal figurines with square bodies, and so-called centaurs (embodying a combination of

Fig. 3. Early ALPC pottery from Bükkábrány-Bánya VII (selection)

Fig. 4. Early ALPC pottery from Bükkábrány-Bánya VII (selection)

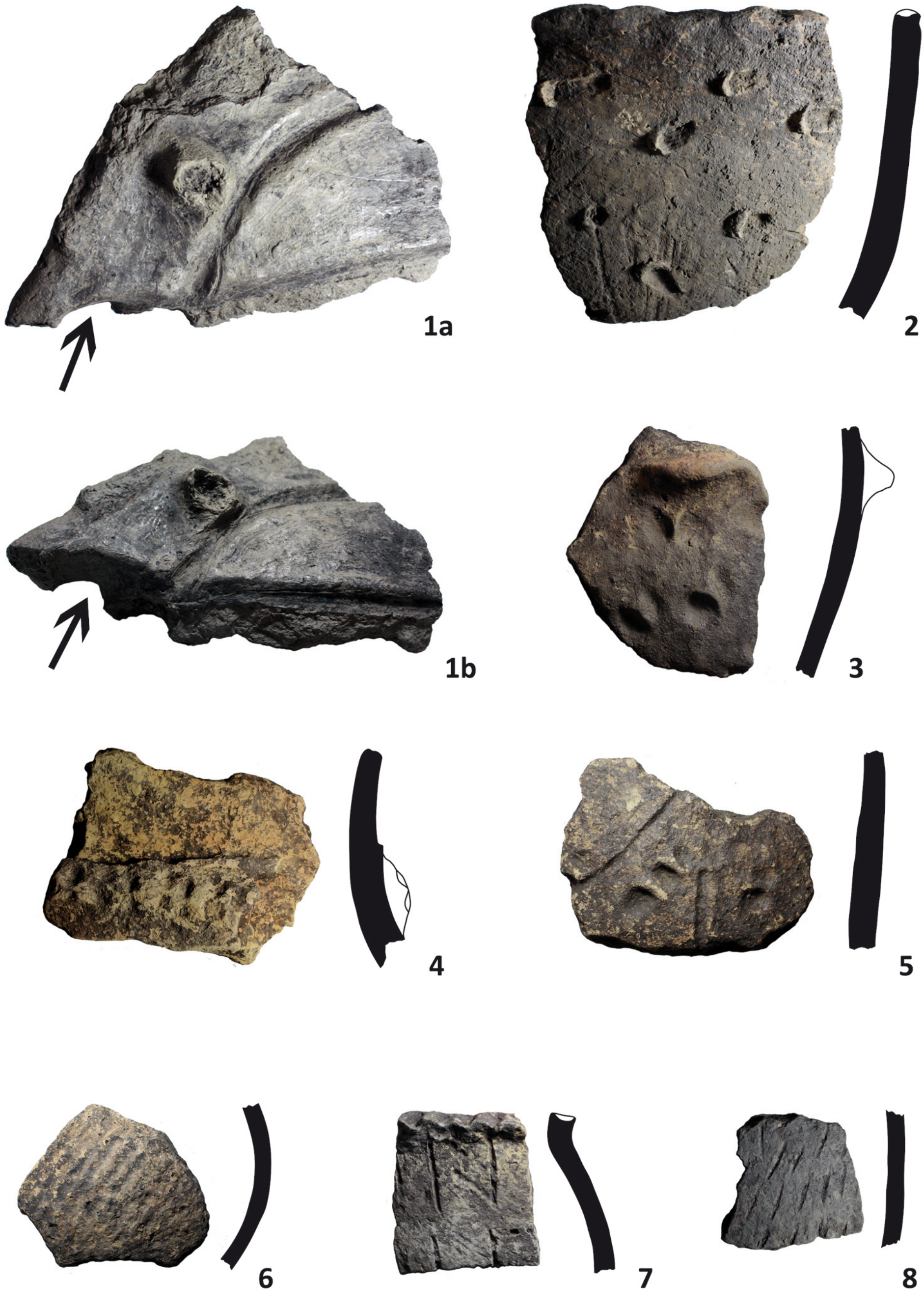

Fig. 5. Early ALPC pottery from Bükkábrány-Bánya VII (selection)

Fig. 6. Antropomorhic representations from Bükkábrány-Bánya VII (selection)

Fig. 7. Centaur figurines (1-2), curved clay objects (3-16), and clay beads (17-18) from Bükkábrány-Bánya VII (selection)

Table 1. ^{14}C data from Bükkábrány-Bánya VII

Sample ID	Sample	^{14}C age (yr BP) (±1σ)	Calibrated age (cal BC) (±2σ)
DeA-9195	BAVII 456	6312 ± 38	5370-5210
DeA-9196	BAVII 314	6302 ± 35	5350-5210
DeA-9534	BAVII 258	6378 ± 36	5470-5300
DeA-9535	BAVII 215	6209 ± 35	5300-5050
DeA-9536	BAVII 254	6249 ± 44	5320-5060
DeA-9197	BAVII 134D	6305 ± 35	5360-5210
DeA-9537	BAVII 20	6341 ± 35	5470-5220
DeA-9538	BAVII 208	6441 ± 36	5480-5340
DeA-9539	BAVII 134E	6318 ± 45	5470-5210
DeA-9543	BAVII 312	6291 ± 35	5340-5210
DeA-9198	BAVII 325	6340 ± 37	5470-5220

the two) made up a characteristic segment of early ALPC assemblages (Domboróczki 2005; Csengeri 2013). With the sites Füzesabony-Gubakút (hereinafter Füzesabony, Domboróczki 1999), Mezőkövesd-Mocsolyás (hereinafter Mezőkövesd, Kalicz and Koós 1997), and Hejőpapi-Szemétlerakó (hereinafter Hejőpapi; Domboróczki *et al.* 2017), the assemblage can be classified into the typochronological group of the early ALPC (ALPC1). We have 11 AMS dates from Bükkábrány that allow us to estimate its lifespan as 250-280 years, between 5470-5210 BC, though two outlier measurements move this period up to 5050 BC (Tab. 1). A significant portion of the dated samples were collected from the western third of the northern row of houses (Fig. 2), preventing us from conducting a more detailed intrasite analysis. As a result, for the time being, the archaeological record of the settlement can only be interpreted as imprints of long-term activities spanning 2.5-3 centuries.

The finding of a similarly built ALPC hamlet (Site XIA) approximately 240 meters east of Site VII added to the relevance of the phenomenon. In the Bükkábrány micro-region, essentially in the valley of the Csincse stream, the presence of two parallel rows of buildings facing each other, along with a well in the space between them, proved to be repeating elements (Kalli and Tutkovics 2017, 6-7, Fig. 5).

2. ANALYSES OF THE ARCHAEOLOGICAL ASSEMBLAGE OF BÜKKÁBRÁNY-BÁNYA VII

Although a large amount of material was excavated at the Bükkábrány site, only a partial analysis has been conducted for the time being due to the limited resources available. Nonetheless, a simple comparison of the frequency and weight of the find types produced results that can be used to better understand the internal structure of the settlements as well as the functioning of early ALPC communities. Salvage excavation methods did not allow for the detailed intra-site analysis that could be achieved with systematic find collection in sampling units, ideally per square meter and level. The reconstruction of the deposition process in a feature (Füzesi *et al.* 2020), as well as modeling the household activities based on the features around the buildings (Tóth *et al.* 2020), are important methods of archaeological induction. Thanks to the large scale of space and time, data recorded by closed features provide a less detailed, but more broad insight into the operation of a settlement.

For each type of find, data collection was simplified and finds were classified as ceramics, animal bones, chipped and polished stone tools, quern stones, and so on. We did not differentiate between the specific types that would be required for a more detailed analysis within these categories (*e.g.* fine and coarse ware in pottery). Because the archaeological material is still unrestored and the storage conditions have allowed for further fragmentation, the frequency data in all groups is a maximum value, which is what is available at the moment. We corrected this bias by collecting weight data. The evaluation also included measured values and ratios computed from the two base data sets. Aside from statistics, a series of GIS maps were created. The Kernel density method was used to generate distribution patterns from counted and weighed data.

The size of the assemblage is well presented by the 224,586 fragments of ceramics, weighing 4,851 kg. There is a large amount of daub (45,291 pieces, 1,420.0 kg), which is common in Neolithic sites. However, the extremely low proportion of animal bone material (5,698 pieces, 74 kg) is striking, particularly when compared to other Middle and Late Neolithic collections in Eastern Hungary (Bartosiewicz 2005, table 6.1; Bickle and Whittle 2013, 13-17; Raczky *et al.* 2015, 32-34, tab. 3-4; Füzesi *et al.* 2020, 152, fig. 9). This phenomenon can be explained by the high soil acidity of the microregion, which accelerates bone decay (Open acces data of pedology: AGROTOPO (mta-taki.hu/hu/keptar/agrotopo). The lithic collection includes 2,365 (16.0 kg) chipped stones, 169 (11.6 kg) polished stones, and a considerable number of quern stones (1,190 pieces, 377.0 kg). Unworked stones (437 pieces, 22.7 kg) were also discovered close to their sources. We observed a large number of other rocks (silicified wood) that community members experimented with among these raw materials, in addition to rocks suitable for grinding (Fig. 8; Faragó *et al.* 2015). Due to the acidic soils mentioned above, the number of bone tools (28 pieces, 398 g) and shell fragments (58 pieces, 217 g) was extremely low. Finally, ochre, a popular mineral pigment in the Neolithic period, was discovered in significant quantities (332 pieces, 9.8 kg).

Differences in the use and abandonment of each type of object are well presented by the number of features in which they appear. Almost all features contained ceramic (254) and daub (256) fragments. Less than half of the features yielded animal bones (96), chipped stones (123), and querns (98). Polished stone tools (51), unworked stones (60), and ochre (54) were found in less than a quarter of the features. Only a few cases of bone tools (7) and mussel shells (8) were registered in the discovered material. The hotspots in

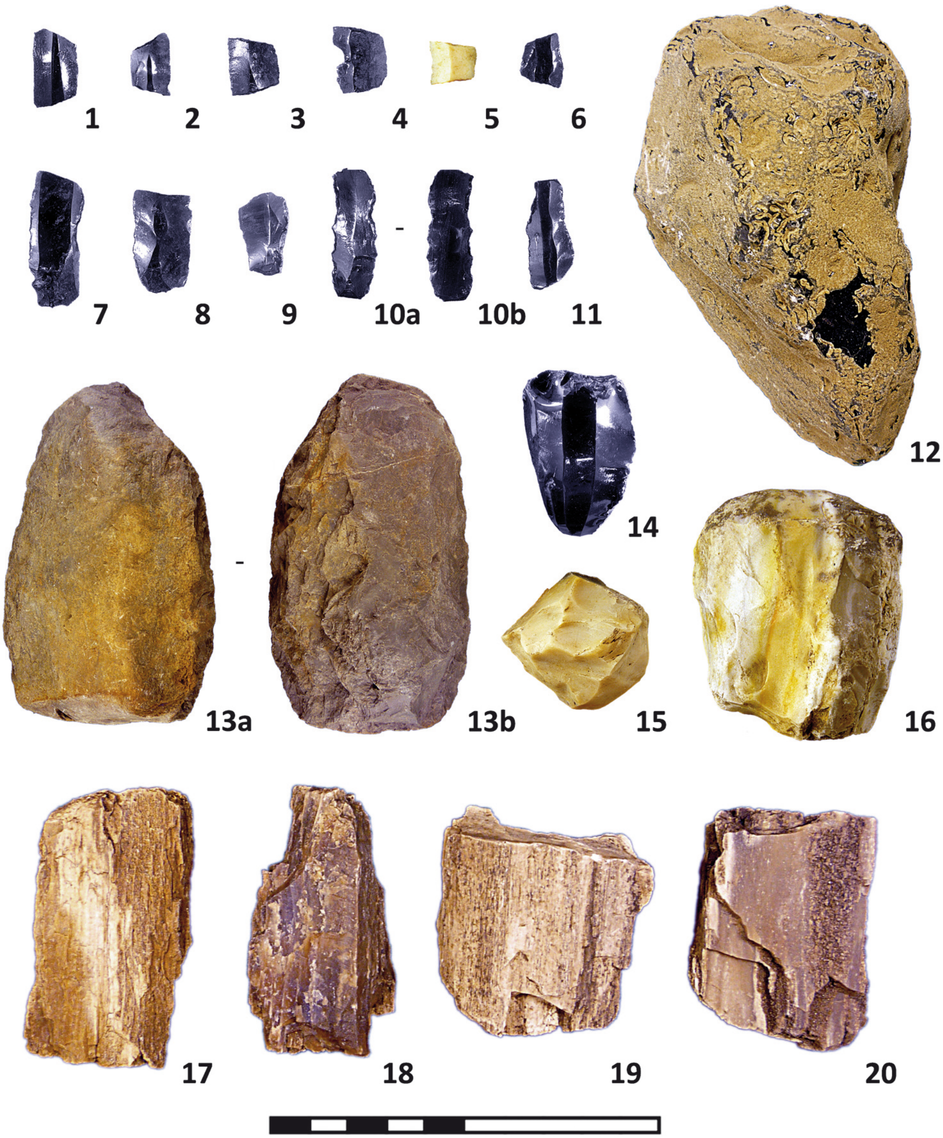

Fig. 8. Chipped stones (1-12, 14-16), preform of polished stone (13), and unworked stones (17-20) from Bükkábrány-Bánya VII (selection)

the settlement can be identified using spatial differentiation and frequency and weight data separately. However, based on the average weight per find, their ratio allows for the evaluation of the degree of fragmentation and characteristics of the deposited material, as well as the deposition process itself. Boxplots (Fig. 9), which show the median and outlier

