NOTES ON THE CULTURAL PROCESS IN THE LATE BRONZE AGE FINAL STAGE IN EASTERN UKRAINE: INSIGHTS FROM CERAMIC TECHNOLOGY

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Introduction

The transition from the Late Bronze Age (LBA) to the Early Iron Age (EIA) in Eastern Europe is considered as a separate stage – the 'transitional', or 'final' period of the Late Bronze Age (Gershkovich 2016; Bochkariov and Kashuba 2017; Otroschenko 2018). Its essence is associated with the decline of the Zrubna culture (or 'Zrubna cultural and historical entity'; other names: 'Srubnaya', 'Timber-Grave' culture) and the emergence on its basis of the so-called 'Post-Zrubna' culture (or cultures), which, in turn, was at the origin of the following Early Iron Age.

In different parts of Eastern Europe, cultural processes had their own specific features. In this paper, I focus on a micro-region: the middle reaches of the Siverskyi Donets River in Eastern Ukraine using materials from two sites that are considered as reference for the study of the LBA in this area. The findings may also have implications for the study of cultural development within a broader chronological and territorial framework. The focus is on the analysis of ceramic technology, which is much less frequently involved in cultural reconstructions than features of pottery form and decoration.

Archaeological context. Zrubna, Post-Zrubna and Bondarykha cultures: terminology, relationship and role in the transition to the Early Iron Age

Zrubna culture, which is believed to represent the Indo-Iranian languages (Otroschenko, Vovk 2001), was a large-scale phenomenon whose development defines the content of the LBA period in a large area of Eastern Europe. Occupying the vast steppe and forest-steppe zones of Eurasia, from the Urals to the right bank of the Dnipro River, it played a leading role in cultural processes and the development of metallurgy in the region. Extensive contacts during the culture formation cover territories from the Trans-Urals to Mycenaean Greece. Traditionally, there were close ties with the eastern neighbours, the genetically related cultures of the Andronovo and Post-Andronovo entities. At the late stage of the development, contacts and cultural diffusion with the entities of Central Europe – Noua-Sabatynivka-Coslogeni and Tshynets entities are recorded (Gershkovich 1999; Otroschenko 2002; Kuzminykh and Degtiariova 2006, 222-256; Gershkovych 2006).

This paper focusses on the period of decline of the Zrubna culture which took place during the transition to the EIA (12th - 9th centuries BC). To date, its fate is not fully understood and is the subject of only a partial compromise between scholars (see: Romashko 2013, 17-41; Podobed *et al.* 2012; Otroshchenko 2012). The first hypothesis (Otroshchenko, Lytvynenko, Brovender, *etc.*) links the decline of the Late Zrubna culture with a change in the funerary rite at the turn of the 13th/12th century BC (Otroshchenko 2001). Since that time, it is believed that under the influence of new cultural traditions, the new 'Post-Zrubna' cultures have emerged. These are the Bohuslav-Belozerka and Otradne cultures but in this paper we use the generic name 'Post-Zrubna' culture to denote them. However, the analysis of the settlements does not record a sudden change in material culture, suggesting that its transformation took place under the influence of cultural diffusion (Gorbov, Usachuk, Podobed). Supporters of this point of view believe that in a modified form, the Zrubna existed in the first half of the transition period, approximately until the 11th century BC (Podobed *et al.* 2012).

During this time, we can observe the 'decomposition' of archaeological cultures and the regrouping of their elements over large areas of Eurasia. According to the scheme by Ya. Gershkovych, which I use in this paper, new types of ceramics mark this process in the southern part of Eastern Europe – the 'Western', the 'Eastern' and the 'North-eastern' group (Gershkovich 1998). Schematically, the directions of influence of different traditions and typical examples of ceramics representing them are shown in Figure 1A.

(1) The impact of the 'Western' tradition is recorded as a fading indirect influence of Halstatt cultures reaching the Siverskyi Donets through the Carpathian-Danubian and Dnipro basin cultures. It is represented as 'western' pottery types – burnished beakers, 'korchagas', bowls and scoops, however, mostly represented by local replicas.

(2) The 'Eastern' influence, which is much more intense, is observed in the presence of ceramics of 'Volga-Urals-Kazakhstan origin'. Scholars see its sources in the Post-Zrubna and Post-Andronovo cultures of the Volga-Urals, so we can state a remote cultural proximity of this component to the latest Zrunba and Post-Zrubna assemblages from Eastern

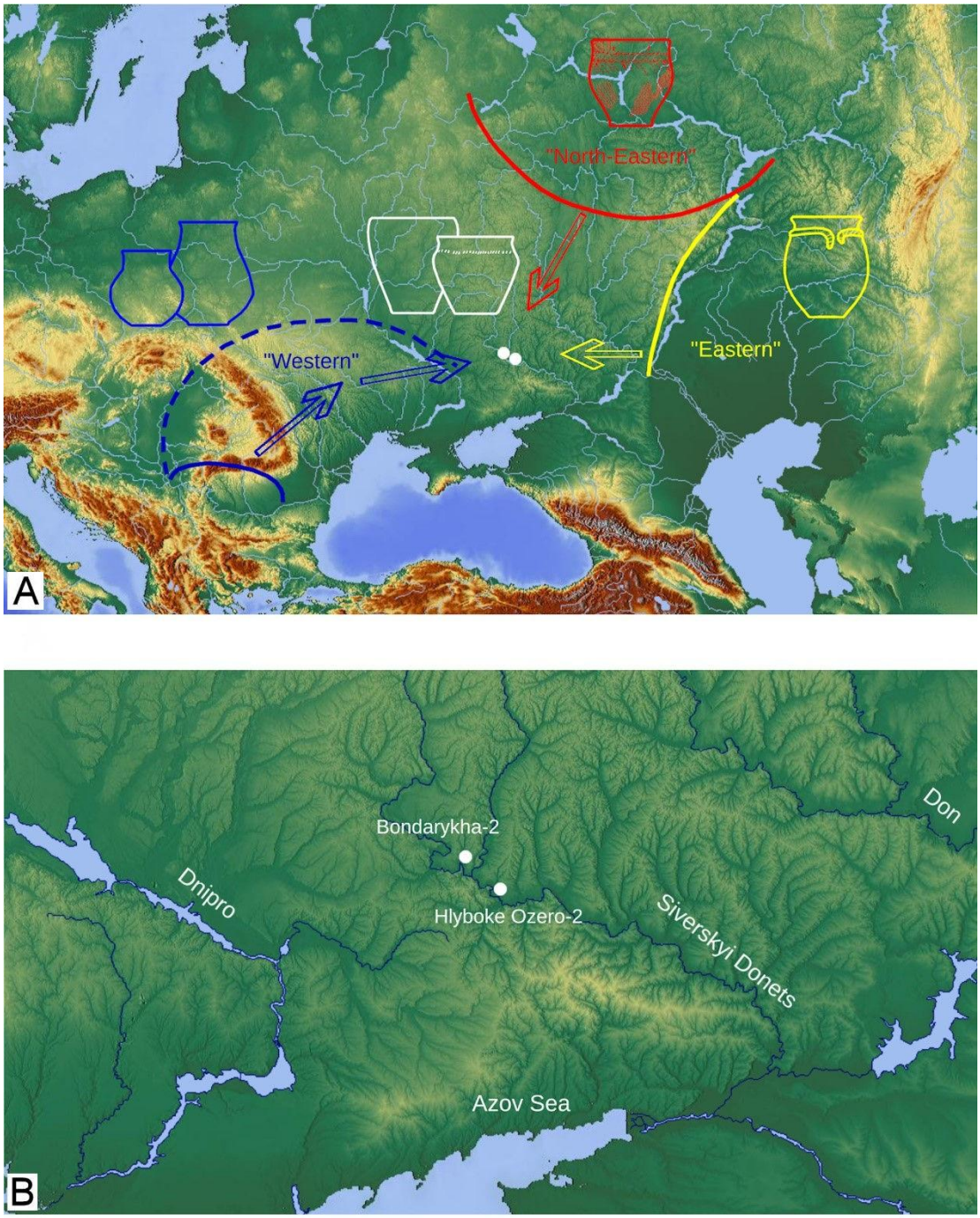

Figure 1. A – the influence of cultural traditions in the Siverskyi Donets basin in the final period of the Late Bronze Age and characteristic ceramic types; B – location of the sites mentioned in this study.

