

New evidence of contacts across the Baltic Sea: Analysis of Kukuliškiai Late Bronze Age pottery

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Abstract

The Late Bronze Age (1100–500 cal BC) has been the focus of many recent studies in the Baltic region. The contacts between societies in the Baltic Sea area are identified by bronze, amber, pottery and other artefacts, but there is still little evidence of contact between the western and eastern coasts. This article presents analysis of a pottery assemblage from the Kukuliškiai site (880–400 cal BC) (Lithuania) and its macroscopy and inductively coupled plasma mass atomic emission spectrometry (ICP-MA/ES) results. Macroscopic examination of the pottery revealed that the assemblage consists of various vessel surface types: smooth (41%), rusticated (11%), Kukuliškiai-Otterböte type (4.5%), striated (13%) and burnished (8%). The assemblage has more similarities with pottery in Scandinavia and northern Poland than with the eastern Baltic Late Bronze Age pottery.

The ICP-MA/ES analysis of a sample of sherds from Kukuliškiai has shown that the vessels were most likely made from partly different clays collected in the vicinity of the settlement. This pottery was locally made but the assemblage's composition and the presence of the Kukuliškiai-Otterböte pottery type (KOP) suggests intensive cultural exchange between the two sides of the Baltic Sea.

Introduction

The Late Bronze Age (1100–500 cal BC) has been the focus of many recent studies in the Baltic region. The questions of the emergence of fortified settlements, contacts between different regions and material culture have been thoroughly examined. The Bronze Age in the Baltic region marks significant changes in sociocultural and economic areas. The emergence of enclosed hilltop settlements in the southeastern Baltic is one of the main signs of changing relations and behaviour in Bronze Age societies.

These changes are identified through the analysis of various artefacts. As pottery is the most abundant artefact and is chronologically sensitive, it is one of the most suitable materials for investigating Bronze Age societies. In recent years, southeastern Baltic region Late Bronze Age pottery

has received more thorough analysis (Visocka 2022; Visocka and Podėnas 2022; Podėnas 2022; Muradian 2022; Podėnas et al. 2014). Scandinavian Late Bronze Age pottery has been and continues to be thoroughly studied. However, the archaeological research still lacks a consistent approach to and a material comparison of the whole Baltic Sea region. The contacts between societies in this region are identified through bronze, amber, pottery and other artefacts (Luchtanas and Sidrys 1995; Lang 2007; Jaanusson 1981; Reisborg 1989; Eriksson 2009). In particular, Lusatian influence is emphasised as one of the significant traits of Late Bronze Age Baltic coastal communities. Contact is detected through the spread of specific artefacts (glass beads, pottery) or decoration and technological motifs (e.g. burnished highly decorated

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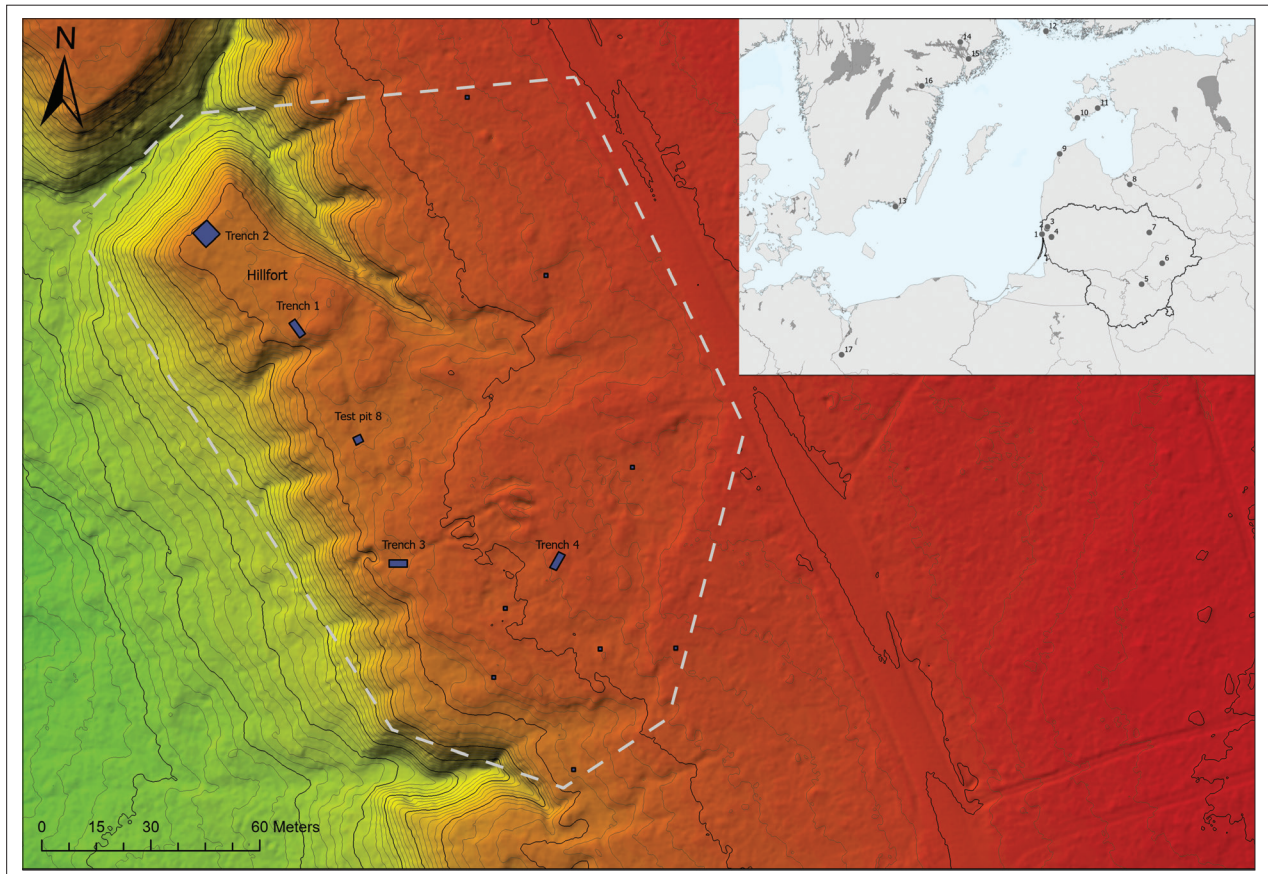


Figure 1. Location of the Kukuliškiai site and other sites mentioned in the article. Lithuania: 1. Kukuliškiai; 2. Padvariai; 3. Kurmaičiai; 4. Kvietiniai; 5. Kakliniškės; 6. Luokesai; 7. Kupiškis; Latvia: 8. Ķivutkalns; 9. Staldzeme; 10. Tehumardi; Estonia: 11. Asva; Finland: 12. Otterböte; Sweden: 13. Sturkö; 14. Apalle; 15. Hallunda; 16. Prysgården; Poland: 17. Chojna (map by Pranckėnaitė).

pottery, rusticated pottery). Scandinavian contacts have been identified in Latvia and Estonia: stone ship settings in Kurzeme and Saaremaa, and the hoards of Stalzene and Tehumardi (Visocka 2022, p. 162).

Kukuliškiai hillfort, and subsequently the hilltop settlement, was discovered recently on the Lithuanian Baltic Sea coastline and excavations revealed a thick, organic-rich cultural layer with buildings, wooden structures and an abundant collection of artefacts, including macrobotanical and osteological remains. Analysis of the pottery assemblage shows a strong foreign pottery-making influence mixed with local traditions, making this assemblage exceptional on the eastern Baltic coast (Fig. 1).

This article presents the pottery assemblage and its visual and ICP-MA/ES analysis results from the Kukuliškiai site and discusses contacts between the western and the southeastern Baltic areas in the Late Bronze Age.