	Pottery	Daub	Animal bone	Chipped st.	Polished st.	Quern stone	Bone tool	Mussel	Ochre	Unworked st.
N	254	256	96	123	51	98	7	8	54	60
Min	0.6111111	0.3333333	0.2666667	0.6666667	2	2	1	1	0.5	3
Max	179.5547	569.009	38	44	721	4035	52	7	109.2	980
Sum	4142.732	7688.267	744.6933	871.9142	4724.783	38104.09	111.9432	31.91504	1744.439	4894.442
Mean	15.57418	29.12222	7.160512	6.506823	85.90515	362.8961	15.99188	3.98938	29.07398	76.47566
Std. error	0.9766962	3.657387	0.7225543	0.5847883	17.25421	51.2264	6.406509	0.8417728	4.782596	18.50939
Variance	253.7468	3531.391	54.29681	45.82496	16373.93	275535.1	287.3035	5.668651	1372.393	21926.23
Stand. dev	15.92943	59.42551	7.368637	6.769414	127.9607	524.9144	16.95003	2.380893	37.04583	148.0751
Median	13.42256	11.60865	5.112245	4.920455	44	224.2857	10.125	4	16	25.77381
25 prcntil	6	2.45	1.666667	2.766667	20.8	101.5571	6	1.696023	8.0375	12.375
75 prcntil	20.499	30.80342	10	7.628632	100	475	17.81818	6.285714	35.33333	62.78125
Skewness	5.38592	5.403594	1.9139	3.220886	3.605338	4.735645	1.993965	0.003160113	2.67429	4.282827
Kurtosis	46.9856	36.83076	4.563488	13.01384	14.91249	28.18773	4.476219	-2.093329	7.978825	22.48063
Geom. mean	10.80191	9.389071	4.19785	4.596544	43.06942	191.9387	9.625465	3.250785	15.40136	30.77967
Coeff. var	102.281	204.0555	102.9066	104.0356	148.9557	144.6459	105.9915	59.68077	127.4192	193.6238

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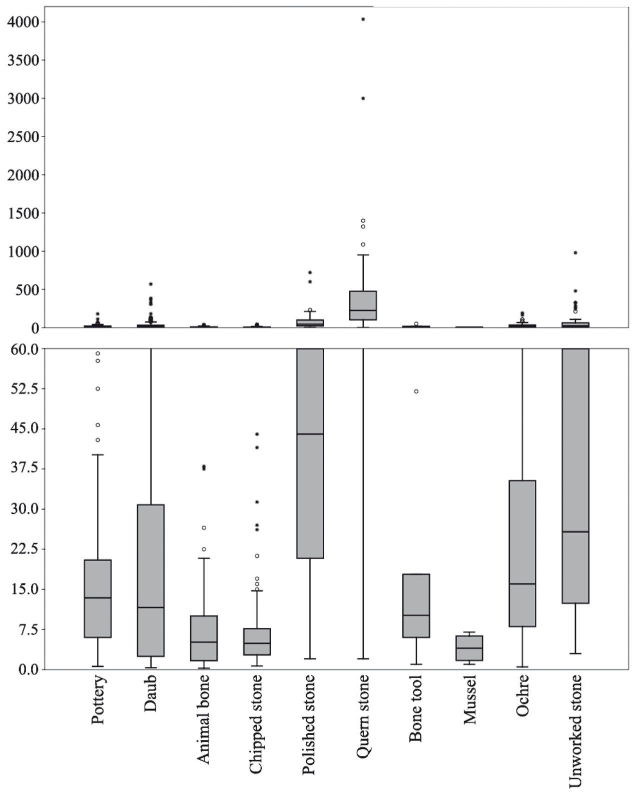

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Fig. 9. The ratio of weight and frequency by different find types: univariate statistics (1), and boxplot graph (2)

values, among other details, were used to evaluate these data sets for all ten find categories. The ratio indicates the degree of fragmentation, implying the activities in which the objects were involved. Besides the obvious results (median weight is the highest among quern stones, 224.0 g), finer details were revealed. The median is higher for ceramics (13.4 g) than for daub fragments (11.6 g), *i.e.* the rubble of the buildings were not treated according to later Neolithic practice (creating a new context by depositing the remains), but they accumulated naturally in the features, during a long weathering process. Daub fragments found in several postholes indicate the same. The plunging values of animal bones, bone tools, and shells (5.1, 10.1, and 4.0 g respectively) confirmed the already mentioned strong taphonomic loss. The median of unworked stone (25.7 g) falls between the values of chipped and polished stones (4.9 and 44.0 g), far below the median of the quern stones, referring back to the knapping attempts with the Zemplén silicified wood. Outliers on the boxplots could represent hotspots for specific types of deposition. The boxplots showed extreme values in various zones of settlement, and these are not always identical with segments that are significant in terms of weight or frequency.

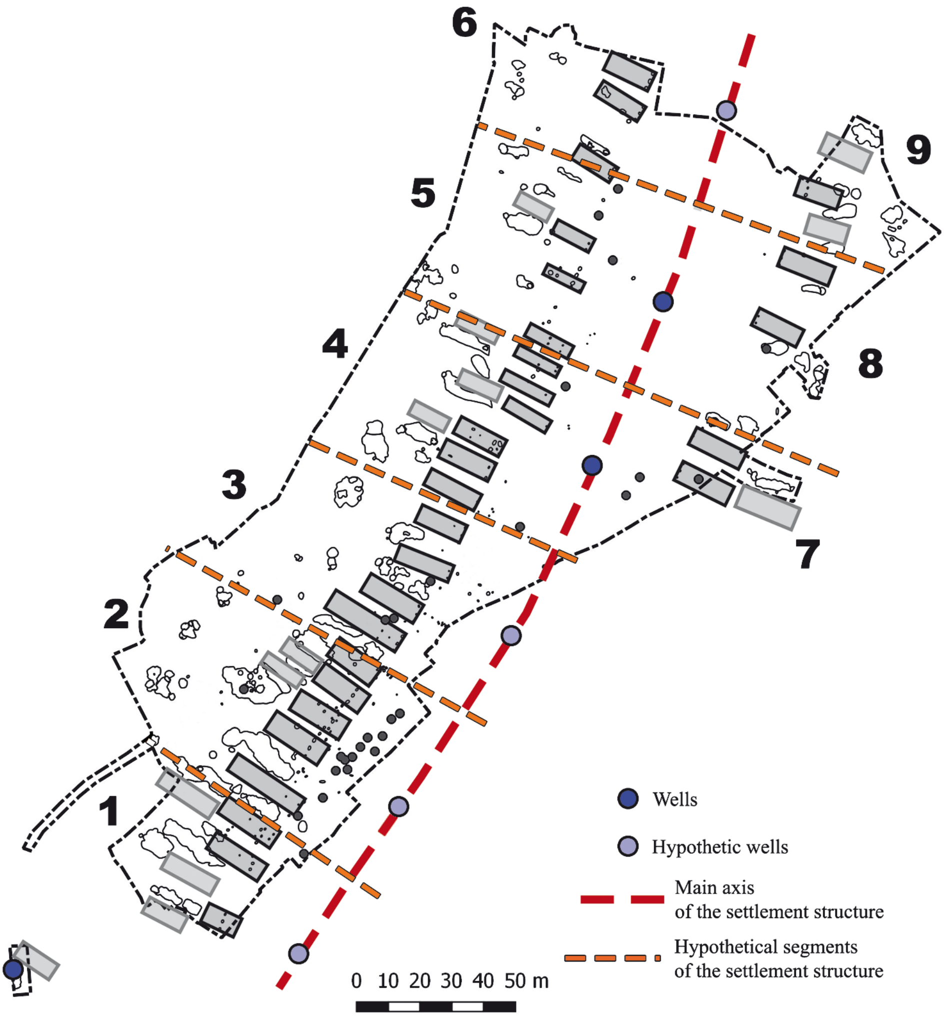

Fig. 10. The intrasite analyses of the settlement structure in Bükkábrány-Bánya VII – 1-9 spatial units based on the main structural elements

Bill Hillier interpreted space as the result of the interaction of social actors and physical phenomena, strengthening the link between structure and process even further (Hillier 2007). This approach and associated aspects of research, such as differentiated spaces, paths between them, and the degree of spatial integration, are well suited to archaeological studies. The central space is the most important access path in the early ALPC settlement of Bükkábrány, and the row of wells can be identified as important locations. For further site analysis, our hypothesis assumed that the spatial arrangement of the individual elements in the regular settlement structure was also consistent. Despite working with a limited data set, we set up a row of wells on the central axis at a distance of 55 m apart, and based on these nodes, we divided the settlement area into equal-sized segments (Fig. 10). While the "staging area" and the wells were the physical focal points of the settlement, the existence of a central organizing principle allowed for the metaphysical permanence of this structure. Structure and process were linked in the establishment of these settlements, so these two approaches can be used together in our reconstruction: spatial segments delimited by settlement structure and processes reconstructed by finds.

3. TRENDS IN DEPOSITIONAL PRACTICES – HOTSPOTS IN THE SETTLEMENT

The spatial relations of the data taken from the ten find types present a relatively diverse picture of the settlement and its activity patterns. The rarity of bones and similar materials can be explained by the previously mentioned acidic medium. The frequencies of the other finds were determined by the former significance of the given object type and the intrasite spatiality of the related activities.

As a raw material for construction and pottery, clay played a fundamental and versatile role in the functioning of households in South-Eastern Europe and the Carpathian Basin (Bánffy 2019, 134). A waste management process covering the entire settlement area can be reconstructed using ceramic material and the remains of destroyed houses (Fig. 11: 1, 2). The finds of the second examined group revealed special functions and activities that, despite their rarity, played an important role in the community's life. Quern stones were used to crush grain for food, but they were also used to make bone tools and to pulverize ochre paint (Kaczanowska *et al.* 2016; Řidký *et al.* 2014). Chipped stones indicate lithic tool production areas or have been used as tools for a variety of purposes. These two types of finds are distributed in the same way that ceramics are. Polished stone axes have become important tools in the creation of various constructions such as buildings, in addition to working hard organic materials (wood, animal bone, *etc.*) (Weiner 2013, 832). Based on specific contexts (*e.g.* burials) and symbolic representations (*e.g.* the "Axe God" of Szegvár-Tűzköves), this artifact type served as an important sign in material culture communication (Makkay 2005; Ilon 2009; Hedges *et al.* 2013, 377-380; Siklósi 2013, 230-232; Zsiga-

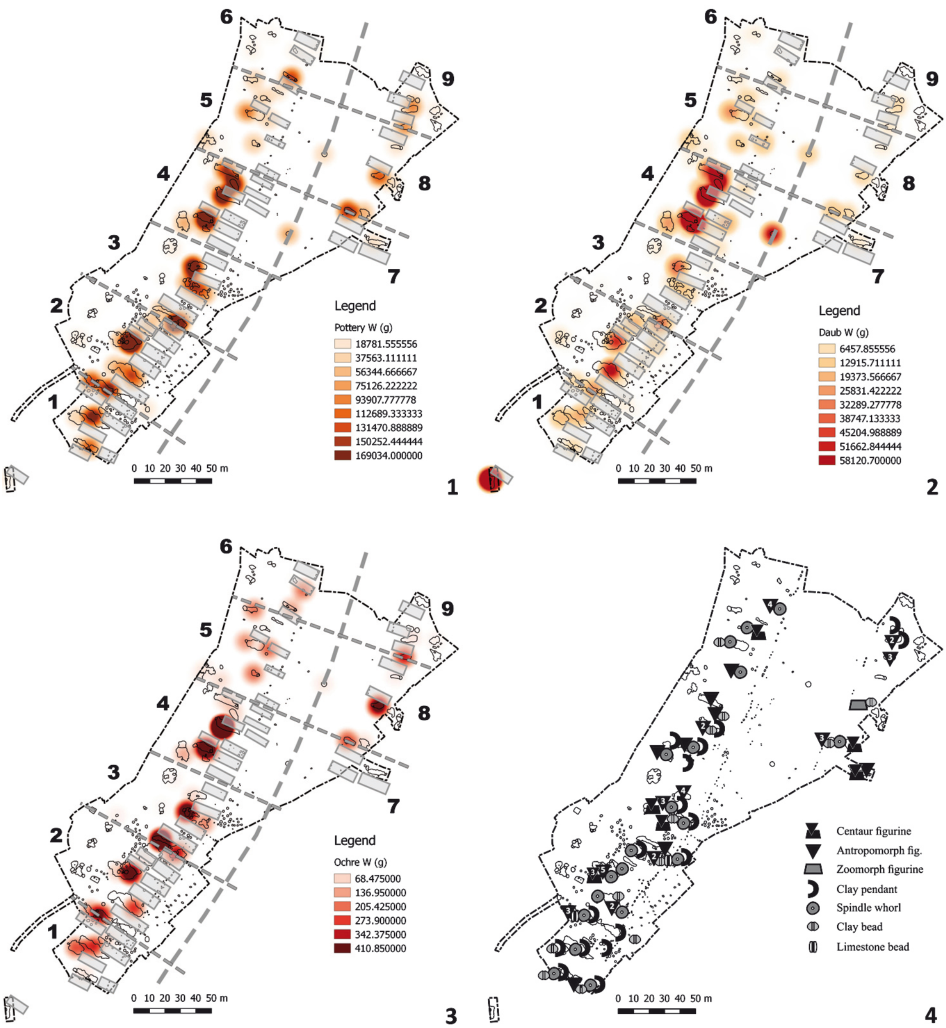

Fig. 11. Distribution patterns of the archaeological record: pottery (1), daub (2), ochre (3), and special artefcats (4) – Kernel density (1–3) fitted to spatial units