Ukraine. This is the reason for a certain similarity of 'eastern' ceramics and those of the local Zrubna tradition, but the separate status of the incoming 'eastern' cultural component is still obvious.

(3) Finally, the 'North-eastern' component appears in the region as a result of the migration and transformation of the cultures of the Volga-Kama forest zone – hypothetically, bearers of Proto-Ugric languages (Tolochko *et al.* 2000, 42). They are known in the Dnipro-Don interfluve as the Bondarykha culture and its cultural variants (12th - 9th centuries BC). In the assemblages of the Siverskyi Donets region these three components are recorded in different proportions and degrees of syncretism.

In this situation, given the complexity of cultural processes and the discussion around their interpretation, I focus my attention on the question of how we can deepen our knowledge of the interaction of cultural traditions during the transitional period using ceramics as a proxy. Archaeometric methods

and visual observations were applied to reconstruct and compare fragments of pottery production 'operational chains' (*chaîne opératoire*) from two key sites of the region, Hlyboke Ozero-2 in the Donetsk region and the Bondarykha-2 in Kharkiv region (Figure 1B).

The aim of the study was to answer the following questions: (1) is it possible to trace cultural continuity between the deposits of the latest Zrubna and Post-Zrubna cultures based on ceramic technology? (2) Can we see the presence of a new, 'Eastern' tradition in the Post-Zrubna deposits? (3) Do the traditions of ceramic production of the Zrubna, Post-Zrubna and Bondarykha population differ and to what extent?

I focused my attention on two phases of the technological process – paste preparation and forming techniques. These phases have enough 'degrees of freedom' to ensure the originality of cultural choices, at the same time reflecting different mechanisms of cultural transmission (see below).

The sites and their ceramics

Hlyboke Ozero-2 (Zakotne village, Yampil district, Donetsk region) is a settlement of the Zrubna/Post-Zrubna culture located in the middle reaches of the Siverskyi Donets River. The area of the settlement is at least 3000 m^2, of which 1685.5 m^2 were excavated. Nine structures ('dwellings'), 30 household pits and several burials within the settlement were investigated. The cultural and stratigraphic division of the site, developed by Ia. Gershkovych, includes four 'layers' (I-IV). Based on radiocarbon dates from the Kyiv Laboratory and traditional cross-dating methods, the settlement's chronology is between the late 13th and 11th centuries BC (Gershkovych 1998, 63, 86-87). Though the dates of the Kyiv laboratory are subject to criticism (*e.g.*, Gaskevych 2007), the relative chronological position of the site among the LBA cultures, based on analogies from the Northwest Black Sea region, seems quite reliable. Layer I was attributed to the Late Zrubna culture, layers II-IV to the Post-Zrubna period. The 'Post-Zrubna' culture is represented by the strong 'Eastern' component. 'North-eastern' (Bondarykha) materials are presented in small quantities and in a few contexts. No 'Western' ceramics were recorded (Figure 2A).

During the excavations, all fragments of pottery were collected (> 7,000 potsherds). A minimum of 826 vessels were identified, of which 569 were found in a narrow stratigraphic context, *i.e.* they can be associated with a specific stratigraphic 'layer' or 'horizon'. The main pottery types are 'jars' and 'cooking pots' (Figure 2A), which make up 59% and 35% of the Late

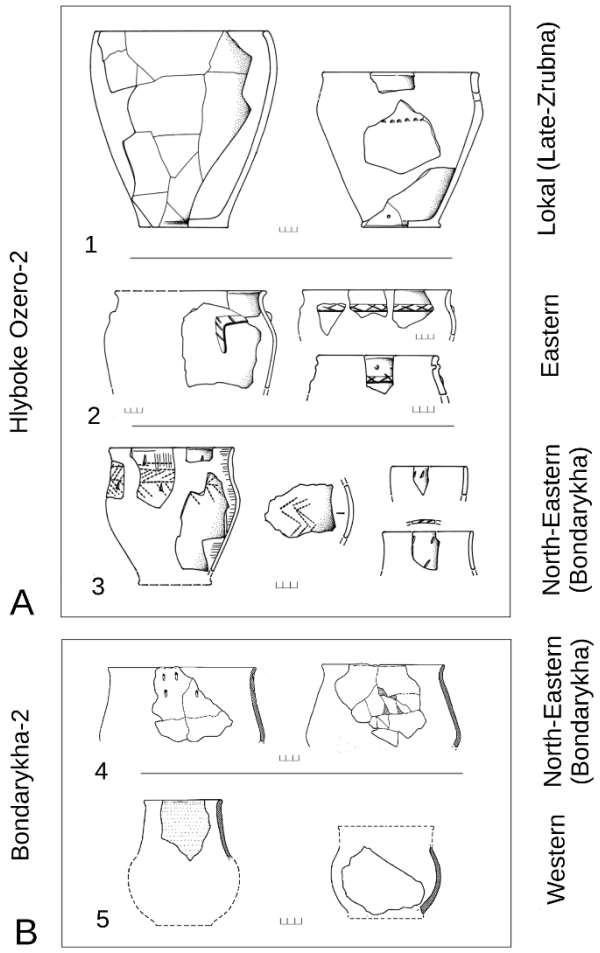

Figure 2. A and B: ceramics of different cultural traditions at the settlements of Hlyboke Ozero-2 and Bondarykha-2.

Zrubna assemblage and 53% and 40% of the Post-Zrubna deposits.

The settlement of Bondarykha-2 (city of Izium, Kharkiv region) is located 57 km upstream of the Siverskyi Donets from the previous site (Figure 1B). This is a small settlement on a dune with a thin cultural layer which is typical of the eponymous culture. The deposits of the Bronze Age are relatively homogeneous and represent the 'classical' Bondarykha culture dated within the mid-11th - late 10th centuries BC (Telegin 1953; Illinska 1961).

The excavated area covered 415 m^2. The presence of a thin cultural layer and several dwellings were recorded. The most suitable for analysis is the so-called 'lower dugout', discovered in 1951–1953 – a slightly deepened structure representing the remains of a dwelling destroyed by fire. Nine household pits and, possibly, one burial within the settlement also reliably attributed to the Final Bronze Age. The pottery of the settlement is absolutely dominated by the 'North-eastern' component. The 'Eastern' component was not recorded, while a small amount

of ceramics replicating the 'Western' tradition is present (Figure 2B).