1. Site information

The Kukuliškiai hilltop settlement is located on the edge of the Littorina Sea terrace, around 300 m from the Baltic Sea shore. The hilltop settlement's surface is uneven, with

World War II trenches and other 20th-century remains, and is around 1.98 ha in size. The complex is bounded by deep headlands and two streams, on the northern and the western sides. The southern part of the site is separated off by a deep ravine, while the western part is delimited by dunes. Today, the area is covered in dense forest, which has the status of a natural reserve, with endangered species of plants, mushrooms and small animals.

The geomorphological landscape of the Kukuliškiai area was formed by the last Ice Age, Littorina Sea transgressions, and later aeolian and erosion processes. The terrace stratigraphy consists of layers of aeolian sand and terminal moraine (different fractions of gravel and clays). The coastal geological structure consists of mixtures of shingle and gravel and of fine and coarse sand. The Kukuliškiai settlement is on a fringe between these two soil types.

Significant alteration of the landscape can be traced back to the 18th century. At that time, the northern coast of Lithuania was covered by a thick layer of the aeolian sand, which had drifted from the Curonian Spit. In the Kukuliškiai area, aeolian sand thickness varies from 10 cm to 4 m (Urbonaitė-Ubė 2022; Urbonaitė-Ubė et al. 2019). The latest geological research suggests that these aeolian

processes even changed the course of nearby streams and rivers (Bučienė et al. 2023, p. 59). The small streams around Kukuliškiai might have been rivers connecting the Baltic Sea and inner land before the sand drifts.

Due to complex landscape features, the Kukuliškiai hillfort was first discovered in the summer of 2016. Since then, archaeological excavations have taken place in 2017, 2018, 2020 and 2022. In 2018, the hilltop settlement was identified around the hillfort. The hillfort is on a northern cape and the settlement is on eastern and south-eastern hills surrounding the northern cape. In this article, the complex of hillfort and settlement is defined as a hilltop settlement because further investigations are necessary to identify the fortifications and connections of both elements.

During the four seasons of field survey, there were 68 m² excavated, 1346 artefacts collected, 141 boreholes drilled, and 34,000 m² of surrounding area scanned with GPR. Fifteen AMS ¹⁴C dates revealed that the site can be dated to 883–400 cal BC, i.e. Montelius periods V–VI and the Pre-Roman Iron Age (Urbonaitė-Ubė 2022, p. 279), and consists of one occupational layer. Archaeological layers are found under aeolian sand and are very well preserved, with no obvious traces of later disturbance. The cultural layer varies in different settlement areas in a few respects. On the northern cape, the layer is 0.25–0.8 m thick with poorly preserved organic material (bones, wood etc.), while in the remaining settlement, the cultural layer is more than 1 m thick (in trench 3, the thickness is more than 3 m) and is waterlogged, with abundant amounts of organic material – bones, wood, grass and other floral material.

2. Kukuliškiai artefact assemblage: A short introduction

The Kukuliškiai site's Late Bronze Age artefact assemblage is diverse and representative as it is probably the only single-layered site, and all the artefacts are dated to the period 880–400 cal BC. Therefore, a chronological typology of artefacts cannot be distinguished. This is also the case for other Bronze Age sites in Lithuania due to the lack of comprehensive archaeological material (Vengalis et al. 2020, p. 24).

During the 2017–2020 excavations, a total of 1062 artefacts were collected (excluding macrobotanical and zooarchaeological material; Urbonaitė-Ubė 2022), while during the 2022 season, 314 artefacts were collected. Pottery was the most abundant group of artefacts, while natural amber pieces were in second place (Fig. 2.1). Amber, and its importance in prehistory, is well analysed (Bliujienė 2007; Earle et al. 2023; Vankilde et al. 2024). There is a historiographic opinion that during the Bronze Age, the

importance of amber declined in the eastern Baltic region (Bliujienė 2007, p. 200) because there are only a few amber artefacts or raw fragments found in Bronze Age sites (settlements, burial sites). However, the example of Kukuliškiai suggests that amber was still an important part of everyday life in at least the Late Bronze Age. The importance of amber can also be confirmed by the fact that in trench 3, six big pieces of amber were found squeezed among the palisade posts (Urbonaitė-Ubė 2021, p. 137; Urbonaitė-Ubė 2022 p. 281, Fig. 16.10). People living at the Kukuliškiai settlement may have deliberately hidden the amber pieces and the amber was most likely deposited in the earth as treasure. This suggests the high value of amber in this society. The lack of processed amber also suggests that raw amber could have been used as an object of trade and exchange. Amber was most likely one of the most important materials in the trade from the eastern Baltic region during the Bronze Age, and this has been proposed in several studies (Čivilytė 2014; Bliujienė 2007; Lang 2007). The correlation between the provenance of bronze and amber has also been confirmed (Ling et al. 2014), and therefore there is a possibility that amber was a trading object in Kukuliškiai, and may have been traded in return for bronze.

Evidence for bronze casting is present at the Kukuliškiai site. In trench 1, during excavations in 2017, a crucible leg was found, which is a unique artefact in Lithuania. The nearest analogue is from Kivutkalns in Latvia, where a three-legged crucible was found (Podėnas and Čivilytė 2019, p. 181). In 2022, three crucible fragments and four casting moulds were revealed in test pit 8. All the crucibles had traces of melted metal and the fabric had been affected by very high temperatures. The moulds were used to cast long, narrow objects, such as neck rings or wire. The raw bronze material may have been obtained from the Alpine region. Studies have posited that the overlapping of bronze artefacts with Scandinavian ones indicates the strong circum-Baltic connections (Čivilytė et al. 2023, p. 630; Sperling 2016, p. 116) and that some artefacts could have come directly from Scandinavia (Podėnas and Čivilytė 2019, p. 183).

Wooden and stone artefacts comprise only 10% of the assemblage. The most important wooden artefacts were uncovered in the summer of 2022, when a spoon bowl, pine bark float and two-pronged hanger were revealed in trench 4. The stone tools are comprised of grinding stones and one fragment of a polished stone axe. Only a few bone artefacts were found, and this group mainly consists of clothing pins and working tools such as an awl. All of these artefacts are closely related to locally adapted subsistence activities, while pottery, as this article will attest, can be treated as a cultural identity indicator.