Csoltkó *et al.* 2021, fig. 24.2). The majority of unworked stones were made from a unique raw material (silicified wood) that possibly originated in the Zemplín Mountains. Members of this community experimented with this raw material based on lithic shatter, but the lack of finished stone tools or other secondary treatment (retouch) proved them unsuccessful (Faragó *et al.* 2015, 29-30). Bone tools served a variety of functions in Neolithic activities (Raczky *et al.* 2015, 35-39), and mussels as a source of protein and raw material for lime is a relatively common occurrence in Neolithic deposits in Eastern Hungary

(Gulyás *et al.* 2007; Füzesi *et al.* 2020). As a pigment (and a component of the Neolithic burial rite), ochre also had a strong symbolic meaning, which was evidenced by its use with anthropomorphic objects and decorated vessels (Borić 2015; Bánffy 2017).

The spatial distribution of diverse archaeological materials (Figs. 11-13) can be used to support complex interpretations. First, we must locate the depositional hotspots in each category of material. There are three different sorts of distribution patterns that might be related to specific discoveries. The first type of distribution was discovered throughout the village; however, it was concentrated most heavily in the northern house row. This was the situation for pottery, polished stones, and chipped stones. The second type exhibited considerably more spatial variance, being significantly present only in a few long pits, and the spatial distributions demonstrated some kind of exclusivity. The data from quern stones, unworked stones, daub, and ochre formed such concentrated and diverse patterns. Animal bones, bone tools, and mussels made up the third category of material, which had undergone considerable taphonomic losses. They concentrated on certain settlement points in both the northern and southern home rows.

Further analyses of the first and third categories were unable to give useful information about intrasite practices. The former was widely used, whereas the latter was significantly modified, *i.e.* taphonomically damaged. The strong connections between specific finds of the third category, on the other hand, confirmed the taphonomic effect of acidic soil, which may be indirect evidence of different spatially separated activities (Yerkes *et al.* 2007). The scatter patterns in the second category served as a jumping-off point for further research. The quern stones were concentrated in the southern part of the northern house row and along the northern edge of the second row. In terms of spatial units, this refers to Segments 1-4 and 9. The unworked, natural stones displayed an opposing pattern, concentrating on the southern house row and the northern portion of the second row (Segments 5, 8, and 9). We can infer from this that certain (spatially or temporally distinct) groups of the community placed a higher priority on experimenting with the new lithic raw material and incorporating it into the spectrum of usable resources (Mester 2013). The presence of daub fragments was significant only in five long pits and in well no. 366. This means that this find was concentrated in the middle of the northern row, especially in segment 4, and in the distinct trench. The ochre distribution is partly similar to that of quern stone (concentrations in Segments 2-4, and 8).

We can summarize the distribution patterns by using spatial units as interpretative frames. Segment 4, in the center of the excavated area, had been a prominent, intense activity zone encompassing nearly the entire investigated spectrum. Ceramics, daub, ochre, chipped stones, and querns were the dominant finds in the northern house-row, with less and less intensity following to the southwest (segments 1-3). In contrast, the northeastern row (segments 5-6) and the southern row (segments 7-9) had different compositions and frequencies. Chipped, polished, and unworked stones were abundant in segments 5 and 6. Aside from a large number of quern fragments in segment 9, the southern row of houses

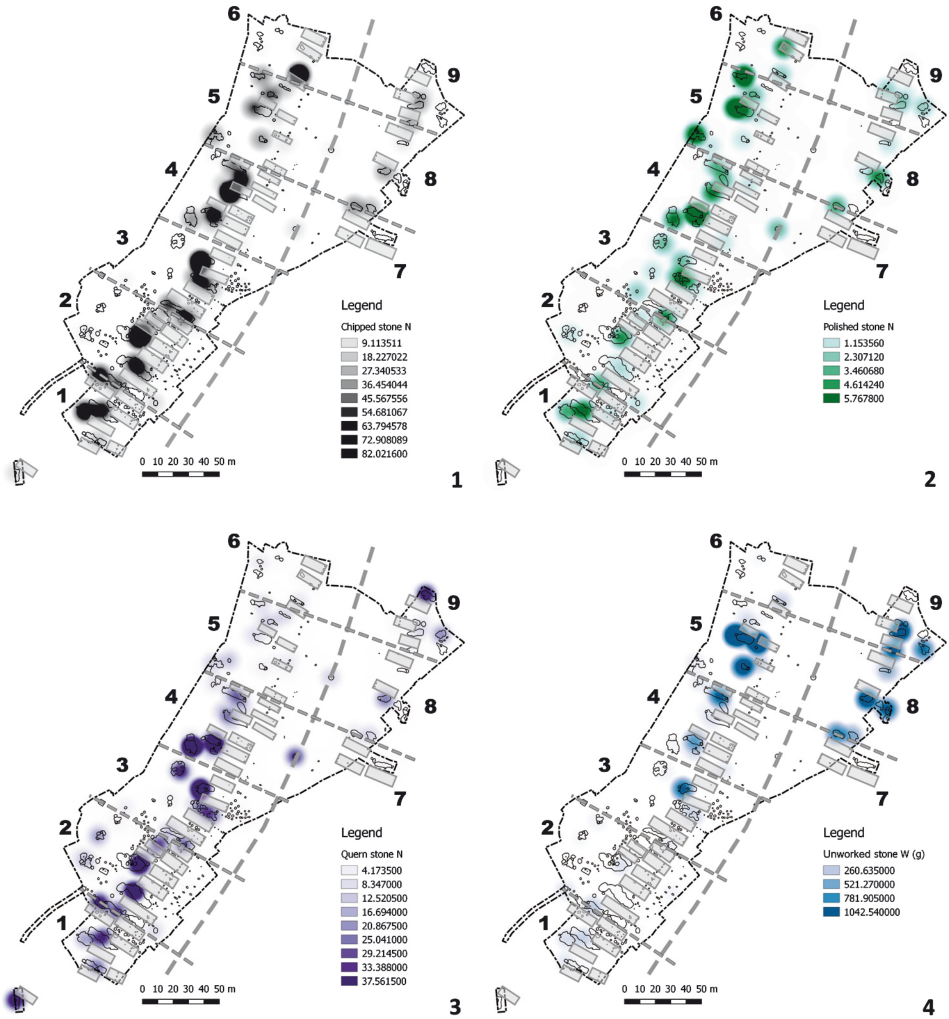

Fig. 12. Distribution patterns of the archaeological record: chipped stone (1), polished stone (2), quern stone (3), and unworked stone (4) – Kernel density fitted to spatial units

yielded mostly unworked stones, indicating local attempts at innovation. Bone tools were also found in a disproportionate amount here (segments 6, 7, and 8).

The most notable of these patterns is the attempt to use silicified wood as a lithic raw material, which sharply divides the settlement into a south-east and a north-east section (Fig. 12: 4). This division is also visible in the distribution of ochre, which, as a raw material of symbolic significance, is most likely the residue of a traditional habitus, contrary to the previous, innovative attitude (Fig. 11: 3). The two patterns fit well together. In practice, the data of chipped stones can be compared to the data of unworked stones shattered by strong blows, if the latter is interpreted as an attempt to replace the former. Even in segment 6, where the incidence of the former is low and the latter is high, the data on chipped and unworked stones (Fig. 12: 1, 4) perfectly balance each other. More types of finds could be associated with the concept pairs of the practical (chipped stone, unworked stone) and the symbolic (ochre), as well as tradition (chipped stone, ochre) and innovation (unworked stone). Adding to this, our spatial observations suggest that the northern half of the settlement preferred innovation, while the southern half preferred tradition in its various practices.

Special artifact types, which are usually considered symbolic and have always received a lot of attention in archaeology, are also suitable for studying the differences between the two parts of the settlement. Anthropomorphic and zoomorphic objects (49 pieces, Fig. 6-7) stand out among the material of the Bükkábrány site. Their distribution (Fig. 11: 4) is fairly even, with centaurs concentrated in the southwestern half of the area (segments 2-3). Anthropomorphic figurines were also found in greater numbers in these segments. Only in segment 8 did a zoomorphic fragment appear. A relatively large number of fragments of curved clay objects (37 pieces) with one end drilled (4 pieces) were found (Fig. 7). These curved artifacts were typically discovered as fragments smaller than 5 cm in length, with missing ends. Based on the drilled specimens, we can identify them as clay pendants, which are similar in shape and size to boar tusk pendants. We can interpret them as clay replicas of these popular late Neolithic grave goods (see *Spondylus* pendant imitations, Siklósi 2013, 228-229), or as symbolic artifacts made of clay and, later, wild boar tusk. The distribution pattern of these objects (Fig. 11: 4) is similar to that of ochre, but it also fits well with the chipped, quern, and unworked stone trend.

The trends described do not imply that particular find types and related activities were absent from the given segment and, thus, from the operation of the group assigned to that segment. The aggregated material residues of short-term actions reveal long-term trends, qualitative differences between activity zones, and strategic differences in the groups' subsistence in each segment. These are the results of the settlement's long-term operation, and the differences were caused by different intra-site groups preferring different activities. The density distribution fits well to the spatial units of the settlement in certain cases (segment 4 in almost all cases), but the rigid geometry of the boundaries would have to be modified elsewhere (separation of segments 7 and 8). Of course, we did not intend to demarcate actual household units, but rather to investigate whether the organizing principles recognized in the settlement structure were related to the activities indicated by the material, *i.e.*, whether the structures demonstrably influenced the processes.

Outliers in boxplots (Fig. 9, 13: 4) can be used to detect diverse depositional practices, particularly deliberate operations, in addition to highlighting remarkable degrees in fragmentation. While daub fragments were concentrated in segments 1-4, the size of the fragments in the opposite half of the settlement (segments 4-9) was much bigger. Many large daub fragments were discovered in segment 4 at the intersection of these zones, indicating

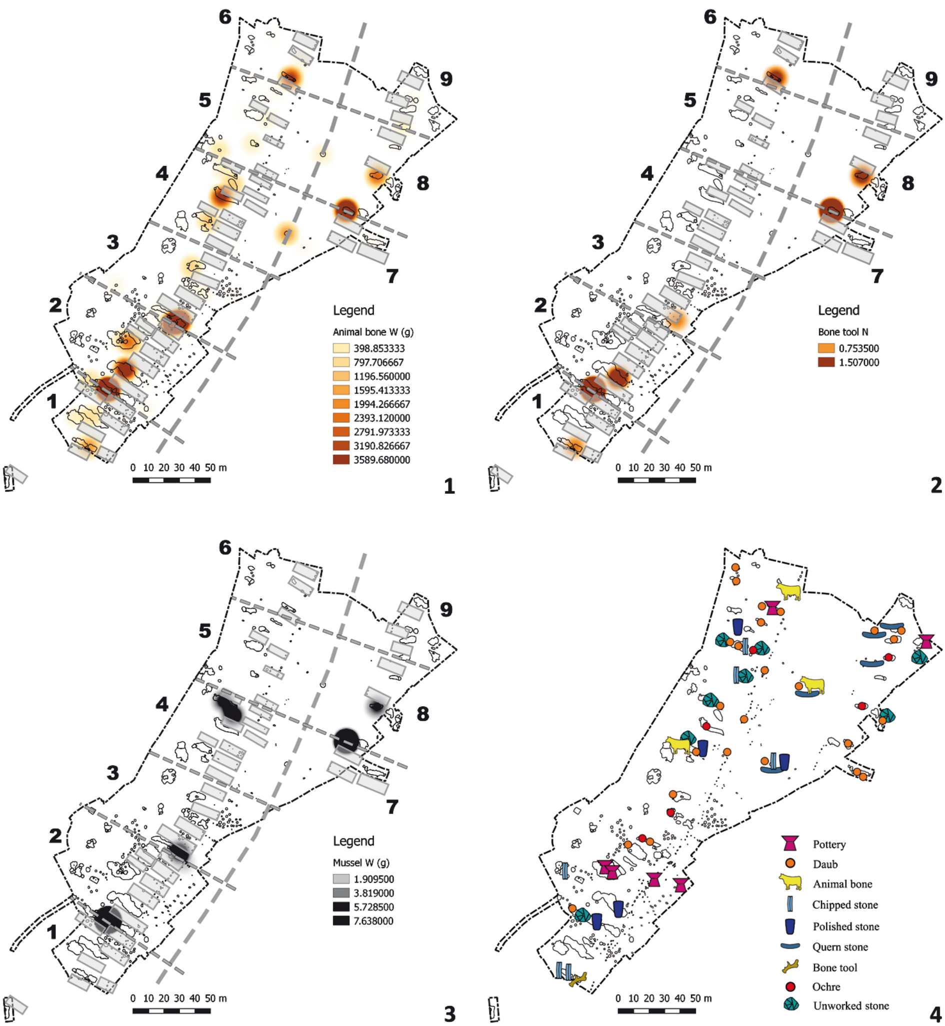

Fig. 13. Distribution patterns of the archaeological record: animal bone (1), bone tool (2), mussel (3) – Kernel density fitted to spatial units. (4) Special depositional locations identified by fragmentation of different archaeological materials (different icons show the outliers of the ratio of weight and frequency)

deposition immediately after destruction. The majority of the dwellings did not burn, and the daub portions that did slowly burn were heated in additional locations. Although the fire had a significant role in the settlement's northern reaches, deposited dwelling remains were only discovered in segment 4. Even though purposeful deposition of house ruins in ALPC long pits was rare (Csengeri 2013, 92, Fig. 1; Füzesi 2016, Fig. 13), it was a common practice in early ALPC societies. In the Late Neolithic, the Bükkábrány assemblages marked a transition between spontaneous disintegration or site formation and purposeful house-burning or ritual.