Establishing the number of vessels found is complicated by the lack of decoration and the incomplete information in the field diaries. Only the most representative vessel sherds were included in the collection (rims, bases, decorated fragments). According to the field documentation, during the excavations of 1951 and 1953, about 894 vessels were discovered, of which 181 were selected for the collection and are currently available for the analysis. The main type of pottery is cooking pots (70-80%) which are highly variable in form. Other, minor and rare types include jars, cups, bowls and beakers (Figure 2B).

It is interesting to trace the difference in ceramic traditions between Post-Zrubna and Bondarykha cultures by comparing the morphometric parameters of cooking pots. This was carried out in one of the author's previous works (Korokhina 2021). The linear discriminant analysis of the main proportions of upper parts of the vessels was performed (Figure 3A and B). The results showed a high degree of similarity in pottery for both groups compared (Figure 3B; compare with the pots of the neighbouring Chornyi Lis/Chornoliska culture). However, the centroids of the clusters in the space of the two discriminant functions are somewhat shifted. Multivariate analysis of the variation of the two sub-samples (MANOVA, Pillai's Trace test) also allows us to reject the null hypothesis of their homogeneity (a=0.05, F-statistics=8.3256, p=4.345e-06). Even more noticeable is the difference between the ceramics of these two groups, recorded through their 'feel', which is mostly based on the researcher's intuitive perception of the technological parameters of the products. Let us consider these parameters in more detail.

Materials and methods

The theoretical basis of the analysis is the interrelated approaches of the *'chaîne opératoire'* and 'technological choices'. The first one links the technological behaviour of ceramic producers with 'groups of common practice' within which the production process is taught and transmitted (*e.g.* Lemonier 1986; Rye 1981; Gosselain 1992; 2018; Sallet 1993; Roux 2017; 2019, 1-14). The concept of 'technological choice' implies potters to follow a certain hierarchy of decisions during the artefact production. Many of the choices and their constraints are culturally determined, though, every technological system allows some number of options and variations, embedded in the cultural tradition (Lemonier 1986; Gosselain 1992, 559-561; Roux 2017; 2019). Thus, the final goal of the reconstructing *chaîne opératoire* is to identify technological traditions which embody certain social boundaries within which they were learned and transmitted (Gosselain 2018; Roux 2017, 101-103).

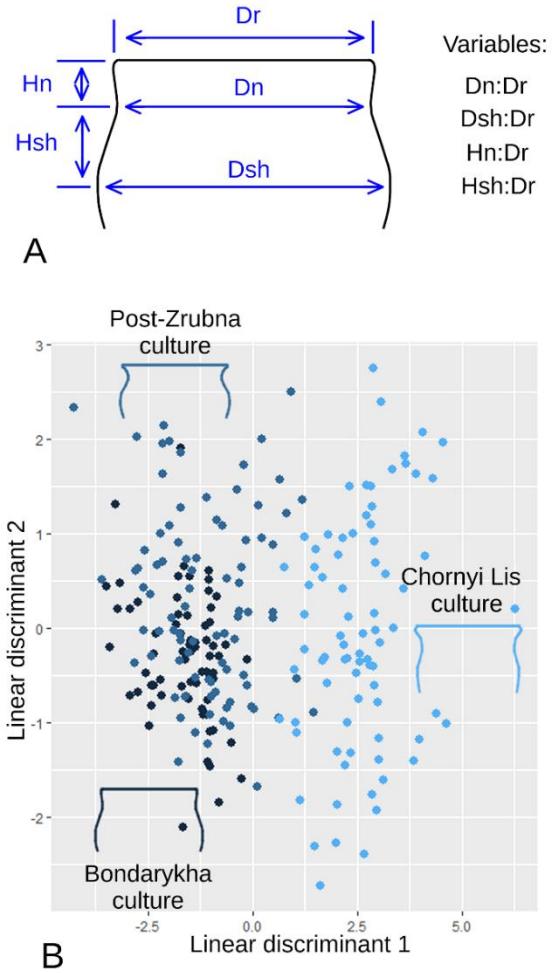

Figure 3. A – measurements of the upper part of the pots and the variables used for linear discriminant analysis; B – the results of linear discriminant analysis of morphometric parameters of pots of the Post-Zrubna, Bondarikha and Chornyi Lis cultures. The profile contour closest to the centroid is placed next to the clusters.

I present here the results of the reconstruction of fragments of *chaîne opératoire*, namely the paste preparation and forming techniques. These production stages, on the one hand, have enough 'degrees of freedom' to sensitively reflect the specifics of particular technological traditions, and on the other hand, they suggest different mechanisms of cultural transmission and different resilience to cultural change. For this purpose, visual observation, digital microscopy and petrography were used, with additional data obtained by SEM-EDS (for a description of methods and equipment, see: Korokhina and Belskyi 2021). The petrographic samples included: the Late Zrubna group – 18 objects,