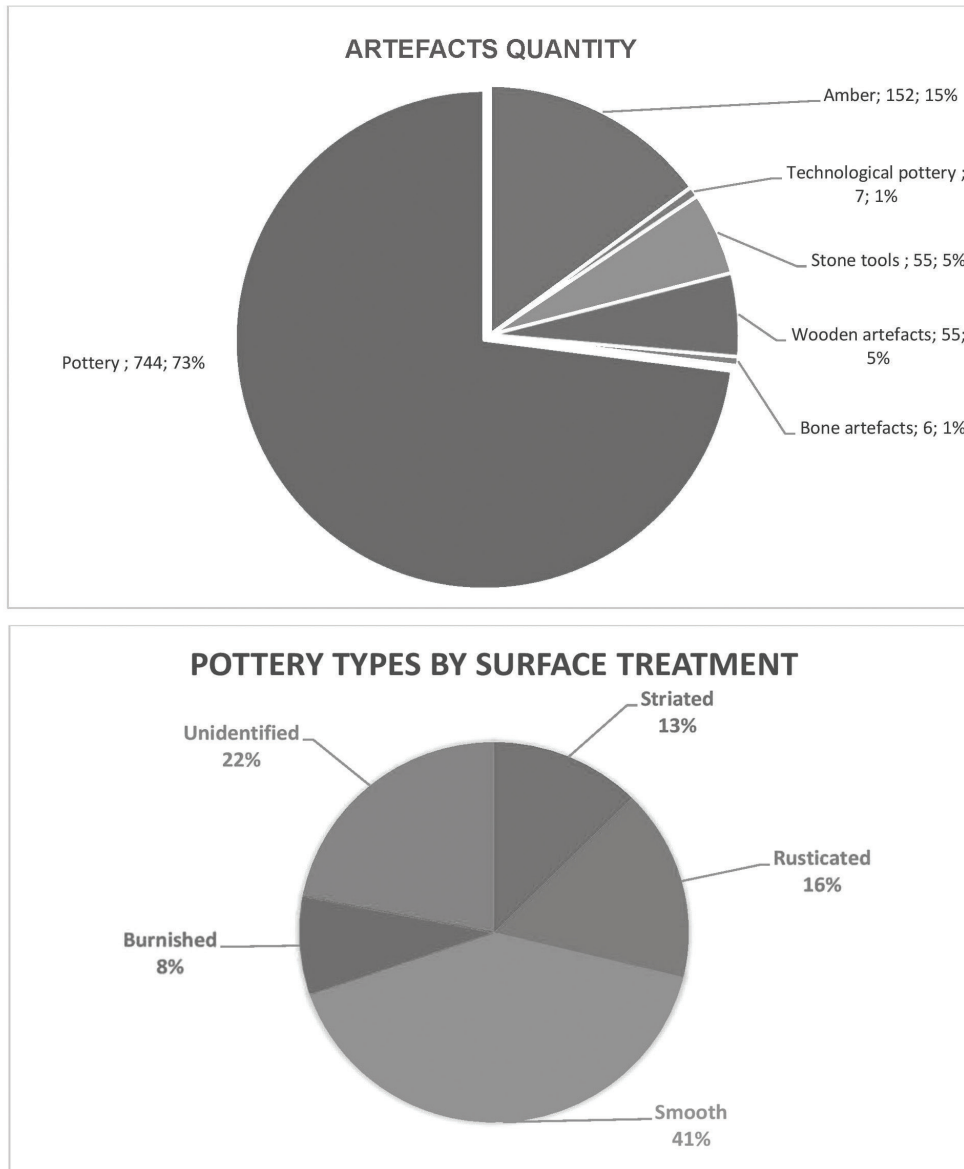


Figure 2. 1. Artefact distribution by type; 2. Pottery types by surface treatment (diagram by Urbonaitė-Ubė).

3. Late Bronze Age pottery in the south-eastern Baltic region

Late Bronze Age pottery types in the Baltics are usually distinguished by their surface treatment. Common types are striated, rusticated, smooth or burnished/polished surface pottery. These types are common for Late Bronze Age Lithuania, and also at the Kukuliškiai site. However, the quantity and distribution differ from region to region in the southern Baltic, including in Lithuania. Striated pottery was the most common type of vessel surface during the period 880–400 cal BC in eastern Lithuania and Latvia, and it was attributed to the Striated Ware culture (which encompasses eastern Lithuania, southern Latvia and northwestern Belarus) (Luchtanas 1992; Grigalavičienė 1995). The ceramics in the coastal part of Lith-

uania and southern coast of Latvia differed from this and were more influenced by southern (Semba Peninsula, Lusatian culture) and western (Scandinavia) cultural regions (Grigalavičienė 1995; Visocka 2022; Visocka et al. 2022). Here, pottery assemblages consisted of striated, rusticated and smooth surface pottery, with no obvious types predominating. One of the indicators of cultural differences is the appearance of rusticated and smooth surface pottery, which is primarily found in the western part of Lithuania (Visocka 2022; Podėnas 2022, Grigalavičienė 1995, p. 242) and to a lesser extent in eastern Lithuania (Luokesai lake settlement, Kakliniškės site, Kupiškis (Aukštupėnai) hillfort) (Pranckėnaitė 2012; Vengalis et al. 2022; Simniškytė-Strimaitienė 2019). The new AMS ¹⁴C dates from western Lithuania (Padvariai barrow, Kurmaičiai hilltop settlement) (Muradian 2022, p. 172; Podėnas et al. 2023) suggest that the appearance of rusticated pottery can be

dated to as early as 880–400 cal BC and might have affected the wider area rather than just isolated sites as previously thought. The same tendency applies to the whole eastern Baltic region – rusticated pottery first appears on the coast and in the Daugava River basin and then spreads deeper into the continent but to a smaller degree (Visocka 2022, p. 162).

In contrast, rusticated pottery was the most common type in assemblages in the western Baltic region during the Late Bronze Age (Jaanusson 1981; Björhem and Säfstestad 1993; Gustavsson 1997a; Eriksson 2009). However, striated pottery has also been found at several dwelling sites in this region, although the number of sherds is normally very small. Striated pottery in Sweden is mostly found in the east, and some of the more well-known sites are Apalle, Pryssgården and Hallunda (Eriksson 1997, p. 89; Stålbom 1998, p. 102; Jaanusson 1981). In Sweden, striation is connected with an increasing eastern influence from the Baltic countries, Russia and/or Finland (Eriksson 2009, p. 128, Fig. 137). The hypothesis regarding the eastern influence has also been put forward from a Baltic perspective (Visocka 2022, p. 145). In the eastern Baltic, rusticated pottery was the dominant type used in burial practices, but smooth surface and striated pottery are found as well, although in much smaller quantities (Merkevičius and Muradian 2021, p. 43). Interestingly, one rusticated urn with finger furrows from the Padvariai burial mound was identified in recent research (Muradian 2024 p. 130; Merkevičius and Muradian 2021, p. 43, Fig. 5). This means that pottery with finger furrows is found in Lithuania not only in settlements but also used in burial practices. And it also shows the necessity for new studies of artefacts and a re-evaluation of the pottery chronologies.

One of the biggest problems with pottery assemblages of this period in the eastern Baltic region is that there is no comprehensive typological sequence, therefore, a typolo-

gy cannot be created to distinguish different chronological phases in the settlement (Vengalis et al. 2020, p. 24), especially when assemblages lack other chronologically identifiable artefacts such as decorated bronze items. Thus, in this article, a typology of the Kukuliškiai site is created based only on visual aspects, with no internal chronological divisions. This type of typology might be useful in the future for filling gaps in Bronze Age typology, chronology and the identification of cultural influences.

4. Material and methods

4.1. Kukuliškiai pottery

4.1.1. Distribution

Pottery finds are the most abundant artefact type at the Kukuliškiai site. During three seasons of excavations, 744 fragments of pottery have been collected (Table 1). Most of the pottery was collected on the northern cape (hillfort) (465 sherds, excavation trenches 1 and 2; Fig. 3). More pottery was found in the living areas, such as in houses or structures related to domestic use (pits, hearths). The quantity of pottery was dense in trench 1 from squares 2A–B to 4A–B, where the internal space of the wooden house with a hearth was and a rich cultural layer (Urbonaitė-Ubė 2022, p. 276).

In trench 2, the inside of a house was excavated, but due to bioturbation and erosion most of the cultural layer was gone and pottery was mainly collected from structures in the subsoil (Urbonaitė-Ubė 2022, p. 278), while in trench 3 and test pit 8, pottery was rather scarce, with only a few larger concentrations. This is likely due to the fact that these excavated areas would have been associated with activities such as melting of metals, wood processing or similar crafts.

Table 1. Pottery types by excavation trench (Urbonaitė-Ubė).