Aside from the main depositional locations, such as long pits, special features may be of interest in boxplot analyses. Significant ceramic fragment accumulation was observed in segment 2, where features such as a long pit, a burial, and a post-hole were affected. A long pit and a post-hole are responsible for the concentration of ceramics in segments 6 and 9. The 2-3 larger ceramic fragments, without matching edges, that were placed in the post-holes may be assigned a stabilizing, supporting role during the period of post erection, rather than a symbolic role, *e.g.* the founding rite (Russell *et al.* 2009). Extreme values of weight were also obtained from post-hole 497, where two nearly intact quern stones were deposited. Similarly, a 1.4 kg fragment of quern stone was discovered in one of the post-holes of the adjacent building (no. 465). The above-mentioned practical, stabilizing role is conceivable in these cases, but the strong symbolic meaning of querns and an associated founding rite cannot be ruled out (Faragó 2019, 314). In both LBK and ALPC cultural contexts, the deposition of querns is an activity that combines practicality and symbolism (Beneš *et al.* 2015; Hamon 2020; Kaczanowska *et al.* 2016).

The main focus of the intrasite activities was the production of various tools. The different stones in the examined find types can be used to evaluate the spatiality of the production process. Chipped stone outliers indicate large cores that have not been exhausted. The presence of moderately reduced cores suggested on-site tool production (Faragó 2019), which was hypothesized for segments 1, 2, and 5, where knapping activity can be detected in the deposition practices. Polished stone tools were maid locally, as evidenced by preforms (Fig. 8: 13) and the fact that the majority of these finds are small fragments (median weight 44.0 g). Outliers, however, testify that larger, damaged tools were also deposited in some cases. The presence of the latter in segments 1, 2, 4, and 5 corresponds to the presence of chipped and unworked stone outliers, implying intensive lithic production and curation in these zones. In segments 1-2, we presume a more traditional industry, and in segment 5, we consider a more innovative industry.

The wells are outstanding objects from the settlement structure, therefore their finds deserve special attention. The material recovered from the two centrally located wells adds to our understanding of the depositional practices in Bükkábrány. In these features, a significant number of finds (total weight 53.0 kg and 168.0 kg) were discovered. The find quantity and stratigraphy indicate intentional deposition; additionally, object fragmentation data indicate deliberate practice in addition to active waste management. Unfortunately, we lack detailed information (which object came from what depth, for example), but the section drawings show an abundance of extremely large daub fragments in the upper 2.5 m of the fill in both wells. A significant amount of quern stones accumulated in the wells, 10 and 32 fragments weighing 13.2 and 34.8 kg, respectively. Aside from the quern stones and daub, above-average sizes were found among the animal bones in well no. 363, as well as among the chipped and polished stones in feature no. 366. Objects of this size were found infrequently, but in both cases, ceramics, which make up a significant portion of the finds, were much less fragmented than average, even though they did not qualify as outliers. In the absence of a thorough examination, the ceramic assemblage discovered shortly after disuse cannot be linked to a community feast or interpreted as a set belonging to one or more households. Although there are only a few Neolithic wells in North-Eastern Hungary, the intention to create a structured deposit can be seen in several cases (Hajdú 2007; Sebők *et al.* 2013; Füzesi 2016). The details of these Middle Neolithic initiatives, which took place in a single micro-region, complement each other to form a rite with simple choreography.

There was no evidence for such rites in Bükkábrány, but based on the deposition pattern of the wells excavated there, we can conclude that the possibility of a later phenomenon exists in this case. The practice of the increasingly intense heat effect, as well as the cleaning and disposal of the house remains, can be identified as the very early antecedents of the complex rite of deliberate house burning. Similarly, we can consider the large number and variety of finds placed in wells as a precursor to later structured deposits. Late Neolithic ritual practices can be traced back to the very beginning of the developmental series, to the peculiarities identified in Bükkábrány.

4. EARLY ALPC COMMUNITIES AT THE FOOTHILLS OF THE NORTH HUNGARIAN MOUNTAINS

As early as the beginning of the 20th century, Ferenc Tompa had outlined the cultural milieu of the *Linearbandkeramik*, whose basic internal chronological and regional groups were identified later, in the 1970s (Tompa 1929; Kalicz and Makkay 1977). Only then did research become significant on the early ALPC, the first agricultural communities to settle in the northern Great Hungarian Plain (Raczky 1983; Nagy 1998). Intensive fieldwork during the 1990s revealed a coherent settlement network in the region (Fig. 14). The sites that have been identified thus far can be divided into two groups based on their habitat preferences: lowland floodplain environments and higher-lying foothills and river valleys. Communities along the Tisza River encountered an environment similar to the southern habitats of the Körös culture. As a continuation of the Bodrogköz and Rétköz, the Eastern Slovak Lowland had a slightly different but still water-rich environment. On the other hand, some communities have gone far beyond the Körös-culture comfort zone (Kosse 1979). Early ALPC sites in the piedmont zone of the North Hungarian Mountains, and even further upland along larger streams, attest to their adaptation to the local conditions.

More early ALPC sites at the foothills of the North Hungarian Mountains have been discovered in the last three decades: Füzesabony-Gubakút (Domboróczki 1999), Mezőkövesd-Mocsolyás (Kalicz and Koós 1997), Bükkábrány-Bánya VII (Kalli and Tutkovics 2016), and Hejőpapi-Szemétlerakó (Domboróczki *et al.* 2017). These sites enriched our understanding

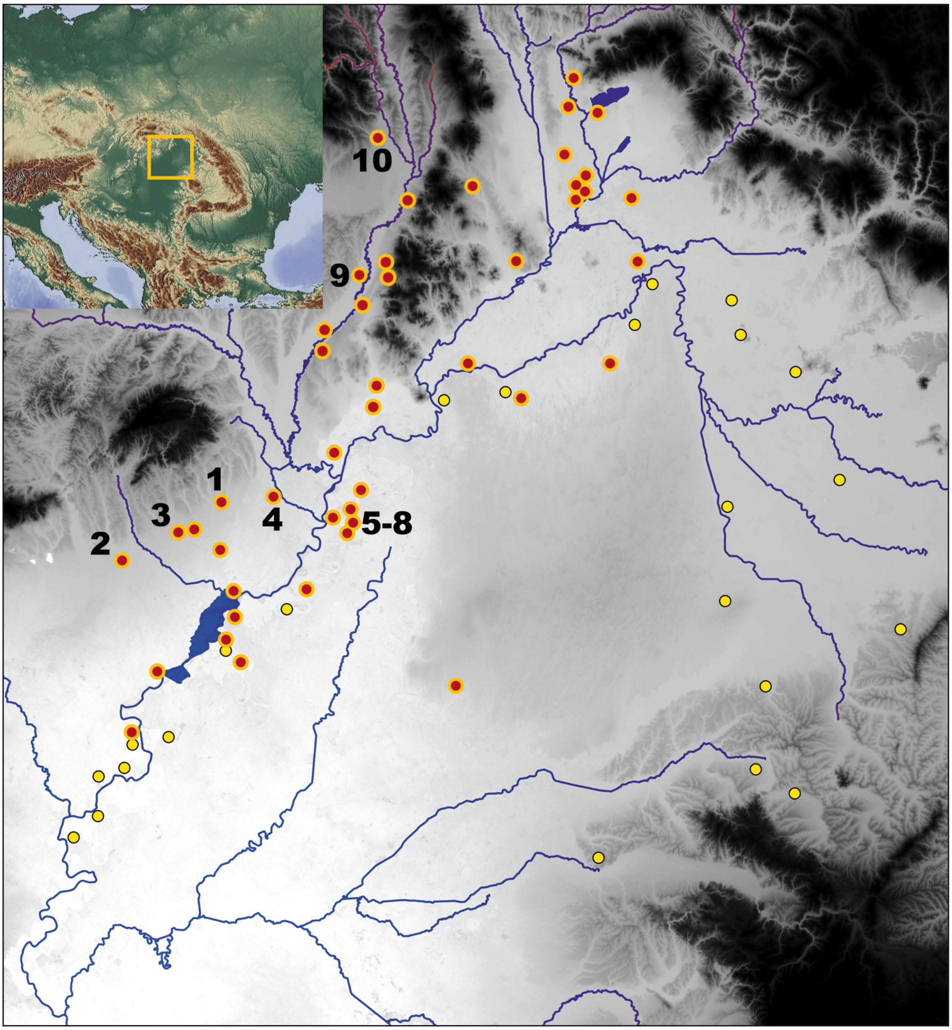

Fig. 14. The early ALPC settlement network in Northeast Hungary (based on Kozłowski 1997; Nagy 1998; Kovács 2007; Csengeri 2018) – yellow dots: Körös sites, red dots: early ALPC sites, 1. Bükkábrány-Bánya VII, 2. Füzesabony-Gubakút, 3. Mezőkövesd-Mocsolyás, 4. Hejőpapi-Szemétlerakó, 5-8. sites in Polgár microregion, 9. Novajidrány, 10. Košice-Červený rak

of the Middle Neolithic period not only due to their specific geographical location. Large-scale excavations there revealed contiguous settlement sections that fundamentally changed our perception of early Linear Pottery communities (Domboróczki 2009; Domboróczki *et al.* 2017). Füzesabony, Mezőkövesd, Hejőpapi, and the previously studied Bükkábrány early ALPC settlements formed a single settlement network in the foothill area of the North Hungarian Mountains, 15 km apart. Except for Mezőkövesd, which we will return to, the internal structures of these settlements are remarkably similar.

The unfortunate lack of comparable large-scale excavations in other micro-regions makes reconstruction of contiguous and complete settlement structures difficult. The Eötvös Loránd University conducted field research on a similar scale in the Polgár microregion. Early ALPC settlements excavated at Polgár-Ferencihát Site 31 (Raczky and Anders 2018, Fig. 1), Polgár-Király-érpart Site 1 (Nagy 1998; Raczky and Anders 2012, 274), and Polgár-Piócási-dűlő (Nagy *et al.* 2014) has demonstrated sparsely scattered settlement structures. The same situation occurred on the approximately 1.5 ha Tiszalúc-Sarkad site (Oravecz 1997, 93, Fig. 1). Piroska Csengeri's regional research investigated the early ALPC settlement network, of which Novajidrány is one of the most promising locations in the Hernád Valley (Csengeri 2018). As a result, for the time being, the similarity of settlements in the piedmont zone can be interpreted as a regional phenomenon. However, the most recent discovery in the Hernád Valley settlement group was Novajidrány-Szőlőalja II (Zsiga-Csoltkó 2021), another early ALPC settlement with a linear structure.