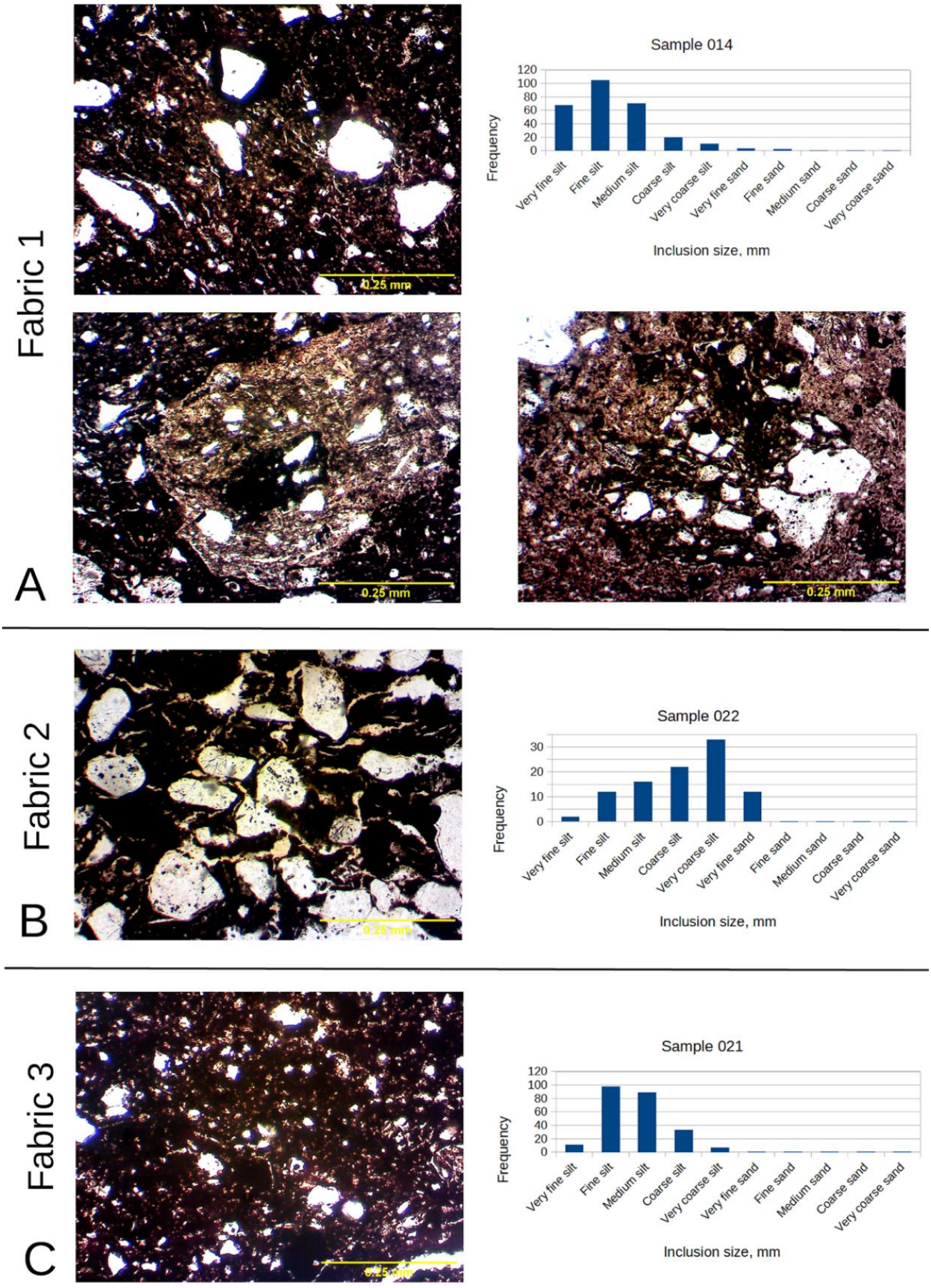

Figure 4. Main petrofabrics of the Hlyboke Ozero-2 settlement: photomicrographs in PPL and histograms of silt/sand size distribution.

the Post-Zrubna group – 36 objects, and the Bondarykha group – 22 objects. SEM-EDS was used to analyse 13 vessel samples from the Late and Post-Zrubna deposits.

Results

Visual observations

The analysis began with an attempt to classify the assemblages into technological groups (Roux 2019, 218-224). If observed with the naked eye, ceramics from both sites demonstrate no clear boundaries between technological varieties. The pottery looks rather homogeneous in terms of colour and fabrics, with small variations. The colour of the outer surface of pottery is often "spotty", ranges from orange to brown, the fresh breaks are predominantly dark or "biscuit" indicating the bonfire firing with a very short soaking time. This also suggests that the majority of the ware was not in direct contact with the open flame during use.

Plastic raw material and paste recipes

The microscopic and petrographic analysis allowed to identify three fabrics, which apparently consumed two types of clay. The first type is a moderately sandy clay, used in 80% of cases and characterised by a log-normal distribution of poorly sorted inclusions with a predominance of fine silt (Figures 4A; 5A). The second type is an inclusion-poor clay ('fat') clay, which was used in about 20% of the samples. It is most often represented in recipes where it was tempered with silt (Figures 4: B; 5: B), though, grog or dry clay also could be used as a temper. According to the results of chemical analysis of the clay matrix by SEM-EDS, the 'fat' clay has a lower content of potassium oxide (see: Korokhina and Belskyi 2021, 209-210, Figure 9). Since grog/dry clay and matrix made of different types of clay occur in various combinations, I am inclined to assume that both types were used simultaneously.

The three fabrics identified by petrographic analysis are as follows:

(1) Fabric 1 – moderately sandy, grog tempered (Figure 4A; 5A) predominates. As far as can be judged from thin sections and broader visual observations, it was recorded in almost 70% of ceramics from Late and Post-Zrubna deposits and in c. 65% of ceramics from Bondarykha. The clay used to produce the pottery of this fabric is moderately sandy, non-calcareous, iron-rich, with poorly sorted inclusions. The proportion of natural non-plastic inclusions (sand and silt) varies between 15-20%, silt fraction predominates. Monocrystalline quartz predominates, occasionally, accompanied by other accessory components (polycrystalline quartz, potassium feldspar, siltstone, mudstone). Limestone, present in part of the samples, is also considered a natural component, with a typical concentration of 15-25%, and a size reaching 1.5 mm. The pastes also contain voids, presumably related to the presence of organics. However, there are no clear criteria for distinguishing between natural and artificial organic component, and therefore its quantity has conventionally been taken as such a criterion: an amount of less than 25% of voids supposedly related to organics is considered as natural. The matrix is heterogeneous, often poorly mixed, often lumpy and contains subrounded opaques, which are probably soil particles. Almost optically inactive in XPL (cross-polarised light), in some samples showing birefringence.

The identification of the clayey temper in this group is difficult. It shows signs of plasticity (the particles are often subrounded and lack ring voids) and I preliminarily identified it as low-temperature grog that partially retained its plasticity, or dry clay (hereinafter: 'grog/dry clay'). It is distinguished from natural clay lumps in the matrix by a different (comparing to the matrix) colour in thin-sections and clear boundaries. Its size ranges from "dust" size up to 0.4 mm, with inclusions of 2–5 mm in diameter being rare. Concentration varies mainly within the range of 15-30%. Such a thorough grinding of the tempering material could have been carried out using tools similar to the massive grinding stone found on the floor of the 'lower dugout' on the Bondarykha settlement.

(2) Fabric 2 – silt-tempered, was prepared using the recipe: inclusion-poor ('fat') clay + silt (Figures 4B; 5B). The samples of this group are always represented in smaller quantities, at c. 20% in all analysed groups. In these samples, the matrix is almost black in plane polarised light (PPL) () and optically inactive in cross polars (XP). The silt temper was identified through its size distribution which is normal, skewed right, with a predominance of the 'very coarse silt' fraction. Approximately 10-15% of the area is occupied by ceramoclasts (clayey non-plastic inclusions), the origin of which is not fully understood. They are often no more than 0.5 mm in size with maximum size of 1.5 mm, differ from the previous group by their darker colour, which merges with the matrix, and often by merging boundaries. This allows to interpret them as non-homogenous features in the clay.

(3) Fabric 3 – fine (Figure 4C; 5C). It represents a finer version of Fabric 1, with a smaller amount of large silt/sand inclusions, which is, however, mostly visible in the microscope but not on the histograms. Includes one sample each from the Late Zrubna and Bondarykha groups. The Bondarykha specimen is a local replica of a 'western' beaker and allows us to assume that the clay was deliberately levigated.

Several loners represent supposedly geological or technological variations of Fabric 1.