Pottery type	2017	2020		2022		Total no	Total %
	Trench 1	Trench 2	Trench 3	Trench 4	Testpit 8		
Striated	25	37	14	8	6	90	12
Striated and smooth	1		2			3	0,4
Rusticated	50	5		18	7	80	10,7
Kukuliškiai-Otterböte type			10	10	14	34	4,5
Rusticated and striated	4	1				5	0,67
Rusticated and burnished			2			2	0,26
Smooth	44	163	23	55	19	304	40,8
Burnished	5	10	18	25	4	62	8,3
Unidentified	54	66	26	9	8	163	21,9
	183	282	95	125	59	744	100

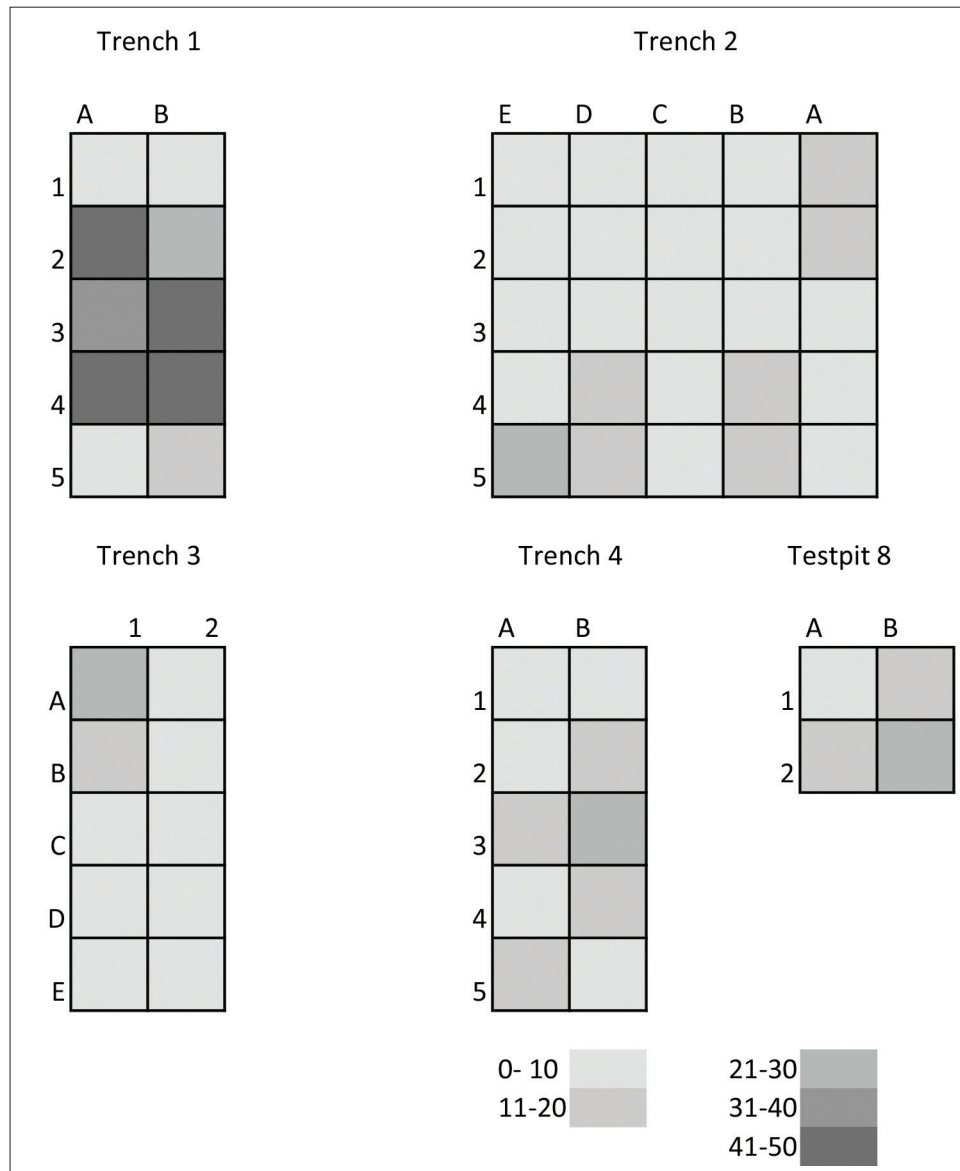


Figure 3. Pottery distribution by quantity (sherds number) in excavated trenches (drawing by Urbonaitė-Ubė).

4.1.2. Classification and fabric

The Kukuliškiai pottery can be categorised into four surface types: striated, rusticated, smooth surface and burnished/polished. There are also hybrid variants of pottery where two surface treatments are used on one vessel. There were few sherds with rusticated and striated surfaces found in 2020 (Fig. 4).

Except for the burnished/polished vessels, all the ceramics from the site had been fired in unstable conditions in bonfires or in hearths. The even colour of cores and surfaces of the burnished/polished pottery indicate more stable atmospheric and more controlled firing conditions than for other types. Macroscopic studies of the ceramics have shown that granite with red feldspar (Fig. 5.9) was commonly used in various types of pottery, but no particular tendencies could be gleaned from the different

inclusions. Interestingly, in test pit 8, raw clay pieces with red granite inclusions were found (Fig. 5.15). These clay pieces were surely the raw material for ceramics, which would have been brought to the site from somewhere else in the region. Future excavations may reveal more information about the micro-zoning of the settlement site of Kukuliškiai concerning the possible location of pottery production.

The most common type of surface on the pottery is smooth (41%) (Fig. 2.2, Table 1), while striated and rusticated pottery comprise one-third of the assemblage. In total, 22% of the sherd surfaces could not be determined due to fragmentation or surface erosion. Ceramic vessels with smooth as well as rusticated surfaces are more common in the coastal and western settlements in the eastern Baltic (Podėnas 2022, p. 199). Striated pottery dominates

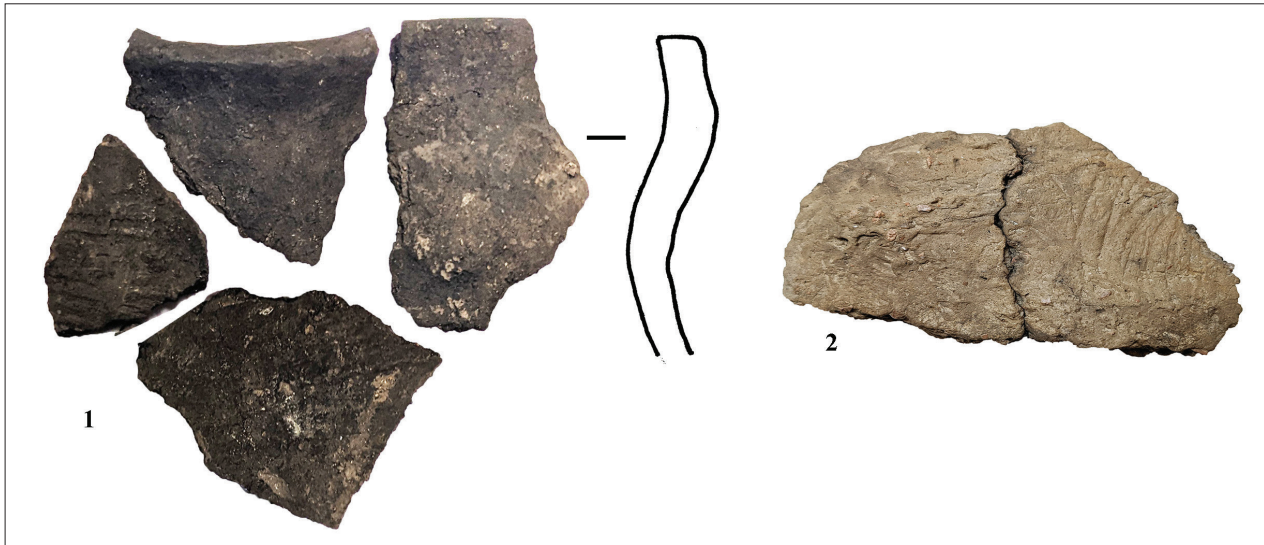


Figure 4. Examples of hybrid pottery types. 1. Smooth-striated vessel; 2. Rusticated-striated pottery (photograph by Urbonaitė-Ubė).

in eastern and northern Baltic regions, while other types are found in lesser amounts or are even absent (e.g. rusticated or rusticated with furrows). The differences in the distributions of the vessel surfaces may be due to more intensive cultural and economic contacts in coastal areas (Grigalavičienė 1995).