László Domboróczki proposed the *Füzesabony-Gubakút Settlement Development Model* (hereinafter FGSDM) at the foothills of the North Hungarian Mountains based on his research in the Füzesabony area, supplemented with the results of complementary excavations. Despite its initial shortcomings, the model fits well into the LBK settlement network and settlement structure transformations (Domboróczki 2009; Domboróczki *et al.* 2017). László Domboróczki excavated traces of characteristic (5-6 m wide, 12-16 m long) timber-framed buildings at the Füzesabony site and reconstructed a special settlement structure based on long pits, burials, and other features (Domboróczki 2009). His results solved the scientific debate over pithouses versus pile-dwellings. In the early 1990s, Nándor Kalicz and Judit Koós conducted a rescue excavation at another iconic site, Mezőkövesd, about 15 kilometers to the east, where they discovered debris from burned houses. Long pits, graves, a well, and other features were found in the vicinity of the closely spaced buildings (Kalicz and Koós 2014). The surveyed section at Mezkövesd appeared to represent a different type of settlement. The remains of burned houses were linked to Körös culture settlements in the Middle Tisza region (Szajol-Felsőföld, Szolnok-Szanda, Raczky 2012). Excavations were conducted at the Hejőpapi site between 2008 and 2010, over nearly 4 ha and covering approximately 90% of an early ALPC settlement, the largest and most complete known to date. Even though only the alignment of a few postholes and long pits per building indicated the houses, which were arranged in two rows, the site added a lot of detail to the previous picture. Burials were located in front of the buildings, while a 40-meter-wide, 200-meter-long empty area, presumably a communal space, unfolded between the two rows of houses. On top of that, a well was discovered in the center of that area (Domboróczki *et al.* 2017, 9, fig. 5).

5. LINEAR POTTERY SETTLEMENTS AND THEIR FOCI

Longhouses are still the defining elements of Neolithic intrasite analyses. Houses and their associated features served as structural units (*Hofplatz*: Boelicke 1982, *Household*: Wilk and Rathje 1982), from which the research sought to decipher Neolithic settlement structures and everyday life within. The courtyard model (*Hofplatzmodell*: Boelicke *et al.* 1988) and the row settlement model (*Zeilensiedlungmodell*: Rück 2012) were also focused on these aims and units. While archaeologists sought to resolve the contradictions of these models a decade ago (Lenneis 2012; Link 2012; Zimmermann 2012), recent research has gone beyond this discussion by incorporating three principles: complex and interdisciplinary research, contextualized interpretation, and examination of higher-level organizational principles (see Wunderlich *et al.* 2020). The case studies that were thoroughly examined confirmed the significance of regional differences and the need for adaptable models to account for them (Oross et al. 2016, 140). Several structural elements gained prominence, such as the role of empty spaces (Rück 2009, 163, 164, Fig. 5), which had not been considered by either the courtyard or house-row models. Although the pit-house concept has been established in Hungarian research for much longer than in international research (Makkay 1982; Domboróczki 1997), recent large-scale excavations and studies in Hungary have been able to be integrated into current settlement archaeology (Domboróczki 2009; Jakucs *et al.* 2018). These case studies not only added to the regional diversity but also broadened the scope of the analysis. With these in mind, we can appreciate and interpret the Bükkábrány settlement structure and assemblage.

The details of these sites have changed our understanding of early ALPC row settlements in northeastern Hungary (Domboróczki *et al.* 2017). The available data suggest that settlement structures have more complex arrangements than axial symmetry. Two double rows of houses were arranged in axial symmetry at the Füzesabony site, while the fifth row of houses, identified by László Domboróczki through the surface collection, was perpendicular to the previous ones and stood alone on the other, northeastern bank of the brook (Domboróczki *et al.* 2017, fig. 3). In Hejőpapi, the postholes of the northeastern row of houses were arranged towards the outer, not the inner side, and the long pits of the third row of houses can also be seen on the site map (Domboróczki *et al.* 2017, fig. 5).

The serial arrangement in axial symmetry is a dominant feature of these early settlements, but it is not the only one. Unlike the examples of the Western and Central European LBK, each of the cases mentioned is a settlement with non-overlapping structures and a centrally located, extremely large empty area. That 40-50-meter-wide zone usually runs between two rows of houses. The Füzesabony and Mezkövesd sites were excavated using a unique hybrid method: the affected area was surveyed with sondages, and the excavation expanded from these trenches until archaeological features were reached and included in the work area (Domboróczki 1999, fig. 1; Kalicz and Koós 2014, pl. 2). As a result, previous interpretations of settlement phenomena exclusively identified courtyards and rows of houses known from German models as defining settlement phenomena. In contrast, full-surface topsoil removal in Hejőpapi and Bükkábrány revealed an empty central area, 40-50 meters wide on average, with wells along its axis. Following these results, a closer examination of other early ALPC settlements in Northeast Hungary reveals structural similarities, such as an empty zone in Füzesabony (Domboróczki 1999, fig. 1) and a well in front of the row of houses and graves in Mezőkövesd (Kalicz and Koós 2014, pl. 2). A well was discovered further away from the row of houses indicated by long pits and associated graves at the Polgár-Piócási-dűlő site (Nagy *et al.* 2014, fig. 4), though the distance is significantly greater than the 40-50 m observed in piedmont zone settlements. After outlining parts of these settlement plans and comparing them to the Hejőpapi and Bükkábrány cases, another common feature emerged: the settlement axes are oriented NNE-SSW. This corresponds to the local relief, implying that, in addition to water proximity, this factor played a role in site selection.

The axially symmetrical house-row settlements are currently unknown in other parts of the LBK area, but they are common in the piedmont zone of the North Hungarian Mountains. Because of the complex, time-averaged Western European settlement remains, the treatment of households (LBK Hofplatz) as basic structural units of analysis was required. These relatively well-defined units were then used in the construction of larger structures in various, often contradictory ways (see Rück 2012), but those attempts never resulted in a coherent model free of residuals. In contrast to the LBK settlements, which are rich in stratigraphic relations, superposition is uncommon in the early ALPC sites. László Domboróczki's detailed absolute chronological studies, on the other hand, confirmed that the formation of these "clean rows" occurred over several generations (Domboróczki 2009, fig. 11). The interpretation of the settlement's macrostructures is aided by the fact that construction activity followed a consistent organizing principle over time (compare with the issue of the pseudo-ditch system: Lefranc *et al.* 2017). Previously, such intentionally planned spatial organization was assumed primarily in monumental architecture: tells, enclosures, and mega sites (Chapman 2012; Raczky 2015; Pásztor *et a*l. 2015). However, Hillier's theory of space syntax (Hillier 2007) now allows for an exact discussion of the topic in archaeological research, even in locations where the spatial organization is not visible to the "naked eye" (Cutting 2003).

6. THE NEOLITHIC HOUSEHOLD: STRUCTURE AND FRAMEWORK OF ACTIVITIES

In his first interpretation of the "Hofplatz", Boelicke linked the structures emerging from archaeological features and the processes reconstructed based on the finds (Boelicke 1982). Simultaneously, Wilk and Rathje published the volume that has come to define household research to this point (Wilk and Rathje 1982). They discovered three governing aspects of households that have interdependent functions: social, material, and behavioral. The role of the human agent came to the fore in the interpretation of household activities such as production, distribution, transmission, reproduction, and co-residence as a result of the influence of post-processual archaeology. However, the difficulties of archaeological research stemmed from the fact that, while the household is a well-understood phenomenon in ethnography, it is a plastic (*i.e.*, sufficiently flexible) social unit located somewhere between the individual and the entire community in archaeology. That is, to be a useful *terminus technicus*, we must cultivate contextual archaeology. The difference in temporality between household operation and site formation on the one hand, and the time-averaged vestiges we recognize on the other, demonstrates the practical difficulties of studying this topic. While establishment and operation are primarily a series of individual actions that result in short-term events, only medium and long-term scales allow for observation (for details, see Allison 1999; Wesson 2008; Hachem and Hamon 2014).

As a determining factor, time was also included in the *FGSDM*. The Füzesabony settlement lasted 340 years, from 5560 to 5220 BC, with the settlement structure developing gradually over five shorter phases (Domboróczki 2009, fig. 7). Each row of houses grew at a different rate over 2-3 centuries. Although they did not expand in a straight line, we agree that their organizing principle was already in place when the settlement was established. The spatial and temporal dynamics at Füzesabony represented the pattern seen in Schwanfeld, which inspired Harald Stäuble to develop the Vater/Großvaterprinzip model (Stäuble 2005). Contemporarneity and succession, as well as temporal dynamics in general, have played important roles in both courtyard and house-row settlement models (Rück 2012; Zimmermann 2012). A realistic estimate of the buildings' lifespan was especially important to Oliver Rück. Instead of the previously accepted 25 years, he proposed 100 years, during which the buildings would serve as connecting points between human generations (Rück 2012). Beyond the elusive short-term patterns, the medium-term patterns thus transformed into a plastic, entangled system. The traditional method for identifying contemporaneity – refitting – does not provide exact results in this new, dynamic framework, but it does shed light on contexts to be considered. In Füzesabony, ceramic refitting resulted in connections spanning 2-3 buildings (30-50 m) within each row of houses (Domboróczki 2009, fig. 5). According to the published data, the affected 2-3 buildings can be interpreted as contemporary households or as buildings established in the same courtyard of a household but at different times.

Because ALPC settlement finds (like LBK) are usually found in a secondary position, we must also consider the phenomenon of deposition and related activities that were encoded into the archaeological material when interpreting them. The significance of deposition in community life was to strengthen the relationship between individuals, objects, and locations (Chapman 2000). Waste management had been the typical context of deposition, which produced a significant proportion of archaeological finds. Structured depositions, created through symbolic acts, opened up a new segment for material culture communication.

However, in some contexts, these two practices became inseparable, as subsistence activities merged with ritual acts (Raczky *et al.* 2018). The primary deposition places, pit complexes, show evidence of both practices, providing exceptional find material in terms of both quantity and quality. Only detailed contextual observation allows for a thorough interpretation of this material and exploration of the various levels in the practice of deposition.

The practice of deposition strengthened patterns of behavior required for the community's survival and success. These practices were influenced by the sedentary, food-producing lifestyle as well as the local environmental characteristics. The individual or community chose the most appropriate activity for themselves from the pool of activities responding to these opportunities and needs. Nonetheless, their decisions were heavily influenced by socialization (learning-teaching), *i.e.* culture. Bourdieu's concepts of *habitus* and *field* adequately describe the relationships (Bourdieu 2020) that an archaeological study of a household undertakes to explore.

However, due to a large number of unknown variables in the analysis, the evaluation of material patterning in archaeology should not be equated with the reconstruction of households. Material culture must be read differently (Allison 1999). When evaluating the finds, we can consider the web of functions and activities in which they were involved. Functional identification of finished artifacts or recognizable tools such as ceramic vessels, bone awls, stone axes, or clay weights is not difficult. By including the deposited objects in the operational chain of related activities, the interpretation of the deposition can be aided. Each object type is located at a different node in the operation sequence (raw material procurement, production, use, and abandonment) (Tixier 2012). The ochre was buried as raw material, the chipped stones as byproducts, the stone and bone implements as finished tools, the broken pottery as waste, and the animal bones as garbage. The spatial patterning of different object types at the sites frequently suggests differences in the functioning of individual households (intrasite groups), illuminating structural phenomena that would otherwise be difficult to observe.

7. ACTIVITY GROUPS IN THE EARLY ALPC COMMUNITIES

The early ALPC site in Bükkábrány has been analyzed based on limited information so far. The determining elements of the obvious and regular settlement structure (rows of houses, a central space between them, centrally located wells) and partially identifiable features (buildings) that became known over a large area were used in the examination of its spatial structure. In doing so, we set up nine spatial segments with an interpretive role in the subsequent analysis (Fig. 10). We determined the temporal frames: the 250-280 years between 5470-5210 BC is the period during which the settlement structure developed and the community that created it was been operating. For the time being, the internal dynamics of this process are lacking in detail. However, the available ^{14}C data show that segment 2 was actively used for almost the entire duration of the settlement (Tab. 1, Fig. 2).

We examined the community's activities using three data sets derived from the found material. The frequency and weight data of ten important Neolithic find types, as well as other objects, were analyzed using a key spatial statistical method (Kernel density estimation) and univariate statistics (boxplot chart). The patterns investigated were consistent with the previously defined spatial segments (Fig. 11-13). Taken together, these patterns revealed that the high or low values of specific find types indicate qualitative differences in the activities performed in each segment. Aside from divergent activities, fragmentation data and the presence of outliers in each find group (Fig. 10) indicate differences in the practice of deposition between individual segments. The analyses of findings support the use of these spatial segments in community and settlement research.

However, when interpreting our findings, we must keep in mind that, while each intra-site social group carried out their activities in the short term at an undetermined frequency, the deposited finds provide a long-term pattern merging past activities. As a result, we cannot equate a spatial segment, the patterning of the objects within it, the practices assumed as a result of this pattern, and any previous social unit. To express this relationship, we must use other mathematical symbol combinations ($<$, $\leq$, $\approx$, $>$, $\geq$) rather than the equals sign. According to ^{14}C data from segment 2, the 3-5 adjacent buildings per segment can be assessed as features built consecutively for one household. However, it has now been demonstrated that the "one household = one house" formula is not always true (Mesterházy *et al.* 2019, 17-21; Raczky *et al.* 2018, 121-123; Raczky *et al.* 2020), implying that the adjacent buildings could be contemporaneous. Concurrent activity areas at the Füzesabony site are comparable in size to the Bükkábrány segments, according to refitting studies (Domboróczki 2009, Fig. 5). However, it is uncertain whether the groups of actors represent individual settlement households, or whether they should be regarded as activity groups in which members of different households collaborated.