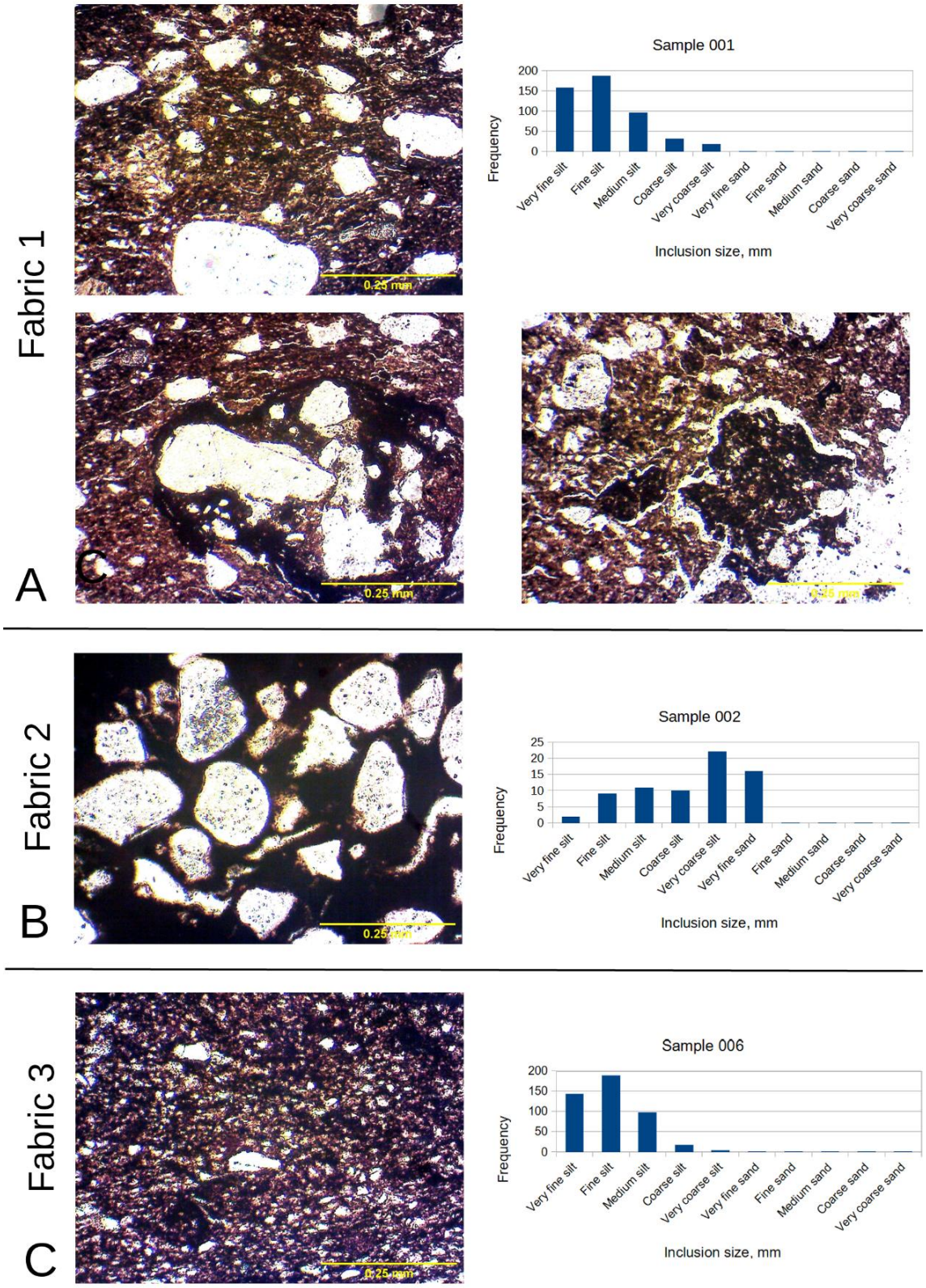

Figure 5. Main petrofabrics of the Bondarykha-2 settlement: photomicrographs in PPL and histograms of silt/sand size distribution.

Forming techniques

All pottery at both settlements is hand-built, with no signs of the use of rotary devices. For the Late- and Post-Zrubna groups, pottery coil-building dominates (Figure 6A).

The forming of the vessel started from the bottom and proceeded to the upper body. The bases were predominantly coiled. The body was constructed using coils, the height of which varies depending on the thickness of the vessel walls (Figure 6A). In most cases, the building elements seem to be an average

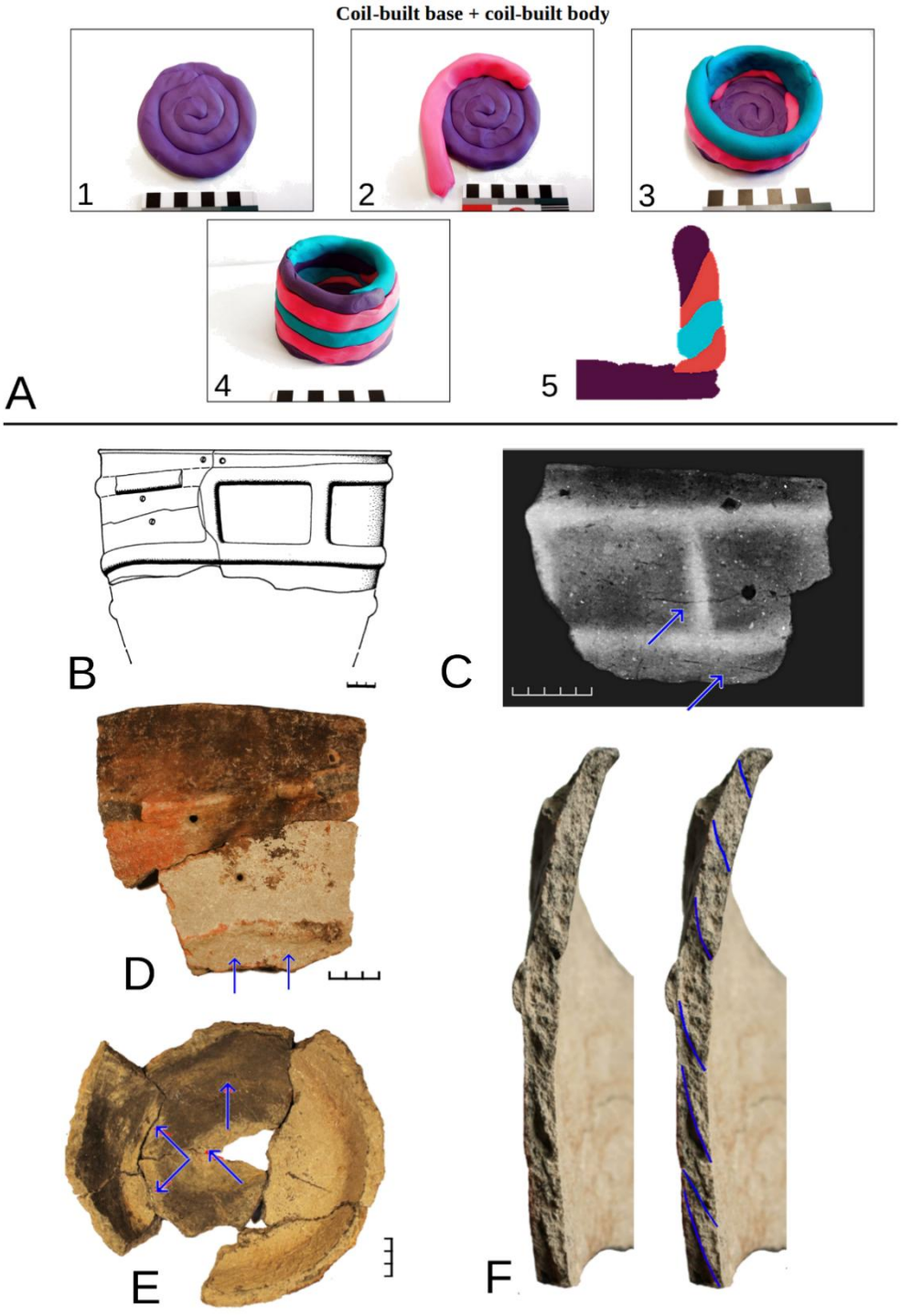

Figure 6. Technological traces of formation of vessels of the Late Zrubna culture from the Hlyboke Ozero-2 settlement. A – scheme of the coil-built preform; B-F – technological traces on the collapse of the vessel found on the floor of dwelling A.

between coils and slabs. During the formation of the roughout the coils were more or less flattened by fingers pressure. A typical sequence of manufacture of the Zrubna pottery can be traced from a collapsed jar from the floor of dwelling A (the Late Zrubna culture). Here, the height of the slabs is 2.7-3 cm. They were applied from the bottom to the top, from the inside of the preform, and just slightly deformed (Figure 6B-F; other typical examples are shown in Figures 7-8). This technique was very common for the thick-walled vessels, especially for jars. Medium and thin-walled Zrubna and Post-Zrubna pottery evidence the use of slabs with the typical height of 3.5 cm. The height of the joints with other slabs of 1.5 cm. The upper part of such vessels was most affected by deformation of varying degree.