4.1.3. Surface treatment

Striated pottery comprises 13% of all pottery fragments at Kukuliškiai (Fig. 5.1, 11, 12). Striations were made when smooth vessel surfaces were rubbed in different directions with grass or other grass-like materials. A few sherds had horizontally striated interior surfaces, but most vessels had a smooth interior. Striated pottery has a coarse-grained fabric with inclusions of poorly sorted crushed granite. The shape of the vessels cannot be determined, and the reason for this is that most of the sherds are small and lack characteristic attributes. The thickness of the sherds varies from 9 to 15 mm. Striated pottery is much more common in eastern Lithuania and the finds in the Baltic area are interpreted as traces of an eastern Baltic influence, originating from the Baltic countries, Russia, Belarus and perhaps Finland (Eriksson 2009, p. 128).

Rusticated pottery (in Lithuanian historiography often known as fine-rusticated pottery (Vengalis et al. 2020; Vengalis et al. 2022; Piličiauskas et al. 2022)) is the most diverse group of all the Kukuliškiai pottery types. The rusticated surface was made by an additional layer of clay applied to the dried vessel. The rustication varies from fine to lumpy (Fig. 5.2–7, 14).

Rustication can be categorised into a few types of this surface treatment. Around 66% of fragments have plain

rustication, 28% have furrows and 6% can be attributed to hybrid variants with rusticated and striated or polished surfaces. Interestingly, the clays that were intended for rusticated vessels with furrows did not contain any granite with inclusions of red feldspar. For now, it is hard to tell if this is coincidence or a pattern of unique Kukuliškiai pottery production.

One plain rusticated vessel had a knob on the rim (Fig. 5.4). This is the only vessel with such a feature. The oval knob was manufactured directly on the rim, probably from the same lump of clay as the vessel and then decorated with rustication. The knob protrudes approximately 8 mm and is 12 mm in length. Gustavsson (1997a) suggested that knobs are associated with vessel function. Knobs might have been used as a handle or to attach a cover for the vessel. Interestingly, pottery with knobs found at the Otterböte site (Åland Islands, Finland) was exclusively connected to rusticated vessels (Gustavsson 1997a, p. 58). Vessels with handles or knobs are very rare in the eastern Baltic (Sperling 2014, p. 222). Rusticated pottery from Kukuliškiai is generally the same as that found in all of the western Baltic region, as for instance in Sweden (Björhem and Säfvestad 1993, p. 45), and has no specific traits.

Rusticated vessels with finger furrows are a distinct type of pottery common in Scandinavia and northern Poland during the Late Bronze Age. In Scandinavia, this type of pottery was first described at the Otterböte site, where it comprised the largest part of the pottery assemblage. Otterböte settlement was a seasonal seal hunting site dated to 1300–900 cal BC. The extensive excavations there took place in the mid-20th century, during which nine ring-shaped stone huts, six hearths, six refuse pits and a water hole were discovered. The thorough artefact analysis by

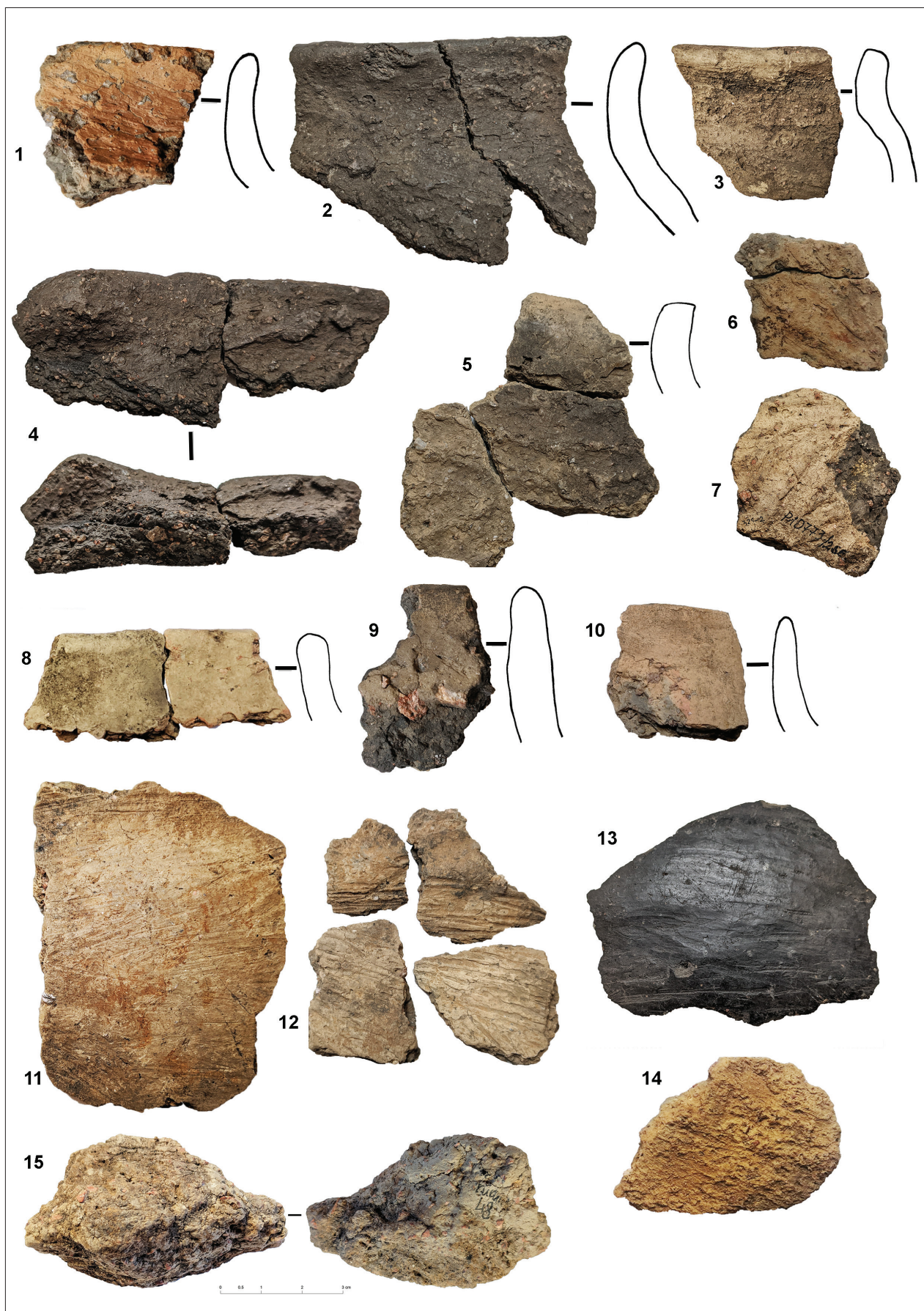


Figure 5. Kukuliškiai pottery examples: 1., 11.–13. Striated pottery; 2.–4., 14. Rusticated pottery; 5.–7. Kukuliškiai-Otterböte type pottery; 8.–10. Smooth surface pottery; 13. Burnished/polished pottery; 15. Raw clay used for pottery making found in test pit 8 (photographs by Urbonaitė-Ubė).

Kenneth Gustavsson (1997a) led to new interpretations of the Lusatian culture influence. According to Gustavsson, it may have been a community of seal hunters that came to the Åland Islands from Lusatian culture territory (Poland) and brought rusticated pottery with finger furrows with them, because the majority of furrowed vessels were large pots, used for storage and/or cooking. However, this hypothesis of Lusatian people travelling along the Baltic coast was never elaborated and no further supporting facts were added.