We consider our results a starting point for further research. The spatial segments delimited by the elements and regularities of the settlement are regarded as analytical units located in scale between the individual features and the settlement as a whole. Their utility has been demonstrated by distribution pattern analyses of various materials. However, these units may prove rigid in subsequent, more detailed analysis. The different patterning of the spatial segments can be explained in a variety of ways: 1) The courtyard model was based on a close, long-term relationship between the spatial unit and its archaeological phenomena; 2) A looser relationship allows the activities of different generations to be linked into a fictitious spatial unit. In other words, as explained by the house-row model, traces of short- and medium-term phenomena accumulated into a long-term settlement structure; 3) By emphasizing spatiality, we direct interpretation toward activity zones; Or 4) by focusing on the activity and the actors, we orient interpretation toward activity groups. These approaches are not mutually exclusive; in fact, they can be used in conjunction when evaluating patterns in archaeological data. Case studies can be used to properly discuss the relationships between households and other social units, archaeological phenomena, and artifacts (*e.g.*, Marton 2013; Müller *et al*. 2013; Stadler and Kotova 2013). Case studies support the diversity of research and interpretation options, as well as the complexities and nuances of the issue of prehistoric "households" and communities.

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Table 1. Catalog ot the LBK and ALPC face vessels in Central Europe. Prepared: M. Korczyńska

ID	Site	N	E	Culture	Fine Chronology	Facial field form	Eyes	Eyebrows	Nose	Nostrils	Mouth	Ears	Hair	Main motif	Additional motifs	"Horns"	Other body parts	Additional Zoomorphic elements	Vessel type	Literature	Cluster analysis two classes	Cluster analysis three classes	Comments
V_1	Remerschen-Schengerwis	49°29'22.0"N	6°21'08.3"E	LBK	Flomborn phase	none	none	none	6A	none	none	none	none	none	none	none	none	none	Schale/Kumpf	Becker 2011, Taf. 75.1; Schwarzberg 2011, 125.2	1	1	
V_2	Köln-Lindenthal -1	50°55'34"N	6°55'34"E	LBK	younger phase	none	2A	none	3A	none	1B	none	none	none	none	none	none	none	Schale/Kumpf	Becker 2011, Taf. 75.5; Schwarzberg 2011, 125.5	1	1	
V_3	Köln-Lindenthal -2	50°55'34"N	6°55'34"E	LBK	LBK	none	none	2A	3A	none	1B	none	none	none	none	none	none	none	Unbestimmt	Becker 2011, Taf. 75.7	1	1	
V_4	Bad Nauheim-Nieder Mörlen	50°22'51"N	8°43'34"E	LBK	late Flomborn phase	none	1D	none	3A	none	none	none	none	2A	4A	none	none	none	Flasche	Schwarzberg 2011, Taf. 124.4	1	1	
V_5	Friedberg-Dorheim	50°20'57"N	8°47'22.3"E	LBK	older phase	1A	1A	none	6A	none	none	incited	none	1	4A	none	none	none	Flasche	Becker 2011, Taf. 58.2; Schwarzberg 2011, Taf. 122.1c	1	1	
V_6	Schöneck-Kilianstädten	50°12'5"N	8°51'13"E	LBK	younger phase	none	3A	none	3A	none	none	none	none	none	none	none	none	none	Schale/Kumpf	Becker 2011, Taf. 75.2; Schwarzberg 2011, Taf. 125.1	1	1	
V_7	Stuttgart-Bad Cannstatt	48°48'39"N	9°13'29.8"E	LBK	Flomborn phase	1A	1A	none	6A	none	none	incited	none	1	4A	none	none	none	Flasche	Becker 2011, Taf. 58.1; Schwarzberg 2011, Taf. 122.1a-b	1	1	
V_8	Acholshausen	49°38'43"N	9°38'43"E	LBK	LBK	none	3A	none	6A	none	2A	none	none	2A	4A	none	none	none	Unbestimmt	Becker 2011, Taf. 73.2; Schwarzberg 2011, Taf. 126.2	1	1	
V_9	Göttingen	51°32' 2"N	9°56'8"E	LBK	LBK	none	3A	2B	4B	none	none	none	none	2A	4A	none	none	none	Flasche	Becker 2011, Taf. 73.1; Schwarzberg 2011, Taf. 124.2	2	2	
V_10	Hausen	49°56'0"N	10°1'0"E	LBK	LBK	none	1A	3B	3A	none	?	none	horizontal	2A	3	none	none	none	Flasche	Becker 2011, Taf. 58.3; Schwarzberg 2011, Taf. 123.2	1	1	
V_11	Kleinfahner	51°2'15"N	10°50'42"E	LBK	younger phase	none	1A	2B	4B	none	none	plastic	none	2A	4A	none	none	none	Flasche	Becker 2011, Taf. 59.1; Schwarzberg 2011, Taf. 123.3	1	2	
V_12	Derenburg	51°52'15"N	10°54'30"E	LBK	older/younger phase	none	3A	2B	4B	none	2A	none	none	2A	8	none	none	none	Flasche	Becker 2011, Taf. 60.1; Schwarzberg 2011, Taf. 124.1	2	2	
V_13	Balrleben	52°12'19.2"N	11°35'25.0" E	LBK	older phase	2A	1A	none	2A	none	none	plastic	none	none	band with strokes	none	none	none	Flasche	Becker 2011, Taf. 59.2; Schwarzberg 2011, Taf. 123.3	1	1	
V_14	Karsdorf	51°16'59"N	11°39'0"E	LBK	younger phase	3B	3C	2B	realistic	present	none	none	none	2A	none	none	none	none	Unbestimmt	Meller 2012: 174	2	2	
V_15	Draschwitz	51°6'1"N	12°10'56"E	LBK	middle-younger phase	none	2A	none	3A	none	none	none	none	1	band with strokes	none	none	none	Schale/Kumpf	Becker 2011, Taf. 66.4; Schwarzberg 2011, Taf. 125.9	1	1	
V_16	Zauschwitz	51°10'49.9"N	12°15'48.2"E	LBK	middle phase	none	3C	2B	4B	none	2B	none	none	none	none	none	none	none	Schale/Kumpf	Becker 2011, Taf. 66.3; Schwarzberg 2011, Taf. 125.4	2	2	
V_17	Eythra	51°14'0"N	12°18'0"E	LBK	middle phase	none	3C	2B	4B	none	?	none	none	none	none	none	none	none	Schale/Kumpf	Lehmann 2019, Taf.11.3	2	2	
V_18	Grana-Kleinosida	51°3'19"N	12°6'19"E	LBK	middle phase	none	5A	2A	realistic	none	?	none	none	2A	4A	present	none	none	Schale/Kumpf	Schwarzberg 2011, Taf.125:6	2	2	
V_19	Mügeln	51°14'17.6"N	13°03'33.4"E	LBK	older phase	1A	1A	none	3A	present	none	none	none	none	none	present	none	none	Schale/Kumpf	Conrad, Conrad, Ender, Herbig, Homann 2012, Abb.7	1	1	
V_20	Kolín	50°01'00"N	15°12'00"E	SBK	late SBK	1B	5A	2B	realistic	none	2A	none	none	strokes	none	present	none	none	Unbestimmt	Pavlů, Šumberová 2017, Fig. 6.2, 6.3	2	2	
V_21	Močovice	49°54'23"N	15°30'54"E	LBK	Music-Note LBK phase	none	3A	2A	6A	present	none	plastic	none	none	4A	none	none	none	Flasche	Becker 2011, Taf. 60.3; Schwarzberg 2011, Taf. 119.1a-b	1	1	
V_22	Poigen	48°41'44"N	15°33'57"E	LBK	late phase	none	5A	2A	4A	none	2B	none	none	none	8	present	none	none	Flasche	Becker 2011, Taf. 67.1; Schwarzberg 2011, Taf. 115.1	2	2	
V_23	Fraunhofen - Ried Milchtaschen	48°40'24"N	15°37'50"E	LBK	Music-Note LBK phase	none	1A	2B	4B	none	none	none	horizontal	none	3	none	none	none	Schale/Kumpf	Becker 2011, Taf. 61.2; Schwarzberg 2011, Taf. 118.3	1	2	

V_24	Breiteneich -1	48°40'27.07"N	15°41'34"E	LBK	late Music-Note LBK phase	none	3A	2A	4A	none	?	none	horizontal	none	none	present	none	none	Schale/Kumpf	Becker 2011, Taf. 61.1; Schwarzberg 2011, Taf. 119.2	2	2	
V_25	Breiteneich -2	48°40'27.07"N	15°41'34"E	LBK	LBK	none	3C	2A	3A	none	1A	none	none	none	8	none	none	none	Unbestimmt	Becker 2011, Taf. 72.4	2	2	
V_26	Pulkau -1	48°42'0"N	15°51'0"E	LBK	younger phase	2A	5A	2B	4B	none	?	none	horizontal	none	8	present	none	none	Schale/Kumpf	Becker 2011, Taf. 67.4; Schwarzberg 2011, Taf. 117.2	2	2	
V_27	Pulkau -2	48°42'0"N	15°51'0"E	LBK	LBK	2A	5A	2B	4B	present	?	none	horizontal	none	8	present	none	none	Schale/Kumpf	Becker 2011, Taf. 68.1; Schwarzberg 2011, Taf. 117.3	2	2	
V_28	Pulkau -3	48°42'0"N	15°51'0"E	LBK	younger phase	none	6A	2B	realistic	none	?	none	none	none	8	present	none	none	Unbestimmt	Becker 2011, Taf. 67.3; Schwarzberg 2011, Taf. 121.4	2	2	
V_29	Ziersdorf	48°31'42.42"N	15°55'37.2"E	LBK	middle-late phase	none	3A	2A	4A	none	?	none	none	none	8	none	none	none	Flasche	Becker 2011, Taf. 56.5; Schwarzberg 2011, Taf. 114.4	2	3	
V_30	Thomasl	48°31'53.6"N	16°23'54.0"E	LBK	Želiezovce LBK phase	none	1A	1A	realistic	none	?	none	stroked vertical lines	none	8	none	none	none	Flasche	Becker 2011, Taf. 54.1; Schwarzberg 2011, Taf. 113.1	2	2	
V_31	Ulrichskirchen	48°24'0"N	16°29'0"E	LBK	LBK	1B	1A	2A	4A	none	2A	none	vertical	none	none	none	none	none	Unbestimmt	Becker 2011, Taf. 71.2	2	3	
V_32	Draßburg - Taborac	47°44'46"N	16°29'17"E	LBK	Želiezovce LBK phase	none	3A	2A	4A	none	2A	none	none	none	none	none	present	none	Flasche	Becker 2011, Taf. 72.7; Schwarzberg 2011, Taf. 112.2	2	3	
V_33	Vavřinec - Koňská Jáma	49°24'9"N	16°43'11"E	LBK	younger Voluten group	none	5A	2B	4B	none	none	none	none	none	band with strokes	present	none	none	Schale/Kumpf	Becker 2011, Taf. 62.1; Schwarzberg 2011, Taf. 119.1	2	2	
V_34	Zalaegerszeg-Andráshida	46°50'21"N	16°51'4"E	LBK	Keszthely group	2A	1D	none	none	none	2A	none	none	1	4A	none	none	none	Flasche	Becker 2011, Taf. 55.2; Schwarzberg 2011, 83.3	1	1	
V_35	Mohelnice -1	49°46'36.5"N	16°55'7"E	LBK	Music-Note LBK phase	none	5A	2A	realistic	present	2A	none	horizontal	none	4A	present	none	none	Schale/Kumpf	Becker 2011, Taf. 68.2	2	2	
V_36	Mohelnice -2	49°46'36.5"N	16°55'7"E	LBK	LBK IV?	none	5A	2B	realistic	none	1A	none	none	none	none	none	present	none	Schale/Kumpf	Becker 2011, Taf. 75.3	2	2	
V_37	Keszthely	46°45'55.2"N	17°14'34.19"E	LBK	late Želiezovce LBK phase	2A	1D	2A	4A	none	2A	none	horizontal	1	zigzag	none	none	none	Schale/Kumpf	Becker 2011, Taf. 62.3	2	3	
V_38	Blatné	48°15'56"N	17°25'15"E	LBK	Želiezovce LBK phase	2A	3A	2A	4A	none	none	none	vertical	1	8	none	none	none	Unbestimmt	Becker 2011, Taf. 70.1	2	3	
V_39	Cifer-Pác -1	48°19'0"N	17°30'0"E	LBK	Želiezovce LBK phase	none	1A	2A	realistic	present	2A	none	vertical	none	zigzag	none	none	none	Schale/Kumpf	Becker 2011, Taf. 64.1; Schwarzberg 2011, Taf. 112.1	2	3	
V_40	Cifer-Pác -2	48°19'0"N	17°30'0"E	LBK	Želiezovce LBK phase	2A	5A	1A	3A	none	2A	none	none	none	none	none	none	none	Unbestimmt	Becker 2011, Taf. 70.4	2	2	
V_41	Győr -1	47°41'0"N	17°38'0"E	LBK	late Želiezovce LBK phase	none	1D	2A	4A	none	?	none	vertical	none	none	none	none	none	Unbestimmt	Becker 2011, Taf. 69.7; Schwarzberg 2011, Taf. 85.4	2	3	
V_42	Győr -2	47°41'0"N	17°38'0"E	LBK	Želiezovce LBK phase	none	3A	none	7A	none	2A	none	vertical	none	none	none	none	none	Unbestimmt	Becker 2011, Taf. 69.8	2	3	
V_43	Balatonszárszó	46°49'33"N	17°50'5"E	LBK	Želiezovce LBK phase	none	3A	2A	4A	none	?	none	horizontal	none	none	none	none	none	Unbestimmt	Becker 2011, Taf. 69.1; Schwarzberg 2011, Taf. 84.1	2	3	
V_44	Ráksi	46°31'1.24"N	17°55'8.76"E	LBK	late Želiezovce LBK phase	2A	1D	2A	4A	none	2A	none	symetrical arched motif	1	8	none	none	none	Flasche	Becker 2011, Taf. 55.3; Schwarzberg 2011, 85.3	2	3	
V_45	Żegotki -1	52°40'31"N	18°12'31"E	LBK	LBK	none	3C	2B	4B	none	none	none	none	none	8	present	none	none	Unbestimmt	Czerniak 1996, ryc. 6	2	2	
V_46	Bajč -1	47°55'0"N	18°13'0"E	LBK	late Želiezovce LBK phase	2A	1D	2A	4A	none	2A	none	none	1	zigzag	none	none	none	Flasche	Becker 2011, Taf. 56.1; Schwarzberg 2011, Taf. 115.4	2	3	
V_47	Bajč -2	47°55'0"N	18°13'0"E	LBK	late Želiezovce LBK phase	2A	none	1C	none	none	none	none	none	1	zigzag	none	none	none	Schale/Kumpf	Schwarzberg 2011, Taf. 116.1	2	3	
V_48	Bajč -3	47°55'0"N	18°13'0"E	LBK	late Želiezovce LBK phase	2A	3A	2A	4A	none	?	none	vertical	none	none	none	none	none	Unbestimmt	Becker 2011, Taf. 64.4	2	3	
V_49	Iža - Velký Harcás	47°45'2"N	18°14'0"E	LBK	Želiezovce LBK phase	2A	3A	2A	4A	none	none	plastic halfround	symetrical arched motif	1	7	none	none	none	Unbestimmt	Schwarzberg 2011, Taf. 120.1	2	3	
V_50	Dvory nad Žitavou	47°59'37"N	18°15'51"E	LBK	middle Želiezovce LBK phase	none	1D	1A	2	none	none	none	horizontal	none	8	none	none	Zoomorpfe handles	Flasche	Schwarzberg 2011, Taf. 111.1	2	2	
V_51	Patince	47°44'15"N	18°17'40"E	LBK	Želiezovce LBK phase	2A	1D	none	3A	none	2A	none	stroked vertical lines	1	zigzag	none	none	none	Flasche	Becker 2011, Taf. 75.4; Schwarzberg 2011, Taf. 114.1	1	3	
V_52	Mužla-Čenkov -1	47°47'32"N	18°35'52"E	LBK	Želiezovce LBK phase	1A	3A	2A	4A	none	2B	none	none	1	zigzag	none	none	none	Schale/Kumpf	Becker 2011, Taf. 63.3; Schwarzberg 2011, Taf. 116.2	2	3	
V_53	Mužla-Čenkov -2	47°47'32"N	18°35'52"E	LBK	Želiezovce LBK phase	2A	3A	none	5B	none	2A	none	vertical	1	zigzag	none	none	none	Schale/Kumpf	Becker 2011, Taf. 63.4; Schwarzberg 2011, Taf. 121.2	2	3	
V_54	Mužla-Čenkov -3	47°47'32"N	18°35'52"E	LBK	Želiezovce LBK phase	1A	3A	2A	4A	none	2C	none	none	none	none	none	none	none	Unbestimmt	Becker 2011, Taf. 65.1; Schwarzberg 2011, Taf. 120.7	2	3	