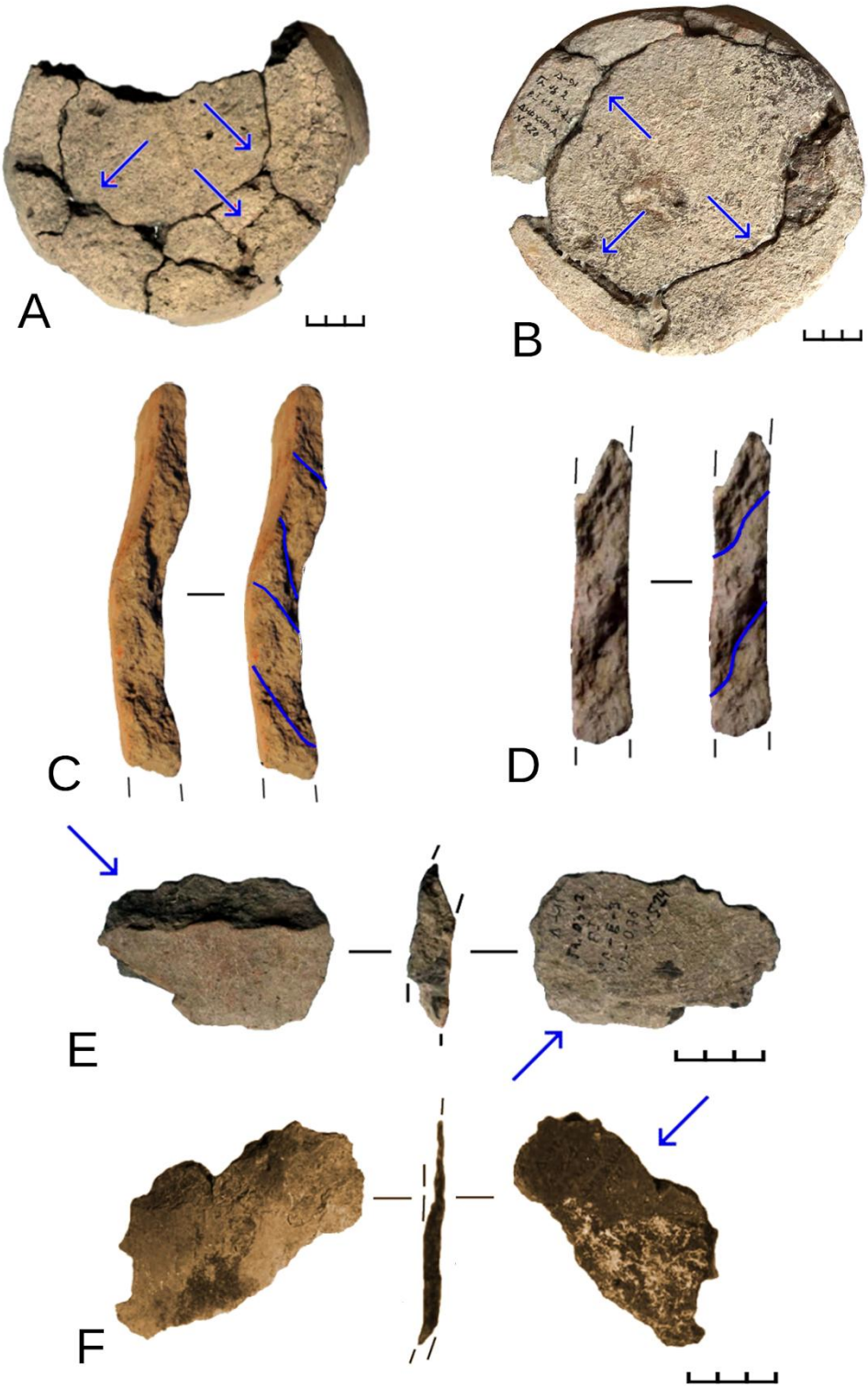

Figure 7. Technological traces of formation of vessels of the Late Zrubna culture from the Hlyboke Ozero-2 settlement.

At the Bondarykha settlement, the predominant methods of vessel formation is two-component (base + coil-built body). The available technological traces indicate a complex method of forming the bases of the majority of local ceramics. I suggest two possible variants, the details of which could vary:

(1) initially, the lower flattened layer (or the 'bowl-like' preform), was formed from a single lump of clay. The lower coils of the body were placed on it and secured with an upper layer of clay that was smeared to the inside of the base (Figure 9A).

(2) Another possible technique could be when the body of the vessel was formed first; in the upside-down position, the bottom layer of the base was attached onto the vessel, after which the vessel was