The classification of the mentioned material has been followed by others and nowadays vessels with finger furrows are often referred to as Otterböte type pottery. Furrowed vessels can be found in Sweden, Denmark and Finland, and their cultural significance in the Baltic region has already been noted (Gustavsson 1997a, p. 68; Eriksson 2009, p. 121). The origin of rusticated vessels with finger furrows is connected to the Ūnėtice culture and this type of surface treatment remains a common feature during the Bronze Age of Lusatian and Scandinavian pottery (Eriksson 2009, p. 121).

Petrographic analysis conducted on sherds from Otterböte in Åland and from Chojna in Poland showed similarities, indicating that the vessels were made of raw materials from the same region (Hulthén 1997). Gustavsson identified these results with the same type of fabrics in the ceramics of the seal hunters from northern Poland who travelled along the Swedish coastline to Åland for seal hunting during the wintertime (Gustavsson 1997a, p. 128). He based his hypothesis on the idea that Otterböte type pottery was only found in a narrow coastal zone along the Danish islands, Scania, the Swedish east coast and the Ålands (Gustavsson 1997b, p. 197). However, this interpretation requires revision because new data from Scandinavian Late Bronze Age sites suggests that rusticated pottery with finger furrows was more widely spread. For example, rusticated pottery with finger furrows was identified in Kvietiniai (Vengalis 2016, p. 344), Padvariai settlement (Jablonskis 1976, p. 11) and Padvariai burial mound (no. 1 urn, Muradian 2024, p. 45). These examples show that furrowed pottery probably existed in a broader area, but that it was not properly identified and its distribution was underestimated.

One important Bronze Age dwelling site with finds of several rusticated vessels with finger furrows is Sturkö in the Karlskrona archipelago in southeastern Sweden, on the other side of the Baltic Sea from Kukuliškiai. The material from here differs from that of ordinary Bronze Age settlements in southern Sweden, with finds of rusticated vessels with finger furrows, several burnished/polished bowls and cups and vessels with decoration. However, although it seemed likely that they were produced elsewhere, ICP analysis of four pot sherds from Sturkö showed that the

ceramic vessels were actually made locally (Borsson 2022, p. 57). A similar situation is identified at Kukuliškiai.

Rusticated pottery with finger furrows has not previously been identified in archaeological sites in Lithuania and the eastern Baltic region. Therefore, in this article it is called Kukuliškiai-Otterböte type (KOP) pottery as ICP-MA/ES analysis showed it was made locally. As was previously mentioned, the KOP assemblage consists of 80 pieces, mostly found in the settlement territory. In some literature, the furrows are regarded as decoration (Gustavsson 1997a, p. 51). They are generally applied horizontally to the rim, followed by vertical ones, and sometimes then followed by a few horizontal furrows near the base. Furrow decorations can be divided into horizontal and vertical. In most cases, their direction is hardly identifiable due to the small size of the Kukuliškiai pottery pieces. However, there are examples of vessels with a smoothed rim and horizontal vertical furrows (Fig. 5.5, 7). It is worth noting that some examples of Lusatian pottery display the same surface treatment as mentioned here, with furrows that appear on a lower part of vessel and a rim that is smooth or even polished (Muzolf 2002, p. 190).

Based on the diameter of rims and bases (Table 3), KOP type vessels were larger in volume than others, with thick walls (8–16 mm), and contained a considerable amount of food remains on the inside surfaces. They were probably used for food preparation, fermentation and/or storage. Interestingly, furrows only appear on large rusticated pots both in the Lusatian territory and in Scandinavia (Durczewski 1985; Jaanusson 1981, p. 121). Even though Lusatian rusticated pottery was very diverse and differed between regions and even sites, some tendencies can be distinguished. Lusatian rusticated pots with finger furrows were S-rim type vessels and some of them also had knobs near the rim as at Kukuliškiai (Durczewski 1985, p. 113, Table 10). These morphological and decorative features correspond with Kukuliškiai pottery. It might be assumed that these pots were actually used as storage containers when travelling because the similarities of these types of pots in the southwestern and western Baltic are remarkable.

Smooth surface pottery comprises 41% of all pottery found in Kukuliškiai and is the most abundant type. Coarse-grained ceramics were fired in an unstable atmosphere, with poorly sorted crushed granite used as temper. The thickness of sherds varies from 6 to 15 mm. It should be noted that this group might be over-represented since the majority of the rims are too small to contain more surface treatment types than smoothing. In other cases, there have been different treatments further down the vessel body.

Burnished/polished pottery is described as smooth surface pottery which had often been burnished, and its surface polished. Only one sherd was not burnished and was

fired in an oxidised atmosphere (Fig. 5.13), while the others were burnished and polished. It is fine-grained ware and the temper added to the clay is well-sorted sand or well-sorted granite. Therefore, the walls of the vessels are thinner (3–5 mm) than in rusticated or other types, which might vary from 5 to 8 mm to as much as 12 mm in thickness. Polishing may have been done horizontally with a wooden stick, as presented in the figure below. However, polishing may have also been done with a smoothing stone (Botwid 2017, p. 75).

In other contemporaneous sites, burnished/polished pottery also constitutes a small percentage of all pottery assemblages (Visocka et al. 2022, p. 11). Burnished/polished vessels are associated with tableware (also defined as fineware), such as cups and plates, and were probably used by higher-status people (Lang 2007, p. 129).

4.1.4. Forms and volumes

The dominant rim profile shapes in Kukuliškiai pottery were S and I types (Table 2). The S-profile type vessel is defined as a strongly profiled vessel with everted rim (Fig. 4.1–3, 6) and the I-profile type is a barrel-type vessel (Fig. 4.8–10) with straight or slightly outward-sloping rim.

Rusticated vessels had mainly S-type profiles; the other groups do not show significant distinctions as regards profile shapes. There are no major correlations between pottery types and rim profile. However, the KOP type is under-represented, while the smooth surface pottery type might be over-represented due to the small size of sherds and unknown surface treatment of the lower part of vessels.

Table 2. Rim profile shapes by pottery type (Urbonaitė-Ubė).

	S	I	Unidentified	Total
Striated	7	5	2	14
Rusticated	10	5	1	16
KOP	2	0	1	3
Burnished/polished	1	1		2
Smooth	15	16	8	39
Total	32	27	12	74

Only a small portion of the ceramics (39 sherds, 5%) offer information about the sizes of vessels used at Kukuliškiai. The diameters of the rims vary from 10 to 22 cm, and the bases between 5 and 20 cm. Unfortunately, it was not possible to determine the height of the vessels, and the shape

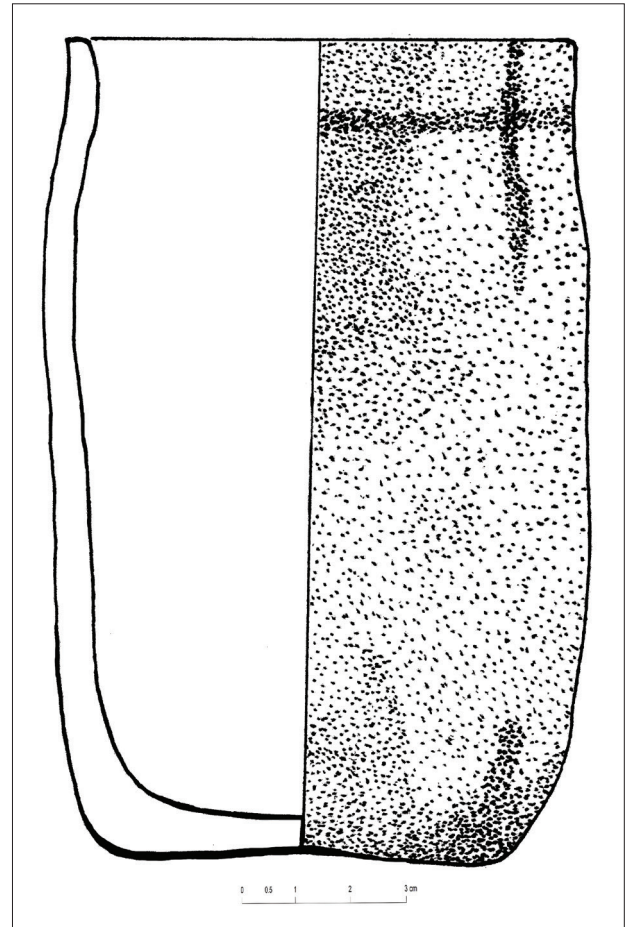


Figure 6. Reconstruction of small vessel with smooth surface (drawing by Urbonaitė-Ubė).