V_55	Bíňa	47°55'20"N	18°38'33"E	LBK	Želiezovce LBK phase	2A	3A	2A	realistic	present	?	none	vertical	1	7	none	none	none	Flasche	Becker 2011, Taf. 70.3; Schwarzberg 2011, Taf. 115.3	2	3	
V_56	Vel'ký Pesek / Sikenica - Agota Major	48°4'30"N	18°43'0"E	LBK	Želiezovce LBK phase	2A	5D	2A	4A	none	2B	none	symetrical arched motif	1	none	none	none	none	Flasche	Becker 2011, Taf. 69.9	2	3	
V_57	Štúrovo -1	47°47'56"N	18°43'20"E	LBK	Želiezovce LBK phase	2A	3A	1A	3A	none	2A	none	none	1	zigzag	none	none	none	Schale/Kumpf	Becker 2011, Taf. 63.1; Schwarzberg 2011, Taf. 116.3	2	3	
V_58	Štúrovo -2	47°47'56"N	18°43'20"E	LBK	Želiezovce LBK phase	none	4A	none	5B	none	2A	none	none	none	zigzag	none	none	none	Schale/Kumpf	Becker 2011, Taf. 63.2; Schwarzberg 2011, Taf. 117.4	1	1	
V_59	Štúrovo -3	47°47'56"N	18°43'20"E	LBK	Želiezovce LBK phase	none	3A	none	3A	none	2A	none	stroked vertical lines	none	7	none	none	none	Schale/Kumpf	Becker 2011, Taf. 70.5; Schwarzberg 2011, Taf. 121.1	1	1	
V_60	Biatorbágy-Tyúkberek	47°28'0"N	18°50'0"E	LBK	late Želiezovce LBK phase	2A	1D	1B	2A	none	2A	none	symetrical arched motif	1	zigzag	none	none	none	Flasche	Becker 2011, Taf. 55.1; Schwarzberg 2011, Taf. 83.1	2	3	
V_61	Tupá	48°7'0"N	18°54'0"E	LBK	Želiezovce LBK phase	2A	3A	2A	4A	none	2A	none	none	1	8	none	none	none	Unbestimmt	Becker 2011, Taf. 70.2; Schwarzberg 2011, Taf. 120.3	2	3	
V_62	Törökbálint-Dulácska -1	47°26'42"N	18°55'44"E	LBK	late Noteknopf/Želiezovce LBK phase	2A	3A	none	2A	none	2A	none	symetrical arched motif	1	zigzag	none	none	none	Unbestimmt	Schwarzberg 2011, Taf. 85.1	2	3	
V_63	Törökbálint-Dulácska -2	47°26'42"N	18°55'44"E	LBK	late Noteknopf/Želiezovce LBK phase	2A	3A	none	2A	none	3A	none	horizontal	1	7	none	none	none	Unbestimmt	Schwarzberg 2011, Taf. 85.2	2	3	
V_64	Budapest-Aranyhegyi -1	47°34'45.0"N	19°01'48.2"E	LBK	Želiezovce LBK phase	2A	1D	1B	2A	none	2A	none	vertical	1	none	none	none	none	Flasche	Becker 2011; Schwarzberg 2011	2	3	
V_65	Budapest-Aranyhegyi -2	47°34'45.0"N	19°01'48.2"E	LBK	Želiezovce LBK phase	2A	3A	1B	2A	none	2A	none	vertical	1	none	none	none	none	Flasche	Becker 2011; Schwarzberg 2011	2	3	
V_66	Budapest-Aranyhegyi -3	47°34'45.0"N	19°01'48.2"E	LBK	Želiezovce LBK phase	2A	3A	none	2A	none	2A	none	horizontal	1	8	none	none	none	Schale/Kumpf	Becker 2011; Schwarzberg 2011	2	3	
V_67	Budapest-Békásmegyer -1	47°36'0"N	19°3'0"E	LBK	late Želiezovce LBK phase	2A	1D	2A	4A	none	2A	none	symetrical arched motif	1	none	none	none	none	Flasche	Becker 2011, Taf. 54.2; Schwarzberg 2011, Taf.83.2	2	3	
V_68	Budapest-Békásmegyer -2	47°36'0"N	19°3'0"E	LBK	late Želiezovce LBK phase	2A	1D	2A	2A	none	2A	none	symetrical arched motif	1	3	none	none	none	Flasche	Becker 2011, Taf. 55.4	2	3	
V_69	Budapest-Békásmegyer -3	47°36'0"N	19°3'0"E	LBK	late Želiezovce LBK phase	2A	1D	2A	4A	none	2A	none	none	1	none	none	none	none	Flasche	Becker 2011, Taf. 55.5	2	3	
V_70	Budapest-Békásmegyer -4	47°36'0"N	19°3'0"E	LBK	late Želiezovce LBK phase	2A	1D	2A	4A	none	2A	none	none	1	none	none	none	none	Flasche	Becker 2011, Taf. 55.6	2	3	
V_71	Budapest-Békásmegyer -5	47°36'0"N	19°3'0"E	LBK	late Želiezovce LBK phase	2A	1D	none	2A	none	2A	none	stroked vertical lines	1	8	none	none	none	Unbestimmt	Becker 2011, Taf. 69.4; Schwarzberg 2011, Taf. 84.5	2	3	
V_72	Budapest-Békásmegyer -6	47°36'0"N	19°3'0"E	LBK	late Želiezovce LBK phase	2A	1D	2A	4A	none	2A	none	none	1	none	none	none	none	Unbestimmt	Becker 2011, Taf. 69.5; Schwarzberg 2011, Taf. 84.10	2	3	
V_73	Budapest-Békásmegyer -7	47°36'0"N	19°3'0"E	LBK	late Želiezovce LBK phase	none	1D	2A	realistic	none	2A	none	none	none	none	none	present	none	Schale/Kumpf	Becker 2011, Taf. 61.4; Schwarzberg 2011, Taf. 84.9	2	2	
V_74	Szécsény -1	48°5'0"N	19°31'0"E	LBK	Želiezovce LBK phase	2A	3A	2A	4A	none	none	none	none	1	zigzag	none	none	none	Flasche	Becker 2011, Taf. 57.1	2	3	
V_75	Szécsény -2	48°5'0"N	19°31'0"E	LBK	Želiezovce LBK phase	2A	3A	2A	4A	none	2A	none	vertical	1	none	none	none	none	Flasche	Becker 2011, Taf. 57.2	2	3	
V_76	Szécsény -3	48°5'0"N	19°31'0"E	LBK	Želiezovce LBK phase	2A	1D	2A	2A	none	none	none	symetrical arched motif	1	6B	none	none	none	Flasche	Becker 2011, Taf. 57.3	2	3	
V_77	Szécsény -4	48°5'0"N	19°31'0"E	LBK	Želiezovce LBK phase	2A	3A	none	2A	none	2A	none	horizontal	1	zigzag	none	none	none	Schale/Kumpf	Becker 2011, Taf. 65.1	2	3	
V_78	Csanytelek-Újhalastó -1	46°19'19"N	20°00'19"E	ALPC	Szakálhát group	none	1D	none	2A	none	none	none	stroked vertical lines	1	none	none	present	none	Vorratsgefäß	Becker 2011, Taf. 177.4; Schwarzberg 2011, Taf. 89.3	1	1	
V_79	Csanytelek-Újhalastó -2	46°36'22.28"N	20°06'17.29"E	ALPC	Szakálhát group	none	none	none	2A	none	none	none	horizontal	1	none	none	none	none	Vorratsgefäß	Becker 2011, Taf. 178.5; Schwarzberg 2011, Taf. 86.1	1	1	
V_80	Tarnaméra-Cselőháza	47°39'22"N	20°09'29"E	ALPC	late Alföld LBK	none	1D	none	3A	present	2A	none	stroked vertical lines	arched motif	3	none	none	none	Unbestimmt	Schwarzberg 2011, Taf. 79.2	1	1	
V_81	Szelevény-Felsőföldek	46°48'07"N	20°12'04"E	ALPC	Esztár-Piscolt-Raskovice group	none	2A	2B	6A	none	1A	none	none	arched motif	3	none	present	none	Flasche	Becker 2011, Taf. 176.6; Schwarzberg 2011, Taf. 81	1	1	arched motive is painted
V_82	Szentes-Ilonapart	46°39'16"N	20°14'25"E	ALPC	Szakálhát group	none	1D	none	3A	none	2A	incited	stroked vertical	1	none	none	present	none	Vorratsgefäß	Becker 2011, Taf. 178.2	1	1	