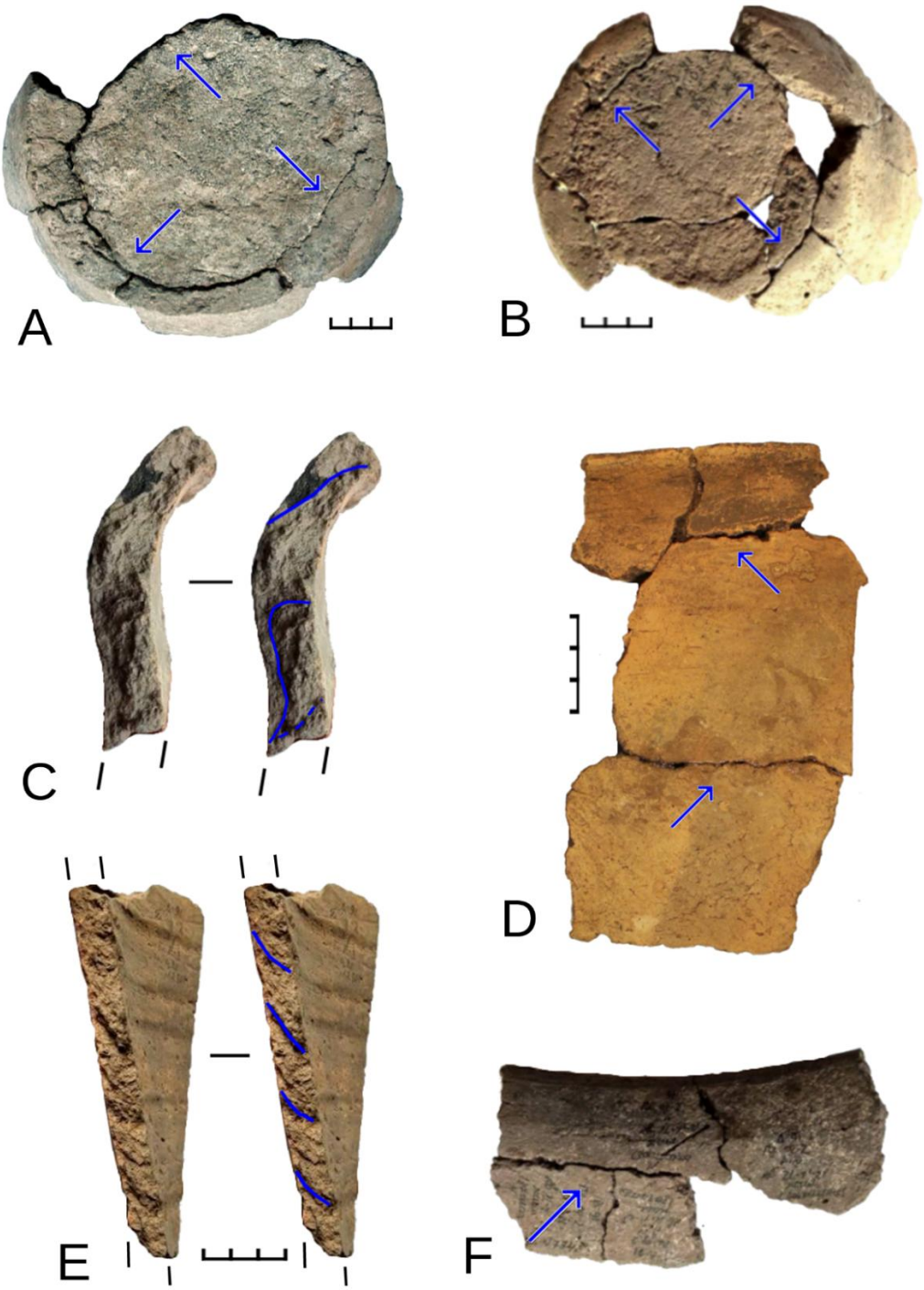

Figure 8. Technological traces of formation of vessels of the Post-Zrubna culture from the Hlyboke Ozero-2 settlement.

turned upside down, and an upper layer of clay was smeared to the inside of the base (Figure 9B; archaeological samples: Figure 9C-E)[1]. The second version may have one important argument: since the Bondarykha ceramic tradition is presumed to have originated from the Pozdniakovo and Early Textile Ceramic cultures (Korokhina 2014), such a technique could have been rudimentary from the method of coiling round-bottomed vessels common in these ancestral cultures. The bodies of the preforms just like in the Zrubna/Post-Zrubna tradition from Hlyboke Ozero-2, were constructed from coils. Perhaps the difference in the forming is the lower degree of deformation of the Bondarykha ceramic walls, which is noticeable on thin-walled vessels (Figure 10).

[1] The author is grateful to Ihor Butskyi who pointed out the possibility of using the second technique.

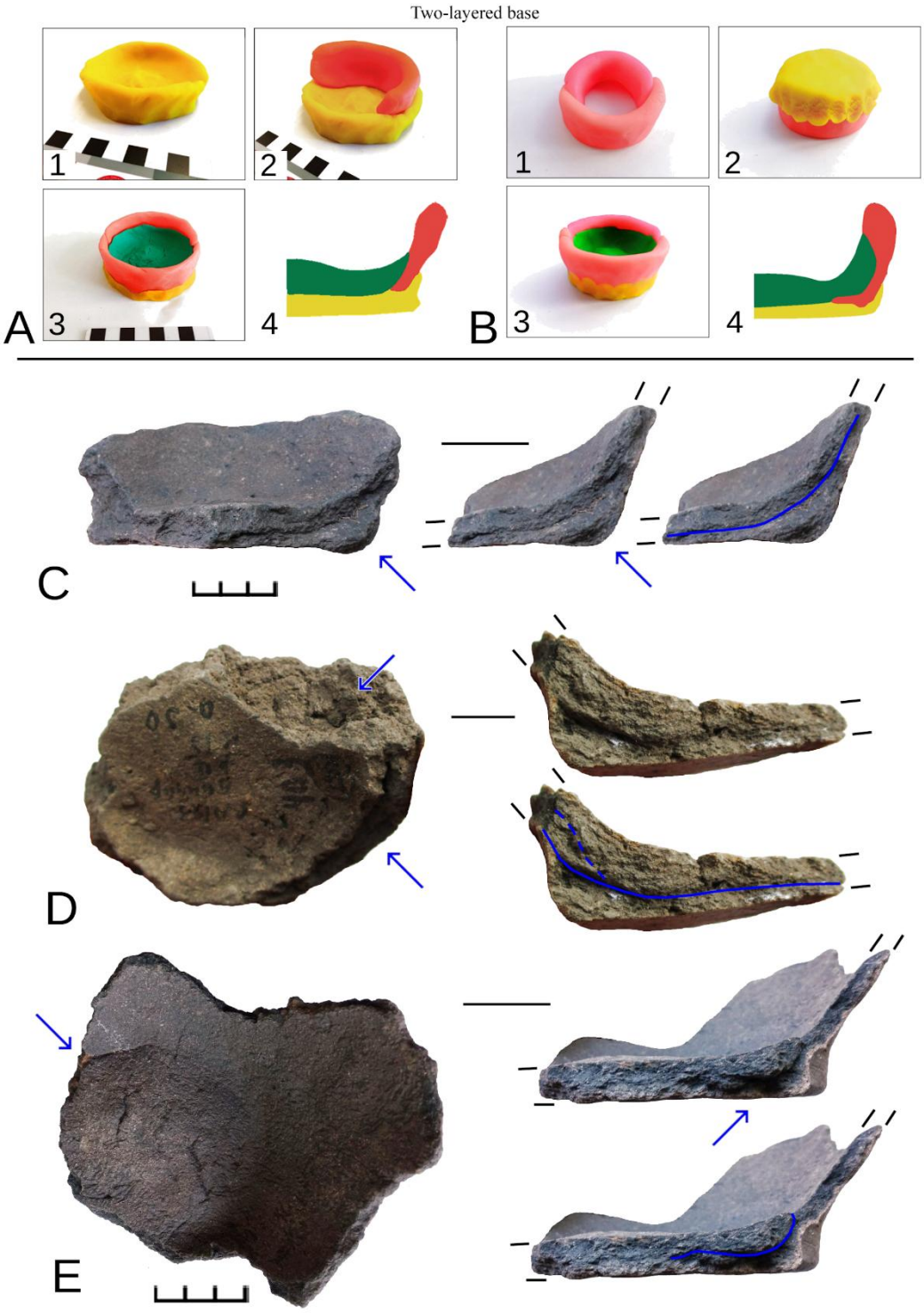

Figure 9. Technological traces of formation of vessels of the Bondarykha culture from the Bondarykha-2 settlement. A-B – variants of two-layered base forming schemes; C-E – technological traces on the vessel fragments.

Discussion and conclusions

In this paper, based on the materials of two settlements in the middle reaches of the Siverskyi Donets River in Eastern Ukraine (Hlyboke Ozero-2 and Bondarykha-2), I analyse the technology of pottery production of three groups – Late Zrubna, Post-Zrubna and Bondarykha cultures. I focused my attention on the analysis of two technological phases – the paste preparation and the forming techniques – which provide the most important information about