of the vessels is also still unknown. However, the profile of one vessel with smooth surface could be reconstructed (Fig. 6). Sherds from this vessel were revealed shattered in trench 4, and the vessel was 14 cm in height with a base diameter of 7 cm. It has been classified as a small jar, and this vessel type was not typical of the Kukuliškiai material. The rims of the striated and the smooth surface pottery and the size of the bases are also quite similar, however, the rusticated vessels are clearly distinguished from the other types.

The KOP group is notably distinct. The average size of rim diameter is 17 cm, while other groups vary from 13 to 14 cm (Table 3). This might suggest that vessels were of a larger volume. It is worth noting that a lot of food remains were found inside of KOP type vessels, which also suggests that this group was used for food preparation, fermentation or storage. Of course, food remains were found in other types of pottery, but to a lesser extent, and in trenches 1 and 2 remains were very rare. This was due, however, to the overall poor survival of organic materials in this part of the settlement.

Table 3. Diameters of rims and bases according to pottery type (Urbonaitė-Ubė).

Pottery type	Number of rims	Minimum and maximum diameter (cm)	Number of bases	Minimum and maximum diameter (cm)
Striated	5	7–20	1	10
Rusticated	5	10–26	1	7
KOP	3	15–22	3	11–15
Smooth	12	8–19	9	5–12

4.2. ICP-MA/ES analysis of pottery sherds from Kukuliškiai

In order to determine the geographical origin of five of the vessels, ICP-MA/ES analysis was performed. The material covered different types of vessels with different surface treatments. One of the samples can be classified as fineware with a burnished surface (Kukuliškiai1) (Fig. 5.13). Three of the sherds were rusticated (Kukuliškiai2, Kukuliškiai3, Kukuliškiai5) (Table 4, Fig. 5.14) and sample Kukuliškiai2 had finger furrows on the rusticated surface and can be classified as KOP type. Finally, a striated vessel (Kukuliškiai4) (Fig. 5.11) was analysed as well.

The vessels were compared with four clay samples from Kukuliškiai. Two of the samples were collected at the seashore, on an eroded slope, about 1.6–1.7 km from the hilltop. The location of these samples was chosen because local potters take clay from these slopes to make pottery. The assumption was made that as this clay is suitable for pottery building, it might have been used in the Bronze Age as well. Previous research in hilltop settlement pottery production in eastern Lithuania suggests that nearby

clay deposits were used to make pottery (Podėnas et al. 2014, p. 213; Visocka et al. 2022, p. 167) Therefore, two other samples were collected from the slope of a hill in the north of the settlement. The clay was found approximately 70 cm below the surface, under the forest soil and aeolian sand layers.

For the present analysis, the amount of 12 different elements was measured, namely aluminium, chromium, gallium, manganese, vanadium, calcium, magnesium, strontium, cerium, lanthanum, sodium and cobalt. The selection is based on previous experience that demonstrated a reliable discriminating processing (e.g. Thompson and Walsh 1989). The basis for the analysis is that clays and soil from different areas consist of different chemical compositions and those that are similar are from the same site or area. The analysis was carried out at OMAC Laboratories Ltd., Ireland, while the comparative analysis, statistical processing and interpretation was conducted by this article's co-author Torbjörn Brorsson. The results are presented in Table 4.

Thin section analysis of pottery from several Bronze Age sites in Sweden and the Åland Islands has been undertaken since the 1970s. By this method, it is possible to determine whether the choice of clay and temper material used for the pot and vessels made from the same type of raw materials may have been from the same production site. However, a major problematic aspect of the sources is that the soils and rocks are very similar throughout northern Europe and it is not possible to use the mineralogical composition to determine the provenance of the ceramics. For this purpose, a chemical method is necessary, and this is one of the main reasons why ICP-MA/ES was used on the Kukuliškiai pottery.

To be able to determine geographic origin, results need to be compared with reference data from other analysed sites. This data was collected from the extensive database of Ceramic Studies, Sweden, which currently contains

Table 4. Results of the ICP-MA/ES analysis of the pottery and clays from Kukuliškiai (Brorsson).

Sample	Al	Ca	Ce	Co	Cr	Ga	La	Mg	Mn	Na	Sr	V
	%	%	ppm	ppm	ppm	ppm	ppm	%	ppm	%	ppm	ppm
Kukuliškiai1	7,18	0,81	98,9	10,8	68	20,7	47,6	0,78	252	0,85	123	71
Kukuliškiai2	7,63	0,65	109	10,2	88	20,6	52,1	0,88	551	0,58	141	73
Kukuliškiai3	7,88	0,65	114	11,3	78	22,7	52,6	1,07	728	0,7	118	75
Kukuliškiai4	7,24	0,96	100	8,2	73	20,3	47,1	0,77	463	0,94	190	63
Kukuliškiai5	7,31	0,74	121	10,8	58	20	56,5	0,73	286	1,02	111	61
Kukuliškiai6	4,34	5,53	50,1	7,4	37	10,8	24,5	1,44	425	0,48	115	48
Kukuliškiai7	4,21	5,59	51,6	7,6	37	10,5	24,9	1,42	462	0,44	106	47
Kukuliškiai8	4,78	9,09	63,6	9,5	43	12	31,1	1,9	720	0,52	141	55
Kukuliškiai9	4,87	0,43	70	9,6	43	12,7	31,4	0,57	287	0,54	72,8	54

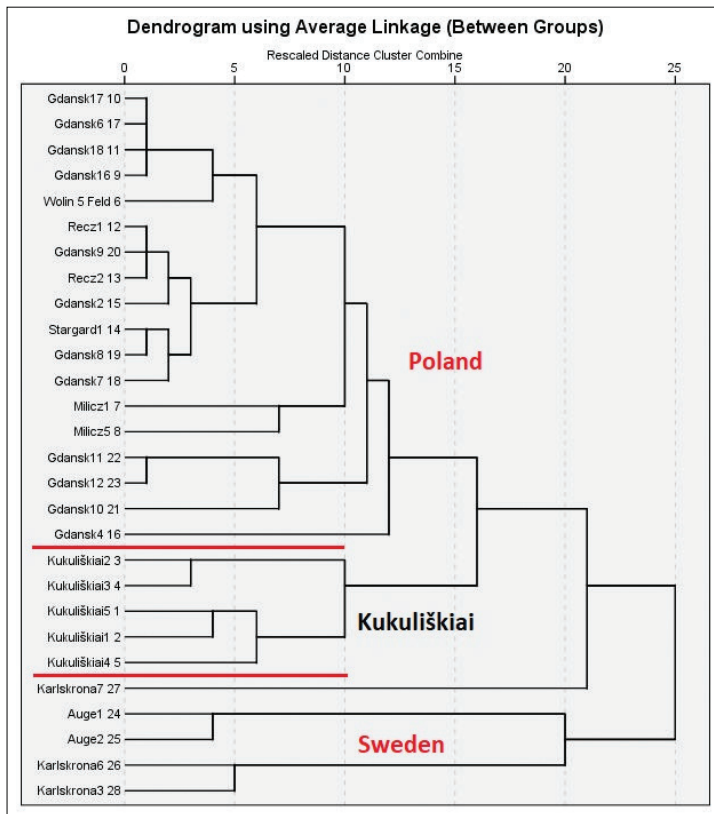


Figure 7. Comparative analyses of pottery samples (Brorsson).

information from almost 14,000 unique sites in northern Europe. The reference material consists of waste materials from kiln sites, raw clays and different types of ceramic materials from archaeological excavations. In this case, comparisons were made with material from Latvia, Estonia, Finland, Sweden, Denmark, Poland and Germany.

The ICP analysis of the ceramic vessels and the raw clays from Kukuliškiai has shown that the vessels were not made from the raw clays that were collected in the vicinity of the hilltop. The difference in the chemical composition is most likely due to the coarseness of the clays, and the raw clays may consist of different inclusions than those in the clays used for the pottery.

The vessels are divided into three groups according to the chemical composition of the fabrics (Fig. 7), which may reflect different areas where the raw materials were collected. Samples Kukuliškiai2 and Kukuliškiai3 are identical, and these two vessels were made of clays and temper materials that were collected at the same site. Both vessels had a rusticated surface but one of the samples also had finger furrows. The samples Kukuliškiai1 and Kukuliškiai5 are also identical, and these two vessels were also made from raw material from one site. Sample Kukuliškiai4 is similar to these, and this vessel was made from materials collected near to the source of the others. The chemical differences between the vessels are not that great and it seems very likely that all five vessels were made from raw materials that were collected in the same region. The interpretation of the origin of

the vessels is that they were made from clays that were collected somewhere in the region, and it may not have been very far from the settlement at Kukuliškiai. It is worth mentioning that identification of the clay deposits used is very difficult due to the thick (up to 3–4 m in depth) aeolian sand layer which covers surrounding areas (Urbonaitė-Ubė 2022, pp. 272–273).

Conclusions

The analysis of the Kukuliškiai hilltop settlement revealed that this community used a variety of pottery types: striated, smooth surface, rusticated and burnished. A new Kukuliškiai-Otterböte subtype of rusticated pottery was distinguished according to finger furrows on a rusticated surface.

The ICP-MA/ES analysis of a selection of sherds from Kukuliškiai has shown that the vessels were most likely made in the vicinity of the settlement. Unfortunately, a precise clay source has not been identified yet and the search for possible sources is challenged by aeolian sand layers. Even though all the pottery was made locally, based only on assemblages analysed with ICP-MA/ES, the Kukuliškiai pottery assemblage is more similar to south-eastern Scandinavian and the Åland Islands pottery than to that from southern Sweden and Denmark.

This community mainly used multifunctional vessels, particularly pots. Due to the small size of vessel fragments,

only pots and one small jar with smooth surface were identified. The KOP group consisted of large-volume pots with food crusts inside. They would have been used for cooking and storage. The KOP and other types of pottery was not decorated at all. The lack of decoration on all types of pottery corresponds with Scandinavian Late Bronze Age pottery traditions (Jaanusson 1981, p. 121). In comparison, Lusatian pottery was mainly decorated with different ornaments, and only small groups of pots or jars were left plain.

Burnished/polished vessel forms could not be identified, but they can be attributed to fineware. Cups and small jars with handles were produced from this fine-grained fabric. This suggests that the same community used very different technological and stylistic types of vessels.

The low percentage of striated pottery is a common trait for the western Baltics, but not for the eastern Baltics. Striated fragments constitute only 13% of the Kukuliškiai assemblage, while, for example, striated pottery comprises more than 70% of the assemblage in Ҷivutkalns, and in Narkūnai (eastern Lithuania) more than 90% (Visocka et al. 2022, p. 169, Fig. 5). The lack of striated pottery in the Kukuliškiai assemblage shows that rusticated and smooth surface pottery was dominant here and that corresponds with western and southwestern Baltic pottery assemblages. The pottery assemblage differs from many other Late Bronze Age assemblages in Lithuania and in the southeastern Baltic region in general. Discovery of the Kukuliškiai site also expands the territory of Otterböte type pottery distribution.

Cultural and technological connections with the western Baltic area are also visible at Kukuliškiai in terms of agriculture (Minkevičius et al. 2020) and other artefacts (e.g. crucibles, amber; Urbonaitė-Ubė 2022). And this supports the hypothesis that the Kukuliškiai community had strong and active contacts around the Baltic Sea and adopted foreign elements into their daily lives, and was part of a Late Bronze Age circum-Baltic network.

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Abbreviations

Archaeol. Anthropol. Sci – Archaeological and Anthropological Sciences

AAOA – Archaeology and Anthropology: Open Access

Archaeol. Baltica – Archaeologia Baltica

Arch. Lituana – Archaeologia Lituana

Archaeol. Sci. Rep – Journal of Archaeological Science: Reports

ATL – Archeologiniai tyrinėjimai Lietuvoje/Archaeological Investigations in Lithuania

Estonian J. Archaeol – Estonian Journal of Archaeology

Liet. Archeol. – Lietuvos Archeologija

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Naujausi duomenys apie Baltijos jūros kontaktus: vėlyvojo bronzos amžiaus Kukuliškių keramikos analizė

Miglė Urbonaitė-Ubė, Torbjörn Brorsson

Santrauka

Baltijos jūros regiono vėlyvojo bronzos amžiaus (1100–500 m. pr. Kr.) problematika yra vis dar aktuali ir nuolat naujų duomenų sulaukianti tyrimų sritis. Bendruomenių tarpusavio ir prekybinius ryšius atskleidžia įvairių artefaktų (bronzinių dirbinių, gintaro, keramikos) tyrimų rezultatai. Tačiau tai labiau sporadiški paminėjimai, bet tam tikrų radinių grupių įvairiose Baltijos regiono vietose platesnio palyginimo vis dar trūksta.

Šis straipsnis pristato Kukuliškių kalvos gyvenvietės (880–400 m. pr. Kr.) keramikos komplekso tyrimų rezultatus ir elementinę keramikos fragmentų sudėtį, naudojant ICP-MA/ES (induktyviai susietos plazmos masių išėigos spektrometriją) (1 pav.). Vizualinis keramikos tyrimas parodė, kad kompleksą sudaro keramikos fragmentai su įvairiu paviršiaus apdirbimu: lygiu paviršiumi (41 %), kruopėtu (11 %). Kukuliškiai-Otterböte (KOP) tipo keramika (4,5 %), brūkšniuotoji (13 %) ir gludinta (8 %) (2–6 pav., 1–3 lentelės). Komplekso sudėtis pagal paviršiaus apdirbimą rodo, kad jis panašesnis į Skandinavijoje ir Lenkijoje aptinkamus nei rytinio Baltijos kranto keramikos kompleksus. Taip pat svarbu paminėti, kad kruopėtoji keramika Lietuvos teritorijoje atsiranda anksčiau, nei manyta – Kukuliškių bendruomenės gyvenimo laikotarpiu, o ne I tūkstantmečio pr. Kr. pabaigoje, kaip buvo manoma iki šiol.

ICP-MA/ES analizė atskleidė, kad Kukuliškių keramika buvo gaminta vietoje iš kelių skirtingų molio šaltinių, kurie turėjo būti greta gyvenvietės (7 pav., 4 lentelė). Deja, molio šaltinių nustatyti nepavyko. KOP tipo keramikos buvimas ir kiekis rodo intensyvius kontaktus su kitomis Baltijos jūros bendruomenėmis, ypač Skandinavija ir galbūt šiaurine Lenkija.