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V_83	Szentes-Jaksorpart	46°39'16"N	20°14'25"E	ALPC	Szakálhát group	none	1D	none	3A	present	none	incited	none	1	7	none	present	none	Vorratsgefäß	Schwarzberg 2011, Taf. 91	1	1	
V_84	Szentes-Komitatshaus	46°39'13"N	20°16'03"E	ALPC	Szakálhát group	none	3A	none	3A	none	2A	incited	stroked vertical lines	1	7	none	none	handles	Vorratsgefäß	Becker 2011, Taf. 178.3; Schwarzberg 2011, Taf. 90	1	1	
V_85	Füzesabony-Kettőshalom	47°45'00"N	20°25'00"E	ALPC	classical phase	none	3A	2A	4A	none	2C	plastic halfround	none	arched motif	3	none	none	none	Unbestimmt	Becker 2011, Taf. 176.4; Schwarzberg 2011, Taf. 89.1	1	1	
V_86	Kömlő	47°36'04"N	20°26'28"E	ALPC	Szakálhát group	none	1D	none	2A	none	none	plastic	stroked vertical lines	1	none	none	present	none	Vorratsgefäß	Becker 2011, Taf. 177.3	1	1	
V_87	Domica cave -1	48°28'39"N	20°28'10.06"E	ALPC	Bükk culture	1A	3A	none	2A	none	2A	none	stroked vertical lines	arched motif	3	none	none	none	Unbestimmt	Becker 2011; Schwarzberg 2011	1	1	
V_88	Domica cave -2	48°28'39"N	20°28'10.06"E	ALPC	Bükk culture	none	none	none	none	none	T-shaped	none	stroked vertical lines	none	3	none	none	none	Unbestimmt	Becker 2011; Schwarzberg 2011	1	1	
V_89	Aggtelek cave -1	48°28'16.5"N	20°29'51"E	ALPC	Tiszadob group	2A	none	none	6A	none	6A	none	none	arched motif	3	none	none	none	Unbestimmt	Schwarzberg 2011, Taf. 78.7	1	1	
V_90	Aggtelek cave -2	48°28'16.5"N	20°29'51"E	ALPC	Tiszadob group	none	1D	none	none	none	T-shaped	none	zickzack	none	3	none	none	none	Unbestimmt	Schwarzberg 2011, Taf. 79.9	1	1	
V_91	Spišský Hrhov -1	49°00'00"N	20°38'30"E	LBK	Želiezovce LBK phase	2A	3A	2A	4A	none	?	none	vertical	1	8	present	none	none	Schale/Kumpf	Becker 2011, Taf. 68.3; Schwarzberg 2011, Taf. 118.1	2	3	
V_92	Spišský Hrhov -2	49°00'00"N	20°38'30"E	LBK	Želiezovce LBK phase	2A	3A	2A	4A	none	2A	incited	vertical	1	zigzag	present	none	none	Schale/Kumpf	Becker 2011, Taf. 68.4; Schwarzberg 2011, Taf. 118.2	2	3	
V_93	Mezőkeresztes-Cet-halom	47°49'49"N	20°41'22"E	ALPC	Tiszadob group/Bükk culture	none	none	none	none	none	T-shaped	none	horizontal	arched motif	3	none	none	none	Unbestimmt	Csengeri 2014, fig.8.2	1	1	
V_94	Miskolc-ALDI	48°05'50"N	20°44'53"E	ALPC	Tiszadob group/Bükk culture	none	none	none	none	none	T-shaped	none	horizontal	arched motif	3	none	none	none	Unbestimmt	Csengeri 2014, fig.9.4	1	1	
V_95	Tiszavalk-Négyes	47°41'18"N	20°44'58"E	ALPC	Szatmar group	none	3A	3A	3A	none	6A	none	none	arched motif	3	none	none	none	Unbestimmt	Becker 2011, Taf. 176.2; Schwarzberg 2011, Taf. 78.4	1	1	
V_96	Sajószentpéter I	48°13'02"N	20°46'53"E	ALPC	classical phase	1C	6A	none	6A	present	?	none	none	arched motif	3	none	none	none	Unbestimmt	Becker 2011, Taf. 176.3	1	1	
V_97	Sajószentpéter-Kövecses	48°13'02"N	20°46'53"E	ALPC	Bükk culture	none	3A	none	3A	none	2A	none	stroked vertical lines	none	none	none	none	none	unbestimmt	Schwarzberg 2011, Taf. 93.5	1	1	
V_98	Gyoma-Őzed	46°56'10"N	20°49'025"E	ALPC	Szakálhát group	none	3A	none	3A	none	T-shaped	plastic halfround	none	1	none	none	present	none	Vorratsgefäß	Becker 2011, Taf. 177.2; Schwarzberg 2011, Taf. 86	1	1	
V_99	Sajóvámos	48°11'29"N	20°49'54"E	ALPC	Tiszadob group/Bükk culture	none	1D	none	none	none	2B	none	none	arched motif	3	none	none	none	Unbestimmt	Csengeri 2014, fig.7.4	1	1	
V_100	Biskupice	49°57'35"N	20°7'28"E	LBK	Želiezovce LBK phase	2A	1D	2A	realistic	present	?	none	none	1	none	present	none	none	Schale/Kumpf		2	3	
V_101	Battonya-Gödrösök	46°17'0"N	21°01'00"E	ALPC	Szakálhát group	2A	3A	none	2A	none	2A	none	horizontal	1	3	none	present	none	Vorratsgefäß	Becker 2011, Taf. 177.1; Schwarzberg 2011, Taf. 89.1	1	3	
V_102	Battonya-Vid	46°21'42"N	21°01'15"E	ALPC	Szakálhát group	none	none	none	3A	none	none	none	none	1	none	none	present	none	Vorratsgefäß	Becker 2011, Taf. 178.1	1	1	
V_103	Battonya-Parázs tanya	46°23'42"N	21°03'15"E	ALPC	Szakálhát group	none	1D	none	6A	present	?	none	horizontal	none	3	none	none	none	Vorratsgefäß	Becker 2011, Taf. 178.4	1	1	
V_104	Polgár-Nagy-Kasziba	47°52'02"N	21°07'00"E	ALPC	late Bükk culture	2C	none	none	3A	none	none	none	none	arched motif	3	none	none	none	Unbestimmt	Raczky/Anders 2003, 159, 162 u. 161 Abb. 3,7; Schwarzberg 2011, Taf. 93.1	1	1	
V_105	Encs-Kelecsény -1	48°19'42"N	21°07'15.2"E	ALPC	Tiszadob group/Bükk culture	none	1B	none	6A	present	none	none	stroked vertical lines	none	3	none	none	none	Unbestimmt	Csengeri 2014, fig.6.4	1	1	
V_106	Encs-Kelecsény -2	48°19'42"N	21°07'15.2"E	ALPC	Tiszadob group/Bükk culture	none	3A	none	realistic	present	?	none	none	arched motif	3	none	none	none	Unbestimmt	Csengeri 2014, fig.9.5	1	1	
V_107	Garadna-Elkerülő út - 1	48°25'07"N	21°10'29"E	ALPC	Bükk culture	none	3A	none	6A	none	T-shaped	none	stroked vertical lines	arched motif	3	none	present	none	Vorratsgefäß	Csengri 2011, fig.1,2,3	1	1	
V_108	Garadna-Elkerülő út - 2	48°25'07"N	21°10'29"E	ALPC	Bükk culture	none	3A	none	none	none	T-shaped	none	horizontal	none	3	none	present	none	Schale/Kumpf	Csengri 2011, fig.4	1	1	
V_109	Garadna-Elkerülő út - 3	48°25'07"N	21°10'29"E	ALPC	Bükk culture	none	3A	none	none	none	6B	none	horizontal	arched motif	3	none	none	none	Unbestimmt	Csengri 2011, fig.8.1	1	1	
V_110	Garadna-Elkerülő út - 4	48°25'07"N	21°10'29"E	ALPC	Bükk culture	none	1A	none	1A	none	none	none	none	arched motif	3	none	none	none	Unbestimmt	Csengri 2011, fig.8.2	1	1	

V_111	Garadna-Elkerülő út - 5	48°25'07"N	21°10'29"E	ALPC	Bükk culture	none	none	none	none	none	none	none	stroked vertical lines	arched motif	3	none	none	none	Unbestimmt	Csengri 2011, fig.8.3	1	1	
V_112	Garadna-Elkerülő út - 6	48°25'07"N	21°10'29"E	ALPC	Bükk culture	none	3A	none	none	none	none	none	stroked vertical lines	arched motif	3	none	none	none	Unbestimmt	Csengri 2011, fig.8.4	1	1	
V_113	Mezőzombor-Temető	48°08'54"N	21°16'07"E	ALPC	Tiszadob group	1A	small stroke	none	2A	none	T-shaped	none	none	arched motif	3	none	none	none	Flasche	Becker 2011, Taf. 179.2; Schwarzberg 2011, Taf. 80.1	1	1	
V_114	Kéked-Hosszúföldek	48°32'45"N	21°20'45"E	ALPC	initial phase Alföld LBK (ALPC I)	none	3A	none	3A	none	6A	none	none	none	3	none	none	none	Unbestimmt	Csengri 2018, Tab.2.2	1	1	
V_115	Tiszavasvári-Keresztfal	47°57'08"N	21°22'18"E	ALPC	Tiszadob group	2B	1D	none	3A	none	2A	none	none	none	none	none	present	none	Unbestimmt	Schwarzberg 2011, Taf. 78.10	1	1	
V_116	Tiszavasvári-Paptelekhat	47°57'08"N	21°22'18"E	ALPC	Tiszadob group	2B	6A	none	3A	none	2A	none	none	arched motif	3	none	none	none	Unbestimmt	Schwarzberg 2011, Taf. 78.12	1	1	
V_117	Szegi-Ady Endre	48°11'42"N	21°22'35"E	ALPC	Tiszadob group/Bükk culture	none	none	2B	4B	none	none	none	none	none	none	none	none	none	Unbestimmt	Csengeri 2014, fig.7.6	2	2	
V_118	Kenézlő-Fazekaszug	48°11'53"N	21°31'46"E	ALPC	Tiszadob group	1B	small stroke	none	none	none	T-shaped	none	stroked vertical lines	none	3	none	none	none	Flasche	Becker 2011, Taf. 179.1	1	1	
V_119	Berettyószentmárton-Morotva	47°11'53"N	21°32'18"E	ALPC	Esztár-Piscolt-Raskovice group	none	2A	none	3A	none	none	none	none	arched motif	3	none	none	none	Unbestimmt	Becker 2011, Taf. 176.7; Schwarzberg 2011, Taf. 82.1	1	1	arched motive is painted
V_120	Debrecen-Tócópart	47°32'0"N	21°38'00"E	ALPC	Esztár-Piscolt-Raskovice group	none	none	none	3A	none	none	none	none	arched motif	3	none	none	none	Unbestimmt	Becker 2011, Taf. 176.8; Schwarzberg 2011, Taf. 82.4	1	1	arched motive is painted
V_121	Tiszaigar-Homokbánya	47°32'0"N	21°38'00"E	ALPC	Esztár-Piscolt-Raskovice group	none	1B	none	3A	none	none	none	none	arched motif	3	none	none	none	Unbestimmt	Becker 2011, Taf. 176.10	1	1	arched motive is painted
V_122	Szilmeg, Polgár-Folyás	47°48'33"N	21°48'21"E	ALPC	Szilmeg group	none	3A	none	6A	none	none	handles	none	none	none	none	present	none	Flasche	Becker 2011, Taf. 176.5	1	1	
V_123	Šarišské Michaľany -1	49°4'9"N	21°8'14"E	ALPC	Bükk culture	none	none	none	3A	none	none	none	stroked vertical lines	arched motif	3	none	none	none	Flasche	Becker 2011, Taf. 179.7; Schwarzberg 2011, Taf. 114.2	1	1	
V_124	Šarišské Michaľany -2	49°4'9"N	21°8'14"E	ALPC	Tiszadob group	none	none	none	3A	none	T-shaped	none	stroked vertical lines	arched motif	3	none	none	none	Flasche	Schwarzberg 2011, Taf. 114.3	1	1	
V_125	Šarišské Michaľany -3	49°4'9"N	21°8'14"E	ALPC	Tiszadob group	1C	3A	none	2C	none	none	none	none	none	8	none	none	none	Flasche	Becker 2011, Taf. 179.5; Schwarzberg 2011, Taf. 115.2	2	2	
V_126	Šarišské Michaľany -4	49°4'9"N	21°8'14"E	ALPC	Tiszadob group	none	3A	none	realistic	present	?	none	none	arched motif	3	none	none	none	Flasche	Becker 2011, Taf. 179.4; Schwarzberg 2011, Taf. 121.7	1	1	
V_127	Šarišské Michaľany -4	49°4'9"N	21°8'14"E	ALPC	Bükk culture	none	none	none	6A	none	T-shaped	none	stroked vertical lines	arched motif	3	none	none	none	Flasche	Becker 2011, Taf. 179.6	1	1	
V_128	Sonkád „Új Élet“	48°3'0"N	22°45'0"E	ALPC	Szatmar group	1C	none	2B	4B	none	none	plastic halfround	none	none	none	none	none	none	Unbestimmt	Becker 2011, Taf. 176.1; Schwarzberg 2011, Taf. 78.6	2	2	
V_129	Iacobeni	47°26'35"N	27°19'08"E	LBK	Želiezovce LBK phase	none	3A	2A	realistic	present	1A	none	none	none	none	none	none	none	Schale/Kumpf	Becker 2011, Taf. 61.3; Schwarzberg 2011, Taf. 98.2	2	2	
V_130	Huşi	46°40'27"N	28°3'35"E	LBK	LBK	1B	6A	2B	4B	none	2B	none	none	none	none	none	none	none	Unbestimmt	Becker 2011, Taf. 72.8; Schwarzberg 2011, Taf. 98.1	2	2	