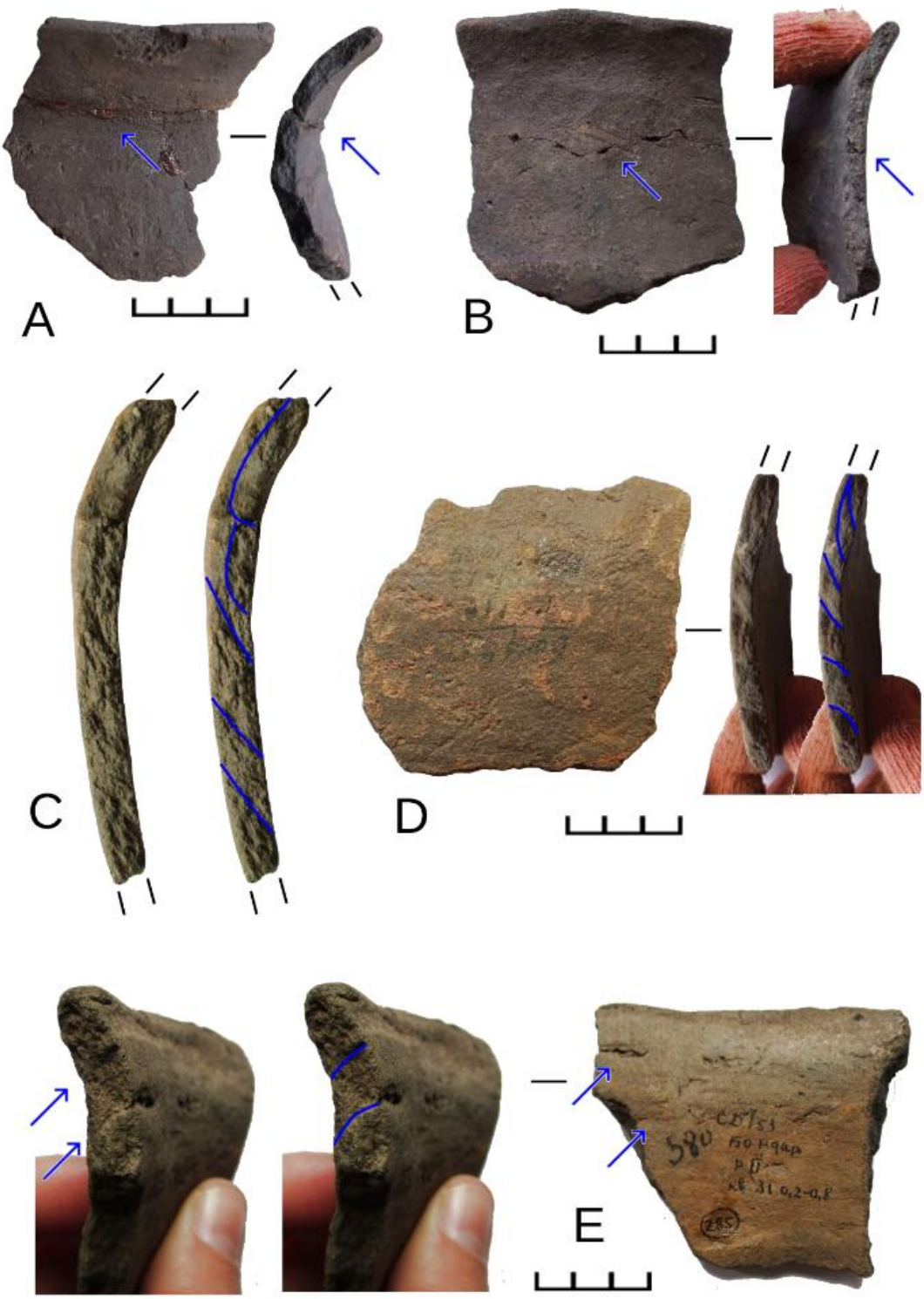

Figure 10. Technological traces of formation of vessels of the Bondarykha culture from the Bondarykha-2 settlement.

the forms of possible interaction of the prehistoric population, reflecting different mechanisms of cultural transmission. As the conclusions drawn below relate to individual sites, they should be extended to materials from other sites and regions with caution.

Previous studies have shown that, fixed through learning, the features of the cultural tradition are reproduced in space and time with certain variations (*e.g.,* Lemonier 1986; Sellet 1993; Gosselain 1992; 2018; David and Cramer 2001, 138; Eerkens and Lipo 2005; Eerkens and Bettinger 2008; Roux 2019). The production phases, as established by the previous studies (Arnold 1981, 37-40; Rye 1981, 5; Gosselain 2000; 2008; Roux 2019, 293-303), have different

resistance to change and are transmitted through different learning mechanisms. In particular:

(1) techniques that can be reproduced after initial learning (or observation of the production process or product characteristics) and are markers of situational interaction between the bearers of tradition (preforming, decoration, prefiring, and postfiring);

(2) operations that also do not require specialised training, but cannot be traced back to the characteristics of finished products – markers of cooperation networks (clay extraction, clay processing, firing);

(3) finally, forming techniques that were acquired during the process of targeted training and are considered to be the most stable and deep markers of social identity (Arnold 1981, 37-40; Rye 1981, 5; Gosselain 2000; 2008; Roux 2019, 293-303).

Turning to the results, high homogeneity of all three cultural groups in terms of many technological parameters was noted, as well as in terms of morphometric parameters of one of the leading types, cooking pots. The technological pattern reflects the picture previously observed by the analysis of morphology. Namely, low taxonomic diversity coincides with high variability within taxa, which is a characteristic feature of non-specialised ceramic production. The small set of 'cultural variants' also indicates limited cultural exchange, or exchange that took place in a culturally kindred environment.

The choice of clayey raw materials and the operations for preparing pastes is an important technological stage, driven by cultural, functional and environmental factors. This part of the operational chain includes a range of choices that form the specifics of particular technological tradition. In this regard, consider the high uniformity of the parameters of raw materials and fabrics at both sites. The plastic raw material is predominantly moderately sandy alluvial clay, often rather carelessly mixed. It was mixed with low-temperature grog or dry clay. The admixture parameters, as well as its concentration, are similar for all three groups – Late-, Post-Zrubna and Bondarykha. In about 20% of cases, potters 'experimented' with inclusion-poor ('fat') clay. This may as well be the result of chance reflecting natural variations of clay within the deposit and attempts by the potters to adapt it to the desired requirements. Typically, this task was solved by the tempering of inclusion-poor clay with coarse silt which was probably a 'functional' answer to the properties of 'fat' clay. It is important to note that none of the sherds of the 'Eastern' tradition analysed in this study showed any significant technological differences from local Zrubna ceramics.

The forming techniques reflect the patterns that are acquired by direct learning, are most resistant to socio-cultural change, and, it can be argued, is largely a product of cultural factors. Forming techniques do not seem to undergo significant changes during the transition from the Zrubna to Post-Zrubna deposits at the Hlyboke Ozero-2. The vast majority of vessels were made of coils (or low-height 'slabs'), with subsequent deforming (thinning) of the walls. In the Bondarykha tradition, the vessel body was also coil-built, though, what fundamentally distinguishes it from the Zrubna culture is the method of forming of the base which consisted of two parts – superimposed clay layers.

We suggest the following explanation for this situation. During the transition to the Early Iron Age, there was no drastic change in the technological tradition at the Hlyboke Ozero-2 settlement. The emergence of new features in pottery morphology and decoration (the so-called 'Eastern' ceramics) may have been made possible by the cultural and, possibly, limited demographic diffusion of a culturally kindred population. People of the Bondarykha culture, who appeared in the microregion at the beginning of the Final Bronze Age, presumably as a result of migration from the Volga-Kama basin, inherited a fundamental difference in the origin of the technological tradition, which is most clearly demonstrated by the way the vessel bases were formed. The strikingly similar principles of the paste preparation, on the other hand, can be explained by systematic contacts with local, Late/Post-Zrubna communities, which, let us assume, included a targeted exchange of technological information. Further directions of research on this issue are seen in expanding the sample (involving observations from other sites), as well as in adding information obtained through examination of ceramics using digital microscopy.